

Inv-2423

INTERSTATE COMMERCE COMMISSION
WASHINGTON

REPORT OF THE DIRECTOR
BUREAU OF SAFETY

ACCIDENT ON THE
NEW YORK CENTRAL RAILROAD

LITTLE FALLS, N. Y.

APRIL 19, 1940

INVESTIGATION NO. 2423

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SUMMARY

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Railroad:	New York Central
Date:	April 19, 1940
Location:	Little Falls, N.Y.
Kind of accident:	Derailment
Train involved:	Passenger
Train number:	19
Engine number:	5315
Consist:	15 cars
Speed:	59 m.p.h.
Operation:	Automatic block-signal and automatic train-stop system
Track:	Four; 7°24' curve; ascending grade westward
Time:	11:33 p.m.
Weather:	Cloudy
Casualties:	31 killed; 51 injured
Cause:	Excessive speed on sharp curve combined with a run-in of slack resulting from throttle being closed suddenly

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June 5, 1940

To the Commission:

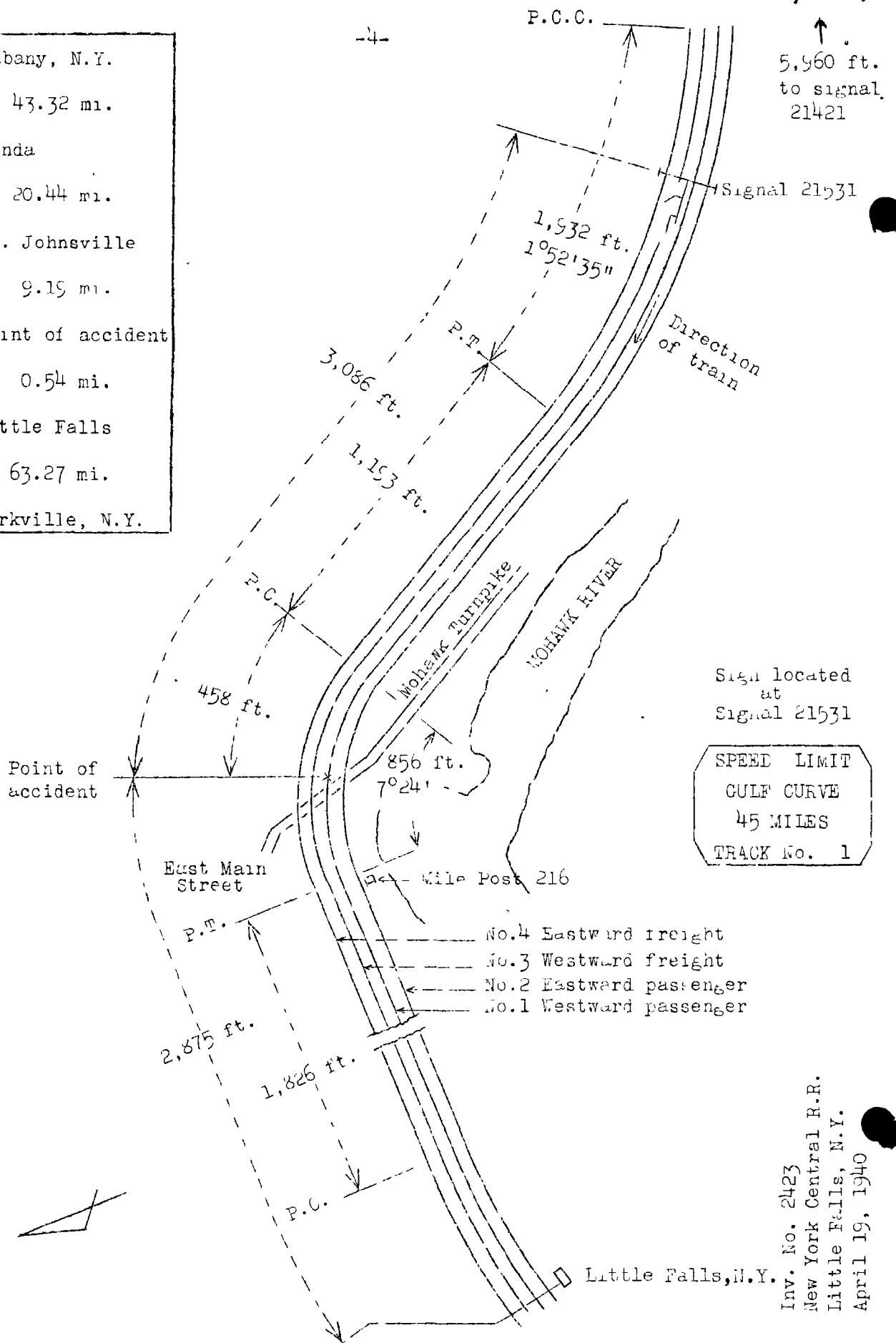
On April 19, 1940, there was a derailment of a passenger train on the New York Central Railroad at Little Falls, N.Y., which resulted in the death of 26 passengers, 2 Pullman porters, 1 train porter, and 2 train-service employees, and the injury of 47 passengers, 1 Pullman porter, 2 dining-car employees, and 1 employee on duty. This accident was investigated in conjunction with the New York State Public Service Commission.

Location and Method of Operation

This accident occurred on the Mohawk Division which extends between Albany and Kirkville, N.Y., a distance of 136.76 miles. In the vicinity of the point of accident this is a four-track line over which trains are operated with the current of traffic by an automatic block-signal and automatic train-stop system; signal indications supersede time-table superiority. The main tracks from south to north are: No. 2, eastward passenger; No. 1, westward passenger; No. 3, westward freight; No. 4, eastward freight. The accident occurred on track No. 1 at a point 2,875 feet east of the station at Little Falls. Approaching this point from the east on track No. 1 there is a series of curves and tangents followed, in succession, by a compound curve to the right 1,932 feet in length having a maximum curvature of 1°52'35", a tangent 1,193 feet in length and a 7°24' curve to the left 856 feet in length. The derailment occurred on this latter curve, known as Gulf Curve, at a point 458 feet from its eastern end. The grade varies between 0.26 and 0.50 percent ascending westward a distance of 8,600 feet, and following this gradient there is a vertical curve a distance of 200 feet to the point of accident and 200 feet beyond.

In the vicinity of the point of accident the tracks are laid on a side-hill cut and parallel generally the north shore of the Mohawk River; the rails of track No. 1 are approximately 48 feet above the river. At the north a rock cliff parallels the tracks a considerable distance, and at the east end of Gulf Curve the cliff is broken by a valley extending northward. Bridge No. 456, on which are laid the four main tracks, is located about 550 feet west of the east end of Gulf Curve, is 37 feet 9 inches in length, of girder construction, and provides an underpass for Mohawk Turnpike. Mohawk Turnpike extends under the tracks at a depth of 16 feet and at an angle of about

o Albany, N.Y.
43.32 mi.
o Fonda
20.44 mi.
o St. Johnsville
9.19 mi.
X Point of accident
0.54 mi.
o Little Falls
63.27 mi.
o Kirkville, N.Y.



