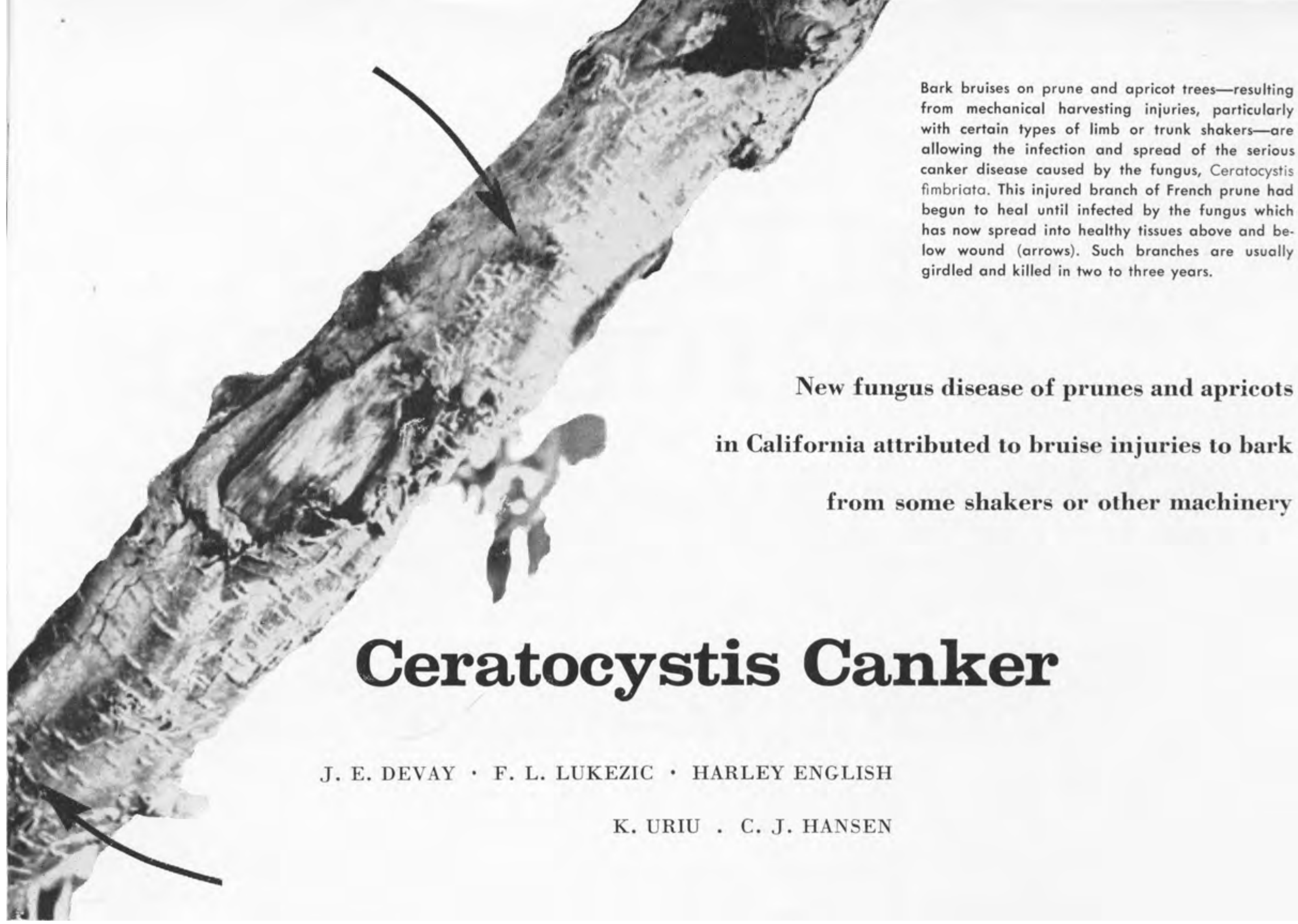

Bark bruises on prune and apricot trees—resulting from mechanical harvesting injuries, particularly with certain types of limb or trunk shakers—are allowing the infection and spread of the serious canker disease caused by the fungus, *Ceratocystis fimbriata*. This injured branch of French prune had begun to heal until infected by the fungus which has now spread into healthy tissues above and below wound (arrows). Such branches are usually girdled and killed in two to three years.

New fungus disease of prunes and apricots in California attributed to bruise injuries to bark from some shakers or other machinery

Ceratocystis Canker

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Ceratocystis canker is a disease well known to almond growers as mallet wound canker. It has found recently in some prune orchards in Yolo, Sutter, Butte, and Colusa counties and in some apricot orchards in Yolo and San Benito counties. Two of the orchards of French prunes that were studied were about 50 acres in size with trees from 10 to 15 years old. In one, 87 per cent, and in the other, 74 per cent, of the trees were severely diseased with Ceratocystis cankers. These cankers were also observed on French prune trees that were 24 to 27 years old. These cankers were also found on Imperial and Robe de Sergeant prune varieties.

All cankers observed so far have originated in bruised bark tissues. In apricots, where the occurrence of bruise injuries has been less common, cankers are not as prevalent as in prunes or almonds. The main reason for the prevalence of Ceratocystis cankers in prune orchards is bark injury from harvesting equipment, especially shakers. Bark tissues damaged by shakers and other machinery are ideal sites for tree infection by the fungus.

