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NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

RAILROAD/HIGHWAY ACCIDENT REPORT

COLLISION OF A BURLINGTON NORTHERN FREIGHT TRAIN WITH A BUS

STRATTON, NEBRASKA AUGUST 8, 1976

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At 9:26 a.m., c.d.t., on August 8, 1976, an eastbound Burlington Northern freight train struck a southbound bus at a grade crossing in Stratton, Nebraska. The bus was en route to a local church where the passengers were to attend Sunday school. Of the 17 persons in the bus, 9 were killed and 8 were injured.

The National Transportation Safety Board determines that the probable cause of the accident was the failure of the busdriver to perceive the approaching train and to stop his vehicle short of the tracks. Contributing to the accident was the inadequacy of the grade crossing's obsolete wigwag warning signal as a warning device, the visual obstruction of the signal and partial obstruction of the train by parts of the bus, and the inadequacy of the train's horn as a reliable warning system.

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SYNOPSIS

At 9:26 a.m., c.d.t., on August 8, 1976, an eastbound Burlington Northern freight train struck a southbound bus at a grade crossing in Stratton, Nebraska. The bus was en route to a local church where the passengers were to attend Sunday school. Of the 17 persons in the bus, 9 were killed and 8 were injured.

The National Transportation Safety Board determines that the probable cause of the accident was the failure of the busdriver to perceive the approaching train and to stop his vehicle short of the tracks. Contributing to the accident was the failure of the grade crossing's wigwag warning signal to attract the busdriver's attention, the visual obstruction of the signal and partial obstruction of the train by parts of the bus, and the inadequacy of the train's horn as a reliable warning system.

INVESTIGATION

The Accident

On August 8, 1976, Burlington Northern Railroad, Inc., freight train No. 100 departed Akron, Colorado, eastbound en route to McCook, Nebraska. As the train approached Stratton, Nebraska, at a recorded speed of 57 mph, the engineer was operating the train controls at the right front of the lead locomotive. The brakeman was seated in the left rear seat of the lead locomotive, and another brakeman and the conductor were riding in the caboose. The traincrew reported that the weather was clear and that visibility down the track was excellent.

As the train reached the whistle board, about one-fourth mile west of the Beaver Avenue railroad/highway grade crossing, the engineer began to sound the standard crossing signal with the train horn. A bystander on Railway Street, who was 190 feet north of the crossing as the train approached, reported that the wigwag signal and bell at the crossing were operating (see figure 1), that the two fixed headlights on the front of the locomotive were illuminated (see figure 2), and that the train horn was being sounded.

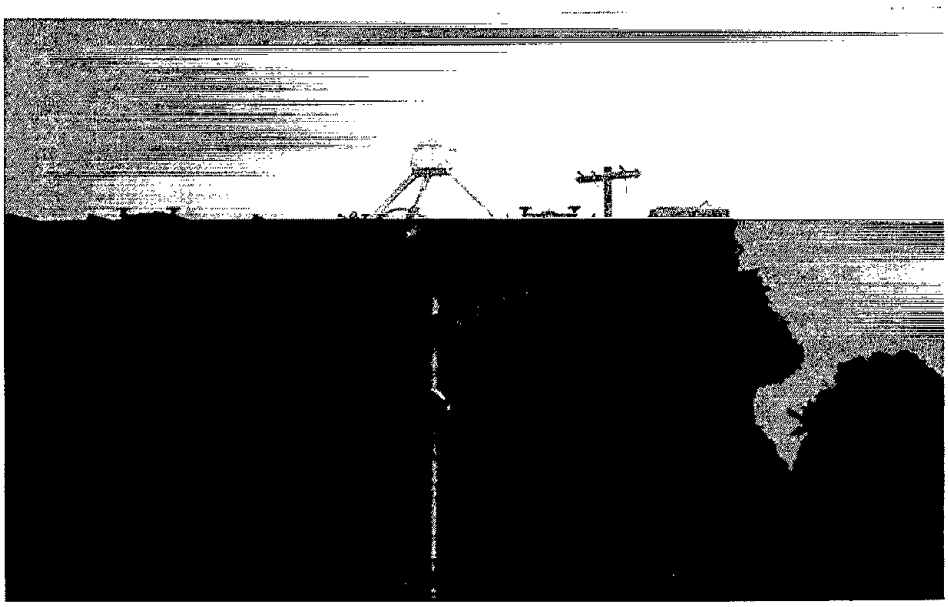

Figure 1. Wigwag Signal at Beaver Avenue Crossing. View looking north on Beaver Avenue.

