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DOMINION OF CANADA—DEPARTMENT OF AGRICULTURE

THE CRANBERRY INDUSTRY

ITS POSSIBILITIES IN CANADA

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with

A Section on Cranberry Diseases

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DOMINION EXPERIMENTAL FARMS



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FIG. 1.—A well kept bog showing arrangement of ditches. Note how free the ditches are of weeds.

The Cranberry Industry and its Possibilities in Canada

The culture of cranberries, although not a widely established industry in the Dominion as yet, can be conducted with profit in many sections which at present know practically nothing of the growing and care of this crop. With the exception of the work done on a few bogs in Nova Scotia, Prince Edward Island, Quebec, and British Columbia, very little has been done in Canada to further the production of this crop, although there are, doubtless, many acres of unemployed land suitable for cranberry bogs.

Canada imports most of its cranberries from the United States. These cranberries could, it is believed, be grown in Canada at a profit, and at such a price that the home market could be kept for the Canadian berries.

As a very large portion of the crop imported from the States is grown on Cape Cod, it will readily be seen that the freight haul of the United States grower is very little less, if any, than that of a Canadian producer who desires to use the western markets.

It would appear, therefore, that there is an excellent opportunity in Canada for the planting of cranberry bogs, which means the utilization of lands which at present are lying idle.

This is especially true when it is considered that this country imports annually around 115,000 twenty-five-pound boxes of this fruit, with a value in the neighbourhood of \$250,000. There would appear to be every justification for the increase of Canadian bogs to the extent of 1,000 acres. At present, it is doubtful if the total area exceeds 150 acres.

THE CRANBERRY

The average person in speaking of cranberries will mention the "high bush" cranberry and the "low bush" cranberry. It is with the latter that this bulletin deals. The "high bush" cranberry is botanically known as *Viburnum Opulus*, and the well-known Snowball, so often used as an ornamental shrub, is a cultivated type of this species. The berries produced by this shrub are often used as a substitute for the common cranberry, but the latter commands a more ready market.

The common cranberry, that is, the cranberry that is offered for sale on the open market, and which is called the "low bush" cranberry, belongs to the genus *Vaccinium*. There are two common species indigenous to this country, viz., *Vaccinium Oxycoccus* and *Vaccinium macrocarpon*. It is the latter species which embraces the many varieties of cultivated cranberry grown on Cape Cod. *Vaccinium Oxycoccus* is a much smaller plant than *Vaccinium macrocarpon*. Its leaves are narrower, its runners much shorter, and the fruit much smaller and generally more ovate than *Vaccinium macrocarpon*. Another species of *Vaccinium* is exported from Newfoundland and the island of Cape Breton in considerable quantity, it growing there in the wild state. This species is commonly known in this country as the Partridge berry or Fox berry, being the same as the Swedish Lingon berry, and is botanically classed as *Vaccinium Vitis-Idæa* var. *minus*. Little is known of the possibilities of the cultivation of either *V. Oxycoccus* or *V. Vitis-Idæa*, although there seems no reason to doubt but that both may eventually find an important place in commercial horticulture. *V. macrocarpon*, however, as stated before, has been under cultivation for many years, with the result that many commercial varieties have been introduced,

and the fruit is now in widespread demand. It is with the culture of *Vaccinium macrocarpon* (the large or American cranberry) that the following pages will deal.

SELECTION OF THE CRANBERRY SITE

The selection of the site for the prospective cranberry bog is the first important consideration. Cranberry sites may be roughly divided into two classes: low bog and high bog sites. The former is, year in and year out, the more profitable site. The term "low bog" is used because, as the name implies, the bog is situated on low ground, thus enabling it to be flooded. The selection of a "low bog" site will first be dealt with.

The "low bog" site is, if well selected, the ideal situation for profitable cranberry culture. Four essential points must be considered. These four points are:—

1. Soil.
2. Location of sand.
3. Drainage.
4. Water privileges.

SOIL

Cranberries, when cultivated, do best under conditions closely approaching those under which they grow in the wild state. That is, they prefer low land, which is moist, or swampy soil composed of a muck or peat formation. A few inches of this muck or peat, however, will suffice and may frequently have a sub-soil formation of blue clay or sand. Again, bogs are often seen which are growing well on hard bottom, that is, the soil consists of sand alone, without the peat or muck on top. Such bogs will, of course, require more fertilizer than the muck or peaty bog, which does well for years on the plant food contained in the muck and peat formation. Frequently a clay swamp, when in a good damp location, gives excellent results as a cranberry bog. Meadow land which has been brought under good cultivation, although possessing the necessary soil requisites, should not be used for cranberry culture, for such lands would be liable to prove too weedy, and furthermore other lands which are incapable of being used for general farm purposes to good advantage will make just as good cranberry bogs.

Sphagnum moss bogs are not desirable cranberry sites. There are plenty of bogs in Canada which are nothing but sphagnum moss formations, sometimes to a considerable depth. These are not peat bogs and should be avoided for cranberry purposes.

The cranberry is an acid-loving plant, and the bog should possess an acid reaction, not an alkaline reaction. There are plenty of alkaline peat and muck soils which are not suitable for this work and care should be exercised that these are not selected.

SAND

Sand is a necessary article in cranberry production. Without it, it is impossible to grow cranberries at a profit. Even the best soil and location, without access to a sand bank, is not capable of good results. Sand is the all-important element, the first great step towards success in cranberry culture. Although a moisture- or water-loving plant, the cranberry requires a few inches of well-drained, well-aerated soil on the surface, in order that it may do its best. Not only is sand necessary for this purpose, but, as will be shown later, it is useful in the control of moss, prevention against frost, etc. The close proximity of the bog to a good supply of coarse, gritty sand then is an essential point. Sand with clay mixed in is not good for this purpose. It must be clean sand, and, although a coarse sand is considered better, fine sand will give good results, if it is clear gritty sand. As sanding is an operation that will need to be carried on at frequent intervals, a good supply is needed, and to cut down the cost of handling, the bog should be located as closely as possible to the sand supply.



FIG. 2.—Showing method of hacking bushes, stumps, etc.

Courtesy A. D. Makepeace and Co., Wareham, Mass.



FIG. 3.—Showing removal of turf and bush stumps.

Courtesy A. D. Makepeace and Co., Wareham, Mass.



FIG. 4.—Dyke building. Hauling turf to the dykes.

Courtesy A. D. Makepeace and Co., Wareham, Mass.



FIG. 5.—Showing the construction of a dyke.

Courtesy A. D. Makepeace and Co., Wareham, Mass.

DRAINAGE

Another important point to be considered is drainage. The bog should so lie that an outlet can be obtained for excess of water in the early spring, otherwise it might be impossible to have the bog free of water in sufficient time for the plants to blossom and set fruit. As the bog now being considered is a low bog, the water from the surrounding highlands will, of course, drain into the bog, so that an outlet to carry off this water is an essential point.

WATER PRIVILEGES

A bog possessing good water privileges possesses the best insurance possible. If the water privileges are such that the bog can be flooded at any time during the season, the owner of such a bog is in a position to fight frost and drought to excellent advantage. Many low bogs, although in positions where they can be flooded in the fall of the year, are not where they can be reflooded by gravitation after the spring waters have been let off the bog. This is a distinct disadvantage, but one which in many cases can be cheaply overcome by the installation of a pumping plant, which will raise the water from a low level in such quantities that the bog can be reflooded in a few hours. These pumping plants are easily procured and are good investments, where water cannot be obtained by gravitation. Many bogs have the reflooding water lifted as high as twelve or fifteen feet, while a six-foot lift is very common, in fact there are very few bogs which have a gravity water supply at their disposal for reflooding purposes. Such bogs are worth a great deal, for they are ideal for profit making. The selection of the bog site, then, from the standpoint of water supply is an important point and one that should be given much consideration. If it is impossible to locate near a constant gravity supply, locate at as low a level as possible, to make the lift reasonably short, in case it is deemed advisable to install a pumping plant. Every prospective cranberry grower should look into the cost of installing a pumping plant for his bog. The question of pumping outfits is discussed in another paragraph.

THE HIGH BOG

The high bog site is only resorted to when it is decided that it is impossible to locate in a low site. A high bog is one located on such high lands that it is impossible at any time of the year to flood it by gravitation, so that the bog has to go through the winter without any water as a protection. The drainage of such a bog is, of course, an easy matter, as the location is higher than the surrounding land, and also because little drainage is required. The two important points to consider then are soil and sand. Both of these points were discussed under the selection of a low bog site, and the same recommendations hold good for the high bog.

PREPARATION OF THE LAND

Having selected the best available piece of land for the cranberry bog, it now remains to prepare it for the reception of the plants or vines.

The first step necessary will be to ditch or drain the bog. This will require considerable judgment and a knowledge of the levels of the area. A marginal ditch opening into the outlet should first be dug. The marginal ditch is dug around the outside of the whole area and thus cares for the water from the surrounding high lands, and also serves as a barrier for weeds and many insect pests from surrounding lands. If the bog is wet, cross ditches will need to be dug across the bog. This should be done by digging one large or main ditch with laterals leading off from it. The closeness of these laterals will depend upon the amount of water to be drained from the bog. Many bogs have the ditches closer than is absolutely necessary from a drainage standpoint, but, on

the other hand, the increased number of ditches renders the distribution of flooding water an easier and quicker task, for a bog which has but few cross ditches is liable to have the flood water pile up and do injury to the vines. Such a bog is also slower to flood than if the water were well distributed through a system of ditches. At the time the ditches are dug, provision should also be made for the location of flood gates and drainage gates.

