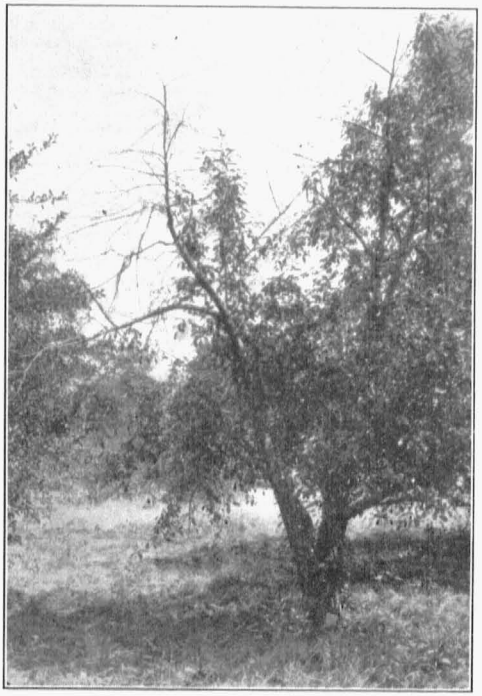
UNIVERSITY OF MISSOURI COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION
BULLETIN 248

Blister and Black Rot Canker



A Ben Davis tree severely afflicted with blister canker. This is the typical appearance of trees affected with the disease.

COLUMBIA, MISSOURI
MARCH, 1927

UNIVERSITY OF MISSOURI COLLEGE OF AGRICULTURE

Agricultural Experiment Station

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Blister and Black Rot Cankers

H. G. SWARTWOUT

ABSTRACT—The losses in Missouri from blister and black rot cankers have been great. Few Ben Davis orchards are free of blister canker. Black rot canker is present in nearly every old orchard of any size. Blister canker is a wound parasite and enters largely through unprotected pruning wounds. The winter spores are first liberated in Missouri about May 1. The black rot canker fungus is primarily a wound parasite. The spores are first disseminated about April 1. Ben Davis and Gano are very susceptible to blister canker and moderately susceptible to black rot canker. Varieties moderately susceptible to blister canker are Collins, Delicious, Transparent, Huntsman, Grimes, Maiden Blush, Willow and Minkler. Rather resistant varieties are Ingram, Jonathan, King David, Rome, Winesap, Arkansas and Stayman. Duchess and York are very resistant. To lessen the danger of canker infections prune lightly, remove small limbs, cultivate well and thoroughly and use fertilizers to promote good growth. In pruning, cut the limbs close and cover wounds over 1½ inches in diameter with a protective dressing. White lead and linseed-oil paint in which is mixed corrosive sublimate dissolved in denaturated grain alcohol is the dressing recommended. Tanglefoot dissolved in alcohol is promising, but grafting wax and sodium silicate are ineffective. Cleaned cankers should be examined and redressed if necessary at least once a year until healing is well advanced.

The blister or Illinois canker and the black rot or New York canker are two trunk and limb diseases of apple trees that have caused heavy losses in Missouri orchards. The blister canker is one of the most destructive of apple diseases, and is especially serious in the Middle Western states, due probably in large part to the extensive plantings of the Ben Davis apple in this region. This variety has proved very susceptible to blister canker and has suffered severely from the disease. About 1910 to 1915 when many Ben Davis trees planted in the two preceding decades had attained considerable size and had begun to bear profitable crops, the disease assumed alarming proportions. Blister canker was present in practically every orchard in the state and many orchards were damaged to such extent as to be no longer profitable. The remnants of many of these older Ben Davis orchards which succumbed to the blister canker are still in evidence in the apple sections of the Ozarks and along the Missouri and Mississippi Rivers.

As a consequence of such disastrous results with the Ben Davis, this variety has since been planted rather sparingly. Despite the fewer and smaller plantings, however, blister canker is still common in Missouri and may be classed among the more important apple diseases. Few bearing Ben Davis or Gano orchards are free from the disease and it is sometimes serious on trees of other varieties.

