



United States
Department of
Agriculture

Forest Service

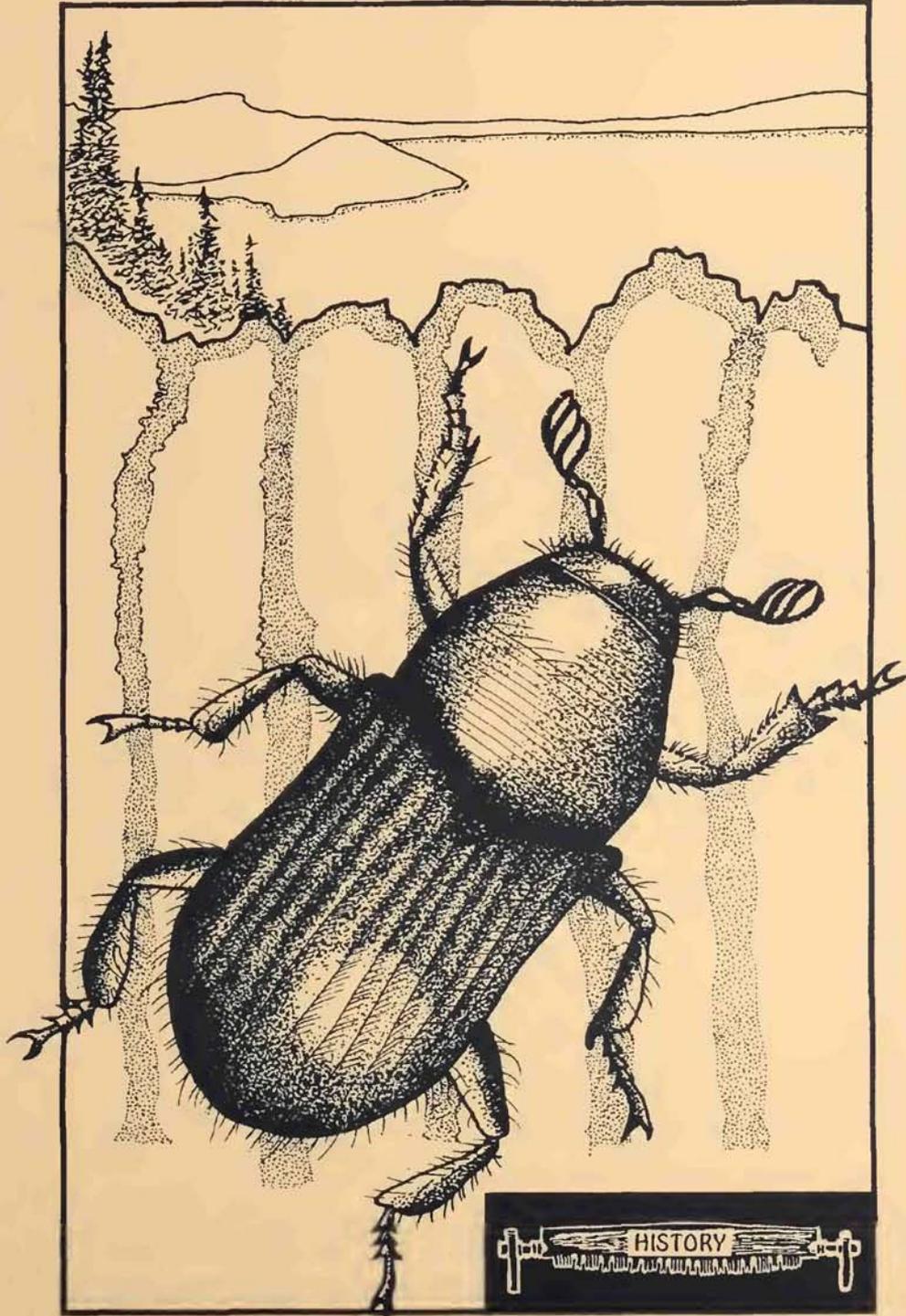
Pacific Northwest
Research Station

General Technical
Report
PNW-GTR-259
June 1990



The Battle Against Bark Beetles in Crater Lake National Park: 1925-34

Boyd E. Wickman



Abstract

Wickman, Boyd E. 1990. The battle against bark beetles in Crater Lake National Park: 1925-34. Gen. Tech. Rep. PNW-GTR-259. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 40 p.

This history records the first large-scale bark beetle control project in a National Park in the Pacific Northwest. It describes the relations between Park Service, Forest Service, and USDA Bureau of Entomology personnel; how the project was organized; the ecological implications of the outbreak; and the long-term results of direct control measures.

Keywords: Bark beetles, Crater Lake National Park, control, Bureau of Entomology, Forest Service, insect outbreaks.

Introduction

The tide of the control battle has ebbed and flowed. The control forces have given the enemy repeated setbacks, but until recently the beetles on the southern front have had their forces strengthened by reinforcements from the north. The northern reserves are now depleted, and the remnants of the beetle army are widely dispersed and rendered ineffective with only a few concentrated groups operating in territory outside the former battlefields. The ultimate victory is now in sight.¹

If this sounds like war, it was. The protection of the lodgepole pine (*Pinus contorta* Dougl. ex Loud.) forests of Crater Lake National Park from destruction by the mountain pine beetle (*Dendroctonus ponderosae*) has engaged the attention of the National Park Service and the U.S. Department of Agriculture, Forest Service and Bureau of Entomology, since 1925, and despite Entomologist F.P. Keen's optimism in 1930, the war was far from over.

Let us go back a few years and see how this quasi-war of man against beetles began and why so much effort and money was expended to win the "ultimate victory." In 1923, the Superintendent of Crater Lake National Park requested help from the Bureau of Entomology because groups of lodgepole pine in the northern portion of the park were being killed by the mountain pine beetle. Because the dominant tree within the park was lodgepole pine, Park Superintendent Colonel C.G. Thomson visualized the park would become a "windblown, sandy desert without the lodgepole pines."² During that summer, John E. Patterson responded for the Bureau from its Ashland, Oregon, field station and made a first examination of the outbreak. Because the Park Service had no funding for insect control in 1924, plans were made to do a more extensive survey in summer 1924 and to request funds to start control operations in 1925.

¹ Keen, F.P. Dec. 1, 1930. Report of mountain pine beetle situation in Crater Lake National Park, fall 1930. Portland, OR: U.S. Bureau of Entomology. 13 p. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

² Correspondence between Superintendent of Crater Lake National Park and Bureau of Entomology. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

The epidemic apparently started 10 years earlier in National Forest stands northeast of the park near Diamond Lake and spread slowly southward killing from 50 to 90 percent of the stand as it progressed.³

In the National Parks, the commercial value of a tree species was irrelevant. Trees provided cover and scenic back drop and the policy at that time was to protect them from fire or insects at almost all costs. As we shall see later in the story, it was a losing battle. And though the beetles essentially won the war, the lessons learned helped bring on a more ecologically enlightened management style decades later.

The purpose of this story is to point out how foresters, land managers, and entomologists reacted to an insect outbreak in Crater Lake National Park during the early 1900s, the lessons they learned, the development of new technology, and how lessons from the past have helped to shape our current pest management policies. Neither the Forest Service nor the Park Service changed or curtailed their bark beetle control policies overnight. The changes took many years and came about after many experiences similar to the one chronicled here.

Crater Lake was not the only National Park with insect problems. Several others also requested funds to control insects at the time, but the situation at Crater Lake may have been the most serious because of the importance of lodgepole pine as forest cover and the intensity and magnitude of the beetle outbreak. Therefore in late July 1924, Patterson, F.P. Keen, J.M. Miller, and F.C. Craighead of the Bureau of Entomology made a survey of the beetle outbreak. In a report to H.C. Albright, National Park Service Director, Patterson pointed out the gravity of the situation (see footnote 3) and requested \$5,000 to start the campaign. It so happened that in 1925 the emergency bill for the U.S. Department of the Interior provided \$25,000 for the suppression of insect epidemics in National Parks. This was the first specific appropriation for insect control work in National Parks, and Crater Lake got its share.⁴

³ Patterson, J.E. Aug. 4, 1924. Memorandum for Mr. H.C. Albright on the forest insect situation in the Crater Lake National Park. Ashland, OR: Forest Insect Field Station. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

⁴ Miller, J.M. Mar. 1, 1925. National Park Service gets into the game. Western Division Newsletter. Northfolk, CA: Forest Insect Investigations, Bureau of Entomology: 4. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

The control project in that first year needs to be described in some detail because it set a pattern for future events.⁵ To do that, a little must also be known about the technical leader of the project Assistant Entomologist, John E. Patterson, from the U.S. Department of Agriculture, Bureau of Entomology, field station in Ashland, Oregon.⁶ John Patterson joined the Bureau of Entomology, Division of Forest Insect Investigations, at its Ashland field station in 1914. Before transferring to the Bureau of Entomology as an entomological ranger, he was a guard at Crater National Forest. He had a varied career earlier as a photographer, surveyor's helper, railroad signal installer, and salesman of packing house products. He was a well-liked and highly competent self-taught entomologist. He published papers on several bark beetle and insect defoliator problems. He was in charge of the Ashland field station from 1921 to 1924 and served as assistant station leader of the Bureau of Entomology's Berkeley laboratory during the last 8 years of his career. He retired in July 1950 and died on July 31, 1962, in Ashland (see footnote 6).

