A REPORT *of the* TWENTY-FIFTH ANNUAL MEETING *of the* CAPE COD CRANBERRY GROWERS' ASSOCIATION, EAST WAREHAM, MASS., TUESDAY, AUG. 20, 1912, *together with a* REPORT *of the* STATE EXPERIMENTAL BOG

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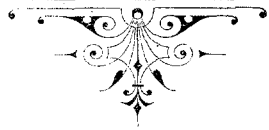

THE COURIER PRESS
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1912

Harvesting Cranberries with Scoops.

ANNUAL MEETING

The twenty-fifth annual meeting of the Cape Cod Cranberry Growers' Association, pursuant to a call duly made by the secretary, (being the third annual meeting of the incorporated body) was held at the State Experimental Bog at East Wareham, Mass., on Tuesday, August 20, 1912.

The meeting was called to order by the President, George R. Briggs.

The Secretary's report was read and accepted.

The president drew attention to the change in the barrel law, stating that it was quite inadvisable to stamp the barrels "100 quarts", as it is not required by law and causes trouble on the selling end. The standard barrel when properly packed will hold 100 quarts, after the pressure is applied, yet when the berries are measured out they sometimes fall short. The cranberry barrel is a legal standard measure when made in the required dimensions. Mr. Briggs gave a review of the laws governing the size of barrels and told of the part the association had played in getting such legislation as was considered fair to the grower and the consumer. He spoke of the attempt being made by congress to establish a standard size for all fruit barrels which would be about the size of an apple barrel. The bill was opposed by representatives of the cranberry interests who went to Washington and appeared before the committee and after much discussion it was finally practically agreed that cranberries will be excepted if the present bill is acted upon this season.

Mr. Briggs said that all that was required of growers is that the barrels be marked "Massachusetts Standard Measure."

The applications for membership of twenty-three growers were received and all were accepted as members of the association.

The following nominations for directors were made from the floor: Colburn C. Wood, George R. Briggs, John C. Makepeace, Joshua Crowell, Franklin E. Smith, Irving C. Hammond

Lemuel C. Hall, Arthur N. Kinney, Franklin F. Marsh, S. N. Mayo and M. L. Fuller.

Messrs. Bradley, Harris and Rogers were appointed tellers to receive and count the votes. The polls were opened and after all had voted who wished they were duly closed. The tellers announced that all those nominated as reported above had been unanimously elected.

President George R. Briggs made the announcement that his name must not be considered for re-election as president.

The following nominations for officers were then made:

President—John C. Makepeace
First Vice President—Myron L. Fuller
Second Vice President—Seth C. C. Finney
Secretary—Lemuel C. Hall
Treasurer—Irving C. Hammond

The members voted and the officers nominated, as reported above, were unanimously elected.

In the absence of the newly elected president the first vice president, Myron L. Fuller, took the chair and presided.

The chair appointed as members of the committee to receive and tabulate statistics in regard to the crop, Lawrence Rogers and Franklin E. Smith.

Col. Bradley moved that a vote of thanks be extended to Ex-President Briggs for the faithful service given the association during his repeated terms of office. The vote was unanimously carried.

On motion of Dr. F. F. Marsh it was voted that the by-laws and list of members of the association be printed in such form as may be approved by the directors and that a copy be mailed to each member.

Dr. Marsh brought up the question as to whether cranberry growers are farmers under the intent of the workmen's compensation act. This brought out considerable discussion which was participated in by Dr. Marsh, Franklin E. Smith, J. B. Hadaway and others. Mr. Hadaway moved that the attorney of the association be authorized to look into the matter to determine whether the farmer's exemption clause applies to cranberry growers. The motion was unanimously carried.

Further discussion followed in regard to the association defending a test case and the matter was laid on the table until after lunch.

When the meeting was again called to order President Makepeace assumed the chair.

After some discussion it was voted:

"That it is the sense of this association that cranberry growers are farmers and that the directors are hereby authorized to insist upon the same before the courts or commission, and that they may at their discretion defend at the cost of the association any suits brought against any of its members in this connection."

The committee appointed to tabulate crop statistics reported as follows: Estimate for 1912, 123,114 barrels; crop of 1911, 112,506 barrels; an increase of 11 per cent over the crop of 1911.

Mr. Chaney reported: Wisconsin crop, 1912, 30,000 barrels, against 30,000 barrels in 1911; New Jersey crop, 140,000 barrels in 1912 against 143,000 barrels last year.

Col. Bradley spoke interestingly concerning the planting of white pine trees on upland and told of what he has done in that direction at Wareham.

A vote of thanks was extended to H. J. Franklin for courtesies extended and aid given the association.

It was voted that a committee be appointed to secure a reduced rate of insurance on cranberry buildings.

It was voted that the president, treasurer and secretary be instructed to prepare, print and distribute the reports of the meeting.

A vote of thanks was given to all the speakers of the day.

The addresses made and the papers read will be found printed in full in the following pages.

On motion duly seconded it was voted to adjourn.

Adjourned.

Respectfully submitted,

LEMUEL C. HALL, Secretary.

THE PLANT FOOD NEEDS OF THE CRANBERRY

By PROF. T. W. MORSE.

Analyses of cranberries and cranberry vines show an unusually small proportion of nitrogen, phosphoric acid and potash, especially in the berries. Reports from Massachusetts and New Jersey agricultural experiment stations contain results which agree very closely, and from them I have calculated that a crop of 100 barrels per acre of berries removes from the bog only 7 pounds of nitrogen, 3 pounds of phosphoric acid, and 8 pounds of potash.

A ton of vines would contain 15 pounds of nitrogen, 6.2 pounds of phosphoric acid and 8 pounds of potash.

Since peat bogs contain tons and tons of these different fertility constituents in an acre foot, it follows that cranberries will not exhaust the plant food in centuries, so far as mere figures can be relied upon.

Yet, on the other hand, the low percentages of plant food in the cranberry vines and fruit indicate plainly that the plant has become accustomed to scanty nourishment, and it may need some form of plant food not provided by the bog in which it is accustomed to grow.

Only three fertilizer experiments have been found reported in the experiment station bulletins, one in New Jersey, one in Wisconsin and one in Massachusetts.

They agree on the need of more nitrogen in the form of nitrate of soda, but differ as to the importance of phosphoric acid and potash. Neither the New Jersey nor Massachusetts experiments were conducted on a typical peat bog, but on a black, sandy soil.

These results of analysis and field trial point to a low availability of the enormous potential fertility of peat bogs under the conditions of cranberry growing.

When peat soils have been drained and used for corn, grass and other farm or truck crops, it has been noticed that nitrogen is seldom required, but that phosphates and potash salts have usually been beneficial The conditions for farm and truck crops are, however, very different from those of the cranberry crop. In the former, thorough drainage is maintained, which means that plenty of air is present to promote beneficial bacterial activity, and nitrates are freely formed.

In fact, peat is one of the materials used in sewage purification because it will hold more water and air together than any other earthy substance.

But in cranberry growing it is necessary to keep the peat satuated with water during a large part of the year, which hinders, if it does not prevent, the action of nitrifying organisms

During the period of flooding, there can be little beneficial oxidation of dissolved soil compounds by which they are made fit for plant food At the other periods, the water table is maintained at a high level so that cranberry vines develop their root systems mainly, if not wholly, in the sand on the surface of the peat

The sand itself is nearly negligible as a source of plant food, but it is continually supplied with water from the peat below it, and this water rises satuated with the soluble compounds from the peat, to be oxidized in the sand by air and bacteria and made fit for nourishment of the vines and fruit

A peculiar property of many bog plants has been observed by botanists namely, a resemblance to desert plants which have a scanty supply of water.

There are differences of opinion about the causes of this resemblance, but a prominently mentioned cause is the probable presence in bog water of poisonous substances, which causes bog plants to develop roots and leaves that resist the passage of water through them, instead of encouraging it, as in most cultivated plants.

The evidence of scanty food requirements on the part of the cranberry may be due to the presence of poisonous matter in the bog water, which the cranberry avoids by using as little water n its interior as possible.

A consideration of the conditions under which changes best take place leads me to the belief that the earlier the water is drained off in the spring and the lower the water table can be maintained during the summer, the more use can be made of the natural fertility by the cranberry vines. I consider it also probable that under the usual methods followed in handling the water on the bogs that the application of small quantities of quickly available chemical fertilizers should be beneficial to the crop.

The experiments at Amherst, with small trial bogs in large tiles, are throwing some light on the problem, as Professor Brooks anticipated.

Fertilizers were applied last year and this. The vines are now two years old and cover the surface with a dense mat and runners extend over the sides of the tile from two to three feet. We have counted the fruits on the individual bogs, and estimate that the average crop is at the rate of 40 barrels per acre. Potash is the only element that appears advantageous for fruit this season.

A study of the composition of the bog water and measurements of the amount drained away last spring and of the quantity added during the present summer, have given data on which to base some tentative calculations of the losses of plant food on the one hand, and of the available nutrients on the other hand.

The surface flood water was found to be practically negligible as a remover of plant food, but the seepage water which next filled the drains and continued to pass away until the close of the rainy season in June, was of some consequence. This seepage water amounted to 72,000 gallons per acre and removed about 15 pounds of nitrogen, 38 pounds of potash and 7 pounds phosphoric acid; but the composition of seepage water from fertilized and unfertilized bogs was practically alike, showing that the fertilizers added to the bogs did not leach away, not even the nitrates.

The amount of water which has been added during the summer to maintain the desired level of the water table, has been 6.9 inches per acre, or 190,000 gallons.

Analyses of saturated bog waters gave the data from which I have calculated that this amount of water rising into the sand

possibly carried with it 53 pounds of nitrogen, of which 25 pounds was in the form of ammonia and nitrates, 30 pounds of phosphoric acid, of which only traces were available, and 85 pounds of potash, all of which was soluble.

