

INTERSTATE COMMERCE COMMISSION
WASHINGTON

REPORT OF THE DIRECTOR
BUREAU OF SAFETY

ACCIDENT ON THE
PENNSYLVANIA RAILROAD

CUYAHOGA FALLS, OHIO

JULY 31, 1940

INVESTIGATION NO. 2440

SUMMARY

Inv-2440

Railroad:	Pennsylvania		
Date:	July 31, 1940		
Location:	Cuyahoga Falls, Ohio		
Kind of accident:	Head-end collision		
Trains involved:	Passenger	:	Freight
Train numbers:	3360	:	Extra 4454
Engine numbers:	4648	:	4454-4533
Consist:	Gas-electric motor-car 4648	:	73 cars and caboose
Speed:	25 m. p. h.	:	20-25 m. p. h.
Operation:	Timetable, train orders and manual block system		
Track:	Single; tangent; 0.62 percent descending grade southward		
Weather:	Clear and hot		
Time:	5:58 p. m.		
Casualties:	43 killed; 5 injured		
Cause:	Failure to obey a meet order and occupancy of a block without authority		

Inv-2440

October 4, 1940.

To the Commission:

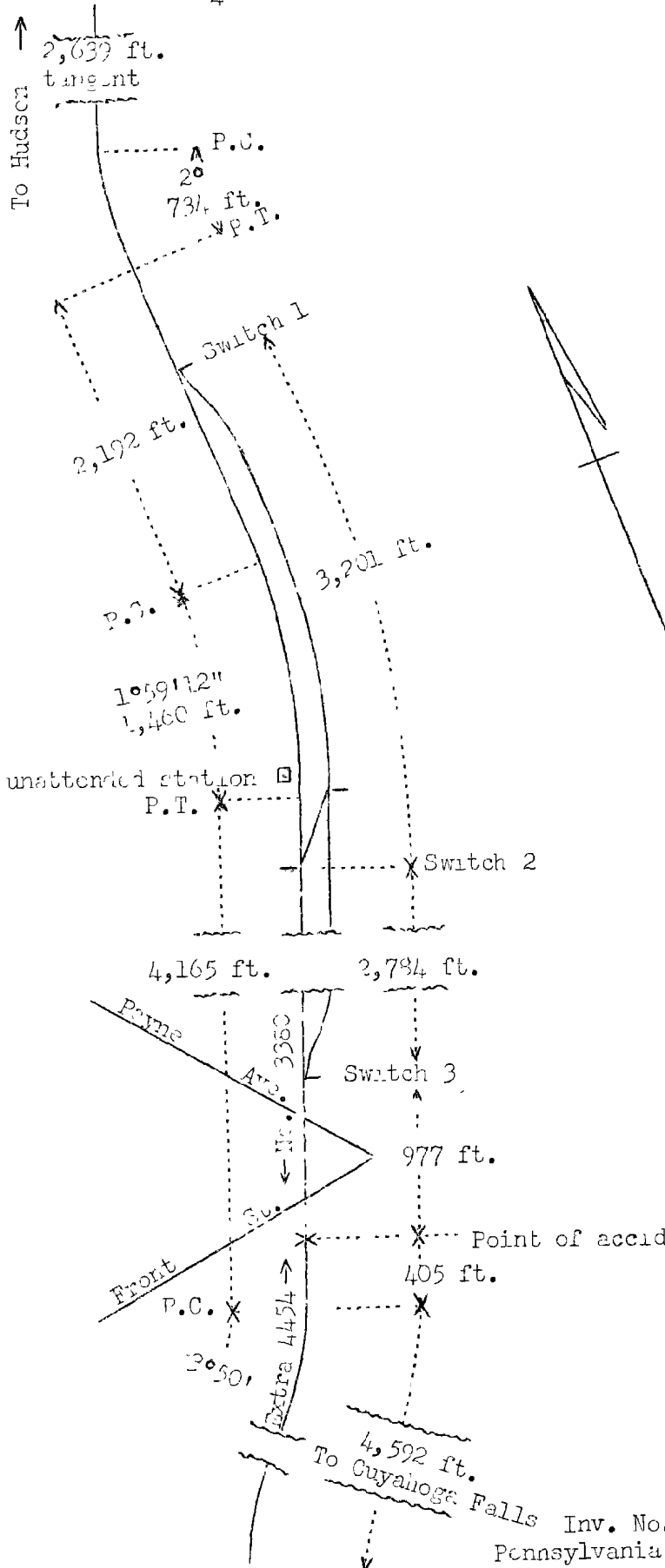
On July 31, 1940, there was a head-end collision between a passenger train and a freight train on the Pennsylvania Railroad near Cuyahoga Falls, Ohio, which resulted in the death of 42 passengers and 1 train-service employee, and the injury of 1 track laborer and 4 train-service employees. This accident was investigated in conjunction with a representative of the Public Utilities Commission of Ohio.