Once infection has occurred, the fungus spreads rapidly into healthy tissues around the bruised area. Expansion of the fungus into healthy bark and wood occurs year-around, but moves fastest in the summer months. Cankers will eventually girdle the trunks or limbs, killing diseased limbs and often the entire tree. It is estimated that limbs 4 to 6 inches in diameter can be girdled by the fungus in 3 to 4 years. The seriousness of the present condition in some orchards is magnified by the fact that frequently all scaffold limbs as well as the trunk of a single tree have extensive cankers—originating through shaker injuries.

Using shakers to grasp and shake the trunks or base of main scaffold limbs usually causes the most injury. Such injuries often allow the development of Ceratocystis cankers that may cause the death of injured and infected trees within a few years. The design of a shaker head and the operation of shakers are important factors affecting the extent of bruise injuries caused in the bark as well as the spread of the disease in orchards.

The continued use of shakers on diseased trees aids in the distribution of the fungus throughout the orchard. When the shaker head contacts older cankers, the possibility exists that fungus spores or mycelial fragments may be picked up and spread to bruised bark on healthy limbs where they start new cankers. Because most of the damage has been to trunks

All main scaffold limbs of this French prune have been injured by a shaker. Injured bark tissues (arrows) have become infected by Ceratocystis.

Shaker injury caused in 1960 has become infected with Ceratocystis on this French prune (top arrow). In 1961, a shaker head contacted the lower edge of this canker increasing the injury (arrow below). Contamination of the shaker head with spores and other cells of the fungus probably occurred, spreading the fungus to injuries on other trees.

and primary scaffold limbs, it may be advisable to shake smaller branches. Cankers that might appear on these smaller branches could then be pruned out without seriously threatening the loss of a tree.

Cracks in crushed bark allow the *Ceratocystis* fungus to grow into the bark and to colonize the inner tissues from which it can parasitize healthy tissues adjacent to the bruise thus causing a canker. The diseased bark usually takes on a water-soaked or darkened appearance and amber-colored gum exudes from the margins around the canker; however, with some cankers little or no gumming occurs. A characteristic red stain is usually present in the diseased tissues of prunes—in contrast to the dark brown discoloration of infected tissues in cankers of almond and apricot trees.

In all cankers, a brownish-black stain permeates deep into the heartwood causing black streaks that often extend many inches past the margins of the canker in the bark. Previous studies have indicated that the stain extends far in advance of the fungus infection, however.

There are no sure methods for curing or stopping the spread of Ceratocystis cankers in infected limbs or trunks. Partial success in stopping the spread of individual cankers in almond trees has been attained by cutting away diseased bark tissues. The cuts must be extended to approximately 2 inches beyond the margins of the canker in the bark. Cutting away the diseased bark tissues exposes non-infected cambium that may form a callus around the wound. Such treatment has, in some cases, arrested further canker development in almonds. Painting the cut-away area of the limb or trunk with a disinfectant, such as 0.3 per cent phenyl mercury nitrate mixed with 8 parts glycerol and 2 parts lanolin, has helped forestall the invasion of the wound by other organisms.

Almonds from trees treated with this mercurial disinfectant have been analyzed by the Pesticide Residue Research Laboratory at the Davis campus and no mercury residues have been found. However, this mercurial preparation has not as yet been registered for use on almond trees by California or Federal agencies. The use of Bordeaux paste has been unsatisfactory for treatment of these wounds due to its toxic effects on the tree.

Cutting out diseased branches and even scaffold limbs—if the cankers have not already advanced into the crotch—offers another possible control measure. Such prunings should be burned because there is evidence to indicate that insects, such as borers, may aid in the dissemination of the fungus. Pruning wounds are apparently not prone to infection by *Ceratocystis*. Only bruise type injuries have allowed growth of these cankers in almonds, apricots, and prunes.

Ceratocystis cankers in prunes should not be confused with the canker and dieback condition in prunes resulting from the infection of sun-injured limbs by *Cytospora rubescens*. This fungus is another canker-causing organism that is present in most prune and plum orchards of California and is particularly severe in its attack on President plums and Imperial prunes. A future article will discuss the nature and possible control of the canker and dieback caused by *Cytospora*.

Methods for minimizing possible injuries to trees, in relation to shaker operation and design, are presented in the following article.

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MINIMIZING BARK INJURY WITH MECHANICAL SHAKERS

Shaker injuries to the bark of trees can be minimized by careful operation of properly designed equipment. One careful grower, Andrew Micke of Tehama County, has been harvesting prunes with a commercial shaker for five years with no indication of serious damage. He has lost a few limbs but no trees. He was probably the first person to mechanically shake prunes with a tractor shaker, according to extension service records.

The first thing that can be done to minimize tree damage is to select a shaker that does the least amount of damage to the tree. For example, the University designed "C-type" clamp, tested and used on inertia shakers, has been shown to result in minimum damage to the tree at the point of attachment—as reported in California Agriculture, August, 1961. Minimum damage results from the linear motion for clamping. Regardless of limb size, the force applied to the limb is nearly in line with the direction of force application. Thus, the total force and also any shear forces on the limb are minimized.

In addition, the hydraulic circuit used for clamping is also designed to yield a minimum force on the limb. This is accomplished by closing the clamp with a low pressure, then blocking the oil flow so as to be able to develop the higher pressures and forces required for shaking.

In addition to the selection of equipment, the following points are also important:

1. Adjust shaker properly.
2. Employ careful operators.
3. Advise operators to avoid infected areas.
4. Carry out preventive sanitation measures to retard spreading of disease.
5. Prune trees for mechanized operations.

Studies are being continued on all phases of the mechanical injury problem. —*P. A. Adrian, Agricultural Engineer, ARS, U. S. Department of Agriculture, and Associate in Agricultural Engineering and R. B. Fridley, Assistant Agricultural Engineer, University of California, Davis.*