Black rot canker while less injurious than blister canker is also of considerable economic importance, probably being present in every

orchard of any size in the state. If allowed to go unchecked, it is capable of doing great damage.

CAUSES OF CANKERS

Canker is a general term used to designate injuries to the bark and growing layer on the trunks and branches of plants. The appearance of the diseased areas varies, characteristic lesions usually being produced by each causal agent. Most cankers are caused by fungi, small plants which lack the green coloring matter found in higher plants. Lacking this green coloring matter the fungous plant is unable to manufacture its own food and must by necessity live upon organic matter already elaborated. Mushrooms, molds and mildews are characteristic and common fungi related to the fungi that cause plant diseases. Both blister canker and black rot canker are due to fungi parasitic upon the apple. The fungus causing blister canker is known as *Nummularia discreta Tul.*; that causing black rot canker is known as *Sphaeopsis malorum* (*Physalospora cydoniae Arnaud.*)

BLISTER CANKER

Symptoms of Blister Canker.—Blister canker on the apple is practically confined to the trunks and larger limbs. Whole limbs or even trees infected with the blister canker organism may show symptoms of disease, but the characteristic cankers produced by the fungus are generally found some distance back from the ends of the branches, usually centered about an old pruning wound. The removal of large limbs leaves exposed a considerable expanse of old wood, the wounds are so large that several years are required for healing, and, unless kept covered with a good wound dressing, check badly. These conditions favor infection with the blister canker fungus. Consequently, where much heavy pruning is done on very susceptible varieties like Gano and Ben Davis, the disease is almost certain to appear sooner or later.

Blister canker first appears as dull brown spots usually several inches in length. The diseased areas enlarge rapidly and soon become depressed below the surrounding healthy bark. Extension takes place more rapidly in the direction of the long axis of the limbs forming long and comparatively narrow cankers. It is not uncommon to find infections four feet or more in length and only three or four inches wide. Lateral extension takes place slowly so that several years usually elapse before a limb is girdled.

In the earlier stages blister canker is not easily distinguished from other cankers. The first identifying mark is a mottled appearance of the inner bark which may be seen by cutting away the outer bark at the edges of the canker. Healthy strips or areas of bark scattered through

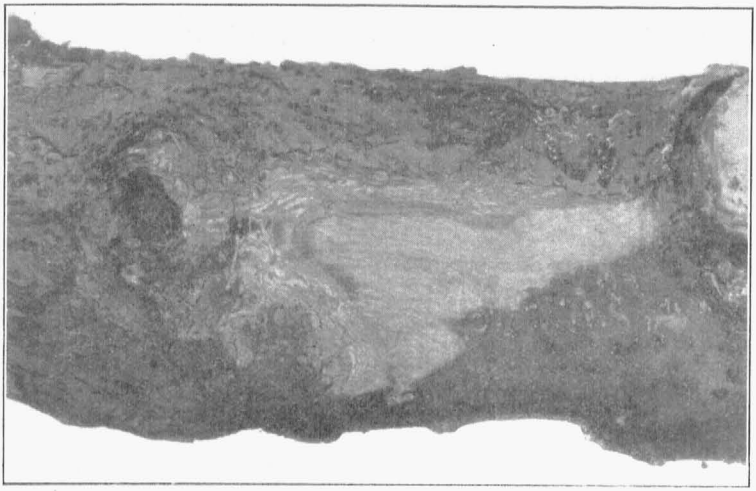

Fig. 2.—Showing the outer layer of bark cut away at the line of junction of the advancing blister canker with the healthy bark. The mottled effect near the margin of the invaded bark is the first identifying symptom of blister canker.