The question may naturally occur to some of you, Why is the phosphoric acid present in the water not available? It is an almost imperceptible mass, which apparently passes readily through the soil spaces, but will not pass a porcelain water filter even under a pressure of 40 pounds per square inch.

From these data, which show considerably more plant food than the cranberry crop will remove, it may be inferred that natural sources are sufficient.

But it comes in instalments throughout the growing season. It is possible and probable that soluble fertilizers added in the spring will be advantageous in giving the start to the vines, that is recognized in most field crops when commercial fertilizers are used.

REPORT OF CO-OPERATIVE CRANBERRY SPRAYING EXPERIMENTS IN MASSACHUSETTS FOR 1911

By DR. C. L. SHEAR, Plant Pathologist
U. S. Department of Agriculture

The following report of the spraying experiments carried on in co-operation with the Massachusetts Agricultural Experiment Station is given at this time simply as a matter of record of progress in this work. As it covers only one season's experiments, it cannot be regarded as at all conclusive. The purpose of these experiments has been to determine whether the fungus rots of the cranberry, which occur in Massachusetts, can be successfully prevented by spraying. It has been frequently observed that a large percentage of fruit, which is apparently sound when picked becomes soft and spoiled before shipment, or in transit. Studies we have made of such fruit show that almost invariably the softening is due to a fungus parasite which is present in the berries when picked, but which did not develop until the fruit is bruised

or submitted to some unfavorable conditions of temperature and moisture, such as frequently occur in the interval between picking and marketing. If these fungi can be prevented from gaining entrance into the berries, the fruit should be able to withstand proper conditions of handling and shipment with little loss. In determining the benefit from spraying, therefore, it is desirable not only to make a record of the quantity of decayed fruit at the time of picking, but also of the loss in the interval between picking and marketing. It seems probable that it will be desirable, also, to carry this one step further and determine the condition of the fruit when it reaches market.

One series of experiments was carried out, under our direction, by John C. Makepeace, and the other by Dr. H. J. Franklin. We wish to express our gratitude to these two gentlemen for their kind assistance in this work. The experiment made by Mr. Makepeace was as follows: A portion of a bog of Early Blacks was divided into six plots and numbered consecutively. The vines on these plots were as uniform in character as could be found and had, in previous seasons, shown about the same amount of disease. The spraying was as follows:

Plot	Variety	Date of Spraying	Fungicide Used	Yield in Bus.
1	Early Black (unsprayed)			4
2	Early Black (sprayed)	June 19, 1911	4-3-50 Bordeaux	
		July 3, 1911	"	
		July 17, 1911	"	
		August 9, 1911	1-5 Copper Acetate	6 3-4
3	Early Black (unsprayed)			17
4	Early Black (sprayed)	July 3, 1911	4-3-50 Bordeaux	
		July 17, 1911	"	
		August 9, 1911	1-50 Copper Acetate	12
5	Early Black (sprayed)	June 19, 1911	4-3-50 Bordeau	
		July 3, 1911	"	
		July 17, 1911	"	
		August 9, 1911	1-50 Copper Acetate	10 1-2
6	Early Black (sprayed)	July 3, 1911	4-3-50 Bordeaux	
		July 17, 1911	"	
		August 9. 1911	1-50 Copper Acetate	15

Eight crates of berries, four from Plot 1, unsprayed, and four from Plot 5, which received four sprayings, were shipped to

Washington, just as they came from the bog. Two crates of each of these lots were carefully sorted, by hand, October 16, 1911, with the following result:

Plot 1	Unsprayed	32.7 per cent rotten
Plot 5	Sprayed 5 times	16.8 per cent rotten

All the fruit, sprayed and unsprayed, sorted and unsorted, was then placed in cold storage at a temperature of 36 degrees F., and kept until February 5, 1912. It was then taken out and again carefully sorted, with the following result:

Plot	Treatment	Total Percentage of Rot
1	Unsprayed and sorted	80.9
5	Sprayed and sorted	43.9
1	Unsprayed and Unsorted	84 7
5	Sprayed and Unsorted	42 4

These results show about twice as much rot in the unsprayed fruit as in the sprayed. The percentage of rot in the sorted and unsorted fruit, when taken from storage in February, was practically the same. These figures indicate that 48.2 per cent rot developed in the unsprayed fruit in storage, and 27.1 per cent developed in the sprayed fruit. This shows a higher percentage of decay developing in storage than was the case in our experiments with New Jersey fruit, as recorded in Bureau of Plant Industry Bulletin No. 100, Part I. The following is a record of the spraying experiments at the Cranberry Experiment Station, East Wareham. As there was little or no rot in these berries at the time of picking, the only record made is that of the amount of soft fruit found at the time of screening, on December 4.

Plot	Variety	Date of Spraying	Fungicide Used	Yield in bus.
A	Howes	June 3, 1911	4-3-50 Bordeaux	
		July 17, 1911		
		August 2, 1911	Copper Acetate and Soap	19.5
B	McFarlins	July 17, 1911	4-3-50 Bordeaux	
		August 2, 1911	Copper Acetate and soap	20.5
C	Howes	July 17, 1911	4-3-50 Bordeaux	
		August 2, 1911	Copper Acetate and Soap	17.33

A-1	Howes	Unsprayed	43.56
A-2	"	"	20.9
B-1	McFarlins	Unsprayed	23.66
C-1	Howes	Unsprayed	19.8

Fruit picked, Sept. 21-23, 1911.

Run through separator, Nov. 7, 1911.

Screened, Dec. 4-6, 1911.

Eighty-five quarts of berries were taken from each plot after passing through separator Nov. 7.

Each of these lots was screened December 4, with the following result:

Plot	Variety	Quarts Sound Fruit	Percentage of Rot
A	Howes, sprayed	75	12.3
A	Howes, unsprayed	65	23.5
B	McFarlins, sprayed	60	29.4
B	McFarlins, unsprayed	47	44.7
C	Howes, sprayed	78	8.2
C	Howes, unsprayed	72.5	14.7

It will be noted that there was from 6 to 13.3 per cent less fruit on the sprayed than on the unsprayed plots, except in the case of check 1 of unsprayed plot A-1, which produced more than twice as many berries as the sprayed plot. The difference in this case is evidently due, in part at least, to some other causes than those which produced the other difference. Dr. Franklin is of the opinion that the difference in yield in most of these cases is due to the injury to fruit caused by tramping over the plots in spraying. Taking it for granted that the average loss to the crop on the sprayed plots was due in some way to spraying operations, it is still much less than the amount of rot which developed in the unsprayed fruit. Whether the saving in sound fruit, between the time of separating and screening, is sufficient to justify the expense of spraying, is evidently not conclusively determined by this experiment. The behavior of the fruit, from sprayed and unsprayed plots, during shipment and marketing, should also be taken into consideration. We have, at present, no data in regard to this, however. The experience of some of the growers and sales agents during the past season indicates that the problem of handling fruit to avoid

loss after picking and during shipment and have it reach the consumer in sound condition is a very important one.

The whole problem of handling cranberries during picking, cleaning, packing and shipping, so as to reduce the loss to a minimum, deserves very serious consideration and needs further investigation, though our studies and experiments have already shown that the great bulk of the loss from softened fruit is due to fungi which are in the berries at the time of picking and which proceed to develop and cause softening of the fruit whenever conditions of temperature and moisture are favorable. It is probable that little or no softening of fruit occurs from other causes. It has been thought by some, that fermentation or a general breaking down of the tissues from chemical change may produce softening of the fruit. There is little evidence, however, to support this idea. Only occasionally do we find soft berries which do not appear to be infested with a fungus. If the fruit can be kept from becoming infected with fungous germs, picked and stored under favorable conditions, and without bruising, there should be little danger of loss from soft or rotten fruit. If, however, the fruit is infested with disease at the time of picking, it requires very careful handling, under conditions of temperature and moisture which do not favor the development of the organisms.

Berries should be placed in a cool, dry place as soon after picking as possible, and bruising should be avoided as far as possible. Other commercial fruits handled in the same manner as the cranberry is ordinarily handled would probably result in total loss. It may be found necessary to modify the present methods of handling the fruit in order to reduce the loss which so frequently occurs at present in storage and transit.

GOOD PACKING

By A. U. CHANEY.

This is a dangerous subject for me to attempt to discuss, as my time and attention have always been given to the marketing end. I therefore will attempt to discuss only the necessity of

good packing and uniformity and reliability of packing from a marketing standpoint.

Business of every kind today is based on credit and reputation, and especially is this true between widely scattered communities. This community, or district, produces cranberries, which it exchanges with the South for cotton, with California and Florida for oranges, Pennsylvania for coal, the Central and Northwestern states for their grain and flour, with the cities for their clothing and manufactured articles, etc. Money is only the medium of that exchange. The communities enjoying the greatest prosperity are those which enjoy the best reputation for producing, manufacturing or packing the most dependable goods —as Sheffield, England, for its cutlery, Minneapolis for its flour, Battle Creek, Mich., for its breakfast foods, Hood River, Ore., for its apples, Colorado for its peaches, Grand Rapids, Mich., for its furniture, etc.

Cape Cod enjoys a favorable reputation now for its cranberries. Strangers to this industry often are surprised to learn that cranberries are grown elsewhere. So favorable has been this reputation that in previous years dealers in many of the principal markets would brand cranberries received from other sections "Cape Cod Cranberries" to facilitate their sale. Cranberries from the other sections would be fully equal to and sometimes better than the average of Cape Cod shipments of the season, but the public demand was for cranberries coming from the community most favorably known to them for that product.

Today the other cranberry sections are alive to the advantage of having a favorable reputation for their product and have come to realize that it can best be secured by encouraging and educating their fellow growers of their state to grade properly, harvest properly and prepare and pack their fruit uniformly and well. They have begun to realize that every package going out of their state improperly packed, graded or marked, injures and retards the reputation of the product of their community. A grower who uses proper care in producing good fruit, harvesting same in prime condition, packing same under favorable conditions and in proper manner does credit to himself and his neighbors and materially enhances the reputation of his district.