Sign located
at
Signal 21531

SPEED LIMIT
GULF CURVE
45 MILES
TRACK No. 1

- No. 4 Eastward freight
- No. 3 Westward freight
- No. 2 Eastward passenger
- No. 1 Westward passenger

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Little Falls, N.Y.
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30 degrees; immediately north of the tracks it turns westward, parallels the tracks, and is designated as East Main Street. At a point 304 feet west of the point of accident the grade of East Main Street rises to a level with the rails in track No. 1. A rock pinnacle rises abruptly to a height of 14.57 feet between track No. 4 and East Main Street at a point about 396 feet west of the point of accident.

The track structure consists of 127-pound rail, 39 feet in length, laid on an average of 24 treated oak ties to the rail length; it is fully tie-plated with double-shoulder canted tie-plates spiked with two rail spikes and two lag spikes per plate, and is provided with eight rail anchors and five gage rods per rail length; it is equipped with 6-hole toeless angle bars 36 inches in length, is laid on 20 inches of crushed rock ballast, and is well maintained. The rail was laid new in June 1939, and was spaced in August 1939. The superelevation of track No. 1 at the point of accident was 8 inches. The north rail of the spiral at the east end of the curve rose from level to a superelevation of 8 inches in a distance of about 200 feet. The gage varied between 4 feet 8-7/16 inches and 4 feet 8-9/16 inches.

Automatic signals 21421 and 21531, which govern westward movements on track No. 1, are located 9,046 and 3,086 feet, respectively, east of the point of accident. Signal 21421 is a 2-unit, color-light, searchlight signal; signal 21531 is a 2-unit, upper-quadrant, semaphore signal; both signals are approach lighted. The most favorable indication displayed by these signals is in accordance with Rule 281A, which provides:

Night Aspect	Indication
Green-over-yellow (Staggered)	Proceed Approaching Second Signal At Medium Speed

Because of this indication, an engineman must operate the forestalling device in order to prevent automatic train-stop brake applications at these signal locations.

Medium speed is defined as: A speed not exceeding thirty miles per hour.

The automatic train-stop system is of the intermittent-inductive type and engines are equipped with forestalling devices. When a brake application is forestalled by an engineman, the train may proceed under his control in accordance with operating rules.

Rules for enginemen and firemen for the operation of intermittent-inductive automatic train-stop read in whole or in part as follows:

Rule 6. Enginemen must not forestall until after signal indication has been observed and is being obeyed.

Rule 7. Enginemen, after complying with Rule 6 may forestall at an inductor, to avoid the automatic stop brake application--

(a) When running forward with current of traffic at signal which displays indication other than "Proceed" or "Proceed at Medium Speed."

* * *

Rule D-251, of the operating rules, reads as follows:

D-251. On portions of the road so specified on the timetable, trains will run with the current of traffic by block signals whose indications will supersede timetable superiority.

Time-table special instruction D-251 reads in part as follows:

D-251. MOVEMENT OF TRAINS WITH THE CURRENT OF TRAFFIC ON TWO OR MORE TRACKS BY BLOCK SIGNALS.

Between Croton-on-Hudson and Kirkville.

* * *

The maximum authorized speed on track No. 1 in the vicinity of the point of accident is 45 miles per hour. A speed board bearing the words, "SPEED LIMIT, GULF CURVE, 45 MILES, TRACK NO. 1," is installed on the south bent of the signal bridge located 3,086 feet east of the point of accident; it is attached to the bridge 10.33 feet higher than the rails and is lettered in black on a yellow background.

A flange lubricator is located on the north rail of track No. 1 at a point 134 feet east of the east end of Gulf Curve.

Mile Post 216 is located 396 feet west of the point of accident.

The weather was cloudy at the time of the accident, which occurred about 11:33 p.m.

Description

No. 19, a first-class west-bound passenger train, with Conductor Grattan and Engineman Earl in charge, and with Road Foreman of Engines Bayreuther also on the engine, consisted of engine 5315, of the 4-6-4 type, one express car, one baggage car, two coaches, four Pullman sleeping cars, one dining car, five Pullman sleeping cars, and one coach, in the order named; all cars were of steel construction. This train departed from Albany, 73.49 miles east of Little Falls, at 10:09 p.m., according to the train sheet, 21 minutes late, passed Fonda, the last place where time is shown, 30.17 miles east of Little Falls, at 11:07 p.m., 23 minutes late, passed St. Johnsville, 9.73 miles east of Little Falls, at 11:25 p.m., and while moving at a speed of 59 miles per hour, as indicated by the speed-recorder tape with which engine 5315 was equipped, became derailed on Gulf Curve.

After becoming derailed, engine 5315 continued a distance of 396 feet diagonally across tracks Nos. 3 and 4 and stopped on its right side against the pinnacle of rock which rises between track No. 4 and East Main Street. The engine stopped with the front end of the smokebox on track No. 4 and the rear end of the boiler suspended on top of the rock pinnacle; the boiler lay at an angle of about 30 degrees to the line of track and the rear end was about 15 feet above the rails. Rock penetrated the firebox wrapper sheet just in front of the backhead, and the crown sheet and the right side-sheet were torn loose and the grate-bars were blown out as a result of an explosion which followed. The right injector, the right boiler-check, and the safety valves were knocked off. The engine truck was torn loose from the engine and stopped on track No. 3 about 5 feet ahead of the engine. The engine frame was broken on the right and left sides through the top and bottom rails between driving boxes Nos. 1 and 2; the frame, with the Nos. 2 and 3 pairs of driving wheels in place, jack-knifed, and the No. 3 pair of driving wheels stopped ahead of the No. 1 pair of driving wheels. The main and the parallel rods on both sides were badly twisted. The throttle lever and its quadrant were distorted badly; the throttle extension-rod to the front-end throttle-box was broken off. The tender, remaining coupled, stopped on its right side, at an angle of 105 degrees from upright, on top of the rock pinnacle; both trucks were torn loose; the rear coupler was broken off. The first car, N. Y. C. express car 3476, became derailed, stopped upside down and parallel to the engine, and fouled tracks Nos. 3 and 4; the superstructure was demolished, the front coupler broken off, the rear coupler shank bent, and both

