FREEZING OF FRUIT TREES.

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"Peach crop ruined" is a headline seen in newspapers after sharp weather almost every winter. So frequently, however, has this prophecy been proven false by the harvest that the public has come to look upon the headline as almost a joke. Yet fruit buds and even trees are killed almost every season; and occasionally such low temperatures are recorded in fruit growing sections that it seems certain, not only that every fruit bud must be destroyed, but that all except protected trees, even of hardier kinds, must be severely injured if not killed outright. Such conditions marked the winter of 1903-4 in New York State, thermometers reading below $-40^\circ$ F. in some parts of the Hudson Valley fruit belt. Temperatures of $-20^\circ$ to $-30^\circ$ were general in this section, while readings of $-15^\circ$ to $-20^\circ$ were not unusual in the fruit areas of central and western New York. These unusually severe winter conditions were made even more alarming by the fact that, in the Hudson Valley in particular, the summer and autumn had been most unfavorable to the development of cold-resistance in the trees. A long continued drought in early summer and severe attacks of insects and fungus dis-

*This is a brief review of Bulletin No. 269 of this Station, on Winter Injury to Fruit Trees, by H. J. Eustace. Anyone interested in the detailed account of the investigations will be furnished on application, with a copy of the complete bulletin. The names of those who so request will be placed on the mailing list to receive future bulletins of the Station, popular or complete as desired. Bulletins are issued at irregular intervals, as investigations are completed, not monthly.
eases, especially upon pear trees, had impaired the vitality of the trees. Moreover, wet weather in the fall promoted late growth so that the new wood was not well matured. Knowing these conditions and finding their trees in late winter with both trunks and branches marked by brown and black discolorations of the inner bark and the vital cambium layer between bark and wood, it is not surprising that many owners thought the whole orchard industry of the Hudson Valley doomed. Great fear was also felt for the orchards of less hardy fruits in other parts of the State. Much harm was done, undoubtedly; and some orchards, even when not torn out or cut down by their owners, suffered irreparable injury. Yet the peach orchards of western New York bore a normal crop of fruit in 1904; and in the Hudson Valley, though the crop of fruit was a general failure, only comparatively small numbers of the trees were killed outright. Some orchards of considerable elevation and with good air drainage even bore a fair crop of fruit.

The ability of the vigorous, healthy fruit tree to withstand low temperatures, or at least to overcome injury from freezing, has evidently been under-estimated; and, in consequence, the extent of injury following cold snaps exaggerated.

Character of injury. The injury from freezing is due, not to rupture of tissue by the expansion into ice of the water contained within the cells, as was formerly supposed to be the case; but by the withdrawal of the water from such parts and consequent drying out, with oxidation and decay following. The more charged with water the tissue is, the more readily it can be withdrawn by freezing, and the greater will be the injury. For this reason, well-matured wood in which the water has been reduced by natural processes is much better able to stand cold weather. The injury after a severe freeze shows itself in the death and drying up of the twigs and smaller branches accompanied by a water-soaked, brown, or black appearance of the tissue beneath the bark on the trunk and larger limbs. This injury may involve only spots or streaks of tissue on exposed sides of the trees and show only as a light brown tinge, or it may include the entire circumference of the tree and appear deep brown or black with a marked tendency
of the bark to separate from the wood. But it is impossible to fix a limit, either of extent of injury or depth of color, which shall be any very useful guide in deciding upon the removal of the tree. For example, trees in a "pocket," where liability to injury was great, were examined on March 24. The bark was found dark brown all through, though tight to the wood, and the wood black in the trunk; yet practically every tree recovered and in the second season bore a good crop of fruit. To have condemned and destroyed such an orchard because of the general discoloration would have been a mistake. If the bark easily separates from the wood, however, over most of the circumference of the trunk and for considerable distances vertically, there is little hope for the tree.

But whether trees which show signs of severe injury shall or shall not make good recovery depends on both previous conditions and the treatment given them. The treatment must differ for young, vigorous trees and for those that are older and less thrifty or for those that have been weakened by insects or diseases. These facts were well brought out by observations and experiments made by Station authorities subsequent to the extreme cold weather of January, 1904.

It is rarely advisable—though it may occasionally be necessary—to cut down or tear out a young orchard, even of peach trees, that has been well cared for and has made a good healthy growth of well-matured wood the previous season. This is usually true, even though the twigs and smaller branches are completely killed and the tissue beneath the bark on trunk and larger branches shows a general browning, with small areas of black. If the roots are uninjured,—and they are seldom injured on good, heavy soils if there has been even a light covering of snow,—and if the injury to the cambium layer beneath the bark is not so extensive as to cause complete separation of bark and wood over considerable areas, the chances of recovery are good.