Having completed the drainage system, the bog by this time will be dry enough to permit of work at clearing. Of course, if the bog can be cleared before being drained, this would be the first operation and drainage the second, the order of these depending upon conditions. By clearing is meant removing trees, bushes, stumps, etc. The brush and old stumps are piled in heaps and burned on the bog. After all the bushes, trees, etc., are disposed of, the next operation is to pare the land. This consists of removing the top sod, by cutting it into strips and hauling it off in wheelbarrows, using planks for the barrows to run on. It is sometimes advisable, where the land will bear a horse, to cut the sod into strips by means of a turf cutter, which is simply a long bar or plough arm with a colter attached. These strips may then be cut into small sections and lifted with a two-prong fork into the wheelbarrows. If the turf is not weedy, it may be turned over and allowed to remain where it is, thus reducing the cost of building the bog.

More modern methods have developed recently in which bogs that are grown up with heavy shrubs may be stripped by a gasoline engine. This is done with a revolving winch which is driven by a gasoline engine. It is set up in the edge of the bog and a large claw attached to a steel cable is then dragged across the area to be cleaned. This claw rips out large shrubs and great pieces of turf, which are pulled to the edge of the bog for burning or removal. The steel cable bearing the claw passes through a large block anchored on the opposite side of the area and, by reversing the winch, the claw may be drawn back and shifted to a new position for the next pull.

In other cases tractors with very broad wheels or caterpillars may be employed for scalping purposes.

DYKING

The turf taken from the bog is then utilized in building the dykes. These vary in width, of course, depending on the amount of water they will be required to hold back. It is often advisable to make the dykes wide enough to serve as a roadway around the bog. Dykes should be built wider at the bottom than at the top, and a properly constructed dyke has a trench dug below the centre and running lengthwise of the dyke. This trench is dug to hardpan and filled with gravel and sand, thus making a good connection with the underlying soil for holding water. The dyke should also be constructed a few feet outside the marginal ditch. At the time of erecting the dykes, provision should be made for the building of the flumes, which admit the flood waters and which also carry off drainage water. These may be built of wooden planks or concrete reinforced, the latter making a much more permanent job.

At the time of clearing the bog and dyking it, attention should be paid to the levels. A bog which is uneven or hilly takes a great deal more water to flood it than a level bog, for the water has to be high enough in the depressions to overflow the higher portions. This will necessitate a higher dyke and more expense in flooding, as well as increased time in reflooding operations. Instances may occur, of course, when it would be very expensive to level off the bog at all. In such cases it may be that the bog, if at all large, could be divided into several smaller ones by means of dykes, and each smaller bog thus made to approach a level. This would facilitate flooding, for the water could be led through flumes to the various small bogs.



FIG. 6.—At the sand pit.

Courtesy A. D. Makepeace and Co., Wareham, Mass.



FIG. 7.—Levelling the sand heaps.

Courtesy A. D. Makepeace and Co., Wareham, Mass.



FIG. 8.—Showing a marking machine in use.

Courtesy A. D. Makepeace and Co., Wareham, Mass.



FIG. 9.—Dibbling in the vines.

Courtesy A. D. Makepeace and Co., Wareham, Mass.

Having completed the ditching and levelling and removal of the debris, the next operation consists of sanding. For this, planks are laid across the bog to the sand pit, the sand carried out on to the bog in wheelbarrows and dumped in small piles, the planks being lifted as soon as one strip is completed. Immediately following the wheelbarrows are men with shovels and levelling rakes, who level off the sand heaps. In this manner three or four inches of good sand is placed over the whole bog. Instead of using planks and wheelbarrows, platforms about ten or twelve feet wide and six long may be used, on which a team can be driven. These platforms are laid across the bog and the wagon load of sand spread on both sides, after which the sections are turned end over end to another portion of the bog, and the operation repeated. Again other growers use a pole railway, the rails being built in sections, but unless the haul is very long, the wheelbarrow method appears to be the most practical.

Where motor transport is possible sand may, of course, be carried some distance by truck and dumped close to the bog and then handled by hand as described above.

Another satisfactory method which is rather cheap is to have the bog scalped and ready for sanding and then wait until winter. The sand may then be spread on the ice by team or motor power.

Following the sanding comes the operation of marking the bog for the planting, which should be done in the spring of the year. For the purpose of marking, a machine such as illustrated in Fig. 8 is used.

This machine makes the lines the desired distance apart and the marking is done both ways, so that the vines are planted at the intersections of the cross lines. The distance is generally one foot apart each way.

PLANTING

For planting, the long trailing vines of the cranberry are used. They are generally cut from around the edges of the ditches and dykes of older bogs. These vines are placed in large baskets, of which each planter takes one and a dibble, and crawling on hands and knees, commences to dibble in the vines. Generally two vines are placed in a hole. This is accomplished by picking up the vines in one hand, placing them flat upon the ground so that they lie across the intersection, and pressing them into the soil with the dibble at this point, at the same time firming the soil with the hand which was holding the vines. This leaves the ends of the vines sticking up and the U-shaped part in the ground, as shown in Fig. 10.

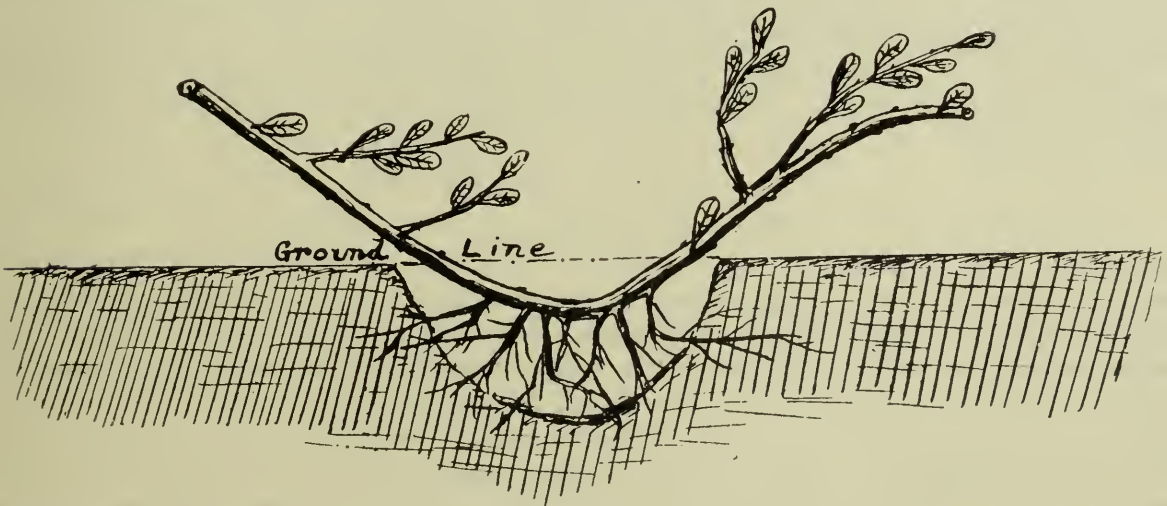


FIG. 10.—One method of planting vines.

In addition to this system of planting, there is another one used by the Nova Scotia growers quite extensively. It consists of marking the bog one way only, putting the row one foot apart, and in some cases as far as eighteen inches apart; long vines are then used, and are planted by pressing them down into the sand at intervals of every few inches, thus making one continuous row of vines. This is illustrated in Fig. 11.



FIG. 11.—Nova Scotia method of planting vines.

Both systems are good, although the Nova Scotia growers claim that by their system a bog is vined over more quickly.

There are other methods available, which are less laborious. Where the bog is at all soft, the young vines may be broadcast over the sanded surface and pressed into the soil by running a tractor with broad cleats over the area. When this is not feasible, some planters put on half the sand, then broadcast the vines and follow with a dressing of sand to cover the vines sufficiently, after which a good rolling completes the operation.

This brings the bog to its completion. It is now ready for its annual care. Before discussing that, however, a few words must be said concerning the high bog, for so far the treatment has been for low bogs. On the high bog the operations are the same as on the low, except that no dykes are needed, fewer ditches are required, and no preparation for reflooding is made, since it is impossible to obtain water.

TREATING THE NEW BOG

After the planting or vine setting has been successfully completed, if the bog has reflooding privileges, it should be reflooded immediately. The ditches should be filled and the water held close to the surface for a couple of days. This will give the vines a start in their new home. After this the water should be drawn off to the bottom of the ditches. Unless a very severe drought sets in, this will be all the reflooding necessary the first season. Throughout the season attention should be given to weeds and all these removed to give the vines as much chance as possible. Weeding the cranberry bog is as important as weeding any other crop.

WINTER FLOODING

In the fall, after freezing commences, attention must be paid to the winter flooding. The young bog should not be flooded for winter until the ground begins to freeze solid enough to cause some heaving. Care must be taken also not to delay the winter flood too long, or heaving of the vines may take place, with consequent serious results. The water flowage should cover the vines to a depth of several inches, and is left on the bog until early spring. On the young bog it is removed during April. Care must be exercised, during quick thaws and spring freshets, to allow all the surplus water to drain off the bog, otherwise when the ice breaks up, the freshet may cause the ice to rise and tear up some of the vines which are frozen in it. This will not occur on a well-drained bog, if care is exercised.