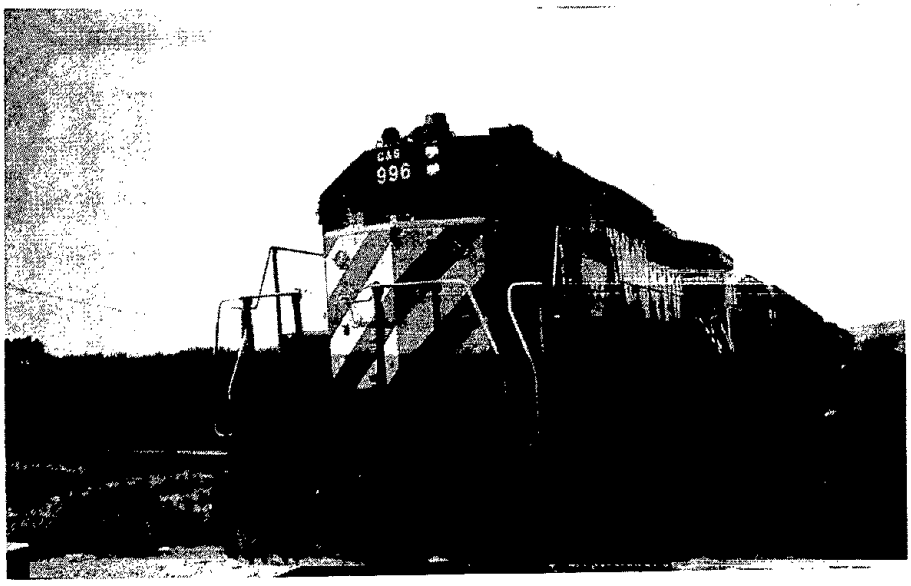

Figure 2. Frontal view of a Burlington Northern Railroad locomotive. The two verticle headlights are burning. The white diagonal stripes are on a background of olive green.

As the train approached the crossing, a schoolbus-type vehicle was traveling east on Railway Street parallel to the railroad tracks (see figure 3). The bus was en route from the Church of Christ building on a routine trip to pick up children for Sunday school classes, which were to begin at 9:30 a.m. The route was less than 2 miles and the bus was approximately 0.5 mile from its destination. The bus, with 16 passengers and a driver, stopped at the intersection with Beaver Avenue. The driver waved to the bystander across the intersection on Railway Street and then turned right onto Beaver Avenue. The bystander noticed that the busdriver's sunvisor was in the down position. The bus a accelerated gradually to a calculated speed of 18 mph, crossed a spur track, and reached the main track 163 feet south of Railway Street. The bus proceeded, probably in second gear, onto the main track crossing without appearing to either slow down or accelerate to avoid the train; the bystander did not see the bus' brake lights come on.

The engineer and brakeman first saw the bus when the train was 800 to 1,000 feet west of the crossing. The bus was turning onto Beaver Avenue from Railway Street at the time. The engineer stated that he thought the bus would stop, so he did not apply the brakes in emergency until just before the lead locomotive hit the bus. The locomotive coupler struck the bus 4 1/2 feet aft of the centerline of the bus' right rear wheel about 9:26 a.m., c.d.t.

The bus rotated clockwise in a horizontal plane and about its longitudinal axis. The bus body was separated from the chassis and came to rest 58 feet east of Beaver Avenue and 26 feet south of the tracks. The chassis stopped 81 feet east of the avenue and 32 feet south of the tracks. The train stopped about 2,500 feet east of the impact point. Sixteen of the 17 bus occupants were ejected from the bus as far as 61 feet east and 24 feet south of the vehicle wreckage.

Injuries to Persons

Injuries	Driver	Passengers	Traincrew
Fatal	1	8	0
Nonfatal	0	8	0
None	0	0	4

Damage to Vehicles

The bus chassis was extensively damaged and a meaningful mechanical evaluation was not possible. However, depression of the brake pedal indicated that hydraulic brake pressure was available; the brake stop light was in working condition; the brake drums and shoes were in good condition; and the steering mechanism appeared to function in a satisfactory manner.