A grower who ships fruit that is carelessly screened, slack packed, improperly marked, or that is misrepresented in any way materially injures, not only his own reputation, but the standing in the markets of his community.

I believe if every cranberry grower understood the great advantage to themselves that would accrue by all growers packing their fruit in the most approved manner and always so marking or branding same as will properly represent the contents, that greater and more willing co-operative efforts would be made toward that end.

One of the difficulties marketing men contend with is berries arriving at destination, often only a comparatively short distance away, in unsound or unattractive condition, after having left the shipping station in apparently prime condition. It is hard to convince the grower that his berries arrived wet, damp or in weakened condition, when they were apparently dry and sound and properly screened only a few days earlier when they left him. Since I have been manager of the Exchange and representing the growers, it has been interesting to verify such complaints and, through the inspectors, trace back to discover the cause. It might be well here to mention some of the causes of such conditions, as—

Packing and screening in damp or foggy weather.

Harvesting the fruit wet.

Storing the fruit in damp places.

Sorting in a room of considerably warmer temperature than the storage.

Too much handling when fruit is very ripe.

Excessive flooding of bog during the time the fruit is coming to maturity.

Assorting the seconds and mixing in with the first grade, instead of packing them separately and so marking them.

Hand Assorting—I wish some method could be devised to properly screen berries without doing so by hand, but today the majority of berries must be hand assorted. Even in the hand assorting, however, I have observed that it is possible to do the fruit injury rather than benefit it. Especially do I believe this

is true of over-ripe, dark colored fruit. It is more or less difficult to detect all of the soft berries in such fruit with the eye. I have observed the sorters rolling the fruit over the table with the pressure of their hands or picking up handfuls and squeezing them to detect the soft ones. By so doing they cause more berries to become soft quickly than they have picked out. Such fruit would frequently arrive at destination in better condition had not a hand touched them. Please understand that I strongly believe in hand assorting, as a rule, but when assorting dark colored fruit unusual care not to bruise the berries with the hands is advisable.

Finally, every grower should have in mind that the consumers are your customers and that the sales company, cash buyer or commission men are only your medium of distribution to them. As your customers increase you will prosper. If you desire to hold the consumers' favor, you must produce such fruit and harvest and pack it so it will reach their eyes and homes in sound condition and with an appetizing appearance. Put a barrel of unsound and unattractive berries in a retail store and you surely retard and often effectively kill the cranberry trade of that store for the balance of the season. A short crop of poor-keeping and unattractive fruit is more difficult to market than a large crop of good quality. Cranberries should be grown, harvested, screened, packed and distributed in such a way that they will reach the consumer in prime condition in order to bring best results.

PROBLEMS OF THE CRANBERRY GROWER AS A BEE-KEEPER

With Suggestions for the Utilization of Honey Bees in Setting the Cranberry Crop

DR. BURTON N. GATES

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With the systematizing of methods for the better cultivation of the cranberry, one of the recent and most marked advances is the possible and probable service of honey bees in the assurance of a maximum crop. The value of insects in general, among them the honey bee, as agents in pollenization of our important fruits and vegetables, has long been known. Each year, however, the particular value of the honey bee is becoming better recognized. Heretofore, as was emphasized a year ago, growers of apples and melons have trusted the setting of their crops to good fortune. The growers depended upon wild insects or upon honey bees kept by neighbors. If, however, the climatic conditions were unfavorable, it has been found that insects failed to set the crop successfully. Recent experiments and observations concerning the cranberry have shown that similar conditions prevail. Favorable or unfavorable weather a large or small number of insects are thought to be closely correlated with a large or small cranberry set. Hence, as has been previously explained, the cranberry grower can well afford to invest a few dollars in bees, maintaining them adjacent to his bogs in order that he may be independent of neighbors bees or the fluctuations of wild insects. This may be looked upon as a matter of insurance. The honey bee at present is the only insect fertilizing agent absolutely at the command of the grower. The writer's recommendation would be flood the blossoming bog with bees, regardless of other insects.

THE NUMBER OF COLONIES FOR A BOG

A question which is frequently asked and which is yet unanswerable from the experimental standpoint concerns the num-

ber of colonies necessary for a given area. A similar question is asked by the growers of fruits and vegetables. It has recently come to light that a colony of bees for at least every twenty-five apple trees is desirable. From observation alone it is suggested that probably five colonies of bees will be sufficient for ten acres of cranberries. The need for and tax upon the honey bee, however, will fluctuate from year to year and depend upon its ratio to the wild insects or neighbors' bees.

In summary, cranberry growers are advised to consider keeping a few colonies of bees. The results which may be obtained from their services are entirely disproportionate to the investment. Moreover, the income from the bees is not entirely limited to the service upon the cranberry bog. It is known that cranberries yield a good grade of nectar and that the bees may store a surplus of cranberry honey. Furthermore, in most localities where the cranberry is grown, there are also abundant wild flowers. Some of these are practically free nectar producers and yield a surplus. Where sumac abounds, delicious honey may be obtained. Around the cranberry bogs are hundreds of acres of clethera, sometimes known as sweet pepper bush, pepper bush, etc. This plant is a profuse bloomer and is not known to fail in nectar production. Some years, more than others of course, the bees will store a greater surplus. It is a light colored honey and considered choice. In the fall the meadows produce a large amount of golden rod and asters, which may furnish surplus honey, or at least abundance of winter stores. Beside the income from honey, colonies of bees usually find a ready sale, varying in price from $5.00 to $10.00 and up.

THE KIND OF BEES

The question which is not infrequently asked especially by the growers of cranberries, is what kind of bee will best serve for the fertilization of the cranberry. The reply usually is that a bee is a bee and the race makes slight difference in the productivity of the cranberry. It may be said, however, that what is known as the leather colored Italian is probably the best all-around race of bees for honey production and for general beekeeping. It has one quality in particular which causes it to be

much desired by beekeepers of late, namely, that it has at least resistance to European foul brood. It is a gentle bee as a rule, prolific, and a good honey producer. Of course the old time black bee or German bee or its hybrid may be as serviceable for the cranberry grower. It is, however, usually less easily handled and has less resistance to an attack of European foul brood and the devastation of the bee moth. Among the other races of bees which are used to a less extent in Massachusetts, may be mentioned the Caucasian, Carneolan, Cyprian and Banat.

THE TYPE OF HIVE

Cranberry growers will not be dissatisfied with what is now considered the standard hive of the country and which is spoken of as the ten-frame, Langstroth hive. The author's personal preference is for a seven eighth inch bottom board, metal roof cover which telescopes and consists of two parts, outer and inner cover. The majority of beekeepers will prefer the spacing devise for the frame, known as the Hoffman spacer. For supers, these may contain either 4x5 or 4 1-4 x 4 1x4 sections. The beekeeper will also need in his equipment and he is especially urged to obtain, a smoker, a good bee veil, hive tool, Porter bee escape (to facilitate in taking off the honey), Alley drone trap and if the protection of the hands is desired, a pair of bee gloves. These are essential only in handling bees under adverse conditions or in gaining self-control and experience. They are very disagreeable to wear and will probably be discarded by the experienced beekeeper. It may also be desirable to draw the trousers around the ankle by means of a pair of pant guards.

SECURE THE STOCK

It is usually advisable to secure your stock as near your bog as possible. Transportation of bees by railroad is not always convenient and is sometimes disasterous unless the colony is properly packed. It requires some experience to close in a colony allowing sufficient ventilation and preventing the melting down of the combs or the smothering of the bees. Beekeepers are also especially warned against the possible purchase of stock which is disease infected. A beekeeper is less likely, however,

to secure diseased stock today than he was a year or more ago. Experience in inspecting during the current year shows a marked reduction of infection. Advice can usually be obtained from the Office of the Inspector at Amherst as to where stock is available or whether a given apiary is healthy.

While it is possible to begin beekeeping at any time of the year, the inexperienced may commence to better advantage late in April, in May or in June. Bees usually cost a trifle more at this season than they do in the fall, but this is over-balanced by the return in honey, increase in bees and the experience which the beekeeper gains during the season. If bees are bought in the fall there is of course the possible danger of loss during the winter.

When the colonies have been secured, it is desirable to locate them with some consideration. It is a current opinion among beekeepers and almost dogmatic, that if placed upon a bog, the bees will perhaps fail to visit the blossoms adjacent to the hive, but fly further away. As a matter of fact, the writer has observed bees of a given colony working within five feet of their hive. This is contrary to the old opinion that a colony of bees set in the midst of a clover field might starve. In slight support of this point, it may be said that a colony will probably be as efficient upon a cranberry bog if within an eighth or a quarter of a mile, as though they were within a few rods of the bog.

SHELTER THE COLONIES

The following points in locating the bees are worthy of consideration. A colony best thrives when sheltered from prevailing winds. This applies not only in winter but in summer and particularly in early spring. A board fence, the shelter of a building, a wind break, hedge, stone wall or the bowl of a large tree is often sufficient. It is also desirable to keep the colony away from dampness. Dampness in winter is especially undesirable. The hives should stand upon a support perhaps twelve or fifteen inches from the ground. It is usually preferable to have the entrance toward the east or south and away from prevailing winds.

QUEENS

A gentleman inquires why a queen should produce a high percentage of drones. This is due to one or two reasons. The Queen is either poorly fertilized or she is incapacitated. Such a colony should be requeened. It is the practice of the larger beekeepers and especially of commercial honey producers to requeen their stock at least once in two years. This they do either by buying their queens of some commercial queen rearer or by raising their queens. The principle is to remove the old queen and introduce a newly mated one. This is done by means of a small cage. In the end of the cage is a small candy plug. The bees, through the hole in the plug eat out the candy, requiring forty-eight hours and thus release the queen. In the meantime the newly introduced queen acquires the particular odor of the hive into which she is introduced and is thus accepted. Where beekeepers buy their queens, directions for introduction accompany each shipment. Information concerning where to secure queens of the various races may be had by addressing the writer.

