Inv-2173

INTERSTATE COMMERCE COMMISSION

WASHINGTON

REPORT OF THE DIRECTOR

BUREAU OF SAFETY

ACCIDENT ON THE

MISSOURI PACIFIC RAILROAD

NASHVILLE, ARK.

May 18, 1937

INVESTIGATION NO. 2173

SUMMARY

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Railroad:	Missouri Pacific
Date:	May 18, 1937
Location:	Nashville, Ark.
Kind of accident:	Derailment
Train involved:	Light engine
Engine number:	1242
Speed:	3-6 m.p.h.
Track:	Tangent; level.
Time:	5:12 a.m.
Weather:	Clear
Casualties:	2 killed; 1 injured.
Cause:	Wooden bridge collapsed.

Inv-2173

July 2, 1937.

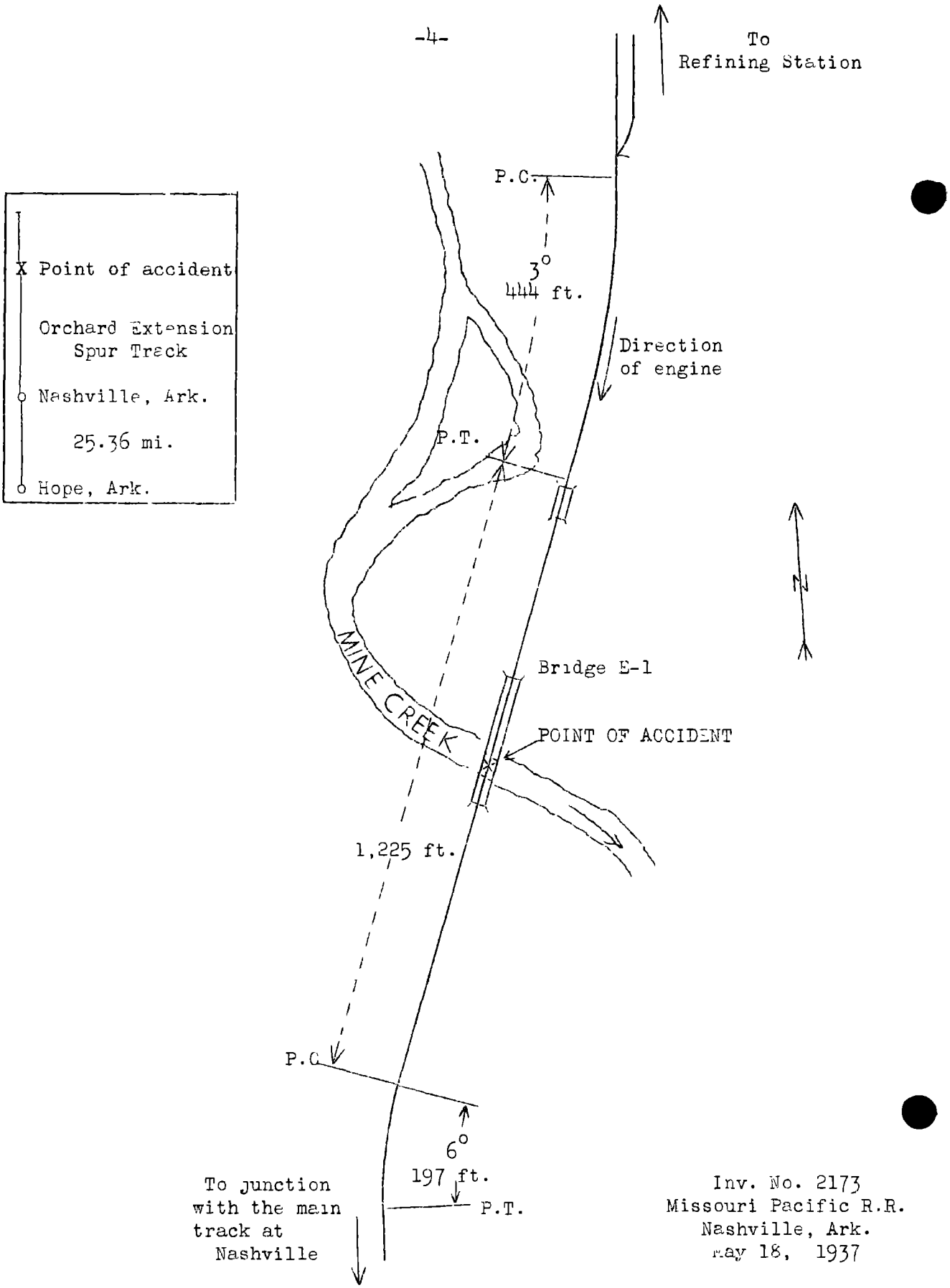
To the Commission:

On May 18, 1937, there was a derailment of a light engine on the Missouri Pacific Railroad at Nashville, Ark., which resulted in the death of 2 employees and the injury of 1 employee.

Location and Method of Operation

This accident occurred on the Nashville District of the Arkansas Division, extending between Hope and Nashville, Ark., a distance of 25.36 miles. In the vicinity of the point of accident this is a single-track line over which trains are operated by timetable and train orders, no block-signal system being in use. The accident occurred within the city limits of Nashville on a spur track known as the Peach Orchard Extension, at bridge E-1, which spans Mine Creek; the track is tangent for several hundred feet on each side of the bridge, and descends from each direction toward the bridge, but is level across the bridge.

Bridge E-1 was a wooden trestle 125 feet in length, with a maximum height of about 13 feet from the base of the rail to the normal water line. It consisted, from north to south, of a 5-panel untreated timber trestle approach, a 30' second-hand skewed I-beam steel-girder span, with each end resting on an untreated pile pier, over the water, and a 2-panel untreated timber trestle approach. The pile pier at the south end was designated No. 1, and that at the north end No. 2. The steel-girder span consisted of six, 24-inch, 80-pound I-beams, weighing 18,000 pounds. Each pile pier consisted of eight, 20-foot oak piles, 14" in diameter at the butt and 10" in diameter at the tip, arranged in two rows of four each, driven to rock and topped by two 14"x 14" x 14' caps, four 12" x 12" x 5' subcaps, and one 12" x 12" x 14' subcap, and was strengthened by two 3" x 10" x 20' cross braces and two 3" x 10" x 18' sway braces, all untreated timber. All bolts were of 3/4" diameter. These piers were set at an angle of 64° with the center line of the track. The bridge was constructed during the fall and spring of 1927-1928 and was designed to carry safely four engine driving-wheel axle-loads of 50,000 pounds each, with engine wheel centers spaced 5 feet apart. In 1936 the piles in the trestle approaches at each end were cut off at, or slightly below, the ground line and replaced with 4-post frame bents, not strutted, with caps, posts and sills of 14" x 14" treated timber. Mine Creek, which



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handles the overflow from the city water supply, is approximately 40 feet in width and normally about 3 feet in depth; the water is not treated with any chemical injurious to piling. Under the bridge the water flows from west to east at a rate of about 2 or 3 miles per hour and there was no evidence of bank washing, scouring or filling at that point. The last heavy rain occurred about 4 weeks prior to the accident.

The track is laid with 56-pound rail, 30 feet in length, laid second-hand in 1927, with 16 ties to the rail length, single-spiked, and adjacent to the bridge is ballasted with about 4 inches of rock on a cementing gravel subgrade.

Engine 1242, the engine involved, is of the Mikado or 2-8-2 type, with a total engine weight, loaded, of 279,300 pounds, distributed on the axles as follows: engine truck, 26,700 pounds; each pair of drivers, 52,700 pounds; trailer truck, 41,800 pounds. The driving-wheel centers were spaced 5 feet 6 inches apart; the driving wheel-base was 16 feet 6 inches, and the total wheel base of the engine was 34 feet 9 inches. The total wheel-base of the tender was 21 feet 4 inches. The overall length of the engine and tender combined was 76 feet 3 inches. The tender had a loaded weight of approximately 159,000 pounds.