During the first three years, the bog is treated as above mentioned, some attention being given to weeds. It must be remembered that many of the weeds which first appear are killed by the winter flowage, so that by acquainting himself with the various weeds present, the grower will soon learn how to control them in the cheapest manner. When the bog has reached its fourth year, it should be ready to bear, and the treatment of the bearing bog will differ from that given a young bog. The winter flowage of the bearing bog should be delayed until early winter, delaying it as long as possible without risking the danger of any severe winter killing. The time of removing the water in the spring will depend upon the conditions. If fruit worm is not present, the winter flowage should be removed as early as possible, but if fruit worm is present this flowage should be held until the latter part of May in Eastern Canada. The bog should be reflooded again during the first part of June, this second reflooding clearing it of fire worm and other pests that may be present. It generally should remain on the bog for about two days. Like other plants, the cranberry is better if watered at night, so that this flowage should be put on and removed during the night time, if at all possible.

PROTECTION AGAINST FROST

The grower who is in a position to reflow his bog during the latter part of May and early part of June has little to worry about from spring frosts. Spring frosts often cause a failure of the crop, or an early fall frost may ruin a crop of nearly mature berries. There is no better protection against these frost ravages than water, and it is not necessary to cover the vines completely. Enough water should be put on the bog to cover the sand to a depth of two or three inches. This is sufficient to maintain a temperature above freezing, as the water radiates its heat into the air. Bogs should not be flooded during or immediately after blossoming. The greatest amount of frost injury is done when the young buds are expanding. Frost injury at this period often escapes the notice of the grower, who may wonder why his bog has not blossomed that year. During September and October it will often be found necessary to flood again as a prevention against fall frosts. Vines and fruit in the fall will, of course, stand a certain amount of frost, and it is not advisable to flood except when absolutely necessary. Slight frosts can often be prevented by simply filling the ditches, without flooding the bog at all. During both spring and fall, reflooding for frost protection purposes should not be resorted to without good reason, and in connection with this point, the grower is advised to keep in touch with the nearest meteorological bureau and obtain from them the probabilities each day. It is, of course, inadvisable to rely solely upon this source of information, so that the grower will necessarily have to be alert on nights when frosts threaten, and learn to acquaint himself with weather peculiarities.

On bogs where it is impossible to reflood special attention should be paid to re-sanding as described below. A well sanded bog can withstand several degrees of frost which might ruin a bog not properly treated in this manner.

RE-SANDING

A bearing bog should be re-sanded at least every other year, and it seems that the fall, after picking time, is the best period of the year for this purpose. At this season the least amount of injury is done to the vines, unless, of course, the sand be spread on the ice during the winter. Bogs left for some time, without being re-sanded, get in very poor condition, for sand serves many purposes. It gives the runners a better opportunity to root by fastening them down, and it forms a better medium for the roots to grow in than would the peat, for it is capable of better aeration; it is a protection against frost, as it absorbs considerable heat during the day, which it radiates at night, and it helps materially

in the control of weeds and moss. Re-sanding is also necessary from time to time to supply new soil for the roots, otherwise they may become soil bound to a certain degree.

Too much emphasis cannot be placed on proper sanding. Several bogs in Nova Scotia, which have been examined by this Department, were found to be suffering from lack of recent sanding. The vines were like old unpruned apple trees and had been unable to establish that renewed root system which is made possible by plenty of sand, and thus were dying out, resulting in a poorly vined bog of little value.

FERTILIZING

On most bogs no attention need be paid to the question of fertilizer. Generally there is sufficient plant food in a bog to supply the vines, and, with a healthy growth of vines, fruit should result. There are instances, however, where it may be necessary to resort to the use of a little nitrate of soda to promote vine growth. Bogs needing such treatment would be those planted on hard bottom, that is where very little peat is present to supply any nitrogenous matter for the plants' use.

While little is yet known regarding the response of cranberries to fertilizers, a few facts stand out from the experiments conducted in the United States. Stable manure is unsatisfactory on account of weed seeds; sulphate of ammonia has caused injury as a source of nitrogen and should be avoided.

The New Jersey Station has recommended a mixture made up as follows:—

Sodium nitrate	75	pounds	per	acre
Dried blood	75	"	"	"
Rock phosphate	300	"	"	"
Sulphate of potash	50	"	"	"

On hard bottoms or shallow bogs, the above mixture may prove of some value.

PRUNING

In cases where the vines become undesirably thick, it may be advisable to practise pruning to a limited extent. This is accomplished with a pruning rake, which is used to thin out the vine runners. This practice is not to be recommended, except in cases of a very thick, matted vine growth.

PICKING AND CARING FOR THE CROP

The time when picking is commenced will vary much with the varieties grown. Like all other fruits, there are early and late varieties among cranberries, so that the picking season extends over quite a period. In Cape Cod it generally runs from September 1 to well into October, whereas in Nova Scotia it rarely starts before the middle of September and has to be rushed along rapidly to avoid fall frosts. The berries should be allowed to colour on the vine as much as possible, for a well-coloured berry will bring a much better price than a poorly-coloured one. For picking purposes a scoop is used. The scoops vary in width considerably and are illustrated in Fig. 15.

The thin portions and edges of the bog are picked by hand and this is generally done before the scoop picking commences. To keep the pickers in line and give them some guide, strings are put down, thus dividing the bog into narrow sections. These strings act as guides and prevent the pickers leaving patches of unpicked berries. This system is illustrated in Fig. 12.

As cranberries should not be handled or stored while wet, picking should not commence until after the dew has thoroughly dried off the vines. Likewise, picking operations should not be conducted during wet weather. If reflooding has to be resorted to during the picking season, on account of frosts, no picking

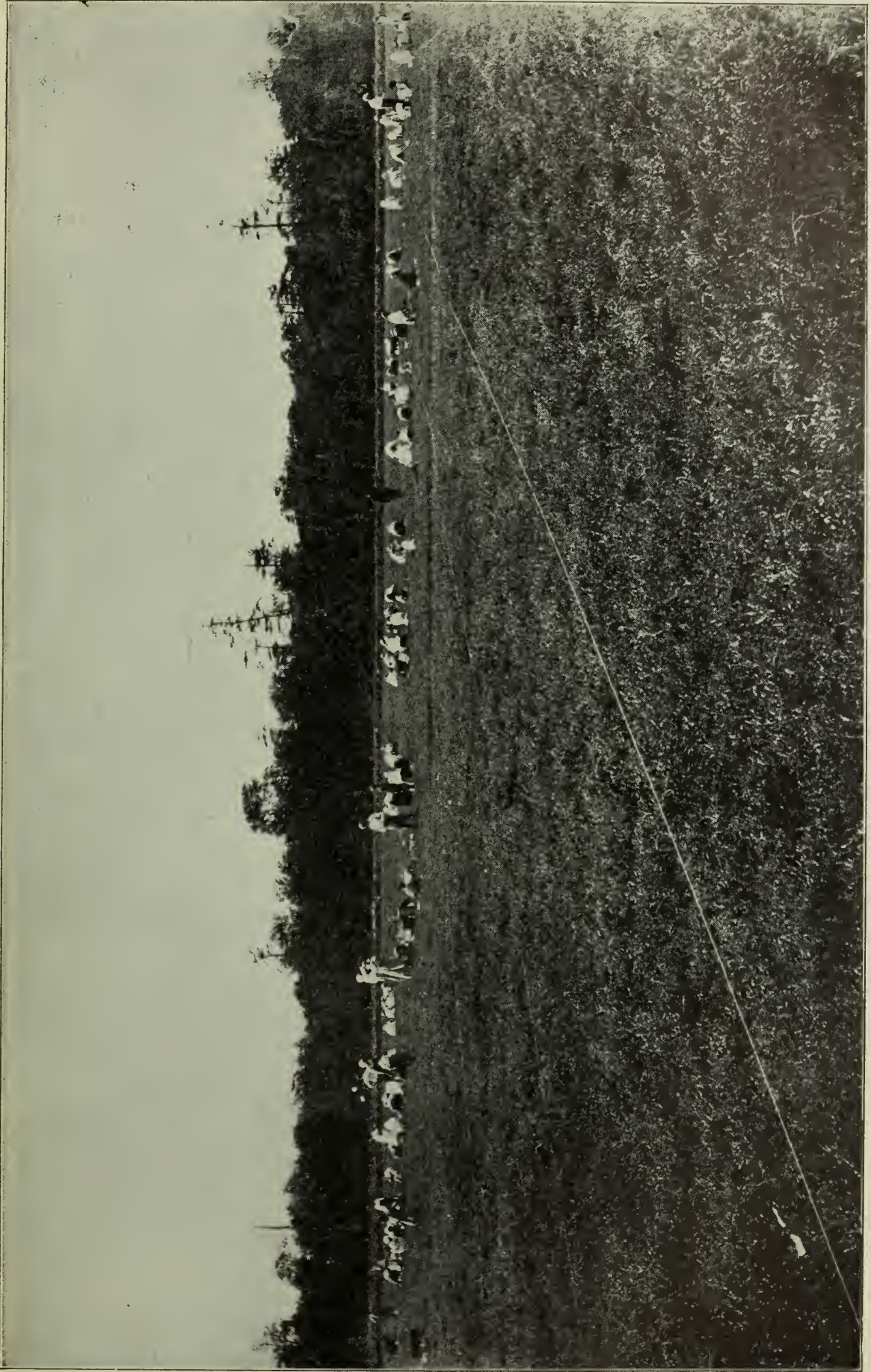


FIG. 12.—Cranberry pickers at work. Note strings put down to guide pickers.