Location and Method of Operation

This accident occurred on that part of the Cleveland Division which extends between Hudson, Ohio, and Joyce Avenue, Columbus, Ohio, a distance of 142.1 miles. In the vicinity of the point of accident this is a single-track line over which trains are operated by timetable, train orders and a manual block system. The accident occurred on the main track at a point 4,592 feet north of the station at Cuyahoga Falls. As the point of accident is approached from the north there are, in succession, a tangent 2,639 feet in length, a 2° curve to the left 734 feet in length, a tangent 2,192 feet in length, a $1^{\circ}59'12''$ curve to the right 1,460 feet in length, and a tangent 4,165 feet to the point of accident and 405 feet beyond. As the point of accident is approached from the south there are, in succession, a tangent 1,625 feet in length, a compound curve to the right 1,787 feet in length having a maximum curvature of $3^{\circ}50'$, a tangent 237 feet in length, a compound curve to the left 1,794 feet in length having a maximum curvature of $3^{\circ}50'$, and the tangent on which the accident occurred. The grade for south-bound trains varies between 0.166 and 0.706 percent ascending a distance of 3,400 feet and then is 0.62 percent descending 1,411 feet to the point of accident. The grade for north-bound trains varies between 0.218 and 0.62 percent ascending a distance of 2,732 feet to the point of accident.

A siding 5,985 feet in length and designated as Silver Lake is north of the point of accident and parallels the main track on the east. The switches are numbered progressively from north to south; the most northerly is designated as switch one, the intermediate, switch two, and the most southerly, switch three; these switches are, respectively, 2.37, 1.58, and 1.05 miles north of the station at Cuyahoga Falls. The accident occurred at a point 977 feet south of switch three. Payne Avenue and Front Street cross the main track diagonally at points, respectively, 677 and 872 feet south of switch three.

An unattended block-station sign is located at a point 2,934 feet south of switch one, 267 feet north of switch two, and 3,050



SI unattended station
P.T.

- Hudson, Ohio
6.3 mi.
- Silver Lake
4,165 ft.
- × Point of accident
4,592 ft.
- Cuyahoga Falls
5.0 mi.
- Akron
2.2 mi.
- Main Street
12 1/2 mi.
- Columbus, Ohio
(Joyce Ave.)

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Pennsylvania Railroad
Cuyahoga Falls, Ohio
July 31, 1940

feet north of switch three. The day aspect is the station call, "SI", lettered in white on a black signboard 10 inches wide and 20 inches long mounted vertically 7 feet 5 inches above the top of the rail on a mast, which is located 9 feet west of the west rail. The night aspect is electrically lighted and is mounted horizontally on the mast 8 feet 11 inches above the top of the rail; it consists of a box 8 inches high and 27-1/4 inches long, in which there are a red and a yellow lens each of which is 5 inches in diameter; the yellow lens is next to the main track. Both the day and the night aspects are visible from either direction. A telephone booth is attached to the block-sign mast.

The view from a south-bound gas-electric motor-car is unobstructed throughout a distance of 4,165 feet north of the point of accident. Switch three can be seen from the left side of a north-bound engine a distance of 1,713 feet, and from the right side a distance of 1,435 feet.

Rules of the operating department read in whole or in part as follows:

Definitions.

Fixed Signal.-- A signal of fixed location indicating a condition affecting the movement of a train.

Home Signal.-- A Fixed-Signal at the entrance of a route or block to govern trains in entering and using said route or block.

34. Immediately upon seeing a Fixed-Signal affecting the movement of their train, the engineman and fireman must, * * *, call its indication by name to each other.

105. Both the conductor and the engineman are responsible for the safety of the train and the observance of the rules, * * *.

211. When a "19" train order has been transmitted, * * *. The operator * * * will then write on each copy the word "complete", the time, and his last name in full, and personally deliver a copy to each person addressed without taking his signature.

* * *

362. Trains must not pass a Stop-signal without receiving a Caution Card (Form D), a Clearance Card (Form C) or a train order authorizing them to do so.

* * *

Special time-table instructions read in whole or in part as follows:

S55. Use of telephones.

S53A * * *

When used for Block Operations, transmitting train orders or making any arrangement pertaining to the movement of trains by trainmen, the conductor or engineman must personally receive all orders on the telephone and make all verbal arrangements pertaining to the movement of his train, but neither is relieved of any responsibility as prescribed by Rule 105.

* * *

D1503. When siding switches are numbered the following will apply:

Only those main track switches connecting a siding used in train movement will be numbered.

Between Hudson and Joyce Avenue, * * *
No. 1 being the most northerly switch, with the numbers increasing toward the south.

* * *

When trains meet at a numbered switch by train order, the train which can enter the siding without backing must do so.

S23A. UNATTENDED BLOCK STATIONS

An unattended block station is a point designated by a sign indicating the limits of a block, the use of which is controlled by Manual Block System Rules, except as hereby modified.

D2508. Unattended block stations are controlled by the Signalman specified in time-table, or Special Instructions.

The sign indicating an unattended block station will display by day the station call, and in addition, by night a red light and a yellow light horizontal; the yellow light next to the main track.

The signalman may give a train oral permission to enter one block, and by the use of

Clearance Card (Form K) may authorize a train to pass one or more unattended block stations.

Unless otherwise provided, trains must stop at unattended block stations, and conductor or engineman must obtain permission from the signalman to enter, and ascertain condition of the block, and report clear.