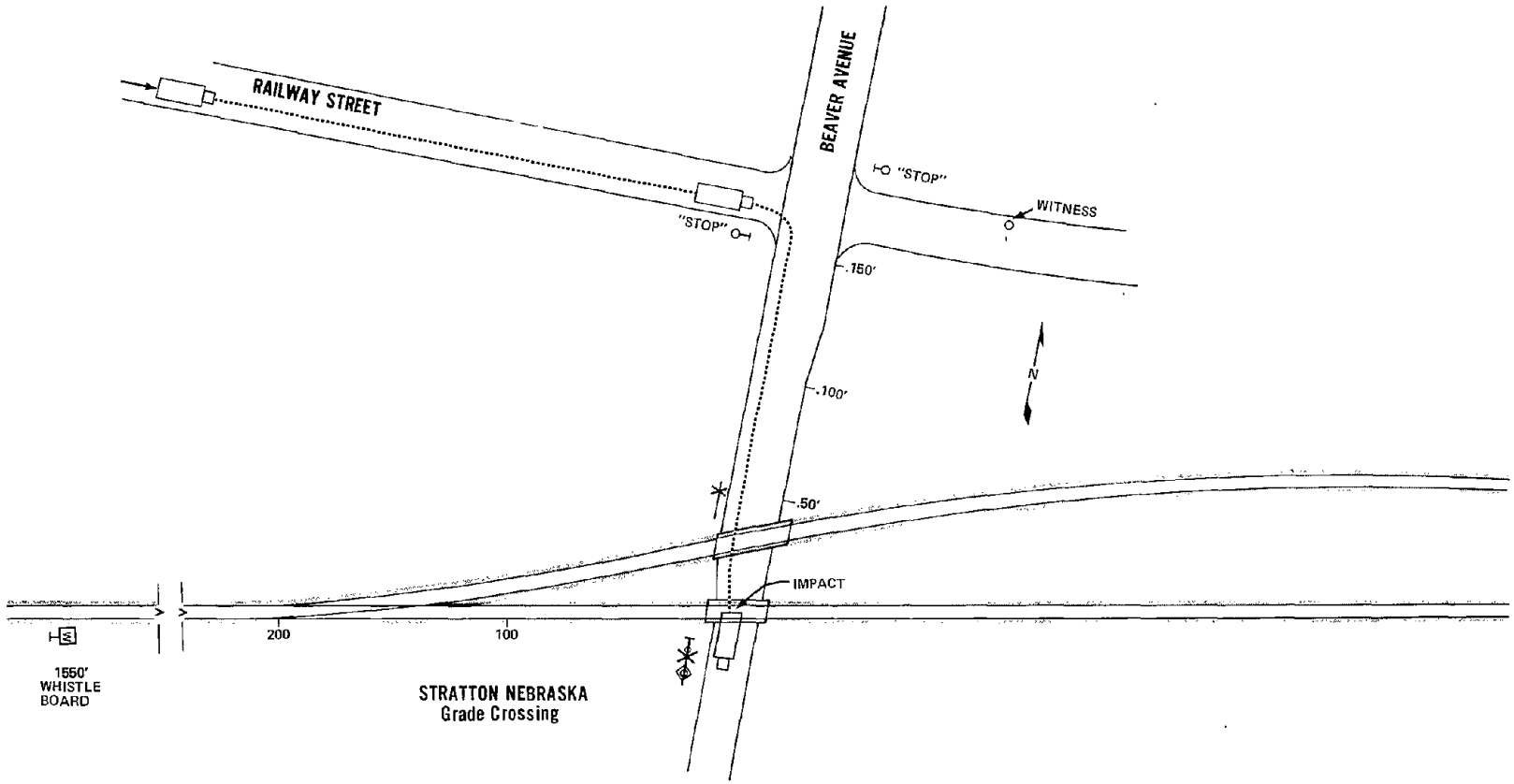

Figure 3. Plan view of accident site.

The bus body separated from the chassis just behind the engine firewall and exposed the passenger area. The windshield was not in place. The emergency door at the rear of the bus was found open. All windows were closed.

The front end of the locomotive received minor damage to the front skirt, right footboard, right lower step, and adjoining grab-ons (handrails).

Operator Information

The 45-year-old, 71-inch-tall busdriver held a valid Nebraska schoolbus driver's permit, which was issued in September 1975 with no restrictions. His driving record in Nebraska, North Carolina, and Georgia revealed no reports of accidents or traffic violation convictions.