(Photo by M. B. Davis.)

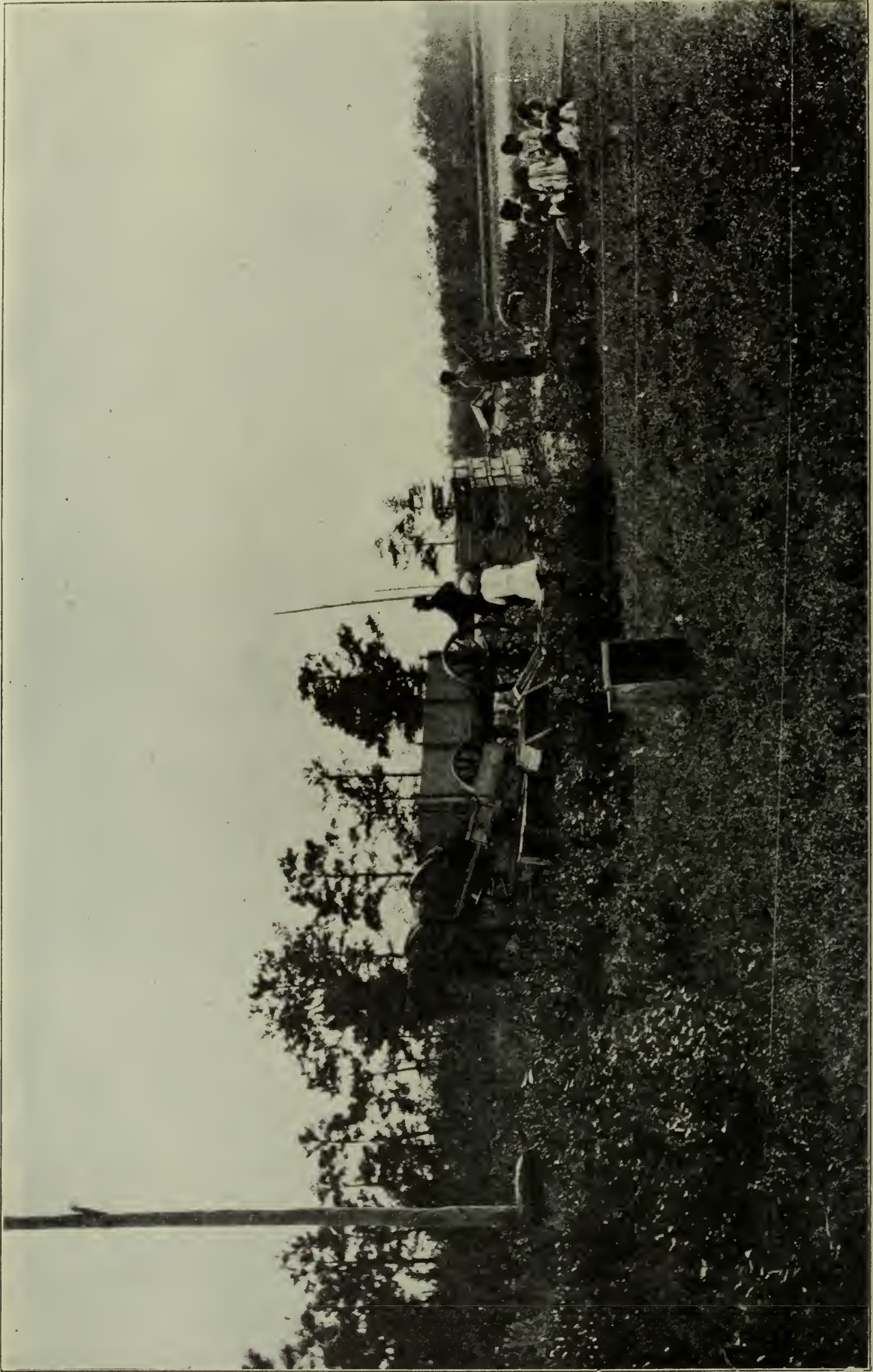


FIG. 13.—Showing cranberries being hauled to the screenhouse in the bushel crate referred to in text. (Photo by M. B. Davis.)

can be done the day following the reflood. After picking for the day is well under way, some men will be necessary to take the berries in boxes and wheel them off the bog to the highland whence they are hauled to the screenhouse. The type of box used for this purpose is illustrated in Fig. 16. The berries are stored in these boxes in the screenhouse until they can be graded and barrelled for the market. The screenhouse is simply an outbuilding, which is capable of being made frost-proof, and which is supplied with good light in the room where the screening is done. The berries are first run through a separator. This



FIG. 14.—Cape Cod wheelbarrow.

separator is provided with a fan for removing the chaff and also with several bounding boards which take out the rotten and light berries. If the berries are free from fruit worm injury, they may be immediately packed after they come from the separator, but if fruit worm injury is present they will have to be put over the screens. These screens vary in shape, but simply consist of long

troughs painted white, down which the berries roll into a barrel at the end. One or more operators stand along these troughs and pick over the berries as they roll by, removing all those affected by fruit worm and permitting only the sound berries to go to the barrels.



FIG. 15.—Cranberry pickers at work showing use of long-handled and short-handled scoops.

The berries are then packed in boxes which contain 25 pounds. This twenty-five pound box of comparatively recent introduction appears to be the most suitable package available at present, and is rapidly superseding the larger or fifty-pound box which in turn supplanted the old cranberry barrel of a few years ago. This question of proper grading and packaging of the cranberry crop is one of the utmost importance to Canadian growers.

The Maritime Provinces Trade Commission to Ontario issued, in 1931, a very excellent treatise on the marketing of Maritime cranberries and one cannot do better than quote certain portions of this bulletin.

"There is, however, gratifying evidence that the Maritime cranberry crop has in the past two or three years increased beyond the demands of the local market. In 1930 growers had difficulty in disposing of their berries, and prices fell. A few trial shipments were made to Toronto, Ottawa, and Montreal and, besides netting returns higher than locally obtainable, made a favourable impression with the trade.

"This year has witnessed a record crop of cranberries which the Maritime Provinces could not absorb. Prices sank in Halifax, Saint John, and other markets to unprofitable levels. Nearly a dozen requests were received by the Maritime Provinces Trade Commission in Toronto from shippers and growers in Nova Scotia, New Brunswick, and Prince Edward Island for assistance in marketing their surplus in Central Canada. Although orders for imported berries had been booked in advance, connections were obtained and several carload and numerous l.c.l. shipments were made to Toronto, Montreal,

Quebec, Ottawa, Peterborough, Kingston, Hamilton, Belleville, Brockville, and other cities. Prices were fairly satisfactory, averaging about nine cents a pound. One grower, discouraged by local prospects, who laid off eighty pickers and decided to leave several hundred bushels on the vines because of local returns, cleaned up his crop on news of his sales in Ontario and is much encouraged with the result. A number of Maritime shippers experienced in the cranberry business and in marketing have had encouraging success and their packs compare favourably with other brands on the market.

"All fruit in Toronto is sold by brands and in a package of standard size or weight. By these brands the wholesalers and the retailers know what sort of commodity they are getting and their first question when they are offered any fruit for sale is, 'What is its brand?' Besides, they are accustomed to handling boxes of a standard size—in the case of cranberries twenty-five or fifty pounds. Larger or smaller boxes are an unknown quantity to them, and are a great handicap in the sale of any product. Another reason they give for not making offers for a new brand of fruit is that they have not always found new shippers reliable. But the great difficulty is that both wholesalers and retailers are unwilling to take a chance on the reception of new cranberries by their customers.

"At present there is a wide variation in the packages used by Maritime shippers. Besides the old-fashioned barrels, there are boxes containing varying quantities of quarts and pounds according to the taste of the shipper. Some are even offered locally in bags. The above incident illustrates what difficulty is caused the wholesaler in selling even boxes which the trade considers off-size.



FIG. 16.—A modern quarter barrel or 25 pound box for marketing purposes.

"The comparatively new twenty-five-pound box, introduced by the American Cranberry Exchange in recent years, has rapidly replaced the fifty-pound box. Being unable to ship twenty-five's as ordered on one occasion, the above party sent eighty-five fifty's and fifteen twenty-five's. The latter were bought on the day they arrived by a chain store; partly because of continued warm weather and consequent poor consumer demand and danger of deterioration, making retailers avoid the large box, it took six weeks to dispose of the former. The loss through shrinkage was very heavy."

Further with reference to brands, the Commission says in part:—

“Standardized brands, well known to the trade, are absolutely essential. Not only must variety be taken into account; a brand should also stand for a certain size and colour, uniform throughout the box, if the highest prices are to be realized. Small and defective berries must be sorted out. The cost will be more than made up in the increased value of the berries through assurance of quality and enhanced reputation.