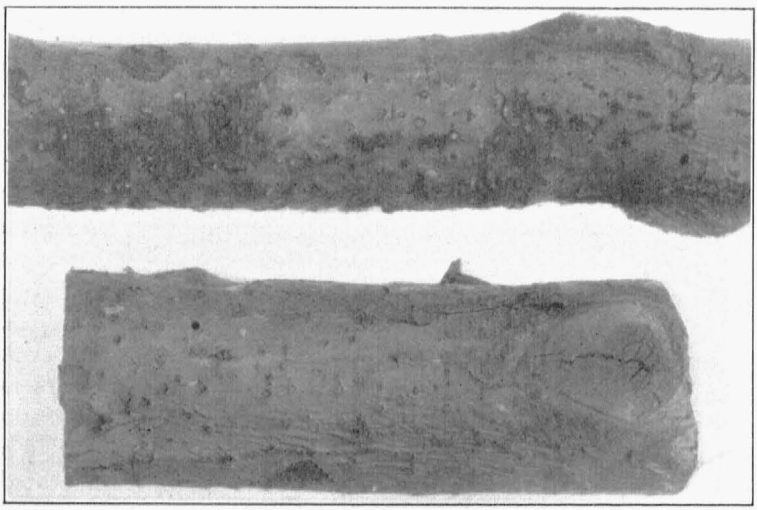

Fig. 3.—Blister canker after the "blisters" have broken and the thin epidermal layer of bark has rolled back liberating the spores (seeds) developed beneath. These more or less circular structures are termed "nail heads" and serve to positively identify the disease as blister canker.

the dead and dying bark at the margin of the canker give to the bark this peculiar mottled effect characteristic of blister canker.

After the fruiting bodies of the fungus appear, the so-called nail head stage of the disease, blister canker can be readily identified. The fruiting bodies occur massed just beneath the outer layer of bark which is raised in blister-like protuberances about the size of shot. Later the thin coverings of bark break and roll back, liberating the spores (seed) beneath.

After several years the bark falls away leaving the fruiting bodies "nail heads" protruding above the exposed wood. These in time fall off leaving dark brown or black irregular rings marking their point of attachment to the wood. These rings are always present on blister canker infections that have fruited and they serve positively to identify the disease. They may be found on any of the older cankers by scraping away the dead bark. Occasionally whole trees are killed by blister canker in one year and in such cases these rings will not be found, because fruiting structures were not formed.

When the growth of the canker is not unusually rapid the tree and portion of the limb above the canker appear normal or nearly so for one to several years. The leaves remain green throughout the summer and the fruit develops naturally. But, when the limb is nearly girdled, the leaves take on a sickly greenish yellow color during the summer and the fruits stop growing. The limbs usually die by the end of the summer, the leaves and shriveled fruit remaining attached to the dead limbs. When the trunk is affected, the whole tree may show these symptoms.

Blister Canker Inoculation and Infection.—The blister canker fungus produces two kinds of spores (seed), conidia or summer spores and ascospores or winter spores. The number of spores produced by an average-sized canker runs into the hundreds of millions. The conidia are produced beneath the blister-like protuberances and are liberated when the outer bark breaks and rolls back. Fortunately, from present evidence, conidia are of little importance in distributing blister canker. Most blister canker infections are due to winter spores. These are produced in bottle-shaped chambers opening out onto the flat or slightly concave surfaces of the "nail heads" which by this time are well developed. Ascospores may be scattered at any time during the growing season that weather conditions are favorable. The first dissemination of spores in the spring has been found to occur in Missouri about May 1. From this time until the first to the middle of June spores are liberated in great numbers and many infections occur, the warm moist weather generally prevailing during this period favoring the germination of spores falling in favorable places and the establishment of the fungous plants within the tissues of the host.

Nature and Growth of Blister Canker.—The blister canker fungus is a wound parasite. Present evidence indicates that it is unable to penetrate healthy uninjured bark. Pruning wounds are the most common source of subsequent blister canker infections though infections are sometimes found at other points of injury to the bark or wood.