Activities in 1925— The First Year

In the 1924 survey report, Patterson recommended that the large, intense outbreak north of the lake be ignored. He pointed out that almost 80 percent of the trees had already been killed so efforts to protect stands from future losses should be centered south of the lake in the following areas: south of Wheeler Creek near the east entrance, between Sand and Wheeler Creeks, in the Pinnacles, south of Wheeler between Lost Creek Ranger Station and Kerr Notch, in Munson Valley, and in Anna Springs.⁷ These areas totaled about 1,920 acres (see footnote 3). Control crews moved into the park on May 25, 1925. The first camp was established at the Ranger Station at the east entrance (no longer in existence). It was difficult to move the crews and equipment into this area because of late persistence of snow 3 to 6 feet deep. Consequently the first few days were spent opening the roads so that trucks could bring in the crews and supplies. Camps were later established at the Lost Creek Ranger Station on May 27 and at Government Camp near Munson Valley on June 24. Control work was completed by July 11 with 4,291 trees treated. Average diameter at breast height of the treated trees was 14 inches (see footnote 5).

⁵ Patterson, J.E. Jan. 12, 1926. Report of the 1925 control work in the Crater Lake Park, Oregon. Stanford University, CA: U.S. Department of Agriculture. 8 p. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

⁶ Wickman, B.E. 1988 (Spring 1987). Early forest insect research in the Pacific Northwest: the Ashland Field Station, 1912 to 1925. *Oregon Historical Quarterly*: 27-48.

⁷ Anna Springs and Anna Creek are now called "Annie."

Treatment methods were similar to those used in the mountain pine beetle control project in northeastern Oregon in 1911.⁸ But some new wrinkles had resulted from some experimental work by Patterson. He described the methods in his report as follows:

All infested trees were felled before being treated. The smaller trees were felled with axes while those above 8 inches in diameter were felled with saws. In the control work on areas A, B, C, D, and E, the felled trees were limbed and the tops and branches piled back on the infested logs and the whole mass was burned. This method was the cheapest one that could be employed to kill the broods of beetles and was used until the lateness of the season made the danger from fire too great to be risked. Consequently on areas F and G, which were treated after June 25th, burning was discontinued. On these areas the felled trees were limbed and topped and the stripped logs rolled to openings in the forest where the sun during the midday period shined directly on them. Owing to the thin bark of lodgepole pine an exposure to the sun under these conditions for a period of at least two hours resulted in bark temperatures sufficiently high to kill the broods of beetles in whatever stage of development. It was necessary to turn the logs after the beetles under the upper bark had been killed in order to expose the rest of the brood to the sun's rays. Although this necessitated covering the same ground twice the additional cost and time involved was much less than that which would have been necessary to guard against the fire hazard attendant upon the first method. The two methods were equally effective in treating the infested trees, but the cost per tree on this project was slightly greater for the sun treatment, except when the fire hazard increased the cost of burning. The sun treatment method is particularly desirable in stands where the burning method would cause damage by scorching adjacent standing timber (see footnote 5).

The sun-curing method of treating beetle-infested lodgepole pine was proposed after studies carried out by Patterson near Ashland in the early 1920s and was the first operational use of the method in a bark beetle control project.⁹

The Park Service spent \$4,954.15 of their \$5,000.00 allotment. Wages represented \$3,131.75 of the total with the rest going for provisions, equipment, and various supplies. Not a bad cost accounting considering the remote area, poor transportation, deep snow, and lack of roads.

⁸ Burke, H.E. 1989. Northeastern Oregon bark beetle control project 1910-11. Wickman, B.E., ed. Gen. Tech. Rep. PNW-GTR-249. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 48 p.

⁹ Patterson, J.E. 1930. Control of the mountain pine beetle in lodgepole pine by the use of solar heat. Tech. Bull. 195. Washington, DC: U.S. Department of Agriculture. 19 p.

After surveys were made in September 1925, Patterson reported that the results of the work were good for most of the units; Kerr Notch was the worst area with 200 newly infested trees. He stated that (see footnote 5),

while the results of this first year's control work were very successful in breaking the epidemic, this reinfestation will, unless removed, soon again become epidemic. To prevent this and secure permanent results from the work already done the following recommendations should be carried out in the spring of 1926.

Thus began a series of rosy proclamations about winning the war against the beetles. The recommendations suggested that about 500 to 700 infested trees would be found the next spring and \$1,000 would be needed to treat them. Some infestation of western pine beetle (*Dendroctonus brevicomis*) in large ponderosa pines (*Pinus ponderosa* Dougl. ex Laws.) near the south entrance were also noted with a recommendation to treat about 200 trees at a cost of \$1,000. Thus, for a measly \$2,000 Patterson stated, "The proposed work should not only maintain the beneficial results of the initial control work, but also should accomplish the practical elimination of all infestations in the south half of the Park" (see footnote 5). Did it? Let us follow the course of the battle.

Events From 1926 Through 1928

In February 1926, Park Superintendent Thomson wrote a disturbing letter to Patterson. The letter acknowledged the recommendation for \$2,000 needed for spring 1926 control work but said that the funds could not be released until after July 1, 1926 (the new fiscal year). The letter ended, "...if it should be too late then to undertake effective control measures, the money will be available for use the following spring (1927) when insect infestations can be treated in time."¹⁰ Patterson replied immediately that he was perplexed over this delay in allotting funds that he thought were arranged. He saw much good work of 1925 going for naught if the remaining infestations could not be cleaned out in spring 1926 before beetles emerged from infested trees. In the meantime F.C. Craighead, Chief of Forest Insect Investigations, Bureau of Entomology, Washington, DC, started lobbying the top echelons of the Federal bureaucracy. He came up with \$1,600 that was intended for Grand Canyon National Park (see footnote 10). This, combined with \$400 left over from other work at Crater Lake, was enough to proceed as planned. New problems arose, however, once the control work started. Instead of several hundred infested trees as estimated in 1925, there were several thousand. This necessitated control work into August and September at Anna Creek and Munson Valley (see footnote 10). This was not good news because it meant treating well into the period when beetles were in flight and making new attacks. Spotters could miss many new attacks. The only good news was that the Park Service allotted \$8,000 to Crater Lake for fiscal year 1927, minus the \$1,600 hijacked from Grand Canyon. But, in the fall when Patterson and Thomson tried to find out exactly how much they had remaining to use in their

¹⁰ Unpublished letters on Crater Lake mountain pine beetle control projects 1925-34. On file with: B.E. Wickman, Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

spring 1927 work, they found the dollars had been slipping away to other parks—Yellowstone for one (see footnote 10). The year-end report by Patterson showed 6,805 trees treated (43 were ponderosa pine infested with western pine beetle) at a cost of \$9,645.16.¹¹ He claimed a reduction of 86 percent in the number of infested trees on all the old units worked in 1925, but new infestations kept cropping up in fall 1926. An area around Crater Peak had 2,500 newly infested trees, and an area east of the entrance in the Crater National Forest continued to be a trouble spot. Patterson claimed that they continued as a source of new infestation for the lodgepole pine stands in the park. Patterson further surmised that the newly infested area at Crater Peak and the trees found in Munson Valley resulted from beetle infestations north of the lake. He felt that this source would no longer be troublesome because most of the trees in that area were dead by 1926 (see footnote 11). He optimistically requested only \$2,500 to \$3,000 for control work in 1927. Patterson was concerned about the reinvasion of areas in 1926, but after examining the old infestations north of the lake he was convinced (see footnote 11)

...that the progress or "drift" of the annual infestations had been consistently in a south-westerly direction. This fact was further supported by examination made in the new infested lodgepole stands in the west-central part of the Park. These stands have only recently been invaded and the drift of the beetles infesting them has also been toward the southwest. This is shown by the fact that the first trees attacked are on the northeast exposure of the infested areas.

The discovery of this drift in the Crater Lake Park was of significance, because the control areas and the lodgepole pine stands in the west-central part just described, are in its path. Further evidence supporting this suspected cause of the re-infestation was the fact that the last trees attacked in the old areas north-east of the lake are located on their south-western border and that these places represent the last stand of the beetles in this locality. These old areas were abandoned in 1926, because all the lodgepole in them had been killed. The flight of 1926 represented the last remnant of their beetle population and this remnant was forced to migrate to living stands of lodgepole. One of the last epidemic centers in these old areas abandoned by the beetles in 1926 is located on the rim of the lake near Round Top, (see map). This point is directly north-east of the Munson Valley region where the greatest re-infestation of the control areas occurred in 1926. This re-infestation is believed to have been caused by an invasion of beetles migrating from these old epidemic centers.

¹¹ Patterson, J.E. Jan. 24, 1927. Report of the 1926 control work in the Crater Lake Park, Oregon. Stanford University, CA: U.S. Department of Agriculture. 12 p. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

Another factor which probably contributed to this movement of beetles into Munson Valley was the burning day and night, during the flight period of 1925, of slash along the new rim road which was under construction from Government Camp to the Lodge at the north end of Munson Valley. It is well known that the mountain pine beetle is readily attracted to burning slash. The map shows the relative location of all the infested areas above discussed. The red arrows are drawn on the map to show the direction of the migration of the beetles. Control areas F, H, and I, are the only areas in direct line with this suspected drift. It seems the above evidence is sufficiently conclusive to warrant the statement that the 1926 re-infestation of the control areas F, H, and I, was caused by beetles migrating from the old-standing infestations north-east of the lake.