“Only an association can determine such regulations and enforce them among its members. Minimum standards, at first perhaps not so detailed and exact as those of the American Cranberry Exchange, could be established and raised as the industry develops. Inspection and possibly penalties might also be provided for in time. The association could be the clearing-house for information as to methods and machinery for sorting, grading and packing for Maritime growers still selling cranberries merely as cranberries.



FIG. 17.—Hand sorting cranberries at the packing house of the New England Cranberry Sales Co., at West Wareham, Massachusetts.

“The association’s whole supply could be sold under a general trade-mark. Then they would be ‘Ocean Tang’ (for instance) cranberries, of a certain brand—say ‘Evangeline,’ ‘Acadia,’ ‘Clipper,’ ‘Loyalist,’ ‘Garden of the Gulf,’ ‘Fundy,’ ‘Scotian,’ ‘Canuck,’ etc.

“A clear distinction must be made between the wild and cultivated cranberries shipped from the Maritime Provinces. This is of considerable importance. In 1931, Central Canada buyers pressed shippers of cultivated berries in one section to accept lower prices because quotations from another section undercut theirs by nearly one-half. The latter cheap berries were wild. The

wild cranberries are smaller and, though perhaps of equal colour and flavour, do not compare with the cultivated in appearance. Serious confusion as to the quality of Maritime cranberries may arise unless the trade and the public are educated to the differences between wild and cultivated berries, and they are sold separately.”

VARIETIES

At present there are practically no named varieties of cranberries in Canada.

Several growers in Nova Scotia have selected varieties of their own and one or two have imported some of the Cape Cod sorts. There are at least six native varieties and probably many more in Nova Scotia and an endeavour is being made by this Department to gather together a collection of native sorts with a view to determining their comparative keeping, shipping and culinary qualities as well as their productivity.

Prospective planters would do well to get in touch with their nearest county agent or experimental station when looking for a source of supply for vines, since the advent of the disease described later as false blossom makes it desirable to know the source of planting material.

In planting a single bog area, one variety only should be used, that is, do not plant two varieties which will both be bounded by the same dye. The reason for this precaution is that different varieties have fungous diseases and insect troubles peculiar to themselves and to have a variety of troubles on one bog would merely complicate the management of that area.

PUMPING OUTFITS

When installing a pumping plant for reflowage purposes, always get a larger capacity pump and engine than will actually do the work. Never tax an outfit to its utmost or it will soon refuse to do its work properly. If possible, purchase the plant from a firm that has had previous experience in installing pumping plants for cranberry bogs. If the lift is under six feet, the ordinary propeller pump is probably the cheapest and most efficient, but if the lift is greater, the rotary pump will have to be installed.

In estimating the capacity of pump required, it should be borne in mind that the capacity must be great enough to flood the bog in question in six or seven hours' time to a sufficient depth to protect against frost. The following table will, probably, be of benefit in estimating the amount of water required:—

Approximate Time to Flood One Acre—in Hours and Minutes

Depth in inches per acre	Gallons on each acre	Time required, with quantity of water available to flow each minute					
		100 gals. per m.	500 gals. per m.	1,000 gals. per m.	5,000 gals. per m.	10,000 gals. per m.	20,000 gals. per m.
1 in.....	27,154	4 h.	54 m.	27 m.	5½ m.	2 m. 40s.	1 m. 20s.
2 “.....	54,309	9 h.	1¾ h.	55 m.	11 m.	5 m. 30s.	2 m. 45s.
3 “.....	81,463	13½ h.	2¾ h.	1¼ h.	16 m.	8 m.	4 m.
4 “.....	108,617	18 h.	3½ h.	1¾ h.	22 m.	11 m.	5½ m.
5 “.....	135,771	22½ h.	4½ h.	2¼ h.	28 m.	14 m.	7 m.
6 “.....	162,926	27 h.	5½ h.	2¾ h.	33 m.	16½ m.	8¼ m.
7 “.....	190,080	31½ h.	6½ h.	3½ h.	38 m.	19 m.	9½ m.
8 “.....	217,234	36 h.	7½ h.	3¾ h.	44 m.	22 m.	11 m.
9 “.....	244,389	40½ h.	8 h.	4¼ h.	49 m.	25 m.	12½ m.
10 “.....	271,542	45 h.	9 h.	4¾ h.	54 m.	27 m.	13½ m.
11 “.....	298,697	49½ h.	10 h.	5½ h.	60 m.	30 m.	15 m.
12 “.....	325,851	54 h.	11 h.	5¾ h.	1 h. 6 m.	33 m.	16½ m.
18 “.....	488,777	81½ h.	16 h.	8 h.	1 h. 38 m.	49 m.	24½ m.
24 “.....	651,703	108½ h.	22 h.	11 h.	2 h. 10 m.	1 h. 5 m.	32½ m.

To find time to flood a bog to a given depth, it being assumed that the ditches are full and the water over the roots of plants (evaporation and seepage not considered), multiply time given in the column under gallons per minute and opposite the depth in inches, by the acres to be flowed.

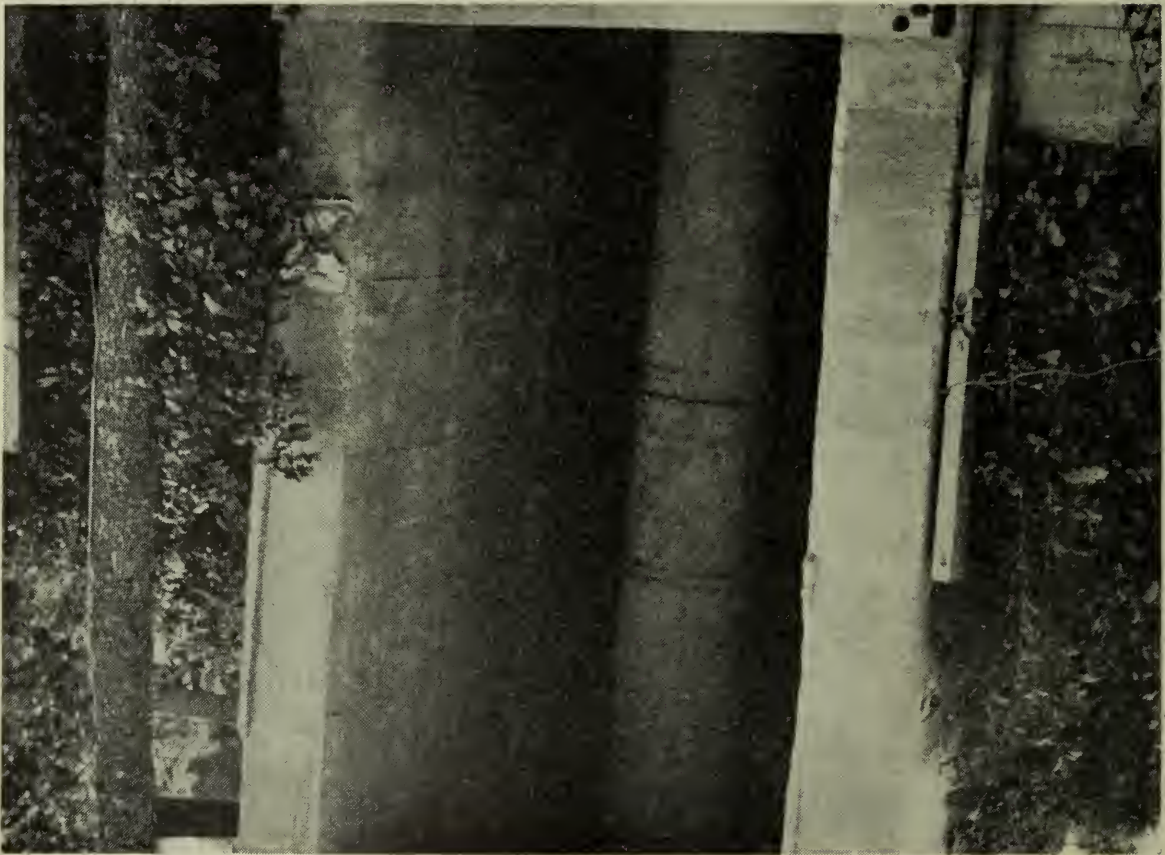


FIG. 18.—Enclosed impeller pump driven by motor. It is housed in a building shown in Fig. 19. It lifts water from a brook and pumps through the flume shown in Fig. 19 to the reservoir shown in Fig. 20.