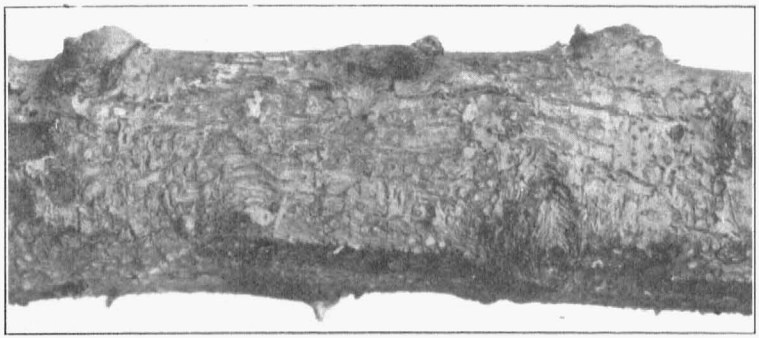

Fig. 4.—Blister canker showing the sloughing off of the epidermal layer of bark; the first stage in the decay of the dead bark from around the "nail heads."

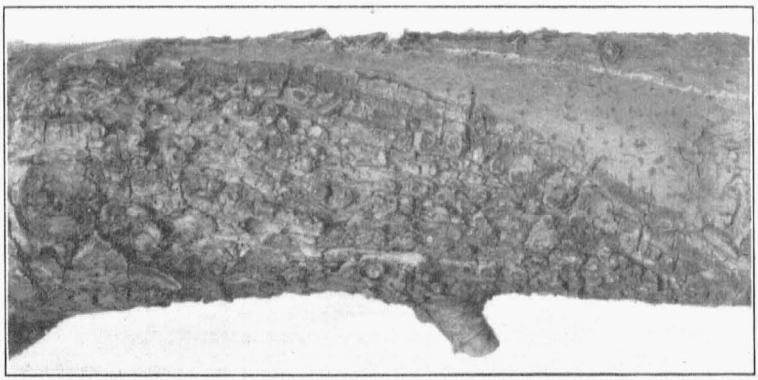

Fig. 5.—Blister canker after most of the bark has fallen off leaving the more persistent "nail heads" standing out conspicuously from the wood.

The fungus grows rapidly in the older wood, soon extending for a considerable distance both above and below the point of entrance. Unless an infected limb is removed this disease will spread eventually into the trunk and from there into the roots and other limbs; then, by radial

growth, reappear at some other point on the tree. This often happens when cankered limbs are removed and it is thought the disease was eliminated and explains the development of canker spots at uninjured

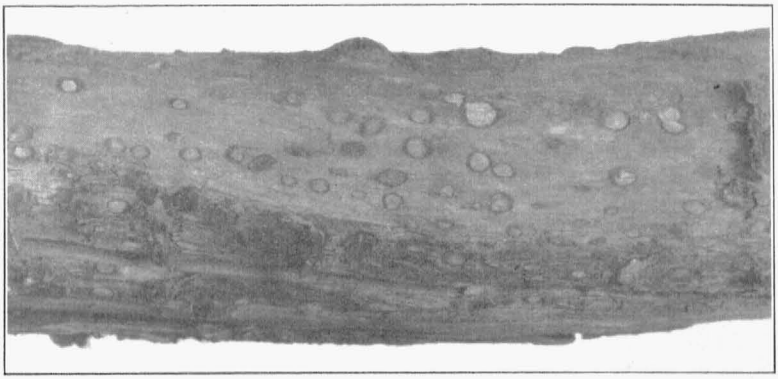

Fig. 6.—Blister canker after most of the bark and "nail heads" have fallen away. The dark rings mark the point of attachment of the "nail heads" to the wood and are characteristic only of blister canker.

Fig. 7.—Cross section of a blister canker infected limb six feet below the canker. The dark irregular ring marks the extent of the invasion of the wood by the fungus. Unless cankered limbs are severed at a point far enough down to entirely remove the disease it is likely to reappear at some other place on the tree.

points. The rapid invasion of the older wood by the fungus and its persistence there makes it practically impossible to control blister canker once the disease has become established.

BLACK ROT CANKER

Symptoms of Black Rot Canker.—Black rot cankers usually are found on the upper sides of the larger limbs. They appear at first as small reddish brown spots which gradually increase in size. Like blister canker, black rot canker progresses more rapidly in the direction of the long axis of the limb. The diseased bark soon dries and shrinks below the surrounding surface at first clinging tenaciously to the wood but in time falling away. On healthy trees many of the cankers remain small and die out after one year, but on weakened trees or under other conditions favorable for their development they may attain considerable size the first year when the infection usually becomes permanent, extending its margin from year to year until the limb is girdled.