That there is no great hazard of such migration and consequent re-infestation of the areas south of the lake again occurring seems assured because there are not enough beetles now remaining in these old areas to make it possible. The 1925 flight represented practically the total beetle population of the region north-east of the lake.

Another budget crisis occurred in October 1926. A letter from Acting National Park Service Director Arno Cammerer to Superintendent Thomson on October 12, 1926, indicates a battle of the budgets as well as the bugs. Cammerer acknowledges a request from J.E. Patterson for an allotment of at least \$2,500 to carry on a beetle project in the park in 1927 but states that there was only \$500 held in reserve for 1927, and it was promised to Glacier National Park. He further said that the Park Service had requested \$15,000 for insect control work in 1928, but this had been cut by the Bureau of the Budget to \$7,500 and, because he understood from correspondence that the control work in Crater Lake had been "pretty well completed," they allotted only \$500 to Crater Lake. He concluded by saying, "I see no possibility of providing you with additional funds as requested for work next spring."¹²

Patterson did not protest and probably assumed that Craighead in Washington, DC, would come through again and prevent Yellowstone from gaining all the funding.

My correspondence files are empty, unfortunately, for 1927 and 1928 so I do not know how the funding was arranged. But a control project was conducted in 1927: 2,936 lodgepole pine trees were treated at a cost of \$2,500. The most remarkable thing was that the outbreak was apparently whipped, or at least stalled, because no control work was recommended for 1928.¹³

¹² Cammerer, Arno B. 1926. Letter dated October 12 to C.G. Thomson. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

¹³ Patterson, J.E. Nov. 30, 1927. Final report on the Crater Lake Park control project, November 1927. Stanford, University, CA: U.S. Bureau of Entomology. 11 p. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

One interesting innovation occurred in the annals of beetle control work in 1927. Because of deep snow at Anna Creek, men and camps were transported successfully by tractors towing sleds. Also in 1927, the adjacent Crater National Forest treated 4,000 trees on the east edge of the park in a show of cooperation; Patterson felt there was little threat from that source in the future (see footnote 13). He did recommend that the Forest Service clean up some small infestations near Sand Creek in 1928. There was one disquieting note in the 1927 report:

Following the control work of 1927 only 545 infested trees have developed on the control areas. These trees represent the total beetle infestation at the present time. The future infestation on the control areas will depend upon the development of these 545 broods. It is not probable that they can soon increase to a point that will again menace the present stands (see footnote 13).

This seems like a risky statement given the history of the outbreak to this time.

In 1928, the Crater National Forest under Administrative Assistant Lee Brown carried out control operations on Sand Creek and north of Sand Creek between Cave Creek and the National Park boundary.¹⁴ Apparently, neither Patterson nor anyone else from the Bureau of Entomology trained the Forest Service staff or worked with them. According to Brown's report, the crew was trained by Forest Examiner A.J. Jaenicke who was in charge of forest insect work in the Pacific Northwest Region. Bureau of Entomology personnel were probably not involved because of the press of business in the park. Brown complained about the lack of experience of the spotters used to locate infested trees (see footnote 14). The trees were treated by the sun-curing or solar heat method advocated by Patterson, so he must have had some exchange with the Forest Service, perhaps in 1927. The Forest Service crews treated 1,257 trees at a cost of \$1,000. They unfortunately ran out of funds before they completed the work. A few small groups of trees were not treated south of Sand Creek Canyon; and about 200 trees were not rolled during the solar treating, which meant that about two-thirds of the beetle brood survived and emerged. The result was that Brown recommended cleaning up the areas worked in 1927 and 1928 and estimated this would cost \$1,500 in 1929 (see footnote 14).

Patterson made a fall survey in 1928 and said "...there had been a considerable infiltration of beetles from north of the Lake, as well as a build-up of the infestation locally during the year when no work was done."¹⁵ So the battle was not over quite yet.

¹⁴ Brown, Lee P. June 16, 1928. Report on Sand Creek beetle control project, season 1928, Crater National Forest. Medford, OR: Crater National Forest. 7 p. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

¹⁵ Patterson, J.E. [n.d.]. Entomological report of the insect control project, Crater Lake National Park, Oregon, season spring 1929. 2 p. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

Events of 1929 and 1930

For the beetle battlers, 1929 was a very bad year. Thousands of lodgepole pine became infested in 1928 from what Patterson described as continued infiltration of beetles drifting from north of the lake, even though very few live trees were supposedly left in that area. Also in some areas, two broods developed thereby producing two sets of infested trees instead of the usual one (see footnote 15). Altogether, 23,239 trees were treated across 9,000 acres at a cost of \$17,038.91. The Crater National Forest treated 8,199 trees at a cost of \$2,000 (see footnote 15). The fall 1928 survey, according to Chief Ranger William C. Godfrey, actually estimated that only 4,500 trees would have to be treated in 1929.¹⁶ This was a 75-percent underestimate when tallies were made at the end of the 1929 control work. Godfrey mentioned that the crews again faced snow depths of 6 feet or more when they tried to set up camps in late April. Again they resorted to tractors to drag camp equipment and crews to Anna Creek. The most disturbing part of Godfrey's report was that they had to leave 4,070 trees untreated (see footnote 16).

Brown was again in charge of Forest Service control work in 1929, and his report makes some interesting statements not included in other reports.¹⁷ Brown thought the smoke from slash fires along the road attracted more beetles to the roadside area in 1929, and he mentioned that 1929 was unseasonably dry and favorable to the beetles. He was in charge of control operations in the park (upper Sand Creek) under J.E. Patterson. This is the first indication that Forest Service crews worked within park boundaries. Brown also made the first mention of possible beneficial effects of opening a stand during logging as follows (see footnote 17):

At Mr. Jaenicke's suggestion an examination was made of sale cuttings in the lodgepole pine in this area. An examination of 70 acres cut over by the Pelican Bay Lbr. Co. for ties in 1925 disclosed two old beetle infested trees and two infested trees whereas adjoining ground not cut over showed groups of from 4-20 trees which had been or were infested. It may be that opening the stand increases beetle resistance of the remaining trees. During 1929 cutting was made by the Algoma Lbr. Co. in lodgepole pine near Boundary Butte. This would offer an excellent chance for experimental study of beetle activity in cut over areas should the District Office or the Bureau of Entomology care to undertake such work.

Unfortunately no followup studies were done.

¹⁶ Godfrey, Wm. C. [n.d.]. Summary of work done on insect control project in Crater Lake National Park, season of 1929. 3 p. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

¹⁷ Brown, Lee P. [n.d.]. Report on Sand Creek beetle control project for season of 1929. Crater National Forest. 10 p. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

Brown also had an interesting antidote for bears in camp:

Bear raided the cookhouse in 1929 due to their having acquired the habit of visiting the road camp. [The Sand Creek entrance highway was under construction.] If they are fed regularly they will come at that time and should be driven away at other times (see footnote 17).

Trained bears no less.

The 1929 work went smoother for the Forest Service because the crews worked both sides of the east boundary of the park, and Jaenicke spent several weeks training men to spot beetle infested trees. Brown said control work should be continued in 1930 and the cost would be about \$1,500 (see footnote 17).

In July 1929, the personnel situation in the Bureau of Entomology changed. J.E. Patterson resigned from Government service to go into the resort business with his father-in-law, Charles William DeCarlow, at Pinehurst, Oregon (see footnote 6). Frederick Paul Keen, an entomologist who started working at the Ashland station in 1914 at the same time as Patterson, was assigned to take his place. Keen was one of the small pioneer group of entomologists along the Pacific coast. He was the first university-trained forest entomologist to work at the Bureau of Entomology, Pacific Slope station (that is, he had both formal forestry and entomology training at the University of California, Berkeley). Keen studied bark beetle biology, ecology, and control methods for several years at the Ashland field station. In 1917, he went into the U.S. Army for the duration of World War I. After farming on family property in southern California for a short time, he joined the new Bureau of Entomology station at Stanford University in Palo Alto, California, in 1921. In 1922, he set up a temporary field station at Klamath Falls, Oregon, and led a cooperative bark beetle control project in the area for several years. Keen went on to a distinguished career in forest entomology. He published many papers on silvicultural control of bark beetles. Lessons that he learned at Crater Lake probably instilled an interest in developing ways to prevent insect outbreaks rather than combat them directly. In 1931, he became leader of the Bureau of Entomology, Pacific Northwest Forest Insect Research Station, in Portland, Oregon. In 1942, he was placed in charge of both the Portland and Berkeley stations of the Bureau where he directed research until shortly after World War II. He then reverted to Chief of the Berkeley laboratory until his retirement in 1953 (see footnote 6).

Keen took over the control work at Crater Lake in late summer 1929 and prepared a report¹⁸ of the activities that year that was more comprehensive than Patterson's cursory report prepared just before he resigned in July. Keen, as a newcomer, took the first broad ecological look at the results of past control efforts and objectives of the current control work, and presented three alternative plans for future control.