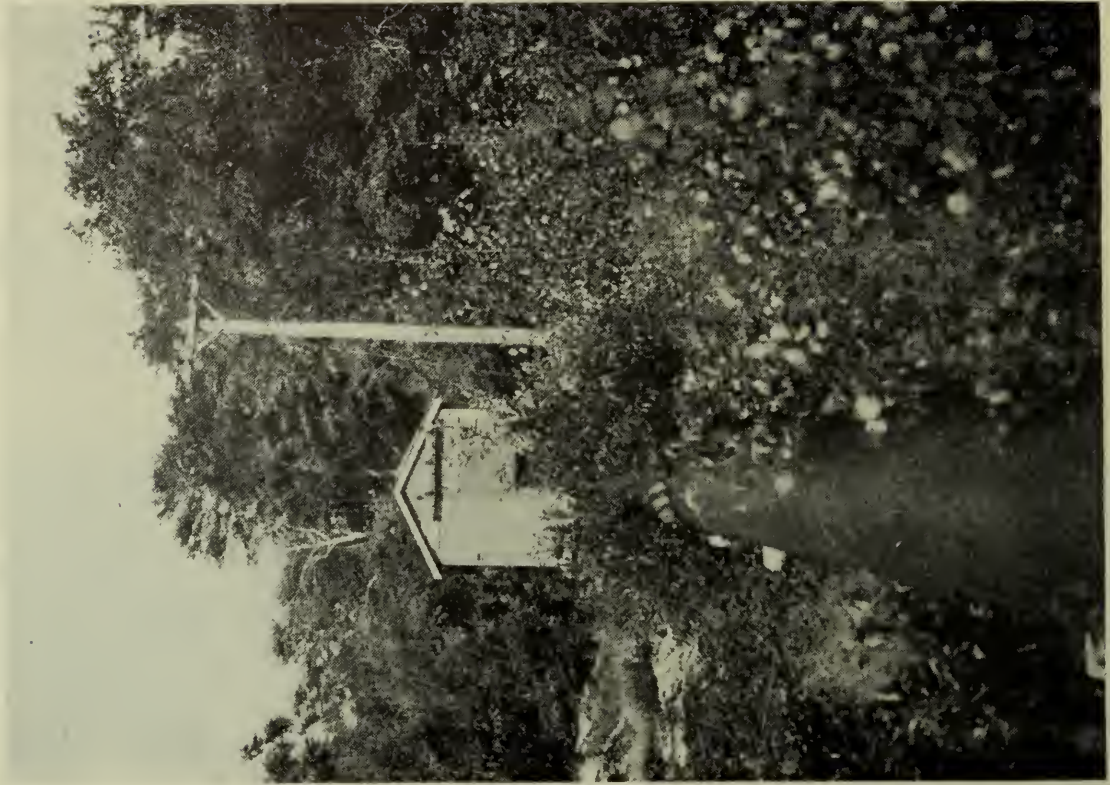


FIG. 19.—Pump house and flume.



FIG. 20.—Reservoir into which water is pumped.



FIG. 21.—A modern cranberry warehouse with screenhouse attached at the right of the illustration.

Knowing the area to be flooded, the capacity of the pump to be purchased will be decided on the amount of time that can be allowed the outfit to flood the bog to a certain depth. For instance, given a bog of three acres, with the water ten feet below the bog, what capacity of pump is required to flood this bog to a depth of three inches, inside of, say, seven hours? By examining the table, it is found that a pump having the capacity of 500 gallons a minute will flood one acre three inches deep in two and three-quarter hours, or three acres in seven hours and a quarter. That is to say, the owner of such a bog should demand of the manufacturers of the pump that they sell him a pump and engine capable of delivering five hundred gallons of water a minute from a level ten feet below the point of delivery.

With the recent developments in impeller pumps, water can be lifted to sixteen or eighteen feet in height at a reasonable cost. Figure 18 shows an installation designed to lift water from a brook and carry it through a flume shown in Fig. 19 to a reservoir sixteen more feet above and a good half mile from the brook itself. From this reservoir or compound shown in Fig. 20 another pump lifts the water another seventeen feet to a thirty-acre bog. In this manner economical flooding can be accomplished in a short time with a capital outlay not at all excessive.

COST OF CONSTRUCTING A BOG

Very little data are at hand regarding the cost of constructing a bog from the rough. A sixteen-acre bog in Nova Scotia was purchased, cleared, turfed, ditched, sanded, dyked and planted for the sum of \$4,500. As this bog had a gravity supply of water close at hand, the cost was somewhat less than if a pumping outfit had been installed. On the other hand, a considerable amount of forest growth was on the piece, so that the cost of clearing was a large proportion of the total cost. Although the cost of construction is comparatively large, the profits from bogs are quite in proportion to the cost, when they are properly handled. Forty to fifty barrels an acre is often obtained, and thirty barrels is an average. As these sell anywhere from five to seven dollars a barrel, and as the cost of maintenance is small, a good bog is capable of returning a handsome profit to its owners.

GEOGRAPHICAL DISTRIBUTION OF THE CRANBERRY

As previously mentioned in this bulletin, the cultivation of cranberries has never been widespread in Canada, so that there is no information at hand concerning the districts in which this crop can be successfully grown. The limiting factors have been discussed in previous paragraphs, but as a further aid to those who contemplate the culture of cranberries, a few notes on the geographical distribution of the different species are here appended.

If the prospective grower ascertains that the cranberry is present in his district in the wild state and is thriving under his conditions, he may be certain that the cultivation of this plant can be carried on successfully in his locality.

The following is taken from Macoun's Catalogue of Canadian plants:—

“*Vaccinium Oxycoccus*, Linn.—Sphagnous swamps around the sub-arctic zone from Newfoundland to the Pacific and south to the Canadian boundary.”

“*Vaccinium macrocarpon*, Ait.—Bogs, and especially on the margins of ponds and small lakelets in the soft mud. Newfoundland, Anticosti, Nova Scotia, New Brunswick, thence westward throughout Quebec and Ontario to Thunder Bay (Macoun). Throughout Canada to the Saskatchewan (Richardson). Ungava Bay and Mackenzie River (McGill Herb.).”

Mr. J. M. Macoun has written the following on the distribution of *V. Vitis-Idæa*, which is previously spoken of in these pages as the Partridge berry and Lingon berry, and which is known in New Brunswick by the common name of Wolfberry:—

“Along the Gaspé coast and the north shore of the gulf of ‘St. Lawrence, the fishermen’s families gather this fruit in large quantities for their own use or for sale, calling it the ‘low bush’ cranberry, and throughout the whole of northern Canada, hunters and trappers, as well as native Indians, have frequently to depend upon it for food when game and fish are scarce. Deemed of no value in the warmer parts of Canada, and pronounced by Gray to be acid and bitter and scarcely edible, it seems when in its home in the cold rocky woods of the north, or along the shores of Hudson bay or the Arctic ocean, to derive size and flavour from the very conditions that dwarf and kill its less hardy competitors.”

CRANBERRY DISEASES

By K. A. HARRISON, *Assistant Plant Pathologist,*

Dominion Laboratory of Plant Pathology, Kentville, N.S.

The cranberry is comparatively free from destructive diseases and it has been suggested that this is due to the fact that it is a native plant growing in its natural surroundings. The chief troubles are a virus disease known as false blossom, several fungus diseases of the vines, and storage rots of the harvested fruit. In addition there are losses from frosts and flooding. A number of the fungus diseases to be discussed have not been found in Canada but they are present in the important cranberry-growing districts of the United States and undoubtedly will be found in Canada as the area planted to this crop increases and more attention is paid to it.

FALSE BLOSSOM

(Caused by a virus)

This is the most serious disease of cranberries in the United States and has recently been found in several bogs in Nova Scotia. It is a virus disease and derives its name from the abnormal flowers. In the early stages of the disease these stand erect instead of drooping normally and the petals have a tendency to be brighter coloured. In more severe cases the flowers do not develop properly and have stunted petals or none. The plants themselves take on a witches’ broom appearance as a result of the lateral branches and small leaves growing close to the stem. Diseased plants do not produce a marketable crop.

The disease is most easily recognized by looking for the symptoms when the plants are in blossom or during the latter part of August when the witches’ brooms are most prominent.

It is carried from bog to bog and district to district in affected vines for new plantings. In the bog and between neighbouring bogs it is spread only by the blunt-nosed leaf hopper.

The control of this disease requires careful attention on the part of the grower. When planting a new bog great care should be taken to get vines from a bog that is healthy and at some distance from diseased bogs. The need of healthy vines for planting cannot be stressed too strongly, for the disease spreads most rapidly in a newly planted bog and most slowly in an old, well-established bog.

If the disease is established at a number of points in a bog, it becomes necessary to control the blunt-nosed leaf hopper, for this is the carrier that spreads this disease from plant to plant.

The disease is so destructive that bogs where control measures are not carried out become unprofitable and have to be planted again. Methods of control of this insect will be found in the section on insects.

All varieties of cranberries are not equally susceptible to this disease. Howes is quite susceptible and Early Black is one of the most resistant.

THE FUNGOUS DISEASES OF THE VINES

A number of fungous diseases cause damage in the cranberry bogs but none has proved destructive over large areas. They are usually limited to one bog or to a more or less definite area in a bog and in such a manner that it is obvious that the surroundings must have determined the severity of the attack. A number of the important diseases in the United States will be described, for it is doubtful which will prove most harmful in Canada.

TIP BLIGHT AND HARD ROT

(Caused by *Sclerotinia Oxycocci* Wor.)

Although this disease kills the young growing tips just before blossoming and is therefore considered a vine disease, it is more important as a fruit rot. This disease starts as a typical blight, killing the tips of the vines. These turn brown and become misshapen by the growth of the fungus at certain points within the bark. These points of growth of the fungus develop a greyish powdery mass of spores which serve to infect the berries at blossoming time. The berries do not show outward signs of the disease until they start to ripen in the fall, although there is a cottony growth around the seeds if an infected berry is cut. The infected berries do not colour naturally, but become yellowish in colour and remain quite firm and hard. They are white and cottony inside. During the fall these shrivel, become mummified and drop to the ground, where they overwinter. In the spring they produce the fruiting bodies of the fungus, and infection of the young tips occurs during wet weather.