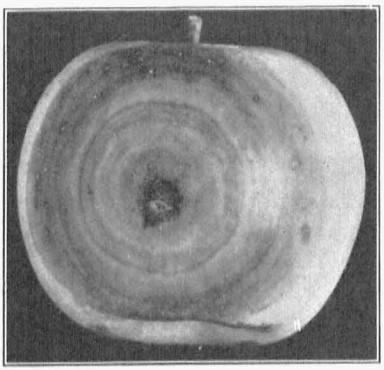

Fig. 8.—Black rot on the fruit showing the concentric bands of brown which so often appear on the affected areas. They are not to be confused with the concentric rings of fruiting bodies found on bitter rot spots. The fruiting bodies of black rot on fruit are scattered irregularly over the diseased region.

The larger cankers develop fruiting bodies near the center, sometimes late the year of infection, sometimes not until the following year. They are formed just beneath the epidermis but soon break through, appearing as slightly raised, dark colored bodies somewhat smaller than the head of a pin, yet large enough to be easily seen with the unaided eye. The fruiting bodies are open at the top and are thickly scattered over the surface of the bark. The presence of such structures clearly distinguishes the disease from blister canker but does not definitely identify it as black rot canker as there are a number of other cankers which produce

similar fruiting structures. Limbs and trees affected with black rot canker present in the more advanced stages of the disease the same symptoms shown by trees suffering from blister canker.

Black Rot Canker Infection.—Black rot canker is due to the same organism that causes black rot of the fruit and the black rot or frog-eye spot on the leaf. The fungus is primarily a wound parasite although Cowart,* working under greenhouse conditions, found that it was able to penetrate sound healthy bark.

The spores of black rot are first disseminated about the first of April and are liberated regularly following rains throughout the remainder of the season.

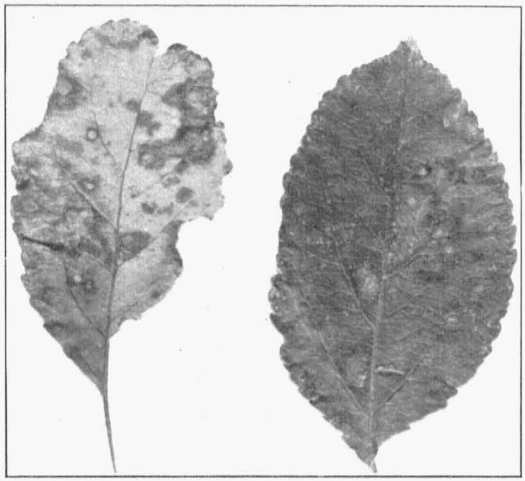

Fig. 9. Black rot or Frog-eye spot on the leaf. Note the irregular zones of brown which make up the older spots. After a time, if the number of infections is very large, the leaves turn yellow and drop.

VARIETAL SUSCEPTIBILITY

Varieties of apples vary widely in their susceptibility or resistance to canker diseases. Some are practically immune, others offer little resistance. Most varieties, however, occupy intermediate positions between these extremes. Observations indicate that those varieties which sunscald badly are more subject to canker than others.

Ben Davis and Gano, closely related varieties, are the most susceptible to blister canker of all the apples grown in Missouri. Moderately

*Cowart, I. C. Injury to Apple Trees, Thesis, U. of, M., 1914.

susceptible varieties are Collins, Delicious, Yellow Transparent, Huntsman, Grimes, Maiden Blush, Willow Twig and Minkler. Rather resistant varieties are Ingram, Jonathan, King David, Rome, Winesap, Arkansas, and Stayman. Duchess is very resistant and York is seldom attacked.

