however, most of the vines had inexplicably died. Farmers altered their farming practices, including their spraying, dusting and pruning methods, to try to combat the vine death, but were unsuccessful. The disease spread to neighboring areas and contributed to the eventual demise of commercial grape culture in Southern California (Olmstead and Rhode 2008).

In 1889, the U.S. Department of Agriculture (USDA) dispatched Newton B. Pierce to Santa Ana to determine the cause of vine death. In 1891, after extensive research, Pierce concluded that the disease was unknown and that it was probably caused by a microorganism for which a cure was not available. Pierce's conclusion closed investigations into the disease for almost 50 years (Olmstead and Rhode 2008).

The disease that killed the grapevines in Santa Ana, now referred to as Pierce's disease, and its insect vectors were not identified until recently. It is now known that the bacterium *X. fastidiosa* causes PD, and it is spread by a variety of leafhopper insects, called sharpshooters. Sharpshooters obtain nutrients by feeding on plant fluids in the water-conducting tissues of a plant (xylem). Their feeding does not usually inflict significant plant damage, although in some cases significant water loss (but not fruit damage) can occur in citrus trees. However, when a sharpshooter feeds on a PD-infected plant, the bacteria may attach to its mouthparts. Over time, the bacteria

Jack Kelly Clark

Vectors of Pierce's disease include the blue-green sharpshooter (*Graphocephala atropunctata*), top, and the nonnative glassy-winged sharpshooter (*Homalodisca vitripennis*), bottom.

BACTERIUM

discovered to be cause of

PIERCE'S DISEASE OF GRAPEVINES

Early conclusions on Pierce's disease

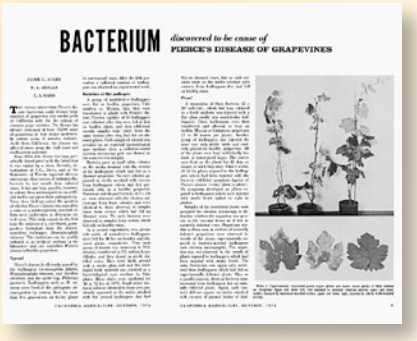
1974 "The newly discovered Pierce's disease bacterium could destroy large numbers of grapevines and render parts of California unfit for the culture of common grape varieties.

"Since 1884, this disease has been periodically investigated with the belief that it was caused by a virus. . . . This study reports for the first time the isolation of a rod-shaped, gram-positive bacterium from the disease-spreading leafhopper *Draeculacephala minerva*.

"A group of noninfective leafhoppers were fed on healthy grapevines, *Vitis vinifera* cv. Mission, then they were transferred to plants with Pierce's disease. Excreta (spittle) of 10 leafhoppers was collected after they were fed at first on healthy plants, and then additional excreta samples were taken from the same vectors after they had fed on diseased plants. Each sample of excreta was streaked on an enriched bacteriological agar medium.

"Bacteria grew as small white colonies on the media streaked with the excreta of the leafhoppers which had fed on a diseased grapevine. No such colonies appeared on media streaked with excreta from leafhoppers which had fed previously only on a healthy grapevine.

"These experiments have demonstrated that a gram-positive bacterium is the etiological agent of Pierce's disease in grapevines, and not a virus, as previously believed. The organism has been successfully cultured on artificial media. By using the leafhopper vector injected with the cultured and purified bacteria, the disease symptoms can be consistently reproduced in healthy grapevines and the same organism reisolated from clean leafhoppers fed on these plants and on naturally infected plants from the field."


BACTERIUM *discovered to be cause of* PIERCE'S DISEASE OF GRAPEVINES

All three authors contributed to the understanding and prevention of plant diseases throughout their university careers. Jaime G. Auger studied plant pathology at UC Davis in the 1970s and went on to a professorship at the Departamento de Sanidad Vegetal, Universidad de Chile, Santiago. Thomas A. Shalla served as professor in the UC Davis Department of Plant Pathology. Besides his classroom work, he pioneered new electron microscopy techniques for the identification and study of viruses and infected plant cells, and led a task force to research and virtually eliminate pear decline, a serious disease in the state's pear industry in the 1960s. Clarence I. Kado is professor emeritus at the UC Davis Department of Plant Pathology. He was a university bacteriologist, both in the classroom and in the laboratory, and author of many scientific articles and a major college textbook on bacteriology.

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