This disease is most important in Wisconsin and on the Pacific coast. No control measures have been recommended.

ROSE BLOOM AND RED LEAF SPOT

(Caused by *Exobasidium Oxycocci* Rostr. and *E. Vaccinii* (Fekl.) Wor.)

These are two conspicuous diseases that immediately attract attention by the bright colours of the diseased parts, but so far they have not been of commercial importance in Nova Scotia.

In rose bloom, dormant buds along the stem are stimulated so that they develop as shoots early in the spring. The foliage on these shoots is bunched, twisted, rose coloured, and its resemblance to a flower has led to its descriptive name.

In red leaf spot the bright red colour of the spot is conspicuous on the upper surface of the leaves. The colour is duller on the lower surface and the spots are covered with a bloom of spores. Sometimes red spots caused by this fungus are found on the fruit.

The organisms causing these two diseases are very closely related and are widely spread throughout the world. They have been of most economic importance on the Pacific coast.

Rose bloom has been controlled by flooding for 36 to 40 hours just before the spores are discharged.

RED GALL

(Caused by *Synchytrium Vaccinii* Thomas)

This disease is recognized by the small shot-like red galls on the young buds, leaves and shoots. It is very erratic in its behaviour and is not usually of great economic importance, although the infected shoots do not bear fruit. Its irregularity in attacking the plants is probably due to the fact that the fungus depends on water for distribution.

This disease occurs along the Atlantic seaboard and has been found in Nova Scotia. No control measures are known and the disease has not been sufficiently severe to warrant any.

FAIRY RINGS

(Caused by *Psilocybe agrariella* Atk. var. *Vaccinii* Charles)

These are related to the fairy rings in lawns and pastures and likewise are caused by a kind of mushroom. In a cranberry bog the vines are killed apparently through the fungus smothering the roots, as the fungus grows in a widening circle from a point. As the circle extends the centre becomes filled in with new vines so that the trouble is most apparent under poor growing conditions or in dry seasons. This disease is troublesome in Massachusetts and New Jersey and can be controlled by ditching around the infected ring.

BLACK SPOT

(Caused by *Mycosphaerella nigro-maculans* Shear)

This is a disease that has been reported from all the American cranberry districts but is of economic importance only in the Pacific coast region. This disease becomes troublesome in seasons with excessive moisture. The leaves are infected first and the trouble spreads until it reaches the stem, where it forms a black canker that frequently kills the plant. This has been effectively controlled by spraying with Bordeaux mixture.

STORAGE ROTS

Storage rots are responsible for an annual estimated loss of 25 per cent of the cranberry crop of the United States. They have been intensively studied by investigators in that country, who have found that fungi are responsible for most of the damage. In a certain percentage of the fruit no organism can be found, and this has been named sterile breakdown. It has been found possible to check this trouble by proper ventilation and sufficiently low temperatures. There are numerous fungous rots and the different kinds are very difficult to tell apart without isolating the fungus responsible.

The rots do not appear in the field in the northern cranberry districts but, as field rots, have caused sufficient damage in the bogs in New Jersey to make it necessary to spray. In New Jersey the important rots are caused by organisms that thrive at much higher temperatures than the serious rot-producing organisms on the Pacific coast or even in Massachusetts. This relationship between the summer temperature and temperature for maximum growth of the fungus has been found to apply for all the districts.

Judging from this, end rot caused by *Godronia Cassandrae* Peck., may be most important over Canada as a whole. Sterile breakdown will occupy an important position. Other rots that may develop locally are: Early rot, caused by *Guignardia Vaccinii* Shear, which has been reported from Nova Scotia and is important in New Jersey and Massachusetts; bitter rot, caused by *Glomerella cingulata* var. *Vaccinii* Shear, which is important in Massachusetts; blotch rot,

caused by *Acanthorhyncus Vaccinii* Shear, which is important in New Jersey and has been reported from Nova Scotia; fruit rot, caused by *Diaporthe Vaccinii* Shear, and black rot, caused by *Ceuthospora lunata* Shear.

The control of storage rots depends on a number of factors and details vary according to the locality. It is impossible to give more than very general suggestions: careful handling is necessary during harvesting to prevent bruising; the berries should be kept dry or if damp when harvested, dried thoroughly, and they should be stored at comparatively cool temperatures with good ventilation. The tenderness of the berries in some seasons and their firmness in others makes it difficult to suggest more than very general rules.

Spraying as a general practice is not an economic proposition in the more northern of the cranberry districts. If it is felt necessary for some particular pest, the formula,

10 pounds of copper sulphate (bluestone),
10 pounds of fresh stone lime,
100 gallons of water,
1½ pounds of commercial fish oil soap,

is recommended.

Dissolve the soap in water and add to the Bordeaux. Hydrated lime may be used at the rate of 15 pounds to replace the stone lime. Spraying starts at blossoming time and should not be applied later than the middle of August.

Anyone wishing to secure further information for his own district or wishing to have diseased specimens identified should communicate with the Dominion Botanist, Central Experimental Farm, Ottawa, or the Dominion Laboratory of Plant Pathology in the province in which the grower resides. These laboratories are located at Saanichton and Summerland, B.C.; Edmonton, Alta.; Saskatoon, Sask.; Winnipeg, Man.; St. Catharines, Ont.; Ste. Anne de la Pocatière, Que.; Fredericton, N.B.; Kentville, N.S.; and Charlottetown, P.E.I.

CRANBERRY INSECTS IN CANADA

By F. C. GILLIATT, *Assistant Entomologist,*

Dominion Entomological Laboratory, Annapolis Royal, N.S.

In Canada, and more particularly in the province of Nova Scotia, on wild bogs along our woodland streams, cranberry¹ vines are frequently found growing among the sedges and other wild growth. Under such conditions insect pests are rarely abundant, and during favourable seasons the berries are comparatively free from insect injuries. In this wild state, however, where competition with other plants is so keen, yields are usually very low. It is necessary, therefore, as a commercial undertaking, to grow the plants under cultivation. Where this is done an artificial condition is established, and this change almost invariably favours an increase of insect pests. This can be readily understood, for on the planted bog no other plants are allowed to become established and insect pests rapidly increase under such a favourable environment. The cranberry, therefore, like all cultivated plants, has its insect pests which must be controlled if satisfactory yields are to be obtained.

In Canada investigations on the life-history and control of cranberry insects have, to date, been very limited. Reliance is placed largely on the methods developed to the south of us, notably in the Cape Cod area, and more particularly by Dr. H. J. Franklin, Director of the Cranberry Research Station, East Wareham, Massachusetts.

There are three principal methods in general use for the control of insect pests of the cranberry, namely, flooding, spraying, and dusting.

¹ *Vaccinium macrocarpon* Ait.

With flood water available there is in the hands of the growers a cheap and efficient method for the control of many cranberry insects. Flooding, however, must be used with considerable caution and skill during the growing season or injury to the vines may result.

Spraying has been in general use for cranberry insect control for many years. There are advantages in favour of this method, but many disadvantages are also apparent. Growers object very strongly to operations on the bog which necessitate tramping over the vines, particularly at or near the blossoming period. As far as the writer is aware, all spraying outfits are equipped with hose of sufficient length to reach at least to the centre of the bog. Although this eliminates driving heavy spraying equipment over the vines, a great deal of tramping is unavoidable in order to handle long hose lines. In addition, spraying outfits are expensive, the operation is slow, some of the spray mixtures are liable to injure the bloom, and water supply may be a serious factor.

Dusting is a comparatively recent innovation as a means of insect control. Two efficient dusters have recently been developed, one a power outfit for large areas and the other a smaller machine operated by hand. Both are built along the same lines with identical methods of delivering dust to the vines. The hand outfit is mounted on two bicycle wheels with a $\frac{1}{2}$ -h.p. gasoline engine to drive the hopper fan. The dust is distributed to the vines by four outlets from a cross boom at the rear, dusting a strip 4 to 5 feet in width. On the level bogs this duster is easily drawn across the bog by two men. Such an outfit is sufficient for a bog of 30 to 50 acres. The material in most general use for insect control is pyrethrum. The pyrethrum is diluted with finely ground gypsum, the former varying from 15 to 30 per cent, according to the pest and severity of the infestation. For instance, to obtain good control of some of the biting insects or where more than one pest is present, the stronger mixture is advisable. One hundred pounds of dust is recommended per acre per application. Frequently, if timed correctly, no more than one treatment may be necessary in a season.

Some of the factors in favour of dusting in comparison with spraying for the control of cranberry insects are: less outlay in equipment, ease of manipulation, reduced injury to the vines, rapidity of application, and efficient pest control.

CRANBERRY FRUIT WORM

One of the most destructive cranberry insects is the cranberry fruit worm.² This insect winters on the bog floor as a mature caterpillar in a small cocoon. The pupa is formed in the spring and the moth emerges during late bloom. The eggs are laid chiefly within the calyx cup of the berry and hatch in from six to eight days. The tiny worm enters the berry usually near the stem. The interior is soon consumed and other berries in turn are attacked in a similar manner. In all from three to five berries are ruined by each worm. When mature, the caterpillar leaves the berry and finds its way to the bog floor, where a frail cocoon is spun for protection during the winter. The mature worm is yellowish green with a pale head and about the size of a mature codling moth larva.