THE BEEKEEPING PROBLEMS OF THE CRANBERRY GROWER

There is little doubt but that the progressive cranberry producer will sieze the opportunity to insure or secure his crop by the introduction of bees. He will thus become a beekeeper, interested in the most marvelous of insects, enthused by their curious behavior and activity, and confronted by the numerous problems of a beekeeper. Cranberry beekeeper, the same as the cucumber greenhouse beekeeper, as the term is, must necessarily study methods, read the beekeeping literature, comprising thousands of titles, contained in the beekeeping periodicals and in treatises. He will attend the beekeepers conventions and acquire the interest and enthusiasm alone peculiar to the art. In a word his problems as a cranberry producer utilizing the decidedly beneficial services of the bee, will differ slightly from those of the practical bee raiser or honey producer.

The Massachusetts apiary service at Amherst comprising instruction, experimentation and inspection will gladly co-operate with you and assist you so far as possible. Perhaps you would

have your colonies examined, would like to take a beekeeping course of which at least three are given, attend institutes, and demonstrations, wish for literature or suggestions. At all times please feel free to write in care of the Massachusetts Agricultural College.

STATE BOG REPORT

By H. J. FRANKLIN

Mr. President and Members of the Cape Cod Cranberry Growers' Association:

The station experiments, which have been conducted during the year that has passed since the last annual meeting of this association, may be discussed under the eight following heads, viz: Weather Observations, Skinner System, Orchard Heaters, Fungus Diseases, Varieties, Bee Experiments, Fertilizers and Insects.

WEATHER OBSERVATIONS

With all our weather instruments and equipment installed, we this spring began our first really thorough and serious year's work in investigating the Cape Cod frost conditions in their relation to cranberry growing. We were favored in this investigation by an unusually large number of frosty nights, especially in the month of June, and we feel that we have already accumulated a considerable amount of valuable experience and information. What we have learned leads me to believe, more firmly than ever before, that we may, in time, become able to forecast frosts and dangerous temperatures with gratifying accuracy. The warnings sent out by the District Forecaster at Boston have not, as a rule, been reliable this year, but I think the service for distributing the warnings has been improved and I believe that the warnings themselves will improve in time. In addition to these warnings, it is our intention to make forecasts here at the station for any who may wish to telephone in for them on doubtful nights. No grower should, however, for some time, at least, place full reliance in these forecasts. Their only purpose at present is to assist in case of doubt, but it is hoped that in time

they may become fully reliable. We have come to feel, however, that as there is so much at stake when a bog promises to produce a good crop of berries, it would be the part of wisdom for the growers to provide themselves with the necessary instruments and learn to make forecasts for themselves. There is such a variety of conditions in the different parts of the Cape and there is evidently so much variation in the minimum temperatures that it may be necessary for many of the growers to do their own forecasting. It will certainly take the station a long time to work out a reliable scale of minimum temperature differences between the State Bog and the various other bogs and locations. Our season's experience indicates that it is probably possible to work out such a scale. If any grower wishes to learn to make forecasts for himself, I shall be glad to assist him in any way that I can. The necessary instruments are:

1. Maximum thermometer.
2. Minimum thermometer.
3. Barograph.
4. Psychrometer (wet and dry bulb thermometer).
5. Weather map (sent daily from Boston on request.)

We appear to be favored in making forecasts here on the Cape, in one important respect. Considerable reliance can apparently be placed on the early evening dew point as an indicator of the minimum temperature to be expected. The dew point is the temperature at which dew will form. It is of no value in some parts of the country as an indicator of minimum temperatures, while in other parts it appears to be very reliable indeed. The following appear to be the best indications that a frost may be expected on any night during the usual periods of frost danger:

1. Low dew point (50 degrees F. or below at station shelter).
2. High (30.00 or above) and rising barometer.
3. A dying out wind from a northerly, northeasterly or north westerly direction.
4. A clear sky.
5. A low maximum day temperature.
6. A low and falling early evening temperature.

SKINNER SYSTEM

Last fall we tried to raise the temperature at the bog surface by running heated water through the Skinner system during freezing weather on two different days when there was almost no wind. We found that the idea of raising temperatures in this way, at least as far as cranberry bogs are concerned, was impracticable. The air temperature, during one of these tests, was 30 degrees F. We raised the temperature of the water to 65 degrees F. and it froze about as fast as it struck the vines.

Because of the failure of our circulating pump during the June frost period, we were obliged to use our Skinner System pump for cooling the engine, and, as this pump was not sufficient for both the engine and the Skinner System, we were obliged to postpone our Skinner System tests. We have, however, discovered certain disadvantages connected with its use for cranberry bogs. In the first place, the pumps necessary for supplying water, under the necessary pressure for a system for several acres are more expensive than we at first supposed. While they are not so costly as to make the use of this system entirely out of the question, it is probable that the expense would be so great that the practical grower would prefer to provide for flooding by any of the other methods ordinarily used. However, this obstacle may be overcome, as certain new and more efficient pumps for pumping against high pressures have been devised and are being put upon the market.

We find another drawback to this system in the clogging of the nozzles by pieces of pipe scale. This clogging has given us considerable trouble in the small system installed here at the bog and on any considerable area the trouble from this cause might be serious. We have, as yet, discovered no sure way to get around this difficulty.

E. E. Hickey has recently brought out a new device which is intended to do the same work as the Skinner System. It seems to have merit and may prove to be of much value. Mr. Hickey has installed this device in connection with our Skinner System installation and it may be observed in operation, by the cranberry growers in general, for the first time today.

ORCHARD HEATERS

A few preliminary tests with orchard heaters were tried here during the June frost period. Four different kinds of heaters were used. The results of these tests were unexpectedly successful, as we feared that the heaters would not raise the temperature appreciably very far from them in a horizontal direction, as would be necessary for the protection of cranberry bogs. Before making these tests, the heating of a cranberry bog looked like a very different proposition from the heating of an orchard, because in an orchard the plants to be protected are above the heaters and heated air rises rapidly on a frosty night. The tests indicated that the smoke from the heaters, when it gets beyond the range of the heat, is of little value in throwing off frost. The temperature of the air around the plants must apparently be raised in order to provide a sure protection. Our most striking test was one in which we raised the temperature, at a horizontal distance of ten feet from a single heater, from 30 degrees F. to 33 degrees F. We plan to carry out extensive tests with various types of heaters this fall and next year.

FUNGUS DISEASES

Dr. Shear has already discussed the fungus question, so I need not go into it.

You will all note that the state bog is bearing a light crop this year, and many of you will probably want to know the reason. I mention this because I believe that some interesting problems may center around the answer to the question. There seem to me to be only two apparent reasonable explanations for the light crop on this bog this year. They are:

1. Because of a fairly heavy crop last year, the bog may be resting and storing up energy for another year. It is commonly believed among cranberry growers that bogs do rest more or less in this way. In this connection I wish to draw your attention to the plot of vines from which bees were shut out last season, and which as a result bore only about 2 ½ quarts of berries last fall. This season this plot is bearing a good crop, more than double the crop of any equal area on the surrounding bog. An

examination of this plot would lead one, knowing what happened there last year, to believe, at first thought, that the surrounding bog is resting.

2. The light crop may, however, be due to a water injury which may have been caused in the following way: During the spring of 1911, I kept the water down very low in the ditches from the time the winter flowage was taken off until the beginning of the blooming period. By so doing, I probably caused the season's root system, up to blooming time, to develop deep down in the bog, as the roots of any plant will always grow toward the water.

At the beginning of the bloom, I raised the water in the ditches as high as it could be raised without having it run onto the bog surface under the vines. I kept the ditches in this very full condition throughout the blooming period, and for two or three weeks after the blossom was past. During the month of July, 1911, I noticed that the very last leaves, in the very tips of a large percentage of the uprights, were dying or dead over most of the bog. I feared then that this injury, whatever might be it. cause, would result in a scanty budding for the following year. Never having observed this injury before, however, I thought that possibly the bog would recover from it before fall and finally succeed in budding well. This recovery, however, did not take place and the bud formation for this season was poor and was naturally followed by a light bloom and the light crop which the bog is bearing. I have been trying to discover the cause of last season's injury to the tips of the uprights. I feel practically certain that it was not insect injury. Dr. Shear has been unable to locate any fungus disease in connection with it. I at first thought it might have been caused by keeping the ditches too empty at some time, but I found that the highest portions of the bog were, as a rule going to produce the most berries. It was pretty certainly not a normal or natural development for the tips. When plants rest from fruiting, they simply produce healthy vegetative buds instead of fruit buds. They do not normally abstain from fruiting by the death of any part. I finally came to the conclusion that I might have caused the injury by drown-

ing out a part of the root system by holding the water high in the ditches, as I did during the bloom and starting of the berries last summer. I am now rather strongly inclined to the opinion that that was what caused the injuries—that the holding of the water very high in the ditches, in the midst of the growing period, after keeping the ditches empty during the first part of the season and by so doing causing a deep root development, drowned and killed a part of the root system. Then, with a part of the root system gone and the development of a fairly heavy crop of berries drawing on the strength of the vines, some part of the development above ground had to give in—i. e., vines above ground probably had to adapt themselves hurriedly to the root system left to supply them. As the tips of the uprights and runners were the most tender parts of the vine above ground, they naturally would give in and die first. It will be seen that the fact that last year's bee experiment plot is this year bearing more berries than the surrounding bog cannot be used as a good argument against this explanation of this year's crop shortage on the bog as a whole. The injury to the tips would naturally be much less where there was no crop making a demand on the root system in addition to the demand of the rest of the vine. If this is the true explanation of the crop shortage and the bog is not resting, it becomes at once evident that great care should be exercised in the holding of water in the ditches during the summer. While it is entirely possible that no general hard and fast rule can ever be laid down for the summer irrigation of cranberry bogs, I feel convinced from numerous observations that most growers are inclined to use too much rather than too little water during that season of the year. It is certainly true that the heaviest crops which I have seen this summer, are on bogs the ditches of which have been kept nearly empty throughout the entire season, with at most only a brief occasional raising of the water. I also feel convinced that the greater part of the injury, which is usually laid to dry weather, is, as a rule, due to other causes. I have been astonished to observe, on various occasions, how much dryness the cranberry vine will endure and still persist in producing its crop. As far as the State Bog is concerned, I propose to cling to the idea of giving the vines little rather than

much water during the summer, until I am convinced that that idea is erroneous.