* * *

Form K. Clearance Card

-----Block Station,-----M-----19---
To Conductor and Engineman: Train-----
Proceed at-----as though-----signal was displayed
Report clear at-----

Signalman.

The signalman may issue this card only when authorized by Superintendent. Before issuing it, the signalman must have proper understanding with other signalmen, if any, having authority over blocks mentioned, and must know that blocks mentioned above have been duly reported clear of opposing trains, and clear of trains that may not be followed in the same block by the train addressed.

The conductor and engineman receiving this card properly filled out and signed, or authorized by the signalman to fill it out, may proceed as directed above.

* * *

Note--Unattended Block Stations Controlled by open Block Stations.

Block Station	Period Unattended	Controlled By
SI	Continuously	Hudson

* * *

The maximum authorized speeds in the vicinity of the point of accident are 60 miles per hour for passenger trains and 45 miles per hour for freight trains.

The weather was clear and hot at the time of the accident, which occurred about 5:58 p.m.

Description

Extra 4454 North, symbol FC-4, a north-bound freight train with Conductor Collier and Enginemen Lodge and Kropf in charge, consisted of engines 4454 and 4533 coupled, 30 loaded and 43 empty cars, and a caboose. At Arlington, 3.7 miles south of Cuyahoga Falls, the last open office and located at the end of double track, the crew received copies of train order No. 99, Form 19, which read as follows:

Eng 4454 run Extra Arlington to Hudson and
meet No. 3380 Gas Eng 4648 at Switch 1
Silver Lake.

The crew also received copies of a clearance message which read as follows:

To C & E Extra 4454, July 31, 1940.
All trains due up to 535 p.m. have been represented.

This train departed from Arlington at 5:49 p. m., according to the train sheet, and, when it was approaching Silver Lake, while moving at a speed estimated to have been about 30 miles per hour, it collided with No. 3380.

No. 3380, a south-bound first-class passenger train, with Conductor Shafer and Engineman Murtough in charge, consisted of gas-electric rail motor-car 4648. At Hudson, 7.9 miles north of Cuyahoga Falls, the crew received copies of train order No. 99, Form 19, previously quoted. While operating on this schedule motor-car 4648 was making a back-up movement; it was operated from a control station located at the left side of the leading vestibule. This train departed from Hudson at 5:49 p. m., according to the train sheet, 4 minutes late, passed switch one, Silver Lake, where it should have taken siding, passed the unattended block station, beyond which it had no authority, and, while moving at a speed estimated to have been about 25 miles per hour, collided with Extra 4454 North.

Engine 4454 telescoped the passenger compartment of gas-electric motor-car 4648 about 12 feet. The motor-car was driven back 537 feet by the impact. The north truck became disengaged and lodged against the south truck; during this process the fuel tank was punctured, the gasoline became ignited, the car was enveloped in flames, and the interior of the car was destroyed by fire. There were a total of 46 persons on this train, and only three survived, these three being railroad employees

who escaped by jumping from the car prior to or at the time of impact. The fact that all the passengers on this train were killed is no doubt due to the severity of the shock of impact and also the fire from the gasoline supply which broke out immediately after the collision. The front end of engine 4454 was badly damaged; the first and the second cars were slightly damaged.

The train-service employee killed was the baggageman of No. 3380. The train-service employees injured were the conductor and the engineman of No. 3380, and the engineman and the fireman of the first engine of Extra 4454.

Summary of Evidence

Engineman Murtough, of No. 3380, stated that his regular assignment was short turn-around passenger service, which consisted of several round trips daily between Akron and Hudson, a distance of 12.9 miles. When he arrived at Hudson on No. 3381, it being customary to operate the gas-electric car backward on the return trip to Akron, he changed the brake-valve handle and the control handle to the control station in the rear vestibule of the motor-car, which was the leading end on the return trip. At Hudson, just before departing on No. 3380, his conductor delivered to him a copy of train order No. 99 and said, "We meet at switch one, Silver Lake." The engineman read the order and understood that his train was required to take siding at switch one, Silver Lake, for Extra 4454 North. The order was legible and in the prescribed form. He understood that his block authority extended from Hudson to Silver Lake only, and that it would be necessary to obtain block authority south of Silver Lake after train order No. 99 was fulfilled. When his train was at a point about 3-1/2 miles north of Silver Lake the thought occurred to him that meeting Extra 4454 at Silver Lake would delay his train sufficiently to result in delay to a B. & O. R. R. train with which his train made connection at Akron; on this account and also because of the short time in Akron before starting the next trip to Hudson it was his practice to avoid delay as far as possible on this trip. He could not recall anything from that point until, as his train was passing switch three, he became aware that he was sounding the road-crossing whistle signal for Payne Avenue and for Front Street and saw Extra 4454 rounding the curve south of the crossings; then he thought of the requirement that his train enter switch one. The speed of his train at this time was about 50 miles per hour. He immediately removed his hand from the brake-valve handle; this operated the safety-control mechanism