In treatment of such trees in the Hudson Valley, the best results followed severe pruning; that is, the twigs and smaller branches were trimmed off and the larger branches cut back to
a diameter of an inch-and-a-half or two inches. The earlier this treatment was given after the freezing the more perfect was the recovery. As an illustration may be cited two orchards on a farm about ten miles from Newburg. These included about 5000 peach trees, of several varieties and from 2 to 5 years old. Pruning of these trees began soon after the extremely cold weather of January 5 and 6 and was finished in one orchard in a few weeks while in another orchard the treatment was delayed until March. When examined in June the pruned trees were making a splendid growth of vigorous new wood,—sometimes so thick as to require trimming,—which bore large, well colored foliage. The trees pruned in March were doing well but were less vigorous than those treated earlier. Only three trees were left untreated, but two of these were dead in June and the other was recovering fairly well, but with the new wood all in the top, making an undesirable tree. Of the whole 5000 trees, less than one-half of one per ct. failed to recover.

When young trees show only patches or streaks of brown in the tissue, even though the browning be quite extensive but not extending round the entire circumference of the tree, recovery may occur without treatment, though thorough trimming of the smaller branches is best in all cases. In orchards where the tests were made, moderately trimmed trees were in much better condition in June than those not treated, the foliage being more abundant in all parts of the trees, of larger size and nearly normal in color, while on untreated trees the leaves were small and of a light green or yellowish tinge. In September the difference was even more striking; for by this time some of the untreated trees had “gone back” and parts of them had died.

Old trees, on the contrary, either peach or pear, should not be severely pruned, but moderately. Where dehorning of trees over 8 years old was tried it was a total failure. The trees made an effort toward recovery, putting out some new growth and appearing to promise well in June; but by September all were dead. This same effect has been observed in Michigan and in Ohio, following similar freezes; so it may be considered proven that, generally, severe pruning is the most effective treatment
for badly frozen young trees; but that moderate pruning is better for less seriously affected young trees and the only treatment—except removal—to be considered for old or unthrifty trees.

When old trees have also become weakened by insect attacks, severe outbreaks of fungus diseases, unfavorable weather or neglect during the previous season, or when they stand in low spots or pockets or have been liable to root injury through blowing off of the snow, the only treatment may be to dig them up and burn them; for in such cases the prospect for recovery after any severe tissue-destroying freeze is very poor.

Of course it is impossible to control the weather How lessen or to shelter an orchard against such remarkable liability drops in temperature as have recently occurred; to injury. but it is by no means impossible to secure a considerable degree of immunity from the worst effects of such freezes.

In the first place, orchards of the more tender fruits should be planted in elevated localities or on the upper portions of hillsides and slopes, so that they will be above the low spots and "pockets" where the cold air settles and remains stagnant for considerable lengths of time. A difference in elevation of only a few feet was frequently found to have a most marked effect upon the extent of injury, trees or vines in pockets or in the lower rows on a hillside being killed while those adjacent to them but a little higher up were not seriously injured. If the hillsides are of light soil and exposed to wind or sun so that the snow blows off or melts off readily, trees on them may suffer more, through freezing of the roots, than do those lower down but on deeper or heavier soil.

Pockets are to be avoided also for a reason apart from air drainage. These low spots are naturally more moist than higher lands and so trees planted in them continue longer in foliage and fail to mature the wood. It is this moisture-filled new wood and sap-filled tissue beneath the bark that suffer most from the rapid drying which causes the injury in freezing; for well-matured wood comparatively free from sap will pass unharmed through very low temperatures. The water in such low spots often lies but a short distance below the surface, hence the trees become shallow-rooted
and much more subject to freezing of these most essential parts than those trees that can and must send their "drawers of water" deeper into the soil.

Trees on drained soil suffer less than those on undrained areas, especially where the land is heavy. Exposure to prevailing winter winds should also be avoided, since these blow off the snow and subject the roots to freezing. In some orchards in the Hudson Valley the influence of this factor was plainly marked by rows or groups of dead trees where the winds had had a "clean sweep."

Good culture to promote vigor of trees, its proper management or the use of cover crops to check growth late in the season, and care in the control of insects and diseases are also influential factors in lessening injury from frost or storing up vitality to recover from such injury.