SOME FRUIT-ROT NOTES

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Rotting of fruit in cold storage.

Should fruit decay in cold storage? This has frequently been a disputed question between the owner of the fruit, or its seller, and the proprietor of the storage house where the product of the orchard lay while its owner waited for a better market. Sometimes the dispute has been carried into court; but absence of carefully secured data on the behavior of various fruit diseases at different temperatures has often made the task of judge or jury difficult.

To secure reliable information on some of these points and similar ones, the Station inaugurated a series of tests in the winter of 1905 and repeated some of them the next year.

In the experiments with decay-producing diseases of the apple, sound fruits of several different varieties were selected, early in March, from apples in cold storage. Six varieties were used in the test of 1905 and nine in that of 1906. The apples were freed from disease germs by the use of corrosive sublimate and distilled water. Part of them were then inoculated with various diseases by puncturing the skin of each fruit in three places and inserting in each puncture a small portion of a pure culture of the fungus producing the disease. The diseases included in the tests were

Apple rots in storage.

This is a brief review of Bulletin No. 297 of this Station, on Investigations on Some Fruit Diseases, by H. J. Eustace.

Any one 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.
bitter rot, black rot, blue mold, brown rot, pink rot and one caused by the fungus *Alternaria*, which has no common name.

The inoculated apples, with others for checks, were packed in crates and taken immediately to a cold storage house. In 1905 duplicate sets were inoculated and stored in different houses, and in 1906 the test was repeated, the apples being stored in one house only.

Three temperatures were employed with different lots of the apples: 31° F., with range from 29° to 33°, 47° with range from 35° to 56°, and 61°, with range from 48° to 69°.

The apples held at the lowest temperature were removed from the storage house in two months or nine weeks. At this time there was no decay from any of the diseases except blue mold. This had progressed quite rapidly from every puncture point.

The apples were then kept for two weeks at room temperature, about 70° F., during the day. Decay immediately began about all puncture points of each disease and developed rapidly, so that at the end of the two weeks from one-half to the whole of each fruit was rotten.

The duplicates of 1905 agreed perfectly in all respects with this test, as did those in the repeated test in 1906.

It is evident that at 31° F. the most common rot of stored apples, blue mold, is not checked so but that much damage may take place. All the other rots investigated are completely checked at this temperature. The germs are not destroyed, however, as all the fungi develop their characteristic rots very promptly when the apples are brought into favorable temperatures.

The apples tested came from cold storage and so were not warm when returned to the low temperature after inoculation. If they had been, especially if contained in large packages like barrels which cool down slowly, there might have been some growth of all the fungi before the fruit reached the point of checking by low temperature.
At the medium temperatures, average 47° F., none of the rots was completely checked. Practically all punctures showed decay in five weeks. The blue mold was worst, of course, with considerable decay from the *Alternaria* rot, bitter rot and black rot and slight damage from pink rot.

At the highest temperatures, average 61° F., all fruits except those inoculated with pink rot were too badly decayed to be marketable at the end of three weeks. The pink rot had begun growth at all punctures but the spots were small.

Three kinds of peaches were selected for a test of the effect of cold storage on brown rot. Some peaches of each variety were inoculated, in punctures from a pure culture of the brown rot fungus and others were moistened with distilled water and then rolled in spores of the fungus, obtained from rotten fruits. All the peaches were then stored at 32° F. for two weeks. At the end of this time, no rot was found on any of the unpunctured peaches; while from 20 per ct. to 44 per ct., according to variety, of the inoculated peaches were still sound. The others showed comparatively small spots at the punctures.

"These results indicate that the development of the brown rot in peaches is practically checked while the fruit is in commercial cold storage."

In tests of sulphur fumigation in tight rooms, it was found that burning a quarter pound of flowers of sulphur in a room containing 720 cubic feet killed the spores of all the common apple diseases except blue mold.

The tests were made by inoculating apples with the different diseases, allowing the fungi to develop until spores were formed abundantly, and then placing the apples in the room fumigated. Laboratory cultures made from the fungus growth on the apples thus treated failed to grow, thus showing that the sulphur fumes had destroyed the vitality of the germs and fungus tissues. To destroy the blue mold required the use of
two pounds of sulphur in the room. In fumigating, safety from fire is secured by setting the small pan or dish of sulphur on two bricks set edgewise in a larger pan of water. The sulphur can be ignited easily by pouring on it over a small spot a teaspoonful of alcohol.

Fumigating with sulphur should never be done when apples are in the room as it is liable to spot and disfigure them. This interesting fact was revealed in a study of the cause of spotting of a box of Oregon-grown Spitzenburgs sent to the Station from a cold storage house in this State. The apples were spotted, as shown on the title page, and a small dot in each spot resembled greatly the spore case of a fungus. Examination proved these dots to be merely lenticels of the apple brought out prominently by the bleaching of the skin of the apple; and neither fungus nor bacteria could be found by careful search. Injury from some external agency was therefore evident; and, almost by chance, the injury was reproduced on apples by the first means tested,—sulphur fumigation. By exposing the sound apples to the fumes of sulphur for five minutes, so close a resemblance to the spots on the Oregon Spitzenburgs was obtained that there seems little question that the injury on these fruits was due to the same or very similar treatment. The history of the box of apples could not be traced to confirm the supposition. The sulphur fumes appear to enter the lenticels of the apples, and produce the bleaching of flesh and skin, which looked so much like fungus injury.

That bordeaux mixture is a preventive, not a remedy for scab, was again proven by tests on spotted fruit. On August 1, some Carolina June apples were selected on the tree, the scab spots numbered in indelible ink and the size of the spots recorded. Part of the marked apples were sprayed thoroughly with bordeaux mixture and
others reserved as checks. The spots under the bordeaux continued to enlarge as rapidly as those on the check fruits. The same proved true on Greening and Fall Pippin apples selected, marked and sprayed at later dates.

The scab fungus grows in the fruit beneath the thin outer covering, the epidermis, hence the margin, or growing part, of the spot is protected by the epidermis from the bordeaux.