The weather was clear and it was daylight at the time of the accident, which occurred about 5:12 a.m.

Description

North-bound Train No. 850, hauled by engine 1242 and in charge of Conductor McCuller and Engineman Moseley, arrived at Nashville, its terminal, at 4:15 a.m., and while engaged in completing yard work at that point, engine 1242 moved northward over bridge E-1, with a car of gasoline, to be placed at a refining station located some distance north of the bridge. During the return movement bridge E-1 collapsed under engine 1242 which was backing up light at a speed of from 3 to 6 miles per hour.

Engine 1242 and its tender fell over on their right sides with the forward portion of the engine in the water, but with the tender on the south bank of the creek. The front end of the engine was 46 feet 6 inches north of the south end of the bridge. The two pile piers supporting the steel girder span and the two bents under the south approach broke and fell toward the south, in the direction the engine was moving, and the debris

of the entire structure south of and including the north pile pier was also moved in that direction. The piling broke close to the water line. The decking, stringers, ties and track which were almost intact declined slightly toward the southeast corner of the bridge. The employees killed were the engineman and fireman, and the employee injured was a brakeman.

Summary of evidence

Brakeman Burleson stated that he rode the left front footboard on the northward trip over the bridge and did not notice any unusual condition or movement of the engine on the bridge. On the return trip the engine was backing up at a speed of about 3 to 6 miles per hour and he was riding on the footboard of the tender. When the tender was close to the south end of the bridge he heard the bridge timbers crack and give way, apparently under the front end of the engine. He did not think that the engine had been derailed and had not been aware of any application of the brakes while they were on the bridge; however, he thought the engine was working steam as the drivers were still revolving when the engine stopped in the bed of the creek.

Brakeman Martin stated that he did not notice anything unusual about the movement of the engine over the bridge on the northward movement. On the return trip he was riding on the pilot step and had reached a point about midway of the bridge when he heard a cracking sound and he was precipitated into the water of the creek. He was unable to state exactly from what point this sound emanated but thought it was close to him. He did not notice any application of the brakes while the engine was on the bridge. Both Brakeman Burleson and Brakeman Martin stated that operation over this spur track is the same as within yard limits or on a side track, and neither knew of any restrictions concerning the class of engine that could be used on this bridge. Conductor McCuller and Head Brakeman Kerr were working at the depot and they were not aware of the accident until informed by Brakeman Burleson.

Section Foreman Dooley, in charge of the territory known as Peach Orchard spur, stated that it is his duty to make weekly visual inspections of bridges on his section. He inspected bridge E-1 about 3:30 p.m., Saturday, May 15, but found nothing to indicate any dangerous condition. After the accident he inspected the top of the bridge, but found no wheel marks of derailment. He also looked at the broken piling, and noticed that the usual sap rotting of untreated piling had taken

place. He had made casual mention to the bridge inspector about the age of the bridge, but had never made any formal report concerning it.

Bridge Inspector Pascoe stated that his last three inspections of bridge E-1 were made on August 6, 1936; January 12, 1937; and February 25, 1937. On the last occasion he inspected both pile piers, using the sharp end of his inspection bar to determine the cross-sectional area of sound timber in the piling, and was satisfied that the bridge was in safe condition. He estimated that a wooden pile having a 6 inch solid core would be safe to hold the weight for which the bridge was designed, and in an examination of the broken piling after the accident he found a good solid heart in each one. He also inspected the caps and girders lying on the ground and all appeared to be in good condition. In his opinion the piling failed as a result of an end-thrust delivered from north to south, but could not explain in what manner a light engine going over the bridge could deliver such a thrust.