pairs of wheels from the rear truck were detached and lying 15 feet southeast of the rear end of the car; the truck frame was lodged on the roof of the third car. The second car, N. Y. C. baggage car 8120, became uncoupled at both ends and stopped, upright, on track No. 1 at a point 285 feet west of the front end of the engine; the front truck was derailed; the front and the rear coupler shanks were bent; the right side-sheet and the left front corner-post were damaged. The third car, N. Y. C. coach 2419, became derailed and stopped on its right side diagonally across tracks Nos. 3 and 4; the roof was bent and torn, and the frame distorted; the end frames and vestibules were demolished, and all side sheets bent and twisted; both couplers were torn out. The fourth car, N. Y. C. coach 2337, became derailed and stopped, in East Main Street, on its right side with its front end against the tender; it was badly damaged; both trucks were torn loose, and the rear coupler was missing. The fifth car, Pullman Red Ash, became derailed and stopped upright in line with track No. 1 and about 80 feet ahead of the engine; the roof was torn off almost its entire length, the right side-sheets were torn away about two-thirds its length, and the interior was destroyed; both trucks were badly damaged and the front coupler-head was broken. The sixth car, Pullman Poplar Arch, became derailed and stopped on its right side diagonally across tracks Nos. 1, 3, and 4; half of the roof was sheared off, the steel center-sills were broken at the front body end-sill, the front end-frame and sheets were bent and torn, and both sides were badly bent and buckled; both couplers were missing; both trucks were torn loose and stopped between tracks Nos. 1 and 3. The seventh car, Pullman Elkhart Valley, was derailed and stopped on its right side diagonally across track No. 4, parallel to the body of the fourth car and on top of the trucks of the fourth car; the front end of the seventh car crushed into the side of the first car; both trucks were in place but the wheels of the front truck were about 15 feet distant from the front end of the car; the superstructure at the front end was demolished and the front coupler-head was broken; the superstructure at the rear end was twisted and bent, the body end-sill and the left side-sill were broken, and the side sheets on the right side were torn, bent, and buckled the entire length of the car. The eighth car, Pullman Poplar Dome, was derailed, stopped diagonally across tracks Nos. 1, 3, and 4, and leaned at an angle of 45 degrees to the north; the front truck was torn loose and stopped, badly damaged, against the rear truck, both vestibule frames were badly distorted, the roof at the rear end was bent and torn, and the right side-sill was distorted; the right side sheets were bent, several of them were torn, and all bore raking marks; the front coupler-pocket was broken and the coupler was missing. The ninth car, N. Y. C. dining car 560, was derailed and stopped across tracks Nos. 1,

3, and 4 and leaned at an angle of 45 degrees to the right; the rear end was about 27 feet distant from track No. 1; the roof sheets and the end frames were bent and broken, the side sheets were bent, and most of the interior was destroyed; the front coupler-head was broken and the rear coupler was missing. The tenth car, Pullman Lake Bruin, was derailed and stopped diagonally across tracks Nos. 2, 1, 3, and 4 and leaned to the right at an angle of about 45 degrees; both trucks remained in place but were badly damaged; the front end-frame, the front sheets, and the roof sheets were bent and broken inward; the front coupler-head was cracked and the rear coupler-head was broken. The front end of the eleventh car, Pullman East Bernard, was derailed; this car stopped with the front end fouling track No. 2 and leaning to the left at an angle of 25 degrees; the side sheets on both sides, the front end roof-sheet, and the front end-sheet were bent. The remaining cars in the train were not derailed and sustained but slight damage.

The employees killed were the engineman and the fireman, and the employee injured was the road foreman of engines.

Summary of Evidence

Road Foreman of Engines Bayreuther stated that he inspected engine 5315 before No. 19 departed from Albany; the engine was in good condition. The air brakes were tested at Albany, a running test was made soon after leaving that point, a stop was made at Schenectady, the brakes were used to control the speed of the train at several points where there were speed restrictions, and in each instance the brakes functioned properly. Approaching the point of accident there was nothing unusual in the action of the engine, and the speed was 74 miles per hour. He said that he and the fireman called the indications of signals 21421 and 21531, which were displaying green-over-yellow aspects, and the engineman responded. Soon after the engine passed signal 21421 the engineman left his seat and examined the depth of water in the tender by opening a gauge cock in the left wing of the cistern and then resumed his usual position on the right seat-box. Between signals 21421 and 21531 the speed of the train seemed to be reduced as a result of the ascending grade. The engineman forestalled at both signals and the whistle in the cab sounded. After forestalling for signal 21531 the engineman made a brake-pipe reduction which did not seem long enough to indicate a proper brake-pipe reduction for the speed of the train and the distance to the point of speed restriction on Gulf Curve. The road foreman of engines said that usually a 14 or 15-pound reduction is made to control the speed of a train approaching speed restriction points; becoming alarmed about the speed, he crossed to the right side of the cab and observed that the

equalizing reservoir gauge indicated a brake-pipe reduction of only 11 or 12 pounds and the speed-recorder indicated a speed of 61 miles per hour. He warned the engineman that the speed was too great for Gulf Curve and instructed him to make a further brake-pipe reduction. The engineman did not answer but closed the throttle suddenly just as the engine entered the critical point of the curve; he did not seem to be ill, but rather in despair and mumbled something as though he realized something was wrong. The engine did not seem to bear heavily against the high rail; however, after the throttle was closed he thought the rear end of the engine started to leave the rail first and there was a jack-knife action at the connection between the engine and tender as though some added force caused the engine to become derailed and overturn. He thought that a speed of 52 miles per hour was the highest speed at which an engine could safely round Gulf Curve, but it was his opinion that if the engineman had continued to work steam in this instance the train could have rounded the curve. He thought that closing the throttle caused a change in force which resulted in the derailment. He said that it was the custom of the engineman involved to apply the air brakes near a point where a reduction in speed was required. The road foreman of engines thought that if a heavy brake-pipe reduction were made at signal 21531 or near it, a train of 15 cars could be controlled properly around Gulf Curve.

Conductor Grattan stated that the air brakes were tested at Albany and were reported as being operative, and they functioned properly en route. He told the road foreman of engines and the engineman that the train consisted of 15 cars. The engineman, who was in his usual position in the engine cab, acknowledged the information by a wave of his hand. Conductor Grattan said that his train departed from Albany 21-1/2 minutes late. There was no unusual incident between Albany and the point of accident; the train was handled as smoothly as usual, the speed was not excessive, and there was no time made up. When the train was approaching the point of accident he was in the fifth car and was not alarmed about the speed, as it was about the same as on other trips. He thought that the brakes were applied about 3 or 4 seconds before the accident occurred. He estimated that the accident occurred at 11:33 or 11:34 p.m. The weather was cloudy, but it was neither raining nor snowing.

Flagman Doran stated that the air brakes were tested before departure from Albany. From the rear platform he inspected the train as it rounded curves and last inspected it on a curve about 2 miles east of the point of derailment; he did not observe any dragging or defective equipment. As the train approached the point of accident he was in the rear car. He thought the brakes were applied about 1/2 mile east

of the point of accident but he did not observe any appreciable reduction in the speed of the train. As his train was approaching Gulf Curve he went out on the rear platform. He said that because of a run-in of slack he was thrown through the end door into the coach. He arose and was thrown down a second time. He did not feel a release of the brakes or an emergency application of the brakes.

Front Brakeman Sewak stated that when the train was approaching the point of accident he was in the fifth car. He felt a severe brake application about 1,500 feet east of the curve involved and thought that the speed of his train was about 45 miles per hour at the time of derailment.