¹⁸ Keen, F.P. Sept. 8, 1929. Report of the mountain pine beetle infestation in the lodgepole stands of Crater Lake National Park, season of 1929. Alturas, CA: U.S. Bureau of Entomology. 7 p. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

Keen concluded that treatment reduced tree losses from pine beetles on areas treated and it reduced fire hazard, but that it had failed to exterminate the beetles in the park. He further recognized that as long as beetle outbreaks were widespread and surrounding the park there would be continued reinvasion of treated areas from these sources. Keen pointed out that protecting trees solely for aesthetic value was not appropriate because, in the course of stand succession, other species of conifers would replace the dead lodgepole. Here he erred because many of the infested stands were already climax lodgepole and would not be replaced by fir or hemlock. Keen thought that reducing the fire hazard was the only justification for spending such large sums of money on beetle control. He did not comprehend, however, that dead trees create fuel for subsequent wildfire, which initiated the development of new lodgepole pine stands, thus perpetuating this fire-maintained species.

Keen presented three plans for consideration by the Park managers (see footnote 18).

Plan 1. Intensive control work on all the areas infested at the present time, with the idea of eliminating the beetles from the Park areas and saving the remaining lodgepole forests.

To stand a reasonable chance of succeeding, this plan would have to take into account all the adjacent infestation within a radius of twenty-five or thirty miles (since it has been established beyond a reasonable doubt that these beetles may travel for such distances). This would involve the tremendous infestations north of the Lake on the Deschutes and Umpqua National Forests and require the cooperation of the Forest Service in controlling all such infestations in the general vicinity, while within the Park boundaries alone 25,000 to 30,000 acres of lodgepole would have to be combed carefully for infestations and all infested trees treated. To attempt this would require an expenditure of at least \$25,000 of Park funds for the fiscal year 1930 and at least half this amount for several years to come. The plan would represent a commendable effort on the part of the Park Service to preserve the lodgepole forests but is doomed to defeat; for it is impossible to eliminate the beetles from such a large area, and sooner or later these stands are due to die and be replaced by other types. The plan is not only futile but would be tremendously expensive.

Plan 2. Control only along the roads in areas of high fire hazard and on recreational areas.

This plan would confine the work to areas on which most of the previous control work has been done, and would mean recleaning these areas for several years until the peak of the present epidemic has passed. It could be carried out with minimum expense and without involving the cooperation of adjacent owners. It would serve the purpose of reducing the fire hazard in areas of high risk and avoid unsightly dead forest areas along the main traveled roads. This plan could be carried out for the fiscal year 1930 with an expenditure of not over \$5,000 and about half this amount for the next three or four years.

Plan 3. To do no control work.

If this course is followed the epidemic will soon die out for lack of suitable host material, as another three or four years will see the end of the present mature lodgepole stands in the Park. While this is the cheapest and easiest course to follow, it will leave a very unsightly mess along some of the roads and a bad fire hazard in the very places where fires are most apt to occur.

Keen recommended a continuation of the protection of valuable areas under plan 2 as the most feasible (see footnote 18).

Some of Keen's analyses of the situation were perceptive and ahead of his time. But it would be 30 to 40 years before many forest managers recognized the futility of trying to control mountain pine beetle in dense, overmature lodgepole pine stands.

Keen sent Patterson a copy of his 1929 report and a long letter on Oct. 6, 1929, saying "It is awfully hard to write up anything that you haven't first hand knowledge of and I'm afraid I have done a pretty sorry job of it."¹⁹ It actually was the most succinct and penetrating analysis of the situation thus far. Keen also told Patterson that though he (Keen) advocated a somewhat revised policy, he still recommended a continuation of the protection of special park areas. He also admitted that it was not an attempt to eliminate the beetles from the south end of the park. He told Patterson that they must "abandon all of the isolated areas and concentrate on the protection of those areas where the fire hazard is the highest and are of the most value from the recreational standpoint—in other words the areas where most of the control money has already been spent" (see footnote 19). There is no record of a reply by Patterson to this letter in the files.

The year 1929 is a good year from which to draw a picture of the control camps, equipment, and personnel employed during the spring treating period. In a memo²⁰ to the Superintendent of Crater Lake National Park, Patterson suggested the following arrangements for 1929:

Control Camps. The personnel of each camp should consist of the following: 1 camp foreman, 1 cook, 1 compassman, 2 spotters, and 14 treaters.

However, the number of treaters may be increased to 20 if conditions warrant. The one spotting crew of 3 men can easily keep ahead of 10 treating crews of 2 men each.

¹⁹ Correspondence between Keen and Patterson for 1929. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

²⁰ Patterson, J.E. [n.d.]. Memo for Supt. Crater Lake Park beetle control, spring of 1929. 2 p. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

Equipment. Each Camp:

Cook tent; stove and necessary utensils for feeding the men.

Provisions

Tents for sleeping quarters, including cots and mattresses.

Tools (based on camp of 1 spotting crew and 14 treaters):

1 Staff Compass

2 Spotting Axes

1 8x10 Tatum Holder

2 5x8 Tatum Holder

Section plats and spotters' record sheets

Timber Crayons

14 double-bitted axes (bastard)

7, 6 1/2-ft. combination falling-bucking saws

15 canthooks

1 light truck for use of the foreman in transporting men to and from work and for hauling supplies. (If it is necessary to do the work before snow has disappeared the truck can not be used and transportation effected by tractor and sleds. In this case it would be limited to moving camp equipment in and supplying camp with provisions.)

Events in 1930-31

This brings us to the pivotal years of the war that had been waged since 1925. Keen, in December 1930, made a detailed report of the 1930 control operations. Before June 11 the work was confined to recleaning units treated in 1929. The work continued until July 8 on the middle fork-east fork plateau in heavy infestations. A total of 9,832 trees were treated, but 1,897 trees could not be treated before the beetles emerged (see footnote 1). F.C. Craighead, Chief of Forest Insect Investigations, Bureau of Entomology, came from Washington, DC, on July 21 to visit the outbreak with Keen. They found an additional 115 whitebark pine (*Pinus albicaulis* Engelm.) and lodgepole pine at high elevations that still contained brood, so these trees were also treated to bring the total for the season to 9,947 trees (see footnote 1). Keen pointed out that lodgepole pine between 75 and 150 years old are very susceptible to the beetle. The estimates for the coming year were that there would be a total of 10,000 trees to treat. "The completion of this work should leave the lodgepole stands in very good shape except for an endemic infestation which should be watched for a few years and controlled if it develops active characteristics" (see footnote 1). An optimistic view in light of 10,000 trees needing treatment in 1931.

In October 1930, Keen wrote a letter to Craighead in Washington, DC, in which he outlined his control recommendations for 1931 before he completed his formal report. Keen for the first time advocated "...treating all of the epidemic infestation in the south half of the Park which I now feel is the wisest policy since the general situation has improved so materially in the past few seasons."²¹ A strange statement in view of the continued rise in number of trees needing treatment since 1927. Keen also hoped the Park Service could allot \$10,000 for the suppression work in 1931; a tidy sum in 1930 dollars (see footnote 1).

²¹ Correspondence between Keen and Craighead in 1930. On file with Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

On October 21, Craighead replied, "Your plan for control work on the Crater [Crater Lake National Park], proposed in your letter of October 12, appears entirely satisfactory to me" (see footnote 21). Craighead went on to recommend "...that every effort be concentrated on the heavier groups of infestation and the outlying, more or less endemic type be left until last or allowed to go until another year" (see footnote 21). He felt there was enough experience to show that scattered infestation would not be an immediate threat. Patterson also replied to a letter from Keen, that is missing from the files, about some control unit designations. In the letter²² was this sad paragraph,

Godfrey's death was certainly a blow to all who knew him. Coming so unexpectedly as it did, I was particularly shocked. He was a dandy fellow and a prince to work with. His habit of hiking off alone on any and all wild goose chases finally got him. He did the same thing when we were in the Park together in 1929. Always out alone with a mightily poor constitution to carry him thru. Both he, Patton, and several others caved-in the day we moved into the Park from the west entrance. Without a knowledge of snow and the individuals possibilities in bucking it, it is a real danger. Solinsky and I made the same kind of trip that Bill attempted, leaving Ft. Klamath at 7:30PM we arrived at Anna Spring at 1:30AM. I never attempted it again.

The following newspaper account of William Godfrey's misadventure and death was found in the Crater Lake headquarters files.²³

BILL GODFREY

The death of William C. Godfrey, chief ranger of the Crater Lake Park service, in a blizzard near Anna Springs last night, has cast a cloud of gloom over the entire community.

"Bill" was a veteran of the park service, having held a responsible position at Yosemite before coming here. Before that time he had been a member of the U.S. Forest Service.

He was a man of fine character, well read, high minded and determined. When he set out to do a thing, he took a genuine pride in doing it. It was this quality so characteristic of the service to which he belonged which was responsible for his death.

Bill felt that he should be at Anna Spring camp. He tried to get through from Medford, but had to turn back. So he tried it from the south entrance, via Fort Klamath and, in spite of the unfavorable weather, he was determined not to turn back again.

* * *

It is easy to say Bill was foolhardy, that he overestimated his own strength and underestimated the strength of the elements. But such a judgment fails to take into account the code of the service to which he belonged, and the dominant elements of his character.

²² Correspondence, Patterson to Keen. Dec. 1930. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

²³ Medford Mail Tribune. Nov. 18, 1930.