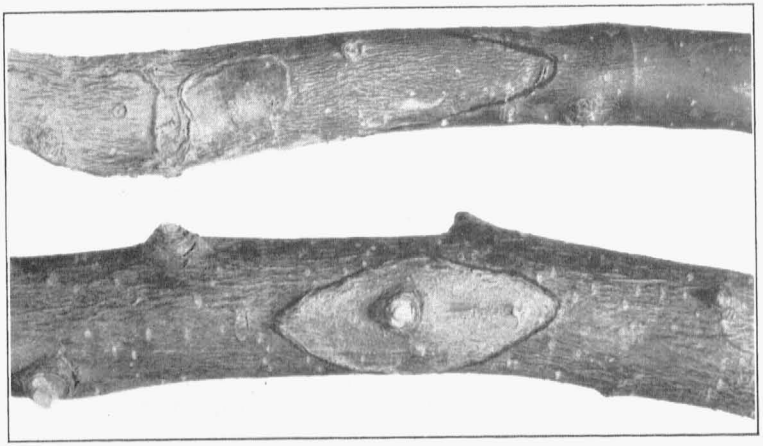

Fig. 10.—(Upper) A black rot canker just above ground on the trunk of a young tree. (Lower) A black rot canker which developed about an injured twig. Note the small fruiting bodies scattered over the surface.

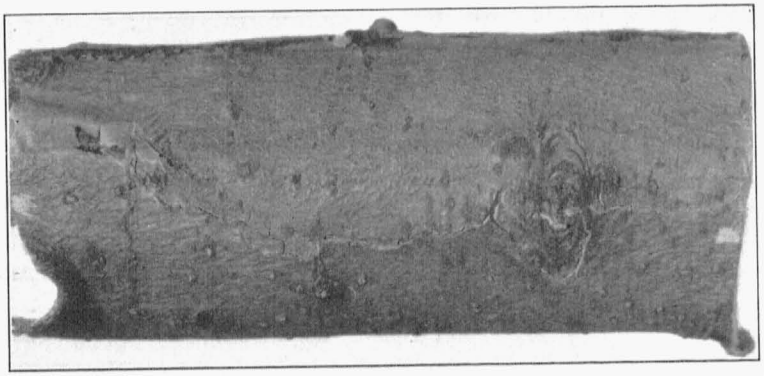

Fig. 11.—Part of a black rot canker on the upper side of a large limb. The shrunken diseased bark has pulled away from the healthy bark leaving a distinct crack and ridge along the line of junction. Note the small pimple-like fruiting bodies scattered over the surface of the diseased bark.

This grouping is based on observations and counts of infections in the University's experimental orchards and in commercial orchards in Missouri. The classification is not a hard and fast one, however, as the num-

ber of infections and amount of injury vary greatly with the locality and the care the trees receive.

Ben Davis and Gano are the most susceptible commercial varieties to black rot canker in Missouri. The disease affects a larger number of other varieties, but information is too meager at present to classify them as to relative susceptibility.

PREVENTION OF CANKERS

Prevent Infections.—Black rot and especially blister cankers are difficult to control once they have become established. The best means of dealing with them is to prevent invasions, or where infections already occur, to confine the disease to the trees affected. As infections usually enter through pruning wounds, care should be taken in making cuts and caring for them until healed. Young vigorously growing trees are seldom attacked by blister canker and are less subject to black rot canker than old trees and trees of low vitality. Consequently, the cultural care of the trees should be such as will keep them vigorous and such pruning as is necessary for shaping the trees should be done while the trees are young when the wounds will be small and will heal rapidly.

Make Cuts Near Branches or Buds.—In cutting back young branches, the cuts should be made near a bud. In removing branches and limbs the cuts should be made to a side branch or flush with the parent branch. Stubs will not heal, but soon die and persist as infection centers for diseases. Even though blister or black rot infections do not occur, heart-rot is almost sure to result. Closely cut wounds, though somewhat larger than if made farther out, will heal more readily.

How to Remove Large Limbs. To prevent spliting in removing large limbs which will leave rough poorly healing wounds, the limbs should first be cut through as far as possible on the under side about a foot from the parent branches. Next saw through the upper side slightly beyond the lower cut until the limbs are severed. The stubs can then be easily and safely removed.