While I am discussing the matter of holding water in the ditches, I wish to draw your attention to an injury which I noticed on several bogs last year. The injury was caused by the combination of holding the water high in the ditches during the spring and first part of the summer and the exceedingly hot spell of weather in July. The holding of the water high in the ditches caused the season's growth to be more succulent and turgid with water than it should have been, the cell walls and the epidermis of the leaves being, from the same cause, thinner than they would have been under more dry conditions. Upon this poorly protected, succulent growth the extremely hot weather of July had a scalding effect, which caused the blossoms to blast, small berries, some of them a quarter grown, to turn red as if baked and dry up, and the leaves, either entirely or partly, to take on a marked, abnormal, sickly looking, dark chocolate color. The proof that the hot, dry weather did not alone, in such cases, cause the injury, was usually to be found on the higher and drier parts of the bog, where the vines and their blossoms or crop were in a normal and healthy condition.

If the true explanation of our light crop here this year is that the bog is resting after bearing a fair crop last year, this fact probably has certain very important bearings on our fertilizer and insect problems, which will be discussed in other parts of this report.

VARIETIES

Last season, we marked with cloth a large number of the uprights, which were bearing four and five berries each, on Early Black, Late Howe and Vose's Belles vines. We thought that those uprights might, perhaps, be regularly, as a rule, more prolific than the uprights which were then bearing fewer berries. We have this season examined carefully these marked uprights and we find that most of them are either dead or barren. Only two or three of them are bearing more berries than the average uprights and their berries are much below the average in size and appear as though they had been produced with considerable

difficulty. We have, however, I think, discovered some of the more certain marks of cranberry prolificness. The most noticeable and evident of these marks appears to be the tendency and ability of the uprights of certain varieties to put out new uprights as branches, even when they are at the same time developing from three to five berries each. We have marked a considerable number of such branching uprights for examination next season. It will be noted in this connection that the uprights of varieties which are most grown (Early Blacks, Howes, etc.) seldom branch in this way, while developing berries. We think it may be possible, by selecting and planting the more prolific of these branching uprights, to eventually develop a more productive variety than any at present known.

BEE EXPERIMENT

We have this season repeated the experiment of shutting out all bees from a small area of bog during the blooming period and for some time afterwards. This time the screen was put in place before a single blossom had opened and we thought we might be able to prove that the cranberry plant was entirely dependent upon bees for the transference of its pollen. Strange to say, there is now nearly as good a crop inside of the screen as outside of it. This season's results, therefore, appear to contradict those of last season. On this account, it is evident that this experiment should be repeated for several seasons. It is possible that, as Dr. Gates has suggested, small, wild, solitary bees may have forced their way into the netting this year and succeeded in pollenizing blossoms without being observed. In future experiments along this line, we intend to use a wire screen, which no bees can force their way through, to make ourselves sure on this point. Solitary bees are very abundant some seasons and other years they are scarce and this may account for the different results obtained in different seasons in these experiments. It is also possible that with certain weather conditions the cranberry blossom is capable of self-pollenation, while with other conditions, it is not so capable of it.

FERTILIZERS

We have continued the fertilizer experiments begun last year on the station bog, but have discontinued those at Waquoit. We kept berries from all the plots on this bog last fall until the sixth of December, and found that, as a rule, the berries from the fertilized plots kept better and showed a smaller percentage of rot, when screened than did those from the check plots. This was even true of the berries from the plots fertilized with nitrate of soda. These results were surprising to us, as it seems to have been the general experience that nitrates tend to impair the keeping quality, not only of cranberries but of fruits in general.

It is evident that the fertilizers have, in this season's experiments, given a marked increase in the amount of fruit that the vines are bearing. Just how great this increase is we cannot definitely say until the crop is harvested. It is plain to be seen, however, that nitrate of soda has given much the greatest increase both in the size of the berries and in their number. This is the first season in six years of experimenting that we have had very marked and definite results in favor of fertilizers. We have been trying to account for this. Up to last year, our experiments were conducted on the Red Brook bog at Waquoit. We probably should not have expected very marked results on this bog last season, as the fertilizers were applied rather late in the season, and the vines probably did not get their full benefit in time to show it to any great extent, in last year's crop. It therefore seems probable that our failure to get results at Waquoit and our success here have been due either to a difference in the character of the bottom of the two bogs or to some difference in their management. Some chemical analyses have been made and others are in progress, which should show whether there are essential differences in the peats of the two bogs. There has been one very considerable difference in their management. The Waquoit bog has, as a rule, been kept rather wet during the growing season, while the state bog has better drainage and has been kept much drier. On the Waquoit bog, the nitrate of soda increased the already very heavy vine growth very much, but the

amount of fruit on the nitrate plots was often markedly less than on the unfertilized plots. On the state bog, the increase in vine growth on the nitrate plots, while apparent, has not been very great and the increase in fruit has been very considerable. It seems quite possible that the matter of drainage may have an important bearing upon the results which may be expected from the use of fertilizers. The indications seem to be that, if a bog is kept wet during the growing season, nitrate of soda will go to the driving of vine growth without increasing and often diminishing the fruit production and that, on the other hand, if a bog is kept dry and the vines are made to fight more or less for their water during the growing season, the amount of fruit will be increased by the same fertilizer (nitrate of soda) which, with wet conditions, would tend to diminish it in favor of vine production, and the amount of vines will, at the same time, not be unduly increased. We plan to again test the keeping quality of the berries from the fertilized and check plots this fall.

INSECTS

The total insect injury has been greater than usual this year. It is a bad fruit-worm year and that pest has not yet finished its work. The damage done by it will probably, before it gets done, be greater than in any other season for four or five years past, though the 1911 injury was very considerable. The blackheaded cranberry worm or fireworm has done greater and more general injury this season than for many years. Growers of long experience tell me that the fireworm prevalence this season reminds them of conditions as they were fifteen or twenty years ago.

THE CRANBERRY SPAN-WORM

The true cranberry span-worm has this season caused serious injury for the first time in many years, having destroyed all the leaves on the greater part of the Old Colony bog at Yarmouth. This appearance of this insect may be the fore-runner of more widespread damage next year. It is evidently spasmodic in its occurrence, like the army-worm, and its coming and going cannot, therefore, be predicted with certainty. It rarely, if ever, however, damages the same bog seriously two years in succession.

This insect is not difficult to control if its presence is detected when the worms are very small. The eggs are laid in clusters and the worms that hatch from each cluster feed out in a circle from their hatching place, growing in size and feeding capacity as they increase the size of the circle. If the infestation is severe, the different masses of worms will spread out and, uniting, form an army which, as it advances, eats every green thing in its path as would an army of army-worms. If the worms are found at work, while they are yet small and in separate masses, they may be destroyed and their work stopped by spraying in a circle around each mass with an arsenical poison—preferably with a combination of Bordeaux mixture, Paris Green and resin fish-oil soap. The presence of this insect in the small worm stage is most easily detected by sweeping the bog with an insect-collecting net every few days during the part of the season in which they might be expected, i. e., the last half of June and the entire month of July.

SCALE INSECT

The scale insect, which I discussed in last year's report to this association as having done serious injury on a bog in Yarmouth, has now almost entirely disappeared from that bog. It seems evident that winter flowage is so detrimental to this pest that it may be entirely controlled without any other treatment, especially if that flowage be applied regularly every year and be kept on the bog until the month of May. It got its foothold, on the bog in question, in a season which followed a winter during which the bog was not flowed. This insect is not a very distant relative of the famous or, rather infamous, San Jose scale, which is such a widespread and dangerous pest to fruit trees and nurseries. Its scientific name is Aspidiotus oxycoccus, and I find it was first discovered in small numbers on a cranberry bog in New Jersey several years ago, by Prof. J. B. Smith of the New Jersey Agricultural Experiment station. It had never been known to do serious injury, however, before we discovered it at Yarmouth last year.

SPITTLE INSECTS

I have had a long and interesting correspondence this season

with some cranberry growers on Long Island. Their bogs seem to have been severely injured by spittle insects. I have seen many bogs infested with these insects here on the Cape, but have never yet seen them do marked damage here. I have seen a few infested bogs which did not seem to be doing well and were in what we would call "poor condition." The spittle insect injury, in such cases, may have contributed to produce this poor condition, but it is doubtful if it could have produced it alone, if the vines had been otherwise healthy and thrifty. By marking infested uprights, I have proved many times that thrifty uprights will develop berries normally in spite of such infestation, and it is my belief that, as a rule, where this insect appears to be causing damage, the bog is, for other reasons, not in the best of condition anyway. It is, of course, possible, however, that there may occasionally occur a much more serious infestation by this insect than any that I have yet seen. Possibly the Long Island growers, to whom I referred, had such an infestation this season. The experience of the Long Island growers indicated that complete reflowing for a day or two, when these insects are at work, will drive them out satisfactorily, and also that contact poisons may be used against them with considerable success where water is not available.

THE GYPSY MOTH

Caterpillars of this insect have been sent in to me this season by cranberry growers more than ever before. It seems to be getting a foothold on some of the bogs in North Carver. I shall make observations this fall and next spring to determine if it can be controlled by ordinary winter flowage.