and resulted in the brake being applied in emergency and the power being shut off. When the two trains were about three car lengths apart he jumped off; at this time the speed of his train was about 25 miles per hour. He could not explain why he forgot to take siding at switch one. There was no other occupant of the rear vestibule and his attention was not distracted from his duties. Because of being alone in the control compartment, to prevent the possibility of becoming mechanical in his operation, he had formed the habit of calling to himself the block authority at unattended block stations. On various occasions he had operated the gas-electric car involved since it had been placed in service in 1927. He was regularly assigned to short turn-around passenger service the latter part of April; at that time he weighed 210 pounds; however, about the time of the accident he weighed 195 pounds. He is 5 feet 8 inches in height. On occasions when he operated the car in normal direction fumes from the motor exhaust caused him to have headaches and loss of appetite; he stated that he knew of one engineman who was unable to operate a gas-electric motor car for the same reason. When the car was operated from the control station in the rear vestibule the only ventilation was that which was provided by a window in the side door; this window was a sliding panel and covered an aperture about 10 by 12 inches. The weather was hot and the humidity high on the day of the accident. He is familiar with the unattended manual-block system and had operated under its provisions since 1931. He thought that a signal which can display two or more indications is more impressive and distinctive than one which displays the same indication for all block conditions. On occasions when an engineman of a train standing on the main track obtains block authority in advance, it results in only one employee being aware of the block condition. When a block signal is operated to display an indication of the condition of the block in advance, all members of the crew can know that condition and check with each other. If one member of the crew fails to observe the condition of the block there would be some other member to call attention to it. He said that an unattended block system results in a purely mental operation since there is no distinctive indication which would visually attract attention to a condition affecting the use of a block in advance. He thought there is greater possibility of error under an unattended block system because in some instances the members of a crew at the rear of a train have no means of knowing the block condition in advance. He said that it is not unusual to receive train orders directing a passenger train to take siding at Silver Lake.

Conductor Shafer, of No. 3380, stated that the train-order signal at Hudson was displayed and he received from the operator both copies of train order No. 99; it is customary for the conductor to obtain any orders at Hudson and to deliver one copy of each to the engineman. He understood that his train was required to take siding at switch one, Silver Lake. He delivered a copy of train order No. 99 to the engineman and said, "We meet at switch one, Silver Lake;" he thought the engineman understood the requirements of the order. He could not recall whether he showed his copy of the order to the baggageman. After No. 3380 departed from Hudson the conductor was engaged for some time in collecting tickets, then proceeded to the smoking compartment to attend to clerical duties. When the clerical duties were finished he observed that No. 3380 was passing switch three, Silver Lake, at a speed of about 45 or 50 miles per hour and that the opposing freight train was approaching closely. He thought he pulled the conductor's emergency valve; however, he was not certain that he did so. Realizing that a collision was imminent he jumped from the side door of the baggage compartment. He said that he was required to load and unload passengers at stations and to attend to other duties. The schedule time of each trip between Akron and Hudson was 25 minutes and as the lay-over at either end was short it was necessary to complete the reports as each trip was being made. He had been on this assignment as an extra passenger conductor for 10 days prior to the day of the accident; however, during the past several years he had been baggageman on this assignment and was thoroughly familiar with the method of operation. In a statement made to the coroner, he said that if an operator had been in charge of the block station at Silver Lake the accident could have been averted; however, in another statement, he said that if all rules were complied with the unattended block system was safe.

Track Laborer Wonn stated that he was in the baggage compartment of gas-electric car 4648 when it was approaching the point where the accident occurred. He did not know about train order No. 99, nor that No. 3380 was required to meet Extra 4454 at switch one, Silver Lake. As the train approached switch one, Silver Lake, he heard the road-crossing whistle signal sounded and again when the train passed switch three. At the latter point he felt the brakes apply in emergency. The conductor jumped out the baggage-compartment side-door and the track laborer followed him out. The track laborer said that en route from Hudson to the point where the accident occurred the baggageman was occupied in making out reports concerning mail, baggage, and express. The track laborer saw the engineman when he changed the controls to the vestibule end of the gas-electric car at Hudson and at that time the engineman appeared normal.

Engineman Lodge, of the first engine of Extra 4454, stated that a terminal air-brake test was made at Columbus, 134.2 miles south of Cuyahoga Falls, and the brakes functioned properly. Cars were set off and others added to the train at South Akron, 7.2 miles south of Cuyahoga Falls. The brakes of the cars to be added were tested before they were coupled to the remainder of the train and the air-brake inspector reported that each brake applied and released. These cars were then coupled to the remainder of the train and the train crew made an application and release test to determine whether the brakes were operative to the rear end of the train. At Arlington, a stop signal was displayed; the brakes controlled the speed of the train properly in stopping at that point. The signal changed to proceed and the operator handed on a copy of train order No. 99, together with a clearance message. Both the engineman and the fireman read the order and understood its provisions. Between Arlington and Silver Lake the engineman held up one finger to indicate that the meet order was effective at switch one, Silver Lake, and the fireman replied in the affirmative. The engineman said that when his train was approaching the point where the accident occurred he closed the throttle preparing to stop just south of the unattended block sign at Silver Lake. At this time the speed was about 30 miles per hour and the fireman called a warning that No. 3380 was on the main track south of switch three. The brakes were applied in emergency when the trains were about 600 or 800 feet apart, but too late to avert the collision. The speed was about 20 or 25 miles per hour at the time of the collision. The gas-electric car immediately became enveloped in flames. The impact drove the gas-electric car back a considerable distance. He said that he was familiar with the method of operation under the unattended manual-block system.