Baggageman Hill stated that he was in the second car as his train was approaching the point of accident. He felt the brakes being applied about 1,000 or 1,500 feet east of the curve involved. He did not think that the brakes were applied in emergency.

Division Engineer Jones stated that he arrived at the scene of the accident about 4 a.m., April 20, and examined the track thoroughly. The first indication of damage was outside the high rail of track No. 1, between the first and the second joints east of the east abutment of bridge 453, and 37 feet west of the middle of the curve. Starting at the east end of the second joint, which was the beginning of the disturbed track and proceeding westward, the conditions were as follows: The inside spikes on the low rail were raised increasingly $1/2$ inch to 5 inches from the first to the ninth ties, inclusive, and were pulled out of the tenth, eleventh, and fifteenth ties; the base of the low rail was raised $1-1/2$ inches at the ninth tie; the inside spikes on the high rail were raised increasingly $1/2$ inch to $2-1/2$ inches from the sixth to the fourteenth ties, inclusive, and on the fifteenth tie the spike was raised $1-1/2$ inches; the rail anchor was marked on the gage side and the gage rod dropped off the low rail but was in place on the high rail; the sixteenth tie was shifted $1-1/2$ inches northward. The first indication of derailment was on the seventeenth tie; the top of this tie was gouged and splintered outside the high rail and the spike on the inside of the high rail was bent backward 90 degrees; the inside spike of the low rail was pulled out. At the north end of the eighteenth tie there was a mark $2-1/4$ inches wide and 1 inch deep the full width of the tie, and the rail anchor was bent. On the nineteenth tie there was a flange mark $3/8$ inch deep and $1-1/2$ inches wide the full width of the tie at a point $11-3/4$ inches outside the base of the high rail; the tie was chamfered at its extreme north end 2 inches wide and 1 inch deep the full width of the tie. The gage rod between the nineteenth and the twentieth ties was off both rails. On the twen-

tieth tie there was a flange mark $3/16$ inch deep and $1-1/2$ inches wide the full width of the tie at a point 12 inches outside the base of the high rail; the tie was cut at its extreme north end and a piece was broken off the west top edge extending from a point 8 inches outside the high rail to the end of the tie; the inside spike of the high rail was bent. On the twenty-first tie there was a flange mark $1/8$ inch deep and $3/4$ inch wide the full width of the tie at a point $12-1/2$ inches outside the base of the high rail, and a piece was broken out of the west edge of the tie 5 inches outside the base of the high rail; there was a bruise 2 inches wide on the west edge of the tie at a point 28 inches inside the base of the low rail. The surface of the north end of the twenty-second tie was splintered and there was a mark on the east edge of the tie; there was a bruise on the east edge of the tie 28 inches inside the base of the low rail but the fiber of the wood was not broken. The surface of the north end of the twenty-third tie was splintered and there was a mark 3 inches deep on the west side; there was a flange mark 31 inches inside the base of the low rail. Between the twenty-third and the twenty-fourth ties the rail anchor and the gage rod were disconnected. The twenty-fourth, twenty-fifth, and twenty-sixth ties were splintered over the surface on the outside of the high rail. The twenty-seventh tie was splintered over the surface and under the tieplate outside the high rail. Beyond the twenty-seventh tie the track was torn up and it was necessary to renew 75 ties. He said it was his opinion that the spikes were pulled by some force which rolled the rails sufficiently to draw the spikes partially; the spikes were drawn by force and not by vibration. The marks on the ties indicated a gradual tapering toward the outside of the track; he did not observe any condition that could cause a change of direction. Marks on the head of the high rail west of joint No. 1 were too faint to establish their cause conclusively. The last authorized work on track No. 1 was performed during August 1939. He said that on April 16, 1940, he observed the condition of the track at the point involved from a train which passed over Gulf Curve at normal speed; at that time the track was in excellent condition. He said that based on an 84-inch center of gravity, the equilibrium speed on track No. 1 was $39-1/2$ miles per hour, the safe speed was 45 miles per hour, and the maximum safe speed was about 48 miles per hour; he did not know the theoretical overturning speed. He thought the reason for an absence of flange marks between the rails at the location of the first marks of derailment was that the left wheels were suspended in the air. On April 20 and 21, he gaged the track eastward from the second joint in the high rail east of bridge 456; the gage and superelevation were as follows:

Joint	Gage	Middle ordinate 62-foot string	Elevation
No. 1	4' 8-9/16"	8-3/8"	8"
Center	4' 8-1/2"	7-3/8"	8-1/16"
No. 2	4' 8-11/16"	7-3/8"	8"
Center	4' 8-1/2"	7-3/16"	8"
No. 3	4' 8-9/16"	7-1/4"	8-1/16"
Center	4' 8-1/2"	7-7/16"	8"
No. 4	4' 8-9/16"	7-1/2"	8"
Center	4' 8-9/16"	7-5/8"	8-1/16"
No. 5	4' 8-1/2"	7-5/16"	8-1/16"
Center	4' 8-1/2"	7-1/4"	8-1/16"
No. 6	4' 8-9/16"	7-1/4"	8"
Center	4' 8-7/16"	7-1/4"	8-1/8"
No. 7	4' 8-9/16"	7-5/8"	8-1/16"
Center	4' 8-1/2"	7-1/8"	8-1/8"
No. 8	4' 8-1/2"	7-1/8"	8-1/8"
Center	4' 8-7/16"	6-5/8"	7-5/8"
No. 9	4' 8-1/2"	6"	6-3/4"
Center	4' 8-7/16"	5-7/16"	5-13/16"
No. 10	4' 8-1/2"	5-1/16"	5-1/16"
Center	4' 8-7/16"	4-1/8"	4-3/16"
No. 11	4' 8-7/16"	3-7/16"	3-3/8"
Center	4' 8-1/2"	2-5/16"	2-3/4"
No. 12	4' 8-1/2"	1-1/2"	1-13/16"
Center	4' 8-1/2"	1"	1-1/8"
No. 13	4' 8-9/16"	9/16"	1/4"
Center	4' 8-1/2"	3/16"	level
No. 14	4' 8-9/16"	1/8"	south rail 1/16"
Center	4' 8-1/2"	0	south rail 1/16"
No. 15	4' 8-9/16"	1/8"	level
Center	4' 8-1/2"	0	level
No. 16	4' 8-9/16"	0	south rail 1/16"
Center	4' 8-9/16"	0	south rail 1/16"
No. 17	4' 8-1/2"	0	south rail 1/16"
Center	4' 8-1/2"	3/16"	1/16"

The middle ordinate at joint No. 1 reflects shifting of track during repair work after the accident. He said that there was no evidence of tampering with the track.