EXPERIMENTAL INSECT WORK

Our experimental work with insects has, for the past year, been confined mostly to the fruit worm and the blackhead cranberry worm or fireworm, though we have also made numerous observations on the girdler.

THE FRUIT WORM

It has seemed probable that certain peculiar weather conditions have a tendency to cause this insect to be unusually plenti-

ful and injurious in some seasons, while different conditions cause it to be less troublesome in other years. We have been getting together data, furnished by the Weather Bureau, and have been making comparisons with our records concerning the injury caused by this insect for a number of years past. We at first thought that an open December, with little snow, was very detrimental to the insect for the following season, while a very snowy December was favorable to it. We find, however, that the records do not substantiate this belief satisfactorily. In fact, the present season's experience is distinctly against such a theory, for this is evidently a bad fruit worm year and there was practically no snow last December on the Cape. As far as I am now able to judge, the data at hand indicate that a very dry summer, especially during the months of July, August and September, is favorable to the insect and will, as a rule, cause it to be numerous and injurious the following year. On the other hand, a wet summer may probably be taken as an indication of comparatively light injury the following year.

Late holding of the winter flowage is the surest method of controlling this insect at present known.

I have heretofore recommended holding this flowage until the 20th of May, every third or fourth year, because late holding every year seemed to reduce the crop of fruit seriously and to give the bogs a tendency toward vine production instead of fruit production. It seemed to me that late holding once in three or four years was not sufficient to make this tendency considerable, while it would not only reduce greatly the fruitworm injury for the season in which the late holding was done, but also tend to reduce the injury for two or three years following. Possibly this is the most practicable method of fruit worm treatment. If, however, the theory that a cranberry bog naturally has years of resting from fruit production and will, on account of a rest one season, produce a heavier crop the next year, is correct, it at once becomes evident that it may be desirable to hold the winter flowage late oftener than once in three years. In fact, it is now my belief that the best results, everything considered, may be obtained by holding the winter flowage until the 20th of May

every other year. This treatment is sure to reduce the fruitworm injury very greatly for both years, and it seems to me that, as a rule, a bog may be expected to make up to a considerable extent, in the years when the water is taken off early, for whatever reduction there may be in fruit production in the years of late holding. Moreover, I am inclined to the opinion that much of the fruit reduction caused by ordinary late holding of the winter flowage is due to increased fungus injury which might be largely averted by proper spraying. There is undoubtedly a direct water injury from late holding, but a very large part of the injury which late holding causes is probably indirect and is directly the result of increased fungus disease or of decreased available fertility of the bottom, which are in turn caused by the late holding of the winter flowage. I believe, therefore, that a satisfactory treatment for the fruit-worm can be worked out as suggested, by holding the winter flowage late every other year and by spraying properly for fungus diseases and, possibly, also, on old bogs, by helping the vines with proper fertilizers.

Our season's observations indicate that early putting on of the winter flowage is of but slight benefit as a treatment for the fruitworm. One bog of about ten acres that lost a large percentage of its crop by this insect, in the season of 1911, was flowed for the winter on the fifth of October and the flowage was not let off until the 8th of May, and even after that long flooding the fruitworm took about 50 per cent of what would otherwise have been a good crop.

I am sorry to say that I cannot recommend spraying as a treatment for this insect. While I have, sometimes, on small plots, succeeded in reducing its injury as much as 60 per cent, my success at other times has been very slight. It is difficult to time the spraying properly for best results and, moreover, the spraying is quite expensive when done as thoroughly as I have done it in my experiments. The need for such a treatment, however, is not very great, for, as I have already said, this insect can be treated with water, where winter flowage is available, and the total acreage of bearing bog, which cannot be winter flowed at a reasonable expense, is only a small percentage of the total bog

acreage. Moreover, most of the bogs, which cannot be reflowed at reasonable pumping expense, for various reasons are not and never were good business propositions and should never have been put in in the first place. However, as there are a few such bogs, scattered here and there, which will pay a moderate return, if the fruit worm is kept within bounds, it seems desirable, if possible, to find some treatment, other than that by water, for this insect. It may be possible to apply arsenical poisons in the form of a dust, after having first wet the vines and berries with a soap solution spray so that the dust will adhere to the smooth surfaces of the green berries, in sufficient quantity to treat this insect effectively. We have tried a few little preliminary experiments along this line this season, and they have given sufficiently promising results for us to conclude to try out this method of treatment more extensively next year. I cannot say, however, that at the present time I have really any very great confidence that this way of applying the poisons will be found more effective or satisfactory than the old method of spraying.

I have this season tried out a method of treatment which we have already found successful against the cranberry girdler—that of heavy sanding while the insect is dormant in the winter cocoon, under the vines in and on the sand on the surface of the bog. I thought that such sanding might, as it does with the girdler, smother the first worm so that the millers would not emerge, during the summer following the sanding, to lay eggs for another crop of worms.

In this experiment I sanded a patch of nine square rods with a full inch of sand, taking pains to rake the uprights up through the sand when they were covered by it, on the 22nd of May. This sanded area was then surrounded with a mosquito netting fence, eight feet high, to keep moths from coming onto it from the surrounding bog, but it was not closed in at the top, for I wanted bees to have free access to the blossoms inside and the moths would not get in at the top anyway because they never, apparently, fly up more than five or six feet from the ground. Unfortunately, the new growth had started considerably when this heavy sanding was done, and, on this account, the injury

done to the buds was very severe, more than three-fourths of them being destroyed. It is evident that this sanding was only partially successful, as numerous fruit worm millers have been seen inside of the mosquito netting fence, during the season, and probably forty per cent of the berries on the plot have been destroyed by the worms. That a large percentage of the millers were smothered by the sanding is shown by the fact that there are now noticeably more berries on the sanded area than there are on any equal area on the surrounding bog and this in spite of the great injury done to the buds by the sanding. The amount of infestation, on the bog where this sanding was done, is shown, in a general way, by the fact that, on a considerable part of the bog, the worms have destroyed all the berries, where there was a blossom and a fruit setting which should have produced not less than sixty barrels to the acre. As it seems probable that this sanding will have a considerable effect on next year's infestation, as well as upon that of this season, I intend to continue the experiment into next season.

As strictly dry bogs usually get either severely winter killed or badly spring frosted about every two or three years, I am coming to believe that the most practicable treatment for the fruit worm, on such bogs, would be to destroy the remnant of the crop, in the years when the severe injury from either frost or winter kill occurs, by spraying the open blossoms with a 20 per cent solution of iron sulphate. This destruction of all the blossoms will cut off the season's local food supply of the fruitworm and the bog's infestation will naturally, for the most part, die off by starvation as a result. In most cases, this destruction of the remaining blossoms, after severe reduction by adverse weather conditions, will not result in a loss to the grower for the season for, if the blossoms are left and the crop remnant is allowed to develop normally, the fruit worms, which, without the interference of weather conditions, would have had more than an ample food supply, will concentrate on the remnant and, as a result, there will be little or nothing left at picking time anyway.

During the season, following one in which a bog's fruit worm infestation is starved out in this way, practically the only infestation present will be that which comes in from the upland dur-

ing that season and that probably will not be very serious in most cases. Another probable benefit, from this method of treatment, is that which will come from not tearing up the vines in picking the small amount of fruit that might be present after the worms got through. *It is very probable that, many times, more is lost, through injury done to the vines in harvesting a light crop, than is gained by saving and marketing the berries. On this account, I think this method of treatment could sometimes be applied advantageously to flowed bogs, as well as to dry ones, if the grower is not pressed for immediate returns. In fact, I doubt if, in the long run, such a treatment would have been a disadvantage, from the financial standpoint, at the State bog this year.*

I stated, at your last annual meeting, that we had begun work on the parasites of the fruit-worm. I am sorry to say that these experiments have, so far, been a failure, for the most part apparently because I have not succeeded in devising a suitable cage for rearing the parasites. I am now starting a new series of these experiments with another kind of cage and I am hoping that these will prove to be more satisfactory than were those used last year.

BLACKHEAD CRANBERRY WORM
(Endemis vacciniana Pack)

Probably a more appropriate and less confusing common name for this insect would be "*the wet bog fire worm.*" It is commonly known by cranberry growers as the "fire worm." Very few, however, think of it as the "blackhead cranberry worm," by which name it was called, by Prof. J. B. Smith of New Jersey, to distinguish it conveniently and certainly from the "yellowhead cranberry worm," which is also commonly known by the growers of the Cape as the "fire worm." In spite of this apparently well reasoned attempt by Prof. Smith to differentiate in the growers' mind the distinguishing characteristics of these two insects, only a small percentage of the growers had up to four or five years ago, learned to separate them by the character difference made prominent by him in their names. This may have been due to the fact that very few of the growers ever received Prof. Smith's bulletin, or the difficulty of readily applying insect

descriptions may account for it. We have learned, however, within the last few years, that in Massachusetts, at least, the so-called "blackhead cranberry worm" seldom, if ever, does serious damage on bogs which are not winter flowed, while the "yellow-head cranberry worm" practically never does serious harm on bog areas which are completely winter flowed. If, therefore, one insect were called the "wet bog fire worm" and the other called the "dry bog fire worm," the general tendency to call them both the "fire worm" would be satisfied and the terms, "wet bog" and "dry bog" used with the common name, "fire-worm" would easily and instantly separate the two insects in the mind of anyone. It seems desirable to retain the word "fire-worm" as a part of the common names of both insects because the work of either, when very serious, is so suggestive, in appearance, of the damage caused by fire.

Not only is this insect confined in its damage to winter flowed bogs, but we find its prevalence on those bogs depends on other peculiar characteristics of the bogs themselves. We find we can grade the bogs roughly according to the extent to which they are, in the long run, troubled by this insect, about as follows, beginning with those most troubled and following, in order, with those less infested:

1. Bogs of great area and blocky shape with scanty water supply for reflowage or with June reflowing not regularly practised. Bogs of this description are never without serious infestation by this insect for any great length of time.