Since he had not received a clearance Form K granting block authority north of Silver Lake, he intended to stop at the block sign to obtain block authority in advance. This would have been given orally by the operator at Hudson and the engineman would have been the only member of the crew to receive first-hand information concerning block authority; however, he would have told the other members of the crew at the front end of his train. He said that he would not have filled out a Form K, since that was required only when information was received concerning more than one block in advance; this procedure is customary. When train orders are copied by an engineman, the copy for the conductor is placed under the lock of the nearest switch, then the train is pulled a distance sufficient for the conductor to obtain his copy before the train proceeds. He understood that the conductor and the engineman are equally responsible for the safe operation of their train. In his opinion it is as important for a conductor to have block information as to have a copy of a train order. Engineman Lodge said that in some instances his train has been required to stop beyond the block sign for a conductor to report clear of the block in the rear. In such instances an engineman does not know whether this is done but relies upon a conductor to perform that duty. These conditions result in instances wherein the conductor does not have knowledge of block authority in advance and the engineman does not know whether the block in the rear has been cleared. At the time of the accident he had been on duty 13 hours 12 minutes.

Fireman Reynolds, of the first engine of Extra 4454, stated that he read train order No. 39, received at Arlington, and understood that No. 3330 was required to take siding at switch one, Silver Lake. When his train was approaching the point where the accident occurred, he was on the left seat-box maintaining a lookout ahead, and the speed was about 30 miles per hour. He saw No. 3330 approaching on the main track in the vicinity of switch three. He warned the engineman, who immediately applied the brakes in emergency but too late to avert the accident. The fireman said that at this point his view ahead was restricted to a distance of about 750 feet. It was not unusual to receive a meet order wherein a first-class train is required to take siding. He was familiar with the unattended manual-block system. In his opinion the operation is safer when all members of the crew have information concerning block authority. When a block station is attended all members of a crew can see the indication displayed by the block signal. He thought a signal which can display two or more indications will attract more attention to block conditions and is more distinctive than a sign which does not change, and that there is

less possibility of error where manual-block signals are maintained.

Engineman Kropf, of the second engine of Extra 4454, stated that he received a copy of train order No. 99 and understood its requirements. When his train was approaching the point where the accident occurred the speed was about 30 miles per hour and he closed the throttle preparing to stop at Silver Lake block station. Because of track curvature he could not see ahead; he first became aware of the approach of No. 3380 when the brake-pipe pressure became depleted by an emergency application of the brakes, which was followed almost immediately by the collision. He is familiar with the attended and unattended forms of the manual-block system and in his opinion they are equally safe provided the rules are obeyed; however, the operation is safer when the conductor is aware of all conditions affecting the movement of the train. He said that if the accident had not occurred his train would have stopped short of the unattended block sign at Silver Lake. The engineman of the first engine then would have obtained block authority to occupy the block in advance, and would have imparted this information to the members of the crew at the front end of the train, but the conductor and the flagman would not have received this information. At an unattended block station when the supply of Form K is exhausted information concerning block authority is written on any paper available; when the supply of train-order blanks is exhausted, train orders are copied on the back of a time-table or any piece of paper available. Engineman Kropf is familiar with the operation of the gas-electric car involved, and said there is nothing sufficiently intricate about its operation to distract an engineman's attention from his other duties.

The statement of Fireman Huntsberger, of the second engine of Extra 4454, added nothing of importance.

Front Brakeman Ferrill, of Extra 4454, stated that he was in the brakeman's booth on the tender of the second engine en route from Akron to the point where the accident occurred. He did not see train order No. 99. When his train was approaching the point where the accident occurred the speed was about 25 or 30 miles per hour. He felt the brakes become applied in emergency and after moving about 16 or 17 car lengths his train collided with No. 3380. He is familiar with both the attended and the unattended forms of the manual block system. He thought the attended block signal was more impressive than an unattended sign because a signal capable of displaying two or more indications gives block information to all members of a crew. The members of the crew at the rear of a train do not

always know the conditions existing in the block in advance. He thought it safer when all members of a crew have information concerning conditions affecting the movement of their train.

Conductor Collier, of Extra 4454, stated that his train was separated at five points en route where cars were set off and other cars were added to the train; the brakes were tested at each point and they functioned properly each time when used en route. At Arlington he received a copy of train order No. 99, understood its provisions, and had often received similar orders. When his train was approaching the point where the accident occurred he was in the caboose cupola; the speed was about 30 miles per hour and the caboose gauge indicated 70 pounds brake-pipe pressure. He felt the brakes apply in emergency, and his train stopped in a distance of 400 or 500 feet. His train had block authority to Silver Lake only, and it would have been necessary for the first engineman to obtain at Silver Lake authority to occupy the block in advance. Since his train was on the main track this would have resulted in the conductor not knowing the block condition. Conductor Collier is familiar with both the attended and the unattended forms of the manual-block system. He thought the attended form of block system was safer since a block-signal indication made it possible for all members of a crew to know the block authority; also a block signal which is capable of displaying two or more indications is more impressive than an unattended block sign which displays only one indication regardless of the block condition in advance. He said that the conductor and the engineman are equally responsible for the safe operation of their train, but in many instances he had proceeded without having block information. He thought it as necessary for a conductor to have block information as to have a copy of a train order affecting the movement of his train. When a train passed for a considerable distance an attended block-station signal which displayed a stop indication, the conductor of that train was held equally responsible with the engineman. He thought that when a train passed an unattended block station without obtaining authority to enter the block the responsibility would be equal. He said that when the supply of Form K at unattended stations was exhausted pieces of paper were used for recording block authority. In many instances an operator delivers both copies of a train order to the conductor who in turn delivers a copy to the engineman.