Inspecting Engineer Bronson stated that he examined the damaged rails, both at the scene of the accident and again at West Albany when they were realigned in their relative positions. On track No. 1 there were 6 rails on the outside of the curve and 4 rails on the inside of the curve that were damaged; these rails were unbroken and they remained coupled to the adjacent rails. Starting with the first rail east of the initial mark of derailment and proceeding westward on the outside of the

curve, the result of the inspection was as follows: The first rail was unmarked and undamaged; as a result of a twisting motion imparted by the third rail, the second rail was twisted outward throughout a distance of 12 feet at the leaving end; there were marks on the head of the second rail which were caused, undoubtedly, by dragging of derailed equipment. There were numerous marks on the gage side under the corner of the head of the third rail which could not be identified with the path of any derailed wheels. Starting about 6 feet from the receiving end of the third rail, on the gage face there was an irregular upward score followed by a downward mark which then extended sharply upward; there was a distinct score on the head of this rail which started at a point 12 feet west of the receiving end and extended diagonally westward across the head of the rail a distance of 13 feet; another mark almost paralleled this diagonal mark; it could not be determined definitely that these marks were caused by wheel flanges; there were marks in the web of the third rail but their cause could not be determined; the spikes on the gage side of the second and the third outside rails were bent outward and the amount of bending and withdrawal of spikes increased progressively westward; undoubtedly these conditions were a result of the equipment following the derailed engine; there were numerous marks on the fourth, fifth, and sixth outside rails and on the first, second, third, and fourth inside rails; however, these marks were of less intensity than those on the second and third outside rails; a line, starting at the third outside rail on track No. 1, extending across a gap in track No. 3, where there was a fractured rail on the inside and a twisted rail on the outside of the curve, and extending to the rock against which the engine stopped, indicated in a general way the path of the engine after it became derailed. The outside rails of track No. 1 were beaded over on the gage side with a lip between $1/32$ and $3/64$ inch wide; the inside rail was beaded over similarly on the gage side. Inspection of the track throughout a distance of 1 mile immediately east of the point of accident did not disclose any condition that might have contributed to the cause of the accident. The ties were spaced regularly and were in good condition. The gage, line and surface were uniform. There was no indication of dragging equipment.

Section Foreman Quinto stated that he had been in charge of the section involved for 29 years. On April 18 he inspected track No. 1 on Gulf Curve for surface and alinement, and also gaged the cross-levels; the condition of the track was satisfactory at that time. One of his men who inspected the track on April 19 did not report any unsatisfactory condition. He had experienced no difficulty in maintaining the desired superelevation on the curve involved. He said that on April 18 he observed trains as they rounded the curve; at that time there was

nothing unusual in their movement. He had never observed trains exceeding the speed limit on Gulf Curve. The last work performed on this curve was in August, 1939.

Master Mechanic Fahey stated that he arrived at the scene of the accident about 4:05 a. m., April 20, and examined engine 5315. The throttle was unlatched and open 10 notches but the lever and the quadrant were bent and the throttle extension rod was broken at the location of the front-end throttle. Immediately ahead of the door sheet there was a jagged tear in the wrapper sheet, the metal of which appeared to be of full thickness and bore no evidence of having been overheated. The crown-sheet metal was of full thickness and disclosed no evidence of having been overheated. He thought the explosion was a result of a rock puncturing the wrapper sheet, as the hole was the shape of the rock that had pierced it. The engine frame on both sides back of the first pair of driving wheels and at the tailpiece was broken. He thought the frame was broken as a result of either the explosion or the impact of the engine against the rock. The engine frame swung around until the third pair of driving wheels was ahead of the first pair and against the back cylinder-heads. After the engine was moved to West Albany Shops he gaged the wheels; the results were as follows:

Wheel Location	Tread wear	Flange thickness with N.Y.C. gage. (Finger reading)
R No. 1 engine truck wheel	4/32"	0
L No. 1 " " "	3/32"	0
R No. 2 " " "	3/32"	0
L No. 2 " " "	3/32"	0
R No. 1 driving wheel tire	2/32"	2
L No. 1 " " "	2/32"	0
R No. 2 " " "	2/32"	1
L No. 2 " " "	2/32"	0
R No. 3 " " "	2/32"	0
L No. 3 " " "	2/32"	0

Spacing back-to-back in four positions:

	0°	90°	180°	270°
No. 1 engine truck wheels	53-5/16"	53-5/16"	53-11/32"	53-11/32"
No. 2 " " "	53-5/16"	53-9/32"	53-9/32"	53-5/16"
No. 1 driving wheels	52-29/32"	52-31/32"	53-7/32"	53-5/16"
No. 2 " " "	53-7/32"	53-1/4"	53-3/16"	53-9/32"
No. 3 " " "	53-5/32"	53-3/16"	53-1/8"	53-3/32"

Note:- The 4-wheel trailer truck was not found and it is supposed that it fell in the river.

Diameters of engine-truck wheels and driving-wheel tires were as follows:

R No. 1	engine truck wheel	36-5/32"
L No. 1	" " "	36-5/32"
R No. 2	" " "	36-5/32"
L No. 2	" " "	36-5/32"
R No. 1	driving-wheel tire	79-1/4"
L No. 1	" " "	79-1/4"
R No. 2	" " "	79-1/4"
L No. 2	" " "	79-1/4"
R No. 3	" " "	79-1/4"
L No. 3	" " "	79-1/4"

He said that the No. 1 pair of driving wheels was placed in a wheel lathe and the axle and the wheel hubs ran true; however, the right wheel-center was dished inward 1/4 inch at the counter-balance location; in his opinion this wheel became dished as a result of striking the rock against which the engine stopped. He said that the lateral of all driving wheels was 3/8 inch. The engine-truck axles were equipped with roller-bearing boxes; 1/8 inch play was maintained in the pedestal jaws. The capacity of the tender of engine 5315 was 28 tons of coal and 14,000 gallons of water. He estimated that 21-1/2 tons of coal and about 11,000 gallons of water were in the tender at the time of derailment.

Assistant Master Mechanic Pease stated that on April 22 he removed the speed recorder from engine 5315. The independent brake-valve handle was broken, the rotary valve was in quick-application position, the automatic brake-valve handle was in emergency position, and the double-heading cock was closed. He said that he attached no significance to the position of the brake valve or of the double-heading cock as they were so located that they might have been disturbed by debris or by persons removing bodies of employees. He examined the radial buffer between the engine and the tender and found that it was in good condition. The coupler and the angle cock at the rear of the tender were broken off. A section of the ashpan, weighing 66-1/2 pounds, and several grate units were found on the south bank of the river 620 feet distant from the engine.

Assistant Superintendent of Equipment Parsons stated that he examined the engine-truck springs, hangers and equalizers, and the driving-box springs, hangers and equalizers, and there were no defects.

General Foreman of Car Department Ruxton stated that he arrived at the point of derailment about 12:55 a.m., April 20. He found nothing wrong with any of the equipment which might have been a contributing cause to the accident. He examined

all couplers, four of which were of the tight-lock type, and found no defects that appeared to have existed prior to the derailment. There were slight brake burns and skid marks on the treads and flanges of all wheels. These brake burns and skid marks were progressively heavier from the front to the rear of the train. He stated that there was no evidence of buckling or telescoping on any of the cars.