Treatment of Pruning Wounds.—It is seldom necessary to give any special care to pruning wounds on trees under 6 or 8 years of age but on older trees all wounds greater than 1½ inches in diameter should be disinfected and covered with a protective dressing. No entirely satisfactory wound dressing has been found. White lead and linseed oil paint, sodium silicate (water glass), tanglefoot thinned with alcohol and a grafting wax made with linseed oil in place of tallow, have been tried by the Missouri Agricultural Experiment Station. Of these materials tanglefoot has proved the most effective in keeping the wounds thoroughly covered, but further work with it is necessary before it can be recommended. Sodium

silicate gave no protection, the wounds to which it was applied being indistinguishable from the checks. The grafting wax used was difficult to get to stick to moist surfaces. It was satisfactory where it adhered tightly but soon became loose and consequently ineffective on many of the wounds to which it was applied. The white lead and linseed-oil checked and scaled, but where a thin paint was used followed a few days later with a thick one this trouble was largely avoided. It is at present the material recommended for use in Missouri. Paint has an added advantage over the other materials used in that a disinfectant can be mixed with it and the dressing and disinfectant applied at the same operation.

Mixing Disinfectant with Paint.—Mercuric chloride (corrosive sublimate)* is the disinfectant generally employed. This material is usually procurable in the form of a powder or small crystals, but if it is impossible to obtain it in this form, the tablet form may be used. Mercuric chloride tablets are of two sizes and come in two colors, blue and white, either of which is satisfactory. One well filled but not heaped teaspoonful of mercuric chloride crystals or sixteen of the large or sixty-four of the small tablets, if purchased in tablet form, will be sufficient for one gallon of paint. Dissolve the mercuric chloride in seven or eight tablespoonfuls of denatured grain alcohol. If the tablets are used, they should first be crushed and then shaken with the alcohol until most of the mercuric chloride has dissolved. They will seldom dissolve completely as will the powder or crystals, and for that reason are less desirable.

Acetone, benzine (benzol) or gasoline denaturated alcohol may be used, but grain alcohol denaturated with any appreciable quantity of wood alcohol is not satisfactory. The alcoholic solution containing the mercuric chloride is thoroughly mixed with the paint. The paint should be stirred occasionally to insure even distribution of the disinfectant. The local druggist can prepare the disinfectant ready for mixing with the paint or it may be prepared at home.

Disinfecting Pruning Tools.—Pruning tools should be disinfected before moving from one tree to another except when pruning young trees which it is reasonably sure are not diseased. Copper sulphate (blue vitriol) 1 pound to 5 gallons of water or mercuric chloride ½ gram to 1 pint of water or 1 tablet dissolved in a pint of water may be used for sterilizing tools. The tools should not be allowed to stand in these solutions and should be washed and wiped dry after each day's work.

In diseased orchards it is important that the healthy trees be pruned first and the diseased ones last. There is then less danger of spreading the disease to uninfected trees.

*Mercuric chloride is a powerful poison and should be kept where children and stock cannot get to it.

TREATMENT OF CANKERED TREES

The best practice with badly infected trees is to remove and burn them filling the vacancies with young trees. Limbs which are nearly girdled should be removed, making the cuts several feet below the lower ends of the cankers. This will often eliminate black rot canker, though it seldom more than temporarily checks blister canker, which extends for a considerable distance downward in the heart wood below the canker. When the canker is small, especially if the limb is a valuable one, the diseased bark may be cut out and the wound sterilized and painted.