Flanagan Milless, of Extra 4454, stated that when his train departed from South Akron the caboose gauge indicated about 68 pounds brake-pipe pressure. He read train order No. 99 which was received at Arlington and understood its requirements. When his train was approaching the point where the

accident occurred the speed was about 30 miles per hour. The train stopped abruptly and he observed that the brake-pipe pressure was depleted. He is familiar with both the attended and the unattended forms of manual block system. He thought that the attended block system provided safer operation than that provided by the unattended block system. He corroborated his conductor's statement concerning operation under the unattended block system.

Dispatcher Weisz stated that he issued train order No. 99. He had been a dispatcher since 1916 and had issued many similar orders. All employees under his supervision were familiar with the provisions embodied in the order. He desired to avert delay; therefore, he conferred superiority on the extra train, since a single-car train could enter and traverse a siding in much less time than a long freight train.

Operator Pickey, on duty at Hudson, stated that he copied train order No. 99, and delivered the engineman's copy to the conductor of No. 3380. The train-order signal was displayed properly. He understood Rule 211 but he considered Conductor Shafer capable of delivering the order properly. When No. 3380 departed from Hudson the block signal at that point displayed a proceed indication which granted block authority to Silver Lake only. He reported the departure of No. 3380 to the operator at Arlington, who in turn reported the departure of Extra 4454.

Operator Whitt, on duty at Arlington, stated that he copied train order No. 99 and delivered, together with a clearance message, copies to the enginemen and the conductor of Extra 4454 as that train passed his office. He said the order was not unusual and he had copied similar orders. He obtained from the operator at Hudson block authority for Extra 4454 to Silver Lake only. Silver Lake unattended block station is under the control of the operator at Hudson. When it is necessary for a train to obtain authority at Silver Lake to proceed into another block, the block records must be checked by the operators at Hudson and at Arlington, then, if the block condition is favorable, block authority is given by the operator at Hudson. When a train is stopped at an unattended station to obtain block authority and it is necessary for that train to report clear of the block in the rear, the engineman is instructed to pull up and stop so that the conductor can report clear. Operator Whitt said that when an emergency arises at an attended station an operator can take action to stop a train, but such action cannot be taken at an unattended station.

Five enginemen who were not involved in the accident were questioned in regard to the method of operation under the

unattended manual-block system. They said that when a clearance Form K is issued at an attended station the rules require that both the engineman and the conductor receive copies. All were of the opinion that operation under the unattended system was as safe as under the attended system. All these enginemen said that an unattended block sign was as impressive and distinctive as a block signal which is capable of displaying two or more indications. None thought that copying train orders or obtaining block authority interfered with his normal duties. All said that the conductor and the engineman are equally responsible for the safe operation of their train. One engineman said that operation was safer when all members of a crew had information concerning block authority; two enginemen said that operation was safe when the engine crew only had information concerning block authority, provided they were thoroughly experienced men; two others said that it made no difference whether the members of the crew at the rear of a train had block information. Four enginemen had operated gas-electric cars; all said that safety of operation was not impaired when a gas-electric car was operated from the rear platform.

Five conductors who were not involved in the accident were questioned in regard to the method of operation under the unattended manual-block system. All these conductors said that the conductor and the engineman are equally responsible for the safe operation of their train. Three of the conductors said that operation is safer when all members of a crew have information concerning block authority; one said that it was safe when the engineman only had block authority, provided the engineman was thoroughly experienced; one conductor said that operation was entirely safe when the engineman only had block authority. Three conductors said that an unattended block sign was not so impressive and distinctive as a block signal capable of displaying two or more indications; two others said that both were equally impressive.

Engineman Grewe, who is regularly assigned to short turnaround passenger service between Akron and Hudson, said that gas-electric motor-car 4648 could be stopped from a speed of 50 miles per hour by an emergency application of the brakes in a distance of 800 or 900 feet.

Electrician Hall stated that he maintained gas-electric motor-car 4648; on the day of the accident it was in suitable condition for service. The power brakes were in excellent condition. He said that no device was used to render the safety-control feature inoperative.

Superintendent Krick stated the rules do not require that a copy of clearance Form K be left at a switch when a train enters the main track at an unattended block station; however, it has become customary to do so on the Cleveland Division. He said that there were about 150 gallons of gasoline in the fuel tank of gas-electric car 4648 just before the accident occurred.