Supervisor of Boilers Usherwood stated that he arrived at the scene of the accident at 11:40 a.m., April 20, and examined engine 5315. There was no indication of overheating of the firebox sheets, nor any defect which might have contributed to the failure of the firebox. Portions of the crown sheet and of the right side-sheet were folded downward over the flue sheet; the remainder of the crown sheet and of the right side-sheet were folded downward over the door sheet. There was discoloration of the crown-sheet metal between the seventh and ninth longitudinal rows of staybolts to the right of the center-line and from the third to the ninth transverse rows of staybolts back of the flue sheet; however, this discoloration was caused by arch brick being wedged between the flue sheet and the crown sheet when the latter was forced downward against the flue sheet. After the engine was removed to West Albany Shops he examined the firebox in detail; the results were as follows: The wrapper sheet was punctured inward, the area of the puncture being 672 square inches; one side of this hole, which was to the right of the center-line of the firebox and triangular in shape, extended along the sixth longitudinal row of staybolts from the back-head to the ninth transverse row of staybolts, the second edge extended along the back-head between the sixth and ninth longitudinal rows of staybolts, and the third edge followed a diagonal course until it met the first edge at the intersection of the sixth longitudinal row and the ninth transverse row of staybolts; from this point there were two irregular tears; one extended diagonally upward to the second longitudinal row and the thirteenth transverse row of staybolts, and the other extended downward and stopped at the tenth transverse row and the tenth longitudinal row of staybolts. There was a depressed area of 10,192 square inches extending from the middle of the third boiler course to the back-head; at a point 27 inches in front of the back-head this depression was 16-3/4 inches deep. The wrapper sheet was 1/2 inch thick. The crown sheet and right side-sheet were torn irregularly. It was impossible to determine the initial point of rupture of these sheets. The crown sheet and the right side-sheet were 3/8 inch thick at the line of tear. There were 453 rigid and 408 flexible staybolts pulled through the sheets. The foundation ring was bowed outward at the right and left sides and at the rear. Supervisor Usherwood said that it was his opinion the explosion was caused by the wrapper sheet being punctured by the rock.

Supervisor of Air Brakes Albers stated that he examined the speed-recorder tape removed from engine 5315. According to indications on the tape the brakes were applied in service a distance of about 1,300 feet and then released at a point approximately 2,000 feet east of the point of accident. The speed was about 59 miles per hour at the time of the derailment. He tested all the air-brake equipment salvaged from both the engine and the cars and found that the independent brake-valve handle was broken off at the rotary-valve stem; the automatic brake-valve handle was bent upward $3/8$ inch and toward the right $1/2$ inch; however, the automatic brake valve functioned properly in all positions; the upper cap of the distributing valve was broken off; however, after renewal of this part the distributing valve performed all its functions properly. This equipment was No. 6-ET. The control valves of nine cars passed all tests, including service stability; the control valves from the remaining six cars were so damaged as a result of the derailment that they could not be tested.

Superintendent of Fuel and Locomotive Performance Raymond stated that the valve-pilot and speed-recorder tape indicated No. 19 was moving at a speed of 74 miles per hour just east of signal 21421, then the speed slowly decreased to 70 miles per hour at signal 21531. He corroborated the statement of the supervisor of air brakes in regard to the operation of the train between signal 21531 and the point of accident. He said that speed recorders are checked for accuracy by an electric timing device and only in rare instances are there inaccuracies of more than 2 miles per hour.

Signal Engineer Elsworth stated that the most favorable aspect displayed by signals Nos. 21421 and 21531 is green-over-yellow, which requires that an engineman forestall to prevent an automatic train-stop brake application. The purpose of this indication is to insure that an engineman is alert when approaching Gulf Curve; however, should an engineman be incapacitated or lost as to location, an automatic train-stop brake application would stop the train before it entered the curve.

Engineman Lasher stated that he was in charge of the engine involved, on No. 158 between Syracuse and Albany, April 19, and arrived at Albany at 4:01 p.m. The engine rode smoothly and there was no excessive lateral motion or side swing. He made 17 stops en route and experienced no difficulty in stopping. He used the brake valve in all positions except emergency position and it functioned properly. He said that he inspected the engine after its arrival at Albany and the springs and the equalizers were in their proper positions.

Engineman Faubel stated that he prepared engine 5315 for service on No. 19, April 19. He examined the firebox and the running gear, and tested the water column and the water glass as prescribed by the rules; all were in good condition. He tested the independent and the automatic-brake valves and they functioned properly. He ran the engine over two test inductors, and the automatic train-stop device functioned properly. There was nothing unusual in the riding qualities of the engine while it was moving from the engine house to Albany station, a distance of 0.58 mile. He said that he delivered the engine to the engineman involved, who appeared to be normal.

Air Brake Inspector Farley stated that the air-brake equipment on engine 5315 passed all prescribed tests before its departure on No. 19, April 19. He said that he adjusted the driving-brake piston-travel to 4-1/2 inches.

Air Brake Inspectors Murtha and Kirchman stated that an air-brake test disclosed that all the brakes on No. 19 applied and released properly; the piston-travel was within the prescribed limits.

Car Inspectors Rohl and Gill stated that there was no defect on the cars of No. 19 before its departure from Albany.

Assistant Station Master Hughes stated that he talked with the engineman involved before his departure on No. 19; the engineman seemed normal in every respect.

Engineman Dyke stated that he was in charge of No. 17 on April 19, and his train passed Little Falls at 10:49 p.m. The engine, of the 4-6-4 type, rode smoothly as it rounded Gulf Curve at a speed of 43 miles per hour. There was no indication of the track being out of line and there was no rough spot in the track on the curve. He said that it was customary to brake for Gulf Curve so that when the brakes were released the speed would be about 43 miles per hour for entering and rounding the curve. The instructions are that the throttle is not to be closed, so that the train will ride smoothly around the curve.

Signal Supervisor Ford stated that the automatic train-stop inductors at signals 21421 and 21531 were examined and found in correct alinement and elevation. He said that upon his arrival at the scene of the accident the signals just east of that point on tracks Nos. 1 and 3 were displaying stop indications; upon restoration of the tracks to service the signals were tested and no defect was observed.

Division Superintendent Wood stated that discipline was administered to enginemen in instances wherein speed in excess of the maximum authorized speed was observed.

According to data furnished by the carrier, the total weight of engine 5315 was 358,000 pounds, distributed as follows: engine truck, 65,700 pounds; driving wheels, 190,700 pounds; trailing truck, front wheels, 46,100 pounds, and the rear wheels, 56,100 pounds. The tender was rectangular in shape and had two six-wheel trucks; its capacity was 14,000 gallons of water and 28 tons of coal. The weight of the tender loaded was 305,500 pounds. The total weight of the engine and tender was 663,500 pounds. The diameter of the engine-truck wheels was 36 inches; of the driving wheels, 79 inches; of the front trailer-wheels, 36 inches; and of the rear trailer-wheels, 51 inches. The rigid wheel base was 14 feet in length; the total length of engine and tender was 95 feet 11 inches. The normal center of gravity was 77.66 inches above the top of the rails.