It is essentially the same code, and the same character, that led our forefathers on the successful conquest across the wilderness and our doughboys across the Hindenburg line. Bill Godfrey's tragedy is merely another example of the fact that there are heroes of peace as well as of war. The rewards for the latter far exceed the rewards of the former, but the qualities of courage and self sacrifice, behind them, are fundamentally the same.

The article goes on to say that Godfrey was 41 years old and had been chief ranger of Crater Lake National Park since April 1929. Previously he was assigned to Yosemite National Park for 2 years and before that 6 years in the Forest Service, including service with the Fremont National Forest in Lakeview, Oregon.

For some reason, known only to himself, Godfrey tried on foot to buck his way through deep snow to Anna Springs with only light clothing and no gloves and against the advice of people with whom he had talked just hours before by telephone at Fort Klamath. He collapsed just 2 miles short of Anna Springs and was found dying from exposure at 9 p.m. by a rescuer, Rudy Luecke. He lived for only several minutes after being found and tried vainly to say something to his rescuer. Significantly, the search party were all using skis so Godfrey's chances in the deep snow on foot were hopeless.

Bill Godfrey was particularly well liked by the entomologists and some time during his earlier work with the Forest Service in California he drew an appropriate cartoon of a bark cutting apparatus used for studying bark beetles. I found the cartoon during a search of the files at the Pacific Southwest Forest Research Station in Berkeley in August 1987 (cartoon on page 20).

The year 1931 might best be described as the year the ax fell on Keen's neck. Keen's 1931 report of control activities is missing from the files, but according to Frank Solinsky, in charge of Park Service operations, work started on April 30. The Forest Service treated 1,020 trees east of the park. Snow and rain storms in the park lasted from June 13 to June 30, delaying the treatment by the solar-heat method considerably, but helping to ease the drought conditions of 1929 and early 1930. With bad weather and all, Solinsky reported 14,747 trees cut in the park that season. Solinsky continues, "In the last three years we have spent over \$33,000 and cut 48,238 trees."²⁴ Solinsky was pessimistic about ever winning the battle unless a complete cleanup of the control units was done. Further, he recommended stopping the control efforts unless this approach was followed. Solinsky also mentions that W. Buckhorn of the Bureau of Entomology spent the whole season in the park helping on the control work (see footnote 24).

²⁴ Solinsky, Frank J. [n.d.]. Crater Lake National Park pine beetle control project for 1931. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

Text continues on page 29.

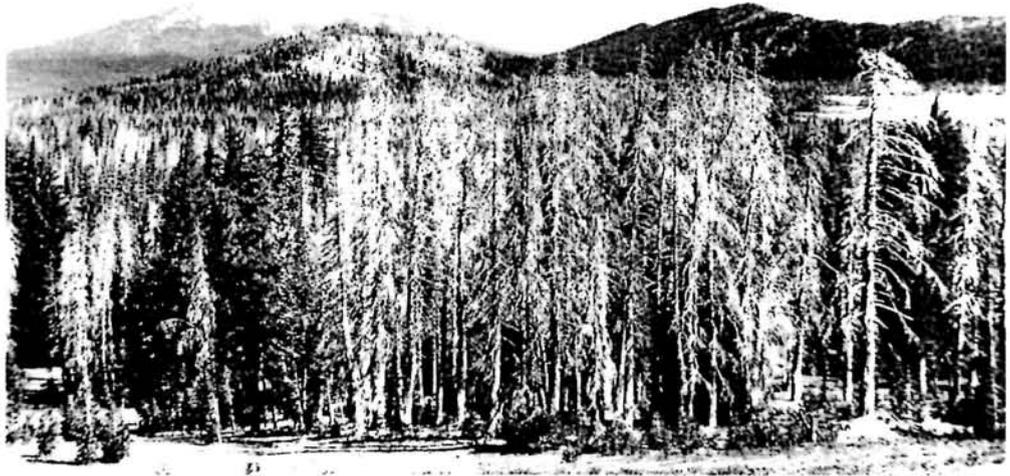


Figure 1—General view of Ghost Forest near Desert Crater. Lodgepole pine north of Crater Lake were killed by mountain pine beetle before 1924.



Figure 2—Dead lodgepole pine in Ghost Forest were killed before 1924.



Figure 3—Lodgepole pine killed by mountain pine beetle, Castle Creek area, Crater Lake National Park, October 1930.



Figure 4—Area treated by sun-curing method. Crater Lake National Park, September 1934.

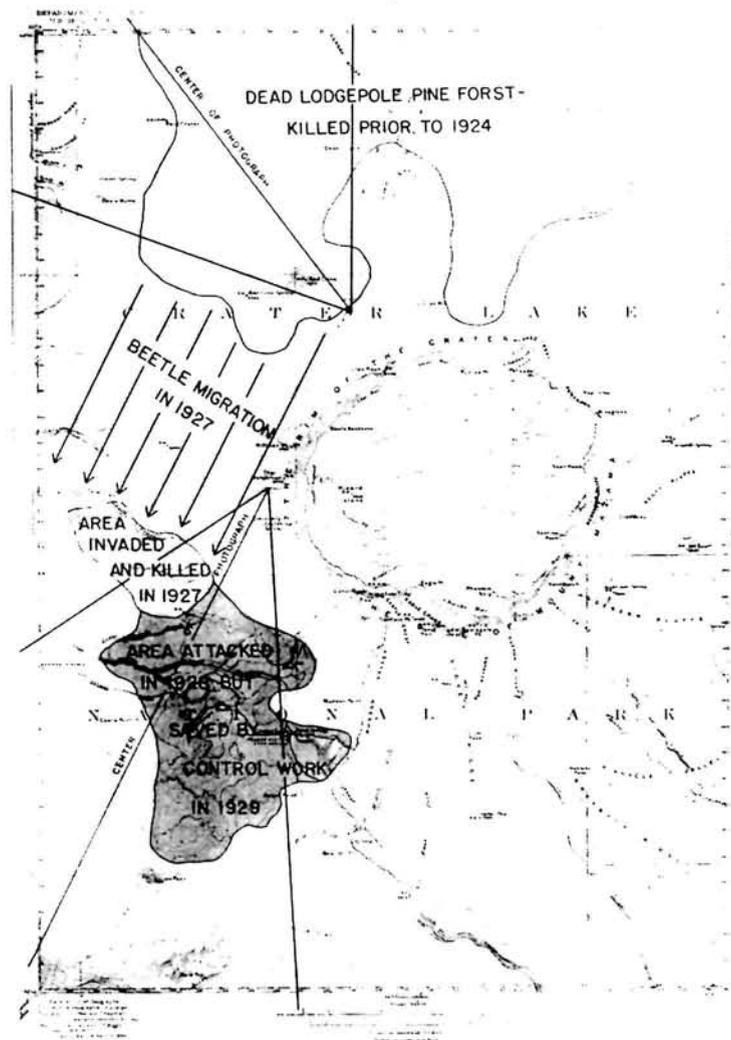


Figure 5—Evolution of mountain pine beetle infestations from 1924 to 1929 in Crater Lake National Park. Beetles migrating from the first established center in the northern part of the park invaded the southern areas, thereby causing great losses in these recreational stands. Control work during 1925 to 1932 was directed against infestations in all the southern forests. Areas where control was carried out in 1947 are shown encircled southeast of Crater Lake.



Figure 6—Lost Creek Forest Service control camp, June 2, 1929. Left to Right, Alex Jaenicke, Forest Service entomologist; Wm. Godfrey, Park Service Chief Ranger; and Lee Brown, Assistant Forest Supervisor.



Figure 7—Crater Lake National Park Superintendent E.C. Solinsky (left) in front of Anna Springs cabin.



Figure 8—Cartoon drawn by Chief Ranger Godfrey when he worked for the Forest Service in California in 1924. It pokes fun at entomologist Morrow's bark cutting machine and the effect it has on the beetles in the bark.



A



B



C

Figure 9—Tractor dragging sleds loaded with control camp gear over deep snow to the treatment areas. Crater Lake National Park, May 1929. (A) Smooth sailing, (B) even caterpillars get stuck, and (C) everybody off and push.



A



B



C



D



E

Figure 10—Munson control camp in May 1929, Crater Lake National Park. (A) Some of the control crew sharpening axes. (B) Left to right, unknown (possibly Frank Solinsky); J.E. Patterson, Bureau of Entomology; and the cook's helper. (C) Left to right, Cook Tremain, Assistant Spotter Carter, and Head Spotter Byne. (D) Left to right, Spotter W. Trowbridge and Patterson. (E) Part of the crew; camp foreman Fred Patten is at extreme left.



Figure 11—Unknown compassman, ca. 1929, Crater Lake National Park.



Figure 12—Compassman and tree spotters (unknown) arbitrate which way the needle is pointing, ca. 1929, Crater Lake National Park.



Figure 13—Spotter blazes lodgepole pine infested with bark beetles and leaves a record-keeping card on the bole for the treaters to fill out, ca. 1929, Crater Lake National Park.



Figure 14—Treating crew falls lodgepole pine infested with bark beetles, ca. 1929, Crater Lake National Park.



Figure 15—Preparing lodgepole pine infested with mountain pine beetle for the sun-curing (solar) treatment. Logs are limbed and topped so that direct rays of sun fall on them, Crater Lake National Park (no date).