2. Bogs of smaller area which are winter flowed and are reflowed not at all or very little.

3. Bogs of great area and blocky shape which have abundant water supply for reflowage and are frequently reflowed.

4. Bogs of small area with abundant water supply for reflowage. These bogs are practically never troubled with this insect, probably not more so than are dry bogs.

Furthermore, when a bog of considerable area first becomes infested, the first "burning" noticed is always at some distance from the upland and usually near the center of the bog. In a system of adjoining bogs of different sizes, the first to become

infested is almost invariably the largest and widest one when the flowage management is the same for all.

In attempting to give reasons for these peculiar facts, concerning the distribution of infestation by this insect, we must begin with the fact first discovered—that it damages winter flowed bogs and only rarely attacks strictly dry ones. In this connection, it should first be stated that this insect, as usually found, is only very moderately parasitized, while the yellowhead, or "dry bog fireworm," is always attacked by parasitic foes in great numbers. I was at first puzzled to account for this, but the reason is not far to seek and becomes apparent after a careful study and comparison of the life histories of these two species, which are so alike in their habits and which anyone would think ought to be curtailed by natural enemies about equally. The yellowhead passes the winter in the moth stage and, in that stage, it cannot endure submergence in water. Winter flowage will, therefore, either kill it or drive it off from any bog. The blackhead, on the other hand, passes the winter in the egg stage and, in that stage, the water of winter flowage protects it from the severity of winter weather (there is a considerable mortality among the eggs of this insect when a seriously infested bog is left without flowage throughout a winter) and, at the same time, relieves it, to a very large extent, from its parasitic and predacious enemies (flies, spiders, etc.,) by killing a part of them and driving most of the remainder ashore. The yellowhead, compelled to confine itself to bogs which are not winter flowed, because of the stage in which it passes the winter, has no such good fortune in escaping its enemies, and this accounts for the apparent difference in the amount of parasitism to which the two species are subject. The difference is an artificial and not a natural one. It is caused by man's interference by his flooding operations, with nature's processes. Indeed, it seems probable that under perfectly natural conditions of the two species, the blackhead is the more severely curtailed by parasitic and predacious enemies. This is indicated by the fact that this insect seldom seriously infests a dry bog, while the yellowhead succeeds, under dry bog conditions, in becoming very injuriously abundant

very frequently indeed. Moreover, practical experience has shown, in a few cases, that when the blackhead succeeds in infesting a dry bog, it, as well as the yellowhead, can be driven out completely with one good spraying with an arsenical poison—apparently because of the presence of an army of parasitic and predacious forms, which concentrate on the remnant left by the poison and clean it out so thoroughly that it does not become abundant again for many years.

Having shown in a general way how winter flooding, by destroying the natural enemies of the blackhead, enables it to get a foothold on a bog and become a pest, I will now attempt to show why, in all probability, the size and shape of a bog have a bearing on its liability to infestation by this insect. As I have already indicated the winter flowage either destroys or drives ashore the natural enemies of this insect and at the same time protects the insect itself in the egg stage and puts it in a position to proceed freely and without molestation in its hatching and development after the water is taken off in the spring. Under these conditions the only parasites or predacious enemies which can succeed in reaching the blackhead must come onto the bog from the upland after the water is taken off. Naturally most of the insects of this sort will probably not come from a very great distance to the bog and on this account a limited and probably not very wide fringe around the bog must supply them. All these things being true, these natural enemies of the fireworm will not become well distributed over a large bog of blocky shape so quickly as they will over either a small bog or a long, narrow one for the two following reasons in particular.

I. The distance from the upland to the center of the bog is of course greater on the large, blocky bog. Therefore, the parasitic and predacious forms have farther to travel before they reach the fireworms at the center of the bog and during the extra time it takes them to go this distance the fireworms gain just so much. It seems probable that it is because of this that infestation by this insect, on large bogs, usually first appears at some distance from the upland and often near the center of the bog.

As a bog of blocky shape increases in size, the increase in its area is out of proportion to the increase in the area of a limited fringe around it. For this reason, what parasitic and predacious forms (Tachina flies, spiders, etc.) come onto the bog from the upland during the season, will naturally, in proportion to their number, be scattered over a greater area on a large bog than they will on a small one. Thus it will be seen that theoretically, at least, the fireworm will, under such conditions, be relieved from its natural insect enemies in direct proportion to the increase in the area of the bog and, from my observations of several seasons, I feel sure that this is actually the case. I have this season made collections on several winter-flowed bogs of great difference in area, at different lengths of time after flooding and at different distances from the uplands, and on a dry bog for comparison, hoping, by this means, to get additional light in regard to this matter. In this investigation, each collection consisted of the material gathered by one hundred sweeps of my collector's net through the vines. Three separate collections were made on each day that the collecting was done and at each location which I selected for comparison, in order to be sure that the collections were truly representative of the insect life present at the time and place that the collecting was done. Comparisons between the different locations, on the different dates, was made by first separating out the parasitic and predacious forms from the rest of the material in these collections, classifying them, counting the individuals in each class of each collection separately, and finally comparing the counts. Perhaps the most remarkable thing that I learned from this was that, of all forms capable of damaging the fire worm, spiders, of numerous species taken collectively, were, in all cases, considerably the most numerous. Moreover, only the spiders gave really striking differences in the counts of the different collections made. In comparing these counts, I found that the dry bog had very many more spiders, and also a somewhat larger number of parasitic insects than did any of the winter-flowed bogs, even as late in the season as the 20th of August, when the last examination was made. A bog of 160 acres, blocky in shape, gave a distinctly smaller count of

spiders, on all parts examined, twenty-seven days after the flowage was taken off, than did a bog of 12 acres of similar shape, on its very central portion, sixty-eight days after the removal of the flowage. The distance from the upland, at the nearest point, to the center of the 12 acre bog, roughly measured by pacing, is about 250 feet. The 160 acre bog, in the material collected from the different portions twenty-seven days after the water was taken off, gave distinctly larger counts and showed a greater variety of spiders near the upland than at the center and, at the same time, some kinds of parasitic insects were collected near the upland which seemed to be entirely absent at the middle of the bog. The distance from the upland at the nearest point to the center of this bog is about seven hundred and fifty feet as measured by pacing.

In a general way, therefore, the results of my collecting and counting support my conclusions, arrived at from my general observations, concerning the cause of the peculiar distribution of blackhead infestation already discussed. But, while it is evident that winter flowage seriously reduces the work of the natural enemies of the blackhead, especially on the large bogs, it must be remembered that, in spite of this handicap, they nevertheless succeed in doing a great deal toward controlling this insect on all bogs and that, in the first beginnings of the most serious infestation, only a few stragglers here and there succeed in escaping them. The escape of these stragglers is, however, a serious matter, for they increase the amount of infestation which these natural enemies must take care of the following season, if they succeed in keeping the pest under control. As the winter flowage comes in and sweeps away these natural enemies again, they cannot increase on the bog to meet the increase in the number of blackheads. The number of the blackheads, therefore, tends to increase, while the number of their natural enemies tends to remain constant from season to season, on account of the water interference (I am now considering the bog as being winter flowed, but not reflowed at a time to reduce the blackheads). When once the infestation has developed beyond the ability of the natural enemies of the insect to control it, its in-

crease is very rapid unless artificial aids to these enemies are provided by man. Theoretically, the escape of two straggler fireworms one year may mean the escape of perhaps fifty the next year and of perhaps 1200 the third year and of 30,000 the fourth year, and so on. To be sure, a single season's natural increase of the natural enemies, in the midst of the very plentiful food supply present after an infestation has developed to a serious extent, will probably do a little toward restoring the balance between the fireworm and its enemies, but, as a rule, this factor will not be sufficient to make any appreciable difference because of the shortness of the season in which this increase must be produced and do its work. It will be remembered, in this connection, that the fireworm does not usually begin to hatch, in the spring, until the middle of May, and that the moths of the second brood appear in late July and early August to lay their eggs for the following year. Even this short period is considerably reduced, as far as the work of the natural enemies is concerned, by the moth and egg stages which come between the first and second broods.

As you will see, the point which I have been working toward, in this discussion of the relations between the "wet bog fire worm" and its natural enemies is this: *Probably the ideal time to spray for this insect with arsenical poisons*, especially on the large, blocky bogs and on bogs which cannot be reflowed in June after having been winter flowed, *is not after an infestation has fully developed and so threatens vines and crop that the need for immediate action is imperative, but is before the infestation starts.* In other words, in treating this pest, try putting a padlock on the stable door before the horse is stolen. Cut off the stragglers and keep infestation from starting by spraying at the proper time every year, whether the insect appears to be present or not. When you spray for the stragglers, your spraying will not need to be as effective as it would have to be under conditions of bad infestation, because the natural enemies of the blackhead are capable of taking care of most, if not all, of the worms which escape your poison. In spraying for a heavy infestation, if your work is not extraordinarily thorough and effective, you will, at the best,

leave a far greater number of worms unharmed than their natural enemies can begin to cope with. *It is quite possible that this method of treatment would not succeed in permanently warding off severe infestation in all cases,* but I feel certain that it would, if properly carried out, at least postpone such infestation for several years.

I expect that some of you will object to this method of treatment on the ground of expense. This may appear to be a serious objection, but it may be questioned if it is really a valid one when we remember that the prevention of the loss of a single average crop will make up for the expense of four good sprayings each year for a period of ten years. Then, too, I am coming to believe that there are other entirely sufficient reasons why most bogs should be sprayed several times each year. Our fungus experiments seem to be indicating a considerable increase in fruit due to spraying this year, in addition to a distinct improvement in the keeping quality of the berries last fall. If we continue to get the improvement, by fungus spraying, which at present seems to have been achieved, it will certainly pay to spray regularly to control fungus diseases and the spraying for the fireworm may be accomplished at the same time, by mixing Paris green with the fungus spray, at an additional annual expense of perhaps three and one-half dollars an acre. I hope to be able to give more exact and conclusive data in regard to this, particularly concerning the results of fungus spraying, at your next annual meeting.