According to calculations submitted by the carrier, the spring-borne weight of the class of engine involved is 237,590 pounds, and the vertical center of gravity of the spring-borne load is 86.6 inches; however, because of rocker action, the average rise on a 7°24' curve with an 8-inch superelevation is 0.61 inch, making a total of 89.21 inches. When an engine of the class involved rounds Gulf Curve at a speed of 40.5 miles per hour, the centrifugal force is compensated for by an 8-inch superelevation. When the speed is increased to 59 miles per hour on the curve involved, the center of gravity shifts outward 1-1/2 inches, and there is an increase of 25 percent of the load on the outside springs and a corresponding decrease of 25 percent of the load on the inside springs; these conditions result in the outside wheels sustaining 75 percent of the total load.

The last previous washout of the boiler of engine 5315 was at Harmon, N.Y., April 11; the last previous quarterly inspection was at Linndale, Ohio, February 24.

A notation on the train sheet indicates that the wires were disturbed at 11:33 p.m., April 19.

The records of the railroad disclose that the engineman involved was last examined on operating rules June 19, 1939. His last periodical physical examination was given on January 26, 1940.

A check of the speed-recorder tapes of engines hauling No. 19 from March 18 to April 18, inclusive, disclosed that the maximum speed at mile post 216 was 48 miles per hour and the minimum speed was 39 miles per hour.

Observations of the Commission's Inspectors

The Commission's inspectors examined the track a distance of 3,046 feet east of the point where it was destroyed, and found no indication of either dragging or defective equipment, nor of any obstruction having been on the track. The track was well maintained; there was no irregularity either in gage or in cross-level. The ties were spaced regularly and there was no indication of seepage under them. The condition of the rails on the curve indicates that there has been little or no excessive speed on track No. 1, as the heads of both the low and the high rails are beaded over an average of $1/32$ inch on the gage side the full length of the curve. There was no indication of abrading or scoring on the gage side of the high rail. The first mark of derailment was outside the high rail of track No. 1 on the north end of the seventeenth tie west of the second rail joint east of bridge 456. The top surface of this tie was splintered and gouged from a point 6 inches outside the base of the north rail to the end of the tie. On the north end of the eighteenth tie there was a chamfer mark 2 inches wide and 1 inch deep the full width of the tie. On the nineteenth tie there was a flange mark $3/8$ inch deep and $1-1/2$ inches wide at a point $11-3/4$ inches north of the base of the high rail; the north end of the tie was chamfered its full width by a mark 1 inch deep and 2 inches wide; the distance between the flange mark and the chamfer indicated that a wheel caused the marks. The angle of the chamfer indicated that the wheel was tilted outward at an angle of about 25 degrees. On the twentieth tie there was a mark $3/16$ inch deep and $1-1/2$ inches wide the full width of the tie at a point 12 inches north of the base of the high rail; the tie was chamfered at its extreme north end and a piece extending from a point 8 inches outside the high rail to the end of the tie was broken out of the west top edge. On the twenty-first tie there was a mark $1/8$ inch deep and $3/4$ inch wide the full width of the tie at a point $12-1/2$ inches outside the base of the high rail; there was a chamfered mark the full width of the tie at its north end. The first mark between the rails was on the twenty-third tie; this mark was 31 inches north of the base of the low rail and extended the full width of the tie. Beyond this point the track had been rebuilt before the inspectors made their observation. All rails recovered from the disturbed track were examined, but because of many marks resulting from the derailment of so many units it could not be established definitely which units of equipment caused the marks. There was no rail in track No. 1 broken. There was no mark on the top of either the low or high rail preceding the first tie mark.

At a point about 103 feet west of the initial-mark of derailment there was a section of the south rail of track No. 3, consisting of about 11 feet of the leaving end of a rail and

about 6 feet of the receiving end of another rail, broken into fragments. At a point about 132 feet west of the initial point of derailment, one of the north rails of track No. 3 twisted into an S-shape, was overturned, and its base was marked on the flange with regular indentations at intervals of about 4 inches. These two rails were about in line with the tangential direction of the engine as it moved from the initial point of derailment toward the pinnacle of rock against which it stopped; the indentations on the north rail of track No. 3 appeared to have been made by flexible stay-bolt caps. These conditions indicated that the engine was on its side a short distance beyond the point of derailment.

The sixth and the eighth cars were equipped with tight-lock couplers and the remaining 13 cars were equipped with older types of couplers. The Commission's inspectors observed that the rear coupler of the tender and the front coupler of the first car were broken off; the rear coupler-shank of the first car and the front and the rear coupler-shanks of the second car were bent; both couplers of the third car and the rear coupler of the fourth car were torn out, but the front coupler of the fourth car was intact; the front coupler-head of the fifth car was broken but the rear coupler was intact; both couplers of the sixth car were torn out; the front coupler-head of the seventh car was broken but the rear coupler was intact; the front coupler of the eighth car was torn out but the rear coupler was intact; the front coupler-head of the ninth car was broken and the rear coupler was torn out; the front coupler-head of the tenth car was cracked and the rear coupler-head was broken. The couplers of the last five cars were undamaged. Although three of the four tight-lock couplers in the sixth and the eighth cars were torn out, none was defective and they were in suitable condition for service.

The brake shoes were discolored by heating; the degree of discoloration was heavier progressively from front to rear. On the treads of all wheels of the cars there were brake burns and skid marks, which were heavier progressively from the front to the rear of the train. The front side posts of the second car were marked by heavy objects having glanced across them. The right side of the car was discolored by water from the boiler and chemicals used for purification of water. Evidently, this car passed the engine an instant after the explosion occurred.

Engine 5315 was examined at the scene of the accident and again at West Albany Shops after its removal to that point. The engine-truck wheels and the driving wheels disclosed but little tread wear, the flanges were of full contour, and the lateral and the diameters of companion wheels were within the

prescribed limits. All engine-truck and driving wheels were gaged back-to-back at four points and found to be within the prescribed limits, except the No. 1 pair of driving wheels which was $3/32$ inch below the minimum spacing as a result of the right wheel being dished inward $1/4$ inch at the counter-balance location because of some severe stress probably imposed by the derailment. All the driving-box shoes and wedges were well lubricated and there was no indication of tight or sticking wedges. All driving-wheel tires were tight and all the wheels were tight on the axles. All the driving-box springs and rigging were out of position as a result of the impact of the engine against the rock; however, all pins, saddles, hangers, and springs were intact, except the right No. 3 spring which was broken through the top third; this was a new break. The engine-truck springs were in place and in good condition. There was no defective condition of the engine-truck frame which could have contributed to the cause of the accident. The trailer truck and the booster engine were missing; most of the ash pan was missing. The Commission's inspectors found the engine frame broken and the driving wheels reversed in the manner as described by the master mechanic. The cab was crushed and distorted. The radial buffer between the engine and the tender was in place; it was well lubricated and did not show indication of excessive friction. All the transverse and the longitudinal splash plates in the tender were securely fastened and in place. The drawbars between the engine and the tender were in place and unbroken.