Figure 16—A patch of lodgepole pine after all the trees killed by the bark beetles are felled for sun-curing treatment, ca. 1929, Crater Lake National Park.



Figure 17—Typical area of beetle-treated group of 100 trees or more, 1929, Sand Creek, Forest Service project.



Figure 18—Lodgepole pine limbed for the sun-curing treatment. Limbs are piled to be burned when conditions are safe, ca. 1929, Crater Lake National Park.



Figure 19—Another type of treatment used in shady areas was to peel the bark from the tree with a spud thus exposing the bark beetle brood and killing it, 1947, Crater Lake National Park.



Figure 20—A chemical, Orthodichlorobenzene, in an oil solution was sprayed on the bark of lodgepole pine infested with mountain pine beetle, 1947, Crater Lake National Park.



Figure 21—Several hundred large ponderosa pine infested with western pine beetle near the south entrance were also treated in 1929, Crater Lake National Park.

**A****B****C****D**

Figure 22—The Pinnacles Valley area, Crater Lake National Park, was visited in August 1987 to see if the mountain pine beetle infestation had once again spread from the north into the park. (A) Several small groups of lodgepole in the left foreground were infested. (B) The stand of lodgepole pine on the flat above Pinnacles Valley has reached an age and density making it susceptible to mountain pine beetle. (C) Jim Milestone (left), National Park Service, and Russ Mitchell, Forest Service, examine new mountain pine beetle attacks found under the bark of lodgepole pine. (D) Mitchell examines downed logs treated by the sun-curing method during the 1930s beetle control project. Lodgepole in foreground were attacked by mountain pine beetle in 1987.

Walter J. Buckhorn started working for the Division of Forest Insect Investigations, Bureau of Entomology, in 1925. His earliest assignment was assisting F.P. Keen in spotting and mapping beetle-killed pine on the southern Oregon-northern California project. In 1930, he was given the task of surveying the infested areas of the park under Keen. He went on to a distinguished career as an entomologist in the Bureau of Entomology Portland laboratory. He was awarded the U.S. Department of Agriculture's Superior Service Award in 1956 for vision and leadership in pioneering and developing forest insect aerial surveys in Oregon and Washington. Buckhorn was a versatile and competent entomologist who came up through the ranks. He was a good-humored field companion who eased the rougher spots according to Keen. He was bitten by the flying bug; he resigned from the Bureau for a short time in the mid-1920s to attend an airplane mechanics school and attempted to start his own flying service. His continued interest in flying after he returned to Government service resulted in his development of the aerial survey techniques that led to his Department award. He retired from the Forest Service in 1962 after 37 years of Government service. He died in Portland, Oregon, on November 9, 1968.²⁵

There is some correspondence missing from my files, but the treating crews were obviously finding more infested trees than they had been told were there. Park Superintendent E.C. Solinsky, in a May 1931 preliminary report, said a very serious infestation containing about 3,000 trees had been found in the southwest corner of the park.²⁶ In a June 8, 1931, memo from Keen to Craighead, Keen tried to mollify Craighead's apprehension, alluded to in a letter of June 2, that the battle of the beetles in Crater Lake National Park was not going well at all. Keen writes several pages of rationale for the poor outcome of control work to date, especially a flare-up of new infestation in an unsuspected area. Keen assumes the full share of blame for not having located these new areas and wonders how big an area should be surveyed to prevent future surprise outbreaks. He finally suggests that all the park and all the adjacent National Forest lands be type mapped and surveyed for new beetle outbreaks, which he said could be accomplished most economically by taking aerial photographs of the area.²⁷ This aerial photography, if it had been approved would have been a massive pioneering type project and was an indication of Keen's innovative and technological bent.

²⁵ Forest Service newsletter, Pacific Northwest Forest and Range Experiment Station, Portland, Oregon, undated. Various Western Division newsletters, Forest Insect Investigations, Bureau of Entomology, Stanford University, California. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

²⁶ Solinsky, E.C. [n.d.]. Preliminary report on beetle control Crater Lake National Park, season 1931. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

²⁷ Keen, F.P. 1931. Letter dated June 8 to F.C. Craighead. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

Craighead's rather testy reply²⁸ arrived a few days later. He stated that he did not agree with Keen's optimistic outlook of certain infested areas given in an earlier letter to Solinsky. He generally disagreed with many of Keen's assessments of the situation and called for a meeting in the fall of representatives of the Park Service, the Forest Service, and the Bureau of Entomology to devise some clear strategies and decide whether further protection is to be continued or the project abandoned. He pointed out to Keen that the Forest Service was only conducting control work in their stands to carry out their obligations to the Park Service. He agreed with Keen that a thorough survey of the park and surrounding forests should be made and doing some of this from the air was appropriate, but he nixed the idea of using aerial photographs to produce a type map. He closed the letter with this admonition,

We have failed so miserably on this project that it has reacted very unfavorably on our work in the region. The only alternative I have left is to now insist that you give the preparation of the survey and plan for next year's control full priority over everything else in your district. I am squarely placing the entire responsibility on you.

Craighead's strong words were in response to 6 years of optimistic reports from his field entomologists that the battle was nearly won. The trouble was that no one told the beetles. Craighead's letter also mentions mapping the outbreak from the air. Keen had come from the use of horse and buggy in 1914 to the air age in his fight against forest insects. Keen had actually been working on aerial survey techniques in California for several years, and an aerial survey had been flown over Yellowstone National Park that year according to a July 21, 1931,²⁹ letter from Craighead to A.E. Demaray of the National Park Service.

Keen's reply³⁰ to Craighead on July 17 makes a strong pitch for making a type map of the park and aerial mapping the park infestation even though Craighead did not feel such maps would be accurate enough. Keen promised to do his best even though he was shorthanded. He blamed his inability to forecast the course of the outbreak to the lack of a forest type map of the Park.

²⁸ Craighead, F.C. 1931. Letter dated June 24 to F.P. Keen. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

²⁹ Craighead, F.C. 1931. Letter dated July 21 to A.E. Demaray, National Park Service. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

³⁰ Keen, F.P. 1931. Letter dated July 17 to F.C. Craighead. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

On September 2, 1931, Craighead wrote two letters to Keen. In one,³¹ he shows pleasure that Keen's August report (not in my files) describes the beetle situation in the park as improving. He asks, "Do you think it would be possible, if the last remaining epidemic center of infestation can be cleaned up next year, to then put the responsibility of annual survey on the Park Service, as we are doing in other areas prior to appearance of epidemics?" The second letter also sounds like a sigh of relief and commends Frank Solinsky for his good work.

The reason for this good cheer comes out in Keen's reply³² to Craighead on September 9, 1931. A major mistake had been made by the new Bureau man, Buckhorn. Keen states,

Your two letters of September 2 in regard to the Crater Lake project are received. When Buckhorn called me by long distance this spring and told me that they had found 10,000 more trees on the Crater and that Solinsky was wiring for more money, I assumed of course that another 'blow-up' had occurred. I must confess I was considerably taken back on visiting the area and seeing what an insignificant amount of infestation had caused all the stir. Buckhorn too feels considerably chagrined at all the excitement which his informal verbal report to Solinsky that "they had found lots of bug trees" caused. The new center is not over 500 acres in extent and contains about 1500 trees of the 1930 attack. There are without question 10,000 trees in the southwest corner of the Park, but there is lots of difference between having that number concentrated in one place or scattered over 25,000 acres.

Keen continues,

Supt. [E.C.] Solinsky and Frank Solinsky both believe that even one bug tree left in the Park is a potential menace and will undo all of the accomplishments of the control work. It is their idea that enough money should be secured this coming year to treat all the remaining infestation in the Park down to the last tree, or just as nearly as that is humanly possible. The theory of treating epidemic infestation and leaving endemic doesn't appeal to them, and although we have never gotten all the epidemic infestation as yet, it is hard to convince them that such a treatment would be satisfactory.

³¹ Craighead, F.C. 1931. Letter dated Sept. 2 to F.P. Keen. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

³² Keen, F.P. 1931. Letter dated Sept. 9 to F.C. Craighead. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

Keen agreed with Craighead's suggestion to turn surveys over to the Park, as follows (see footnote 32):

Your suggestion about putting the responsibility of the annual surveys on the Park Service under our general supervision has my hearty endorsement. In fact it is the plan we have been working under on the Crater in theory at least. Godfrey was supposed to assist me last season, but didn't have much time to give to it. This season Supt. Solinsky and I agreed that the survey should be a cooperative affair and he gave a lot of help on it. This next month when Buckhorn goes back to check up on the fall attacks, the new Chief Ranger, Frank Solinsky and two other spotters furnished by the Park Service will be assigned to assist him. It will then be largely a Park survey made under our general supervision. They all have a very high regard for Buckhorn on the Crater and he and Frank Solinsky, who has been placed in charge of the control work for the Park, work together very smoothly.

What was happening was that heavy centers of infestation were found on Forest Service and private lands around the park. Some of these areas (Sun Mountain, for example) were only 3 or 4 miles from the park boundaries—within flying distance for the beetles. So the entire beetle control question was much bigger than the park, and people were beginning to question if complete control of the outbreak in the park was feasible.