There is a bog near Tremont which I have been watching closely, with much interest, for the last six years. It is a winter flowed bog of about twenty acres and it is blocky in shape, with no water supply for reflowage. Its conditions for blackhead infestation appear to be ideal. This bog has been in bearing for about twenty years, and it has not been infested, to any extent, with the fire worm during the last ten years. The same man has been foreman on this bog for the last thirteen years and, as it happens, this foreman believes thoroughly in spraying and has given this bog a thorough spraying with arsenate of lead a-east once, and sometimes two or three times, in the month of May every year. As I have watched this bog and studied its conditions, I have been compelled to the conclusion that the

only reason for its continued freedom from infestation is that this regular spraying has aided the natural enemies of the insect in keeping down the stragglers to such an extent that it has never been able to get a foothold and start an infestation.

I realize, however, that while you may be more or less interested in this discussion of the prevention of fire worm infestation, some of you are more desirous of being told how to clean out a serious and fully developed infestation. To begin with, I must point out the apparently most serious obstacle met with in ridding a bog of such an infestation.

The hatching period, especially of the eggs that produce the first brood, is always extended over a considerable length of time. The variation, under different conditions, in the length of this hatching period is very great. On account of this variation, it is sometimes possible to control a heavy infestation with either a single good spraying or a single reflowing, properly timed, while under other conditions neither water nor poison nor water and poison combined seem to be sufficiently effective to meet the needs of the occasion. In extreme cases, which are by no means uncommon, the hatching period is so much prolonged that there seems to be no time during the year when eggs of either the first or the second brood are not present in considerable numbers. Several factors may contribute in causing this prolongation of the hatching time, but the chief one seems to be heavy vine growth. A thick vine growth is apparently, in many cases, to a considerable extent, both a cause and a natural result of infestation by this insect. Thick vines seem to so shade the eggs which are laid on the lower leaves that they develop much more slowly than do those which, placed on the tops of the vines, are more exposed to the light and heat of the sun, and, apparently as a result, there seems sometimes to be a difference of as much as five weeks in the hatching time of the eggs of the same brood. I have, this season, seen a similar variation in the hatching time of the "apple tree tent caterpillar," evidently caused in the same way. I found half-grown caterpillars of that insect on cherry trees growing under the heavy shade of pines, some time after the worms of the same species had everywhere finished pupating on trees growing in the open.

When a serious infestation develops, the repeated prevention of crop production by the insects' injury, if it is not brought under control, apparently gives the vines a tendency toward wood growth, which in turn favors the insect.

If a bog is winter flowed and not reflowed at all in the spring and not sprayed with arsenical poisons, it is as likely to become infested with this insect with thin vines as with thick ones. If, however, one or even two sprayings or reflowings are applied at the time which we have heretofore considered the best for treating this insect, a thick vine growth appears to be unfavorable to a successful treatment, apparently principally for the reasons given above.

In my last year's report to your association, I made the following remarks: "For those bogs which are infested with this insect and are heavily vined and can be reflowed only once, or at best twice, with a slow (i. e., taking several days to put on and take off the water) reflowage, I believe that thinning out the vines by pruning and heavy sanding will be found to be an essential treatment to accompany anything like satisfactorily successful treatment, either by flooding or spraying. I know that someone will say that there are bogs which are so determined to produce vines that it is impossible to thin them out and keep them thin very long. I can only reply that I believe that such bogs can, in most cases at least, be satisfactorily thinned and kept thin, if the water conditions are properly adjusted. This necessary adjustment might be along either or both of the two following distinct lines: 1. Early withdrawal of winter flowage with no long continued reflowage. 2. Sufficient drainage."

I still think most of this is probably true. There are, however, apparently other, and perhaps more satisfactory, ways of treating this insect under such conditions. The most successful treatment with water which, all conditions considered, I have ever seen was applied on one of the large bogs this season. In this treatment, the winter flowage was held late, until the 2nd of June, and then the bog was left without flowage or any special treatment until the 25th of June, when it was completely reflowed for two days. Before this reflow, the bog was heavily in-

fested, but after it only a very few fire worms were seen throughout the season. This bog is compact in shape and covers about 150 acres and a considerable portion of it is heavily vined and the infestation was spread pretty well over it. It seems to me that the most reasonable explanation of the success of this treatment is the following:

The water of the winter flowage tended to maintain a condition of even temperature among the vines on the bog. Because of its presence there was not the difference in temperature, between the tops and bottoms of the vines, especially where they were thick, that there would have been had they been exposed to the air as well as to the sun. Under these conditions, all the fireworm eggs present were influenced in their development much more nearly equally by the rising temperature of the spring days than would have been the case without the water. The eggs were thus brought nearly to the hatching condition of development pretty well together, and then the water was taken off, so that in this condition they were at once exposed to the hot weather of June, which naturally hastened rapidly the remaining development of all of them. By this means, the hatching was bunched up and the period of hatching so shortened that, when the bog was reflowed 23 days after the winter flowage was let off, practically all the eggs, on thick vines as well as on thin ones, had hatched and the insect was in the worm stage only and consequently in a condition in which it could readily be drowned by reflowing.

It is quite possible that this method of treatment would not always prove as successful as it did in this case, but it seems to me that it had in this case a good trial, the results of which may well be looked upon as significant. I believe that it should be tried further where seriously infested bogs can be reflowed in June. Moreover, if the reasons given above for the success of this treatment are correct, it seems probable that spraying for a heavy infestation of this insect would be most successful, if it were done after first bunching the hatching of the eggs of the insect by holding the winter flowage late. If this be done, the spraying should all be done within a week after the flowage is

taken off. *I think it advisable to try such late holding and spraying on infested bogs which cannot be reflowed in June.* As the hatching period probably cannot be shortened to much less than three weeks by such late holding of the water, under some conditions it may be necessary to spray twice.

There is little doubt but that any bog can be freed from this pest, by treating it as a strictly dry bog for a few years (i. e., not flooding it at any time under any conditions) and so allowing the natural enemies of the insect to accumulate against it, and at the same time spraying at proper times with arsenical poisons. As the danger from injury by winter-kill is considerable under such conditions, however, the grower must consider whether it is best to take the risk. In my opinion, it is possible, on small bogs, to clean out a bad infestation by spraying, without omitting winter flooding.

Many of you are probably curious to know just what are the natural enemies of the fire-worm, of which I have spoken so many times. There is possibly quite a variety of such enemies, but spiders (of several different species) and Tachina flies are evidently the most numerous and useful. Spiders are known to attack and destroy the worms, and some of the jumping species have been seen to leap into the air after the millers. The Tachina flies resemble houseflies considerably, in general appearance, though they are somewhat smaller than those common insects. They lay the white eggs often seen on fireworms. These eggs are smooth and may be glued to almost any part of the worm's body, but are most often found on or near its head. A maggot hatches from each of these eggs and, boring its way into the body of the worm, lives in its viscera, absorbing nourishment therefrom. Probably the worms are killed in considerable numbers by these maggots.

THE CRANBERRY GIRDLER

(Crambus Hartuellus Hubner)

My season's observations on this insect sustain, in every particular, the conclusions concerning it reached in the past two years. In regard to control, these conclusions are as follows:

1. A serious infestation by this insect, at least on a bog of small or medium size, is almost a certain sign of neglect. On bogs which are kept well sanded, this insect apparently never succeeds in getting a foothold. Resanding every other year is apparently sufficient, on most bogs, to prevent trouble from this source. Badly infested bogs are invariably bogs on which an accumulation of old cranberry leaves has been allowed to collect over the sand under the vines, and usually the worst infestations are on heavily vined bogs.

2. An infestation may be wiped out either by reflowing for ten days to two weeks immediately after picking, where water for such flowage is available, or by resanding the infested area evenly with an inch of sand sometime between the first of December and the first of the following June, and thus smothering the insect so that the moths will not emerge, where water for reflowage is not available. Where such heavy resanding is done it is usually necessary to carefully rake the tops of the vines up through the sand so that the buds will not be destroyed.

3. Reflowing a bog every year, for a week or ten days right after picking, is a sure prevention of infestation by this insect.

There are indications that the girdler is, many times, favored by man's flooding operations in the same way that the "wet bog fireworm" is favored—i. e., by the destruction or driving ashore of its natural enemies. These indications are as follows:

1. Winter flowed bogs, which cannot be reflowed, appear to be more often seriously infested than do strictly dry bogs.

2. The infestation on such winter flowed bogs seems usually to appear first near the center of the bog.

3. It seems to be the experience of the managers of some of the very large bogs that it is relatively more difficult, other things being equal, to keep a large bog free from this pest than it is a small one.

That the girdler should be in the same box with the fireworm in this respect, should, perhaps, be expected, as winter flowage, even if held as late as the middle of May, does not appear to harm it seriously any more than it harms the eggs of the fireworm.

I am inclined to the opinion, moreover, that serious infestation by this insect is common on neglected bogs and very rare on those which are kept sanded because of the protection from natural enemies which the accumulated debris on the neglected bogs affords the worms of this insect.

OTHER EXPERIMENTS STARTED

In addition to the work already discussed, we have, during the past year, laid off seven new plots and begun sanding and picking experiments on them. These experiments may have to be carried on, and records kept in connection with them, for several years before we shall be able to report very definite conclusions. In the sanding experiments I am comparing the results of no resanding with those of resanding every year, every other year and once in three years. In the picking experiments, I am comparing hand picking with scoop picking, and early picking with late picking, in their effects on the vines and on crop production.

RECORD BLANKS

It may interest some of you to know that I have prepared special blank forms for keeping labor records and general records for the State Bog. I speak of this matter because I think it possible that you may wish to keep somewhat similar records for your bogs. I shall be glad to show my record blanks to anyone wishing to see them.