Cranberries infested with this insect turn red prematurely; thus an infestation can be detected readily by passing over a bog. This insect has caused serious losses to growers in Nova Scotia. In 1933, on a majority of the bogs, 15 to 25 per cent of the crop was infested. In addition to the direct loss there is a further expense involved in grading out the defective fruit.

CONTROL.—Holding of the flood water until the end of May usually keeps this insect under control. If undue increases are noted, a flood immediately after picking in September, and holding for 17 days, is recommended. When

² *Mineola vaccinii* Riley.

flood water is not available, a spray of 1 quart of nicotine sulphate to 75 gallons of water, using 400 gallons per acre, just after the blossoming period, may be applied.

FIRE WORMS

There are several species of fire worm that become pests of the cranberry, namely, the black-headed fire worm³, the yellow-headed fire worm⁴, the red-striped fire worm⁵, and the spotted fire worm.⁶ There is some doubt as to which species more frequently attacks the bogs in Eastern Canada. As the yellow-headed fire worm attacks bogs which are not completely flooded during the winter, it is probable that this insect is the most important. Fortunately, it is not a regularly-occurring pest every season, but when outbreaks occur much injury is caused to the vines and fruit. In severe outbreaks the bog turns brown from excessive feeding, with loss of the entire crop.

There are probably two generations each year in Canada. The adult moths winter on the bog and surrounding upland and emerge early in the spring to oviposit on the cranberry leaves. The larvae of the first generation appear in May and feed on the old leaves after sewing the surfaces of two adjacent leaves together and working between them. The adults of the second generation appear in late June and early July. The second generation larvae, which appear about the middle of July, tie together the tender uprights and feed on both the leaves and berries.

CONTROL.—Holding of the winter flood until into May controls this pest. Where water is not available, a spray of 6 pounds of arsenate of lead to 100 gallons of water is recommended, applying 200 gallons per acre. Pyrethrum dust mixture is effective for control of the black-headed fire worm and probably would be effective for the yellow-headed species.

SPITTLE BUGS

The cranberry spittle insect⁷ is another bog pest which in some years becomes numerous, causing considerable injury. The presence of this pest is easily detected by the froth or spittle on the vines. Within each ball of spittle is a single insect which obtains its food by piercing the vines and extracting the plant juices. When numerous, the vines are depleted of vigour, followed by a reduced crop.

There is only one generation of this insect in a season. The winter is passed in the egg stage, the egg being inserted into the bark of the vines. The eggs hatch in early June, and the spittle soon makes its appearance. The adults which emerge in July are easily flushed up from the vines when passing over the bog.

CONTROL.—A spray of 1 quart nicotine sulphate to 75 gallons water thoroughly applied will give excellent control of this pest. In order to obtain complete coverage of all vines it is necessary to apply 400 gallons per acre. Dusting with the pyrethrum mixture is also satisfactory. Applications must be made as soon as the spittle becomes abundant on the vines, in the average season during the latter half of June.

SPANWORMS

Spanworms, at wide intervals, become excessively numerous and may cause serious injury to cranberry bogs.

³ *Rhopobota vacciniana* Pack.

⁴ *Peronea minuta* Rob.

⁵ *Gelichia trialbamaculella* Cham.

⁶ *Cacoecia parallela* Rob.

⁷ *Clastoptera vittata* Ball.

There are several species in this group of insects, viz., the brown spanworm⁸, the green spanworm⁹, the cotton spanworm¹⁰, the big spanworm¹¹, and the chain spotted spanworm¹². The two first named insects are cranberry pests of considerable importance in Massachusetts, but so far as is known, they have not been troublesome on cranberry bogs in Canada. There was an outbreak of the chain spotted spanworm in Nova Scotia in 1924. The cranberry is evidently not the favoured host of this latter insect, but when it becomes numerous on the surrounding upland, migration to the bog is liable to occur, and serious damage may result.

The winter is passed in the egg stage. The eggs hatch in early summer and the caterpillars continue feeding until August. When mature, they are about one and one-half inches in length. They are yellow, with black spots on the head, and a row of white spots along the sides of the abdomen, each usually bordered with two black spots, one in front and another behind. The moths appear in September and October, and lay their eggs indiscriminately on the ground.

CONTROL.—If the marginal upland is kept free of infestation, the bog is largely protected. Also if marginal ditches are kept clean and partially filled with water, migration from the upland is prevented. A spray of 6 pounds of lead arsenate to 100 gallons of water is recommended also, but application must be made when the caterpillars are very small.

BLUNT NOSE LEAF HOPPER

This sucking insect¹³ is not directly of any great importance as injury from it feeding on the vines is not ordinarily noticeable. This hopper, however, is the only known carrier of a serious virus disease of the cranberry, known as "false blossom." This disease has made serious inroads in cranberry production in several cranberry-growing states, particularly Massachusetts, New Jersey, and Wisconsin. In 1933, false blossom disease was identified in Nova Scotia and during 1934 a number of bogs were found to be infested in widely scattered areas in the province. The blunt nose leaf hopper was also found, not only on all the diseased bogs, but on many that do not show any evidence of infection.

Briefly the life-history of the hopper is as follows: The eggs are laid in late summer and early autumn, and thrust under the bark of the tender growth. The eggs do not hatch until the following spring, and the young nymphs, upon emerging, feed on the sap of the current year's growth, including stems, leaves and occasionally buds. The adults begin to appear about the middle of July. They were observed in Nova Scotia on the vines, during 1934, from July 14 until the end of September. During this period oviposition occurs which completes the seasonal life-history.

With reference to the identification of false blossom, the early symptoms of the disease are malformed blossoms which, instead of drooping normally, stand erect like the flower of the common daisy. The petals are redder than normal, particularly in the early stages of the disease. In more advanced stages, the petals are small, often green with a streaked effect; in fact, there is little to suggest a cranberry blossom. Affected blossoms produce little fruit, but the few berries are small, and late in the season or in the following spring become mummified and stand erect on the stem. The leaves are smaller, more reddish, and grow closer to the stem than those on normal plants. Side stems are sent out which frequently develop into a witches' broom effect. The disease can also be

⁸ *Ematurgia amitaria* Gn.

⁹ *Itame sulphurea* Pack.

¹⁰ *Cleora pampinaria* Gn.

¹¹ *Abbottana clemataria* S. & A.

¹² *Cingilia catenarai* Dru.

¹³ *Euscelis striatulus* Fall.

readily detected in the early autumn, for the diseased vines change colour earlier than normal plants and there is a period of about ten days when they can be easily detected. This usually occurs at the end of August.

The disease is more virulent and destructive on new plantings probably because of the attractiveness of the tender growing uprights for hoppers. Under these favourable conditions the hopper population quickly increases accompanied by a rapid spread of the disease. When false blossom is present on newly planted bogs annual treatments to suppress the blunt nose leaf hopper should be considered part of the growers' regular program.

CONTROL.—It has been demonstrated that false blossom disease is controlled by suppression of the blunt nose leaf hopper. Control of the hopper is best obtained by the use of pyrethrum dust. Treatment should be made as soon as all the hoppers have hatched, which occurs about the end of June or early in July. Spraying is also recommended, using 6 pounds of pyrethrum soap to 100 gallons of water. Spraying in full bloom, however, is liable to blast or damage the set. A flood held for 24 hours is also effective. This should be arranged for before many vines are in bloom, otherwise injury may occur to the blossoms.

Cranberry growers should be governed, in their treatments for bog insects, according to the species and density of numbers present. Every cranberry grower should be equipped with an insect net, for there is no better method of determining the insect population on a bog than by the regular use of a sweeping net. Not only are the particular pests and relative numbers determined, but the stage of the insect can also be noted and treatments timed accordingly. In the Cape Cod district and elsewhere the net is used by a large number of growers, who make 50 long sweeps back and forth striking the top of the vines while proceeding slowly across the bog. The blunt nose leaf hopper is not only readily captured but most bog insects are taken in this way. These determinations should be very largely the deciding factor as to when and what treatments should be necessary.

Spring "scum" is not caused by an insect, but may very well be included along with other pests that tend to reduce cranberry yields. Spring scum is due to the green algae so frequently observed growing in stagnant water. On many cranberry bogs at least some water is allowed to stand in the ditches during the growing season. In this warm, stagnant water, green algae are liable to grow and accumulate. This growth is so abundant on some occasions that the free flow of water later in the season is interrupted at a time when drainage is necessary. This may allow water to accumulate and overflow on portions of the bog. When these algae settle on the vines they apparently have a smothering effect. The foliage becomes pale, with an unhealthy appearance, growth is checked, and a greatly reduced or total loss of the crop results.

Algae are controlled by the use of copper sulphate (bluestone). If only the ditches are to be treated, place a few pounds of bluestone in a sack and drag along in the water in the ditch. On a flooded bog, treat in the same way by dragging the sack of bluestone behind a boat, back and forth across the bog. Four pounds of copper sulphate is sufficient to treat an acre of bog with water one foot in depth, and at other depths in like proportion.

There are many other insects destructive to cranberry bogs, such as root grub, blossom worm, girdler, tip worms, cutworms, cranberry weevil, gypsy moth, etc. None of these insects, to our knowledge, is destructive to bogs in the Maritime Provinces; in fact some of them are not known to be present in Canada.