Letters continued to come from Craighead to Keen in September and October 1931 in the interest of nailing down this outbreak that was so embarrassingly difficult to control. In a letter of September 21, Craighead tells Keen,³³

My advice on the Crater would be that 100% treatment be given on all areas where the infestation is grouped and thus aim to thoroughly clean such areas but do nothing on those areas where infestation is scattered and obviously endemic, i.e., where no grouping occurs and where infested trees are not thrifty or do not contain vigorous broods. If such a plan is adopted and all areas are surveyed for the next few years, at least by topographic methods, it should be possible to keep down all epidemic infestation. This however may mean some little work each year for some years to come but I am afraid that is what we are coming to in all lodge-pole forests where protection is necessary without utilization.

³³ Craighead, F.C. 1931. Letter dated Sept. 21 to F.P. Keen.
On file with: Pacific Northwest Research Station, Forestry
and Range Sciences Laboratory, 1401 Gekeler Lane,
La Grande, Oregon 97850.

Craighead recognized, based on a concurrent similar outbreak in Yellowstone National Park, that the battle was a holding action at best. In October, Craighead acknowledged receipt of a report from Keen and Beal on a survey of the park and surrounding area. The report is missing from my files; evidently the number of infested trees was substantial, and there was concern for a newly infested area on Forest Service and private land in the Sun Mountain area.³⁴

A report by Keen dated January 25, 1932, summarized control accomplishments in 1931 and made recommendations for 1932 work.³⁵ The report made some amazing statements considering all that had transpired. For instance Keen stated in his summary:

Ever since control work started on Crater Lake National Park, the treated areas have been menaced with neighboring infestation and the threat of beetle migration from heavily infested centers. In the early years the heavy centers were north of the Lake, but gradually these have been working around to the south and playing out. Control work during the last few years has had less migration of beetles to contend with. At no time, except possibly at the very beginning of this epidemic would it have been possible to wipe out all possible sources of infestation except at a tremendous and doubtfully justifiable expense.

The policy, which has been followed of repeatedly cleaning out the infestation in the recreational areas south of the Lake, and in the last few years of extending this work to take in all neighboring epidemic centers, is in my estimation the only feasible policy which would have been adopted. Far from considering the Crater work a failure, I believe it is the most successful which has ever been undertaken in the control of this beetle under the circumstances of poor isolations which this work has had to face.

Repeatedly and consistently the control work has brought about reductions averaging 75 percent, in spite of the threat of nearby infestation. A record which convinces me that local control is successful, provided sudden and concentrated migrations do not occur. Only in 1926 are we sure that such a migration occurred on the Crater when the beetles swept into the Munson plateau after it had been thoroughly treated. Of course, as soon as it becomes financially feasible to wipe out all sources of migration it should be done, and at the present time this comes nearer to being possible than in any previous year.

³⁴ Craighead, F.C. 1931. Letter dated Oct. 12 to F.P. Keen. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

³⁵ Keen, F. P. Jan. 25, 1932. Report of the mountain pine beetle situation in Crater Lake National Park and surrounding National Forest areas, season 1931 and recommendations for control, spring 1932. Portland, OR: U.S. Bureau of Entomology. 12 p. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

It is estimated that there are 50,000 infested trees within the National Park boundaries and an additional 115,000 infested trees within a ten-mile zone surrounding the Park. But most of this infestation is either endemic or weakly epidemic in old beetle swept areas, so that only the real epidemic centers would appear to be possible sources of migration and need to be considered in any control plans.

Keen still did not recognize that the beetle outbreak was about as irresistible as the ocean tides. As long as extensive, over-mature stands of lodgepole pine were present, the beetle was sure to follow. The fact that the park and surrounding Forest Service lands contained thousands of acres of such susceptible forests made the control policy pursued for 6 years of questionable effectiveness.

In 1931, the Park Service treated 15,767 trees at a cost of \$11,027. The recommendation for 1932 was to treat about 23,370 trees in the park and an additional 21,400 trees on surrounding National Forest lands (see footnote 35). This was gaining ground in retrograde and reminds one of military predictions made by generals during the Vietnam and other wars.

Keen's rationale for the increased numbers of trees treated each year follows (see footnote 35):

This project is a splendid example of what can be accomplished in beetle control under what might be called the "local unit" clean-up plan as contrasted with the "extensive area" or "isolated unit" plan of control. No one questions but what the treatment of all the infestation which might reinfest an area to be protected is the safest course to pursue but at the same time the most costly, as the work in the Yellowstone Park region so very well illustrates. The question then arises as to whether anything less than a complete clean-up of all the infestation in the surrounding country will bring about satisfactory results.

The work on Crater Lake National Park was started in 1925 to determine this point—the feasibility of "local unit" control. Some very satisfactory results were secured but there was evidence of some reinfestation filtering back into the controlled areas each year and in 1926 a concentrated migration from north of the lake into the cleaned Munson plateau unit which completely wiped out the results of the work in that area. Thus control work under this plan prevented the building up of an epidemic in treated units but did not prevent heavy migrations. The net result has been that the protected areas south of the lake have been largely saved from the fate of the unprotected stands even though losing considerable timber through repeated light infestations and control work.

Since 1929 the threat of heavy migrations has been much less as the beetle epidemic waned on the unprotected areas. Then the plan was adopted of going out and mopping up all epidemic centers within the Park and on nearby National Forest lands that threatened the protected areas. With the extension of this program the control results on the protected areas improved; showed little more infestation than might be accounted for from local sources; but in no year have all the outlying epidemic areas been reached. This change in program increased the number of trees treated annually from about 3700 trees before 1929 to an average of 16,800 trees annually since then. This does not mean that the epidemic has been increasing in spite of the control work, but simply that the area has been expanded each year to take in more of the threatening outlying areas.

Keen's statements were blatant rationalizing and partially true, but the fact was that, sooner or later, the beetles attacked every mature stand of lodgepole pine in the park, whether controlled in the "local unit" plan or not.

I remember my own experiences battling mountain pine beetle in Yosemite National Park during a concurrent lodgepole pine needleminer (*Coleotechnites milleri*) outbreak in 1953 to 1958. In 1953, I surveyed a small area of mountain pine beetle outbreak in Conness Basin that contained about 2,050 infested lodgepole pine on 500 acres.³⁶ For the next 4 years the Park Service, with my misguided technical assistance, attempted to control the outbreak on an ever increasing area until thousands of acres and more than 10 times the number of trees were involved. Because most of the trees were over mature and all were weakened by lodgepole needleminer defoliation, it was a losing battle for the managers and the beetles eventually won.

Events From 1932 to 1934—The Final Years of the Battle

The letters between Craighead and Keen were numerous during spring 1932. Keen was sending weekly reports on the progress of the work to a worried Craighead. The letters commented on difficulties of doing the treatment in deep snow and burning some trees with oil rather than using the solar method.³⁷ Keen was continually optimistic, however, that they were on the verge of making a thorough cleanup of the park infestation that year. A last-minute push by Park Service and Forest Service

³⁶ Wickman, B.E.; Hall, R.C. Oct. 27, 1953. Mountain pine beetle Conness Basin, Yosemite National Park, August 1953 appraisal survey. Berkeley, CA: U.S. Department of Agriculture, Bureau of Entomology and Plant Quarantine, Division of Forest Insect Investigations, Forest Insect Laboratory. 4 p. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

³⁷ Keen, F.P. 1932. Letters dated May and June to F.C. Craighead. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

crews cleaned up the infestation around Mount Scott, but the virulent outbreak in the Sun Pass basin continued and no control work was being carried out there in 1932. Craighead closed the June correspondence³⁸ by saying,

I was somewhat surprised at your remarks concerning the Sun Pass infestation. I did not realize that it was so virulent. I too feel that conditions reported within the Park control areas are clearly due to the effects of control. If there was some way to estimate bugs rather than trees the effect of the work already done would be much more pronounced than it is on a tree basis when partially infested trees have to be treated.

On November 12, 1932, Keen sent Craighead a copy of his report on the 1932 activities. In the transmittal letter Keen said, "There was nothing much to report about this situation this year except the good news that the beetles have finally been brought under control, and nothing more is needed except a small yearly maintenance program until stable conditions have been definitely restored."³⁹

Keen reported 20,311 trees treated at a cost of \$17,357. On the old control units, the reduction in infested trees from 1931 to 1932 was 74 percent.⁴⁰ In the report Keen stated, "The goal of the mountain pine beetle control campaign in Crater Lake National Park has finally been reached with the completion of the work of this year. All of the aggressive infestation in and adjacent to the southern half of the Park has been disposed of, and the fall cruises show that there are no longer any active centers in this entire area." He warned that beetles might still invade the park from the Sun Pass area, but his final recommendation was for the Park Service to treat about 5,000 trees in the old control units and the Forest Service to treat 22,000 trees in the Sun Pass area. He called the Park Service work "maintenance control" and thought it would be necessary for only a few seasons (see footnote 40). A report by Frank Solinsky, in charge of control work for the Park Service, referred to the deep snow pack that persisted well into June, thereby slowing control work. He also noted a week or more of cold snowy weather in mid-July that slowed the work further. And he commented favorably on the new development of oil burning infested trees in shady areas where the solar method was not effective. He stated that over 100 men were employed in the bug camps that year by the Park Service.⁴¹

³⁸ Craighead, F.C. 1932. Letter dated June 28 to F.P. Keen. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

³⁹ Keen, F.P. 1932. Letter dated Nov. 12 to F.C. Craighead. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

⁴⁰ Keen, F.P. Nov. 15, 1932. Report of the mountain pine beetle situation in Crater Lake National Park and adjacent National Forest lands, season 1932. Portland, OR: U.S. Bureau of Entomology. 6 p. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

⁴¹ Solinsky, Frank J., III. Oct. 15, 1932. Report on the insect control project, spring 1932. U.S. Department of the Interior, National Park Service, Crater Lake National Park. 9 p. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

Craighead closed the year with these comments in a November 29, 1932, letter to Keen:⁴²

Your report of the present status of the Crater Lake control project transmitted with your letter of November 12 is most encouraging. It finally looks as though we have got the upper hand of this job. Indications are that nothing further will be necessary for the next few years except some maintenance work, provided the Sun Pass infestation on the National Forest does not get out of hand. Obviously it is a toss-up whether or not this will spread into the Park. I am afraid that when the infestation reaches a certain degree of intensity it is going to serve as a source of reinfestation of the park land. This danger will necessitate annual surveys of the Park timber for the next few years and some action will have to be recommended if there is an obvious reinfestation of the cleaned area.