According to data furnished by the railroad, gas-electric motor-car 4648 was built in 1928 by the Pullman-Standard Car Co. It was 73 feet in length over end diaphragms, weighed 122,000 pounds, was divided into an engine compartment, a baggage compartment, a smoking compartment, and a passenger compartment, and had a seating capacity of 70 passengers. The car had a sub-floor of yellow pine 5/8 inch thick covered by maple flooring 13/16 inch thick, on which was laid a composition flooring 1/4 inch thick. The side sheets were of copper-bearing steel 1/8 inch thick lined inside by masonite 7/16 inch thick. The end body-sheets were of copper-bearing steel 3/32 inch thick. The vestibule end-sheets were of copper-bearing steel 3/32 inch thick and the vestibule side-sheets were of copper-bearing steel 1/8 inch thick. The end sills were 8 inches wide and weighed 11.5 pounds per foot. The side sills were of angle construction 3 inches by 5 inches by 3/8 inch open-hearth steel, and 2-1/4 inches by 5-7/8 inches by 1/4 inch Zee copper-bearing steel. The end posts were steel angles 2 inches by 2 inches by 3/8 inch. The side posts were box-section copper-bearing steel 3 inches by 5-1/2 inches by 5/32 inch. The collision posts were of 8-inch channel steel weighing 11.5 pounds per foot. The car was powered by a six-cylinder 275 horse-power gasoline motor which drove two electric motors. The car was equipped with one 250-gallon fuel tank 20 inches wide, 6 inches high and 7 feet 11 inches long; the metal was 1/8 inch thick. This tank was located under the floor, 7-1/2 inches inward from the right side and 28 feet 2-1/4 inches from the front end of the car. The car was provided with AML brake equipment having M-31-C brake valves at each end; the brake valves were provided with a safety-control feature actuated by release of pressure on the brake-valve handle, and with a clutch throw-out chamber to disconnect the power from the motors. When this type of car moves in forward motion it is controlled from a station located in the engine compartment to the right of the motor; when it is moving backward it is controlled from a station located at the left side of the rear vestibule. The volume of the rear vestibule is about 305 cubic feet. Ventilation is provided by a sliding panel window 10 inches by 12 inches located in the left side-door of the vestibule. There is no restriction of view ahead at either end of the car.

According to data furnished by the carrier, Silver Lake block station had been unattended continuously since 1931; it is controlled by the operator at Hudson. On that part of the division extending between Hudson and Joyce Avenue, Columbus, there are eight continuously unattended block stations under the control of operators at attended block stations; there are four other stations which are unattended from 4:30 p.m. to 8 a.m.; on Sundays there are twelve continuously unattended block stations. At night and on Sundays there is one operator who controls four unattended block stations in addition to the attended station where he is located; in another instance, one operator controls three unattended block stations.

Engineman Murtough is 49 years of age. He was last given a periodic physical examination February 22, 1940; his physical condition at that time was normal.

According to Public Health Bulletin No. 195 issued in 1936, entitled, "Review of Carbon Monoxide Poisoning," repeated and continued exposure to carbon monoxide results in saturation of the blood stream. When this saturation rises to a high percentage it results in headaches, loss of appetite, and sometimes loss of consciousness. Following personal experimentation, Haldane reported that the intellect becomes temporarily impaired; however, following restoration, a victim seldom suffers deleterious after effects. The bulletin also reports that an obese person is more susceptible than others to carbon-monoxide poisoning. The combination of carbon monoxide with the blood takes place more rapidly during the first hour of exposure; exercise augments the condition and causes symptoms to appear after short exposure. High temperature and high humidity cause more rapid combination of carbon monoxide with the blood. A doctor reported that during experimentation he wrote the same words repeatedly in his report; two others did not recognize the lapse of time; one other failed to recognize a friend although he was spoken to at intervals during a 2-hour period.

Discussion

According to the evidence, the crew of Extra 4454 understood that No. 3380 was required to take siding at the north switch, switch one, at Silver Lake, for their train. Extra 4454 received a clear block signal at Arlington but their block authority extended only to the unattended block-station sign at Silver Lake. Steam had been shut off on both engines south of switch three, Silver Lake, and the train was drifting, preparing to stop south of the unattended block-station sign, when No. 3380 was seen approaching at a distance of about 1,300 feet. The brakes were applied in emergency but the speed was reduced to only 20 or 25 miles per hour within the distance of

400 feet to the point where the collision occurred.

The conductor and the engineman of No. 3380 received copies of train order No. 99 at Hudson and understood that their train was required to take siding at switch one, Silver Lake, for Extra 4454 North. The conductor delivered the engineman's copy to him and discussed its provisions. This train departed from Hudson with block authority to Silver Lake only; however, it passed switch one, where it was required to take siding, and the unattended block-station sign at Silver Lake, where it was required to have additional block authority, and collided with Extra 4454 a short distance south of switch three.