The firebox wrapper sheet was punctured by rock in a ragged, irregular tear which was depressed inward about 16 inches from the normal contour of the firebox. This depressed area had assumed the shape of the pinnacle of rock which punctured the wrapper sheet. The inspectors found the wrapper sheet and the crown sheet to be in the condition described by the supervisor of boilers. There was no indication of overheated metal. The wrapper sheet, the crown sheet, and the side sheet appeared to be of good metal and of normal thickness. A piece of rail, about 11 feet in length, identified as being from the inside rail of track No. 4 at a point 302 feet west of the point of derailment, penetrated the smoke-box ring and the front flue-sheet at a point midway of the height of the boiler and next to the right shell of the boiler. The outside wall of the right valve-chamber was cut lengthwise by a piece of rail.

The independent brake-valve handle was broken off the rotary valve stem; the rotary valve was in quick-application position. During a rack test observed by the inspectors, the H-6 automatic brake-valve was tested and it functioned properly in all positions; the rotary valve and key gasket did not leak;

the actuator cut-out cock was sealed in cut-in position. The upper cap of the distributing valve was broken off; however, after its renewal, the valve performed all its functions properly. The double-heading cock operated properly but was difficult to move. The brake-pipe vent-valve operated properly. The M-3 feed valve was set for 110 pounds brake-pipe pressure and passed all rack tests.

In the presence of the Commission's inspectors the valve-pilot and speed-recorder device was tested for calibration on a master tachometer at the manufacturer's plant. Because of damage sustained in the accident it was necessary to renew the bottom plate and one gear before the test was started. The test disclosed that the device registered accurately at speeds of 45, 55, 60, 65, 75, and 80 miles per hour.

One PC, one U-12-B, one U-12-BC, and one U-12 control valve of the rear four cars in No. 19 were tested with a single-car testing-device; they passed all tests, including service stability. Two U-12 and three U-12-B control valves, removed from the damaged cars, were tested on a test rack; they passed all tests, including service stability. The remaining six control valves could not be tested because of damage sustained in the accident.

Discussion

According to the evidence, No. 19 was moving at a speed of about 59 miles per hour on a 7°24' curve to the left when suddenly there was a jack-knifing action at the connection between the engine and the tender, and the engine was derailed and overturned to the outside of the curve.

There was no indication of defective or dragging equipment or of any obstruction having been on the track which might have contributed to the cause of the derailment. The rails were in excellent condition and the superelevation was evenly maintained. The ties were solid and there was no indication in the ballast of ties having shifted. The gage of the track was properly maintained from a point a considerable distance eastward to the point where the track was destroyed.

The equipment and the air brakes had been inspected prior to the time No. 19 left Albany and no defective condition was disclosed. The air brakes functioned properly at all points where used en route. Subsequent to the accident, tests of the air-brake equipment did not disclose any defective condition which might have contributed to the cause of the accident. Careful inspection of the engine and the cars involved disclosed no defective condition which might have existed prior to the accident.

The maximum authorized speed on Gulf Curve was 45 miles per hour, and restrictive signal indications were displayed at two signals located 9,046 and 3,086 feet east of the point of accident to insure that enginemen would be alert when approaching the curve. It was the practice for enginemen to make a brake-pipe reduction, about 3,000 feet east of the point of accident, sufficient to reduce the speed to about 45 miles per hour before the engine reached the curve, and to release the brakes just before entering the curve; according to instructions, the throttle was left open so that the train would enter and round the curve smoothly. In this instance the road foreman of engines said that the brake-pipe reduction which was made was not sufficient to control the speed of the train properly; he crossed to the right side of the engine cab and saw that the engineman had made a reduction of 11 or 12 pounds as indicated by the gauge; at that time the speed-recorder indicated a speed of 61 miles per hour. He instructed the engineman to reduce the brake-pipe pressure further; however, the engineman closed the throttle suddenly instead, and did not make a further reduction. According to the road foreman of engines, prior to the closing of the throttle the engine was riding smoothly and was not bearing heavily against the outside rail; immediately after the throttle was closed there was a jack-knifing effect as though some added force had been applied at the connection between the engine and the tender; this action was followed immediately by the derailment and the overturning of the engine; it was his opinion that if the throttle had not been closed suddenly the engine would have rounded the curve safely. Why the engineman failed to make a brake-pipe reduction sufficiently heavy to control the speed of the train or why he closed the throttle suddenly could not be determined, as he was killed in the accident.

The first mark of derailment was found about 6 inches outside the base of the high rail. Since there was no flange mark between the rails or on the head of the high rail and since the engine was on its right side a short distance beyond the point of derailment, it appears that the engine started to overturn prior to being derailed. According to standards of this carrier, as well as A. R. E. A. recommended practice, the maximum safe speed on this curve is about 48 miles per hour; A. R. E. A. tables indicate that the overturning speed is about 78 miles per hour. The speed at the time of the accident was about 59 miles per hour, which is about 11 miles per hour in excess of the maximum safe speed and about 19 miles per hour less than the overturning speed. Apparently another condition combined with the speed of 59 miles per hour was necessary to cause the derailment. When the engineman closed the throttle suddenly, the engine undoubtedly set up a considerable retarding action, and there was a surge or heavy run-in of slack following the closing of the throttle; this is confirmed by

statements of the road foreman of engines and the flagman. This sudden force would be dissipated in a tangential line, which would be to the outside of the curve. The tendency of the spring-borne load of a moving vehicle, when speed is being rapidly retarded, is to incline forward and downward; this action results in weight being shifted from the rear end to the front end, and it is probable that this action occurred immediately after the engineman closed the throttle. Because of the excessive speed, there was a shifting of weight from the low rail to the high rail, resulting in about 75 percent of the weight of the engine being carried on the high rail. From the foregoing, it appears that a sudden run-in of the train combined with the excessive speed was sufficient to overturn the engine or to lift the wheels of the rear end of the engine over the outside rail without marking it.

The investigation disclosed that the train separated at the rear end of the tender; also, each of the first six cars was completely separated at both couplings, two of these cars remaining upright and four being overturned; the seventh to tenth cars, inclusive, were not completely separated but stopped in various positions and at various angles to the track. Many of the couplers on the first ten cars were pulled out, broken or otherwise badly damaged. The front truck of the eleventh car was derailed, but the rear truck of this car and the last four cars remained on the track and the couplers were not damaged. None of the cars was telescoped; the greater part of the damage was in the superstructures of the cars which became separated as a result of the derailment. Had the cars remained in alignment it is probable there would have been less damage to the equipment.

Conclusion

This accident was caused by excessive speed on a sharp curve combined with a run-in of slack resulting from the throttle being closed suddenly.

Respectfully submitted,

S. N. MILLS,

Director.