Bridge Foreman McKamey stated that the last time he inspected bridge E-1 was in May, 1936, at which time he installed frame bents. He examined the piling in the piers under each end of the steel span from girder to ground, using an inspection bar, but found nothing wrong with it and considered it good for 3 or 4 years. There was some sap decay above the water line. After the accident he examined the piling taken out of the bridge, but he did not think that it was badly decayed. The sawed off ends of the piling showed the heart to be what is commonly termed doughty or brash wood, but he thought it to be solid enough to stand the load to which the bridge would ordinarily be subjected. The stringers and caps appeared to be good sound timber and safe for the bridge. In his opinion the bridge first gave way on the north end of the steel span, not due to the load imposed upon it but because something had hit the piling.

Bridge and Building Supervisor Best stated that he made a detailed inspection of bridge E-1 during 1936, using an inspection bar for the purpose. As a result of this inspection the work listed to be done in 1937 was "paint girders, renew cap 3 and 4, (located at the south end of the steel girders) and strut," but for reasons unknown to him these items which constituted desirable improvements but were not vital to the safety of the bridge, were dropped from the 1937 program. After the accident he examined the timbers and the piles that were sawed off and noted that there was a lot of hard wood in the piles;

the heart under the sap was still good material although brittle, and in his judgment would have passed inspection with a bar as to sound and feel if still standing. In his opinion the sound heart remaining in the piles was of sufficient strength to carry a 1200-class engine and withstand the thrust of any ordinary movement of an engine of this kind at a reasonable speed provided there was no extraordinary application of the brakes, or stoppage of engine, and he felt that a brake application at 5 or 6 miles per hour should not harm the bridge. He did not see any evidence of abnormal strain or vertical thrust such as would be caused by an engine with bad flat spots or a wheel improperly balanced. There was no indication of engine derailment on the bridge ties or any marks of dragging equipment. He also expressed the opinion that the piling did not break from a downward load but rather from some force which caused the bridge to have end movement; however, there was no evidence that the bridge had been struck and he was unable to say what had caused its collapse. Brash wood is brittle and easily broken and is a condition not detectable by ordinary methods of inspection. There was no speed restriction on the bridge and he did not think any was necessary.

Bridge Engineer Bates stated that the two pile piers were original construction and consisted of eight piles each. After the accident 13 piles were found and in addition 4 split sections of piles which could not be matched up. The length of the broken-off portions of the 13 piles varied from 6'4" to 8', and due to decay at the water line the diameter of two piles was reduced to 7 inches, one to 8 inches, four to 9 inches and the remaining six were 10 inches or more. The depth of decay varied from $\frac{1}{2}$" to $2\frac{1}{2}$". For the purpose of examination, three piles were cut off below the water line; the downstream batter-pile in the south bent of the north pier showed 10" of solid timber and the upstream batter-pile of the north bent in the north pier showed sound timber 9" in diameter. One pile was split for its full length and showed evidence of heart decay. There was no evidence of attack by insects. The maximum live load concentration on one pier from engine and tender was 86 tons, or equivalent to slightly less than 11 tons per pile. Dead load or weight of structure per pier is about 10 tons, which is equivalent to slightly more than 1 ton per pile, which makes a vertical load of 12 tons per pile. The unit stress is approximately 320 pounds per square inch. New oak timber has a crushing strength of from 3,000 to 4,000 pounds per square inch and there was therefore an ample margin of strength in the remaining sound timber. The caps on each bent of each pier were sound and the individual piles showed no evidence of crushing. The drift bolts, connecting the caps to the piles, were bent as if the cap was forced off the pile in a horizontal direction. The

cross caps immediately above the bent caps were sound and were not broken when the bridge collapsed. The ties, guide timber and stringers were sound and showed no evidence of decay other than a small amount of sap rot at the corners of the individual members, and their strength was in no way impaired. The frame bents in the trestle approach are of recent construction and in good condition. The original piles had been cut off below the ground line and were not examined but there was no evidence of settlement or displacement of the frame bents in the north approach; the south approach was destroyed but its timbers showed no evidence of decay. The nature of the break did not indicate that the collapse was due to the crushing effect of the load imposed on the bridge, but there was evidence that it resulted from the application of a heavy longitudinal force. He said it was possible that an application of the brakes sufficient to lock the driving wheels, would provide a longitudinal force of considerable magnitude, but that while an ordinary service application would produce some longitudinal force it would hardly be sufficient to be a factor in the collapse of the bridge.