According to the evidence, when the engineman of No. 3380 was about 3-1/2 miles north of Silver Lake he thought occurred to him that taking siding at Silver Lake would result in delay to his train. Although he continued to operate his train and sounded customary grade-crossing signals, he could not recall anything that occurred from that time until he saw Extra 4454 rounding the curve south of switch three, then he remembered the requirement that his train enter switch one; he immediately applied the brake in emergency, but too late to avert the accident. He could not explain his failure to obey the meet order nor his failure to stop at the unattended block-station sign, beyond which he had no block authority. There was no other member of the crew in the control compartment of No. 3380 with whom the engineman could check, as is common practice on steam engines. The engineman said that he had trained himself to repeat the block authority at unattended stations so that his operation would not become mechanical. Since April he had been assigned regularly to short turn-around passenger service, on which a gas-electric motor-car is used. During that period he lost about 15 pounds in weight and suffered from headaches and loss of appetite. When the car involved was operated from its forward control-station he suffered discomfort from motor-exhaust fumes. From the investigation it is apparent that the engineman was not in full possession of his normal mental faculties while his train was traversing a distance of approximately 4 miles approaching the point of accident. The symptoms described and the mental and physical reactions of the engineman just prior to the time of the accident point toward the possibility that he may have been a victim of carbon-monoxide poisoning. Research reports state that obese persons are particularly susceptible to carbon-monoxide poisoning, that the first hour of exposure is the most hazardous, and that hot weather and high humidity are conducive to rapid saturation of the blood with carbon monoxide. The engineman was 5 feet 8 inches tall and weighed 195 pounds. He had assumed duty on the motor-car involved 1 hour 30 minutes before the collision occurred. The weather was hot and humidity was high. The engineman had oper-

ated the motor-car from the forward control station from Akron to Hudson and had arrived at Hudson at 5:33 p.m. After being in Hudson only 16 minutes he began the trip involved and 9 minutes later the accident occurred. On the trip involved he was located in a compartment having a volume of only 305 cubic feet and having only a 10 by 12-inch opening in the left side-door for ventilation. It is possible that during the trip northward fumes escaped to the engine compartment instead of through the exhaust pipes and that the engineman absorbed a quantity of carbon monoxide. The aforementioned reports state that a person can be under the influence of carbon-monoxide poisoning with a resultant temporary impairment of mental faculties but not be wholly unconscious, and the manner in which the engineman performed indicates the possibility that he was so affected.

The conductor had completed the collection of tickets and when his train passed the switch where it was required to take siding he was engaged in making out reports which were required for each trip of his assignment. According to the rules he was equally responsible for the safe operation of his train; however, only 9 minutes had elapsed since No. 3380 had departed from Hudson and instead of checking to see that his train stopped at the meeting point he was devoting his attention entirely to clerical duties when his train passed that point and it was occupying the main track beyond the point where its superiority was restricted before he took action to stop the train; it was then too late to avert the accident.

The investigation disclosed that the motor-car was carrying about 150 gallons of gasoline, and some of the fatalities no doubt were caused by the fire which broke out immediately after the collision. The fact that a car carrying passengers also carried a large quantity of this highly inflammable fuel resulted in increased hazard to passengers and contributed materially to the disastrous consequences of this accident.

Under the time-table special instruction for operation of unattended manual-block stations, opposing trains may be admitted to the block on either side of an unattended station and meet at the unattended station. All members of both crews involved were familiar with this method of operation. A majority of the employees interrogated stated that the operation was safe if all rules were obeyed; however, most of the employees questioned stated that the operation was safer under the attended block system, for the following principal reasons: The rules require that a train cannot be admitted to a block at an attended station unless the block signal displays an aspect indicating the block authority, or the crew is given either a clearance card or a train order authorizing the train to enter the

block in advance, and at an attended station when a train is admitted toward unattended block territory a clearance Form K must be delivered to both the engineman and the conductor if the train is to pass one or more unattended stations in advance, whereas when a train receives authority at an unattended station to pass one or more unattended stations the conductor is not required to have information of the block authority and often he does not have this information; under the rules the conductor and the engineman are equally responsible for the operation of their train, but under the unattended block system at times the conductor has no knowledge as to conditions affecting safety of operation of his train; when a signal displays the block authority all members of a crew can have knowledge of the block authority, but when an engineman obtains block authority at an unattended station he alone has first-hand information, and if an engineman errs in obtaining block authority there is no further check to insure safe operation; a number of employees were of the opinion that an unattended block-station sign is not so impressive as a block signal which can display two or more indications. Under the rules conductors are held responsible for observing block-signal indications at attended stations, and it is probable that had Silver Lake been an attended station with a block signal the conductor of No. 3380 would have observed the indication of that signal in time to take action to avert the accident. Had an operator been stationed at this point he might have been able to attract the attention of someone on the passing train and to give warning that the train was required to stop; furthermore, the stop indication of an operative signal might have been sufficient to arouse the engineman, as did the sight of the opposing train, to a realization of the fact that he had no authority to pass this point.

On August 20, 1940, the Pennsylvania Railroad applied for approval of installation of a centralized traffic control and automatic block-signal system between Hudson and Arlington, the territory in which the accident occurred, with the control machine located at Hudson, in lieu of the manual block system. This application was approved by the Commission on September 12, 1940.

Conclusion

This accident was caused by failure to obey a meet order and by occupancy of a block without authority.

Respectfully submitted,
S. N. MILLS,
Director.