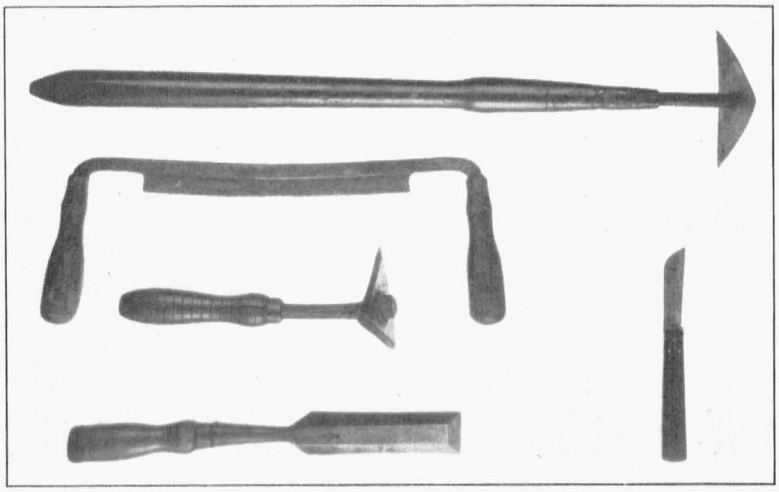

Fig. 12.—Tools employed in cleaning cankers. At top a long-handled and at lower center a short-handled canker tool made of a triagular piece of steel about 4 inches across and sharp on all three edges. With a crook in the shank they make a most useful tool for removing the dead bark. The draw-shave and wood chisel are also useful for this purpose. A heavy bladed knife is desirable for making a smooth vertical cut in the bark at the edge of the cleaned canker.

Properly treated, the life of cankered limbs can often be prolonged several years. Heavy pruning of trees infected with blister canker should be avoided; since such treatment induces further development of cankers.

The work of cleaning and painting cankers is best done in early spring shortly before growth starts, when the cankers can be easily detected and when healing will be rapid.

Cleaning and Painting.—For cleaning out cankers, a sharp heavy-bladed knife and draw-shave or a canker tool such as shown in Fig. 12 are needed. First brush or sponge the dead and diseased bark with a solution of copper sulphate (1 pound to 5 gallons of water.) The diseased

bark may then be allowed to fall on the gound with little risk of spreading the disease. All the diseased bark is next removed leaving a smooth wood surface. With the knife a strip of healthy bark about one-half inch in width should be removed from around the edge of the cleaned canker. The knife should be held upright and drawn steadily down each side of the wound leaving a clean vertical edge.

Proper shaping of the wounds is important. The upper and lower ends should be pointed or rounded. The sides should be evenly curved. Sharp angles must be avoided even though at places it is necessary to remove more healthy bark. The general shape of the wound should be that of an ellipse or oval.

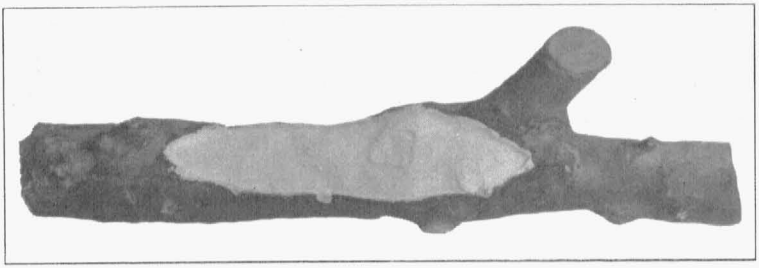

Fig. 13.—A properly cleaned and painted blister canker. The general shape of the wound should be that of an ellipse or oval with the sides vertical and evenly curved.

After being thoroughly cleaned and scraped the wounds should be painted with white lead and linseed-oil paint. The paint should be applied the same as to pruning wounds. Mercuric chloride may be added to the paint as the disinfectant or the copper sulphate solution already prepared may be used, paint being applied as soon as the wounds have dried.

Subsequent Treatment.—The treated cankers should be inspected during the summer and where the disease has advanced all the newly affected bark removed before any fruiting bodies of the disease have formed. Dead and loosened bark along the edges favor the work of borers and the woolly aphis and should be removed. Again, during the winter the treated cankers should be examined and redressed at points where the disease has advanced. Summer and winter inspections should be continued until healing is well advanced or until it is necessary to remove the affected limbs.

INFORMATION YOU WILL FIND IN THIS BULLETIN