Master Mechanic Hanna examined engine 1242 as it lay on its side. There was no indication of slid flat spots on the tires; he could not state whether the brakes had been applied. While he could not state positively that revolution of the wheels after the accident was impossible, there were no marks on the bridge timbers or ties under the driving wheels which would indicate that such was the case. The pipes to the distributing valve were broken and the valve damaged. When the engine was lifted the driving boxes came down on the binders and there was no indication of stuck wedges, or any other condition that would have caused or contributed to the accident. There was nothing to indicate that the engine had been derailed prior to the collapse of the bridge,

At the request of District Claim Agent Davison of the Missouri Pacific Railroad Co., Mr. C. E. Baxter, forester for the Long Bell Lumber Co., Sheridan, Ark., inspected the 13 pieces of broken piling and reported entire stick decay in 3 piles, total decay near the water line in 4 piles, and 30 to 50 percent of normal strength near the water line for the balance. With reference to his tabulated report concerning the condition of the piling he made the following written statement, "After inspecting this I feel sure no further comments will be necessary."

An inspection of the locomotive and the collapsed bridge was made by inspectors for the Commission; nothing was found about the condition of the locomotive that would have had any bearing on the accident. Except for the piling in the two pile piers all bridge timbers appeared solid and in good condition although one of the pier caps was split from end to end and the securing bolts were bent in such manner as to suggest that the cap had been rolled off the top of the piling. Only 13 of the 16 piles which constituted the two pile piers could be matched up; the hearts of some of these piles seemed to be in fairly good condition although they were water soaked and pitted with small white specks referred to during the investigation as "brash wood," which appeared to be the result of parasitic attack. The dimensions at the water line and the amount of sap rot indicated that some of the piles were fast deteriorating.

Discussion

The evidence shows that bridge E-1 was designed and originally constructed to carry weights equivalent to that of engine 1242. The bridge department employees of the railroad company were unanimous in stating that the bridge did not collapse as a result of a crushing force, but rather from the effects of a longitudinal thrust of unknown origin. They expressed the opinion that although the piling in the piers supporting the main span was somewhat decayed it still retained sufficient sound core-wood to provide a safe structure for weights in keeping with those for which the bridge was originally designed. The report of the forester of the Long Bell Lumber Co., however, does not support this latter opinion for it shows total decay at the water line in almost half of the piles constituting the main span piers, and 50 percent or less of normal strength in the balance.

The position taken by the debris during the collapse of the bridge is evidence of the truth of the statement that the piling were snapped off by a longitudinal thrust, but taking into consideration the weakened condition of the bridge caused by the decay in the piling the source of the impact which caused this thrust seems to be rather clearly indicated.

In moving upon the level floor of the bridge from the north the locomotive, weighing 279,300 pounds, passes from an 0.51 percent descending grade, and the impingment of this weight upon the north end of the bridge would constitute considerable urge to southward movement of the entire structure. Added to this is the fact that the absence of struts or "X" braces between the pile piers and the bents of the approaches and between the

individual bents of the approaches resulted in a deficiency of resistance to longitudinal movement, and it appears reasonable to assume that the movement of engine 1242 upon the bridge caused a sufficient end thrust to accomplish the collapse of the bridge. The evidence is conclusive that there was no derailment prior to the destruction of the bridge.

Conclusion

This accident was caused by the collapse of a wooden bridge due to a decayed condition of the piling constituting the main piers.

Respectfully submitted,

W. J. PATTERSON,

Director.