I believe that the work in the past two years on this project shows quite definitely that this beetle can be controlled when funds are available for thorough work and where flight from the outside is not a factor. I can not help but feel from the experience of the past few years that thorough initial work is the key to the success of many of these beetle control projects and in different work, although not intentionally so, is the explanation for some of the poorer results which have been so disconcerting.

The "maintenance" control work in 1933 marked the first use of Civilian Conservation Corps (CCC) crews in insect control in the park. The men arrived from the east just as control work was to begin, and eventually 200 young men were treating trees. Even though they lacked experience using tools and working in the woods, they were given high praise by Frank Solinsky for their eagerness to learn and willingness to work hard to prove themselves.⁴³ The Park Service treated 7,026 trees that season in the old units. Most of the trees were killed by mountain pine beetle, but over 100 trees were mountain hemlock (*Tsuga mertensiana* (Bong.) Carr.) and white fir (*Abies concolor* (Gord. & Glend.) Lindl. ex Hildebr.) killed by other insects (see footnote 43). Solinsky also noted that the Sun Pass infestation was not treated for the second year in a row because of a lack of funds. He also noted that very cold temperatures during the winter 1932-33 caused mountain pine beetle brood mortality in the park and at Sun Pass. Temperatures recorded at the park were -14°F in December and -16°F in February—enough to kill at least some insects under the thin-barked lodgepole pine. Solinsky thought that only 1,000 trees would need treating in 1934 (see footnote 43).

⁴² Craighead, F.C. 1932. Letter dated Nov. 29 to F.P. Keen. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

⁴³ Solinsky, Frank J., III. Aug. 1, 1933. Report on the insect control project, spring 1933, Crater Lake National Park. U.S. Department of the Interior, National Park Service, Crater Lake National Park. 12 p. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

Correspondence for 1933 indicates that neither Keen nor Buckhorn participated in the control work that spring. They were evidently busy moving their office and laboratory in Portland, OR, and doing research on western pine beetle in other areas. Patterson also rejoined the Bureau of Entomology that summer and was put in charge of CCC insect control for the Stanislaus National Forest in California. He promptly got Frank Solinsky a job at the Stanislaus for the remainder of that season as a bug spotter.⁴⁴ The end of the season found Keen and Craighead visiting the park and finding very few infested trees. They noted that perhaps the CCC crews could treat the Sun Pass area and finally end that threat to the Park.⁴⁵

By 1934, only 21 lodgepole pine infested with mountain pine beetle were treated. The battle was finally over. A survey of the old control areas in the park by Buckhorn in October 1934 found less than 500 infested trees, and over half of these did not have enough brood to justify treatment. He recommended that no control be undertaken in 1935 against mountain pine beetle except in recreation centers.⁴⁶ Buckhorn did report that the Sun Pass infestation, though reduced by winter kill of beetle broods in 1932-33, had rebounded in 1934. That spring the Forest Service treated nearly 6,000 trees by using CCC crews. Buckhorn recommended that the estimated 2,000 trees infested in fall 1934 be treated in 1935 to stamp out this infestation (see footnote 46).

The Aftermath

Hindsight is often 20/20, but it is hard not to give the beetles credit for defeating the puny efforts of the entomologists to stop the infestation. The outbreak covered a large area in and around the park, and most of the lodgepole pine stands in this area were at a susceptible age for attack. The control efforts may have delayed the killing of large old trees in high-use recreation areas, but one by one or two by two, most of them also fell victim either during the 8 years of the battle or in ensuing years. The main lesson learned was that once a mountain pine beetle population erupts over a large area of susceptible forest type, and as long as environmental conditions remain favorable, there really is no way to stop it until almost all the susceptible trees are either killed or removed by logging. Killing beetles by treating trees with the solar method or piling and burning perhaps slows the progress of the outbreak, but the outcome is inevitable. Perhaps the cold winter in 1932-33 helped, but most importantly, the depletion of susceptible trees ended the outbreak rather than the annual control efforts for 10 years. And, as Keen himself so perceptively noted (see footnote 18), the lodgepole pine were but one step in the forest successional process on much of the area.

⁴⁴ Solinsky, Frank J., III. 1933. Letters dated July and August to F.P. Keen. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

⁴⁵ Keen, F.P. 1933. Letter dated Aug. 9 to Solinsky. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

⁴⁶ Buckhorn, W.J. Jan. 15, 1935. Report of forest insect conditions in Crater Lake National Park and adjacent areas of Rogue River National Forest, season 1934. Portland, OR: Forest Insect Laboratory. 7 p. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

This lesson unfortunately was not learned at Crater Lake until very recently. In 1946, the mountain pine beetle populations again appeared to be erupting in Pinnacles Valley, Crater Lake National Park. A report by R.L. Furniss, entomologist, Bureau of Entomology Laboratory, Portland, OR, recommended control in 1947 by using the solar-heat method and a new insecticide, Orthodichlorobenzene,⁴⁷ mixed with fuel oil and applied to the infested trees.⁴⁸ In 1947, Patterson was again placed in charge of the control project, and he reported 1,022 trees treated in the old control units of 1929-33. He recommended that an estimated 130 infested lodgepole be treated in 1948.⁴⁹ Only 134 trees needed treating in 1948, and that was apparently the end of the outbreak.⁵⁰ In 1959, a small center of infestation containing several hundred trees along Bear Creek was treated by Park Service crews. By fall 1960, Buckhorn reported control work in the Pinnacles Valley and Bear Creek drainages from September 2 through November 10, 1960, resulted in the treatment of 2,113 trees.⁵¹ This apparently was the end of that outbreak for there are no other references in the files.

All remained quiet until 1984, when lodgepole pine stands in central Oregon were once again ravaged by the mountain pine beetle. By 1985 a severe outbreak covered thousands of acres and extended south nearly to the park boundary. In 1986, beetle-killed trees were found in the northern end of the park. In August 1987, I visited Pinnacles Valley with Jim Milestone of the Park Service and Forest Service entomologist Russ Mitchell. We found groups of lodgepole pine being attacked by the mountain pine beetle, so we have come full circle with a new outbreak in progress.

⁴⁷ The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U.S. Department of Agriculture of any product or service to the exclusion of others that may be suitable.

⁴⁸ Furniss, R.L. Aug. 28, 1946. Forest insect situation in Crater Lake National Park, August 1946. Portland, OR: Forest Insect Laboratory. 5 p. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

⁴⁹ Patterson, John E. Jan. 31, 1948. Mountain pine beetle control project Crater Lake National Park, Oregon, season of 1947. Berkeley, CA: U.S. Department of Agriculture, Bureau of Entomology and Plant Quarantine, Forest Insect Investigations, Forest Insect Laboratory. 14 p. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

⁵⁰ Stevens, Robert E. July 30, 1948. Report of an insect control project in Crater Lake National Park carried on from June 2, 1948, through June 30, 1948. U.S. Department of the Interior, National Park Service, Crater Lake National Park, Oregon. 2 p.

Patterson, J.E. 1948. Memorandum dated Aug. 20 to F.P. Keen. Both on file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

⁵¹ Buckhorn, W.J. Mar. 1961. Forest insect conditions—Crater Lake National Park, 1960. Portland, OR: Pacific Northwest Forest and Range Experiment Station, Division of Forest Insect Research. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.

This story can be best ended with the following ditty by an anonymous author:⁵²

The Song of a Park Ranger

The bugs they're killing the timber

They've worked for many a year,

But the Entomologists come and prophecy

That they'll quickly disappear.

Chorus: Oh! they ain't gwine fly no more, no more,

They ain't gwine fly no more

But how in the -- can the bug men tell

They ain't gwine fly no more.

The crews are cutting the timber

The crews are peeling the bark,

The bug men say the beetles they'll slay

And clean them from the Park,

Chorus:

And now the work is finished

The barkbeetles all are gone.

The Park is free for a century,

Unless the bug men are wrong.

Chorus:

⁵² Anonymous. Western Division newsletter, Forest Insect Investigations, Bureau of Entomology, Stanford University, Calif. Jan. 1, 1925. 10 p. On file with: Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850.