The driver was a minister, did not wear glasses, had not evidenced any hearing difficulty, was a local resident and was familiar with the railroad crossing and with the operation of the bus.

The 51-year-old engineer had 30 years of railroad experience. He was promoted to engineer in 1959. The engineer and crew were subject to the Burlington Northern, Inc., operating rules and the train was being operated in accordance with the rules.

Vehicle Information

The 36-passenger bus was a 1966 Wayne schoolbus body, model CP6-1709, installed on a 1966 Chevrolet chassis in a standard schoolbus configuration. The bus had an 8-cylinder gasoline engine, hydraulic brakes with vacuum assist, a manual 4-speed transmission, and an odometer reading of 10,715 miles.

The vehicle was purchased new by the Stratton Public School System and used as a schoolbus. In April 1976 the bus passed the State-required annual inspection and was acquired by the Church of Christ.

Freight train No. 100 was composed of three locomotive units and 67 freight cars. The lead unit was a General Electric U-30-c locomotive unit and was painted green with diagonal stripes on the front below the windshield. It was a regularly scheduled train that operated 7 days a week and was due in McCook, Nebraska, 30 miles to the east, at 9:00 a.m., c.d.t. If on time, the train passes through Stratton around 8:30 a.m., c.d.t. On the day of the accident, it was almost an hour late.

Highway Information

Beaver Avenue is a two-lane, two-way, undivided, 22-foot-wide roadway with a posted speed limit of 25 mph in the rural town of Stratton. It is paved with concrete up to the north rail of the spur and asphalt-paved beyond. It narrows to 18 feet wide as it continues south across the spur and main tracks.

The north rail of the spur track is 133 feet south of the centerline of the intersection of Railway Street and Beaver Avenue. The north rail of the main track is 163 feet south of the intersection. The roadway is straight and level through the accident area. The view of the tracks to the west along Beaver Avenue from its intersection with Railway Street to the crossing is across an open field which is covered with weeds and a few trees. One tree, located about 600 feet west of Beaver Avenue and 50 feet north of the tracks, could have partially and momentarily obstructed the busdriver's view of the train. There were trees and foliage south of the tracks.

A standard railroad crossing advance warning sign is located on the northwest corner of the Beaver Avenue/Railway Street intersection, facing north along Beaver Avenue. This sign was not visible to the busdriver. (See figure 3.) A standard crossbuck sign was located on the west side of Beaver Avenue 7 1/2 feet off the pavement and 7 1/2 feet north of the north rail of the spur. No warning symbols were painted on the pavement to inform southbound motorists of the presence of the crossing.

An automatic railroad grade crossing wigwag signal was located 10 feet off the west side of Beaver Avenue, 14 feet south of the north rail of the main track. The center of the pendulum was 12 feet 2 inches above the paved surface of the roadway. The actuator for the signal was located more than 3,600 feet west of the crossing. The wigwag signal light operates on a 10-volt electrical system with a 10-watt bulb. The signal has a 20-inch-diameter wigwag pendulum designed to be attention-getting in the daytime and a 5 1/2-inch-diameter red light in the center of the pendulum for nighttime observation. The crossbuck and wigwag signal were clearly visible from the intersection of Beaver Avenue and Railway Street.

This type of signal is no longer listed in the Association of American Railroads signal standards, and is no longer being installed at railroad/highway grade crossings because newer flashing light systems are more effective, more economical to operate, and easier to install and maintain.

The main track crossed Beaver Avenue at an 81° angle. It was straight from three-fourths mile west of the crossing and continued straight for 1 1/4 miles east of the crossing. The track was level from 1,267 feet west of the crossing to 264 feet east of the crossing and was at grade with the surrounding terrain. The maximum timetable track speed for freight trains through this area is 60 mph.

According to Nebraska State Patrol records, no other fatal accidents have occurred at this crossing. Beaver Avenue is the only paved street extending south from Stratton. The accident crossing is considered a

major crossing by the community. A 1975 traffic count recorded an average daily traffic count of 400 motor vehicles and 8 to 9 trains per day using this crossing.

Meteorological Information

The weather was clear and cool. The temperature was between 65° and 70° F. According to the records of the U.S. Naval Observatory, the sun was at 21° elevation and its azimuth was 4° north of east at the time of the accident.

Medical and Pathological Information

A test of the busdriver's blood revealed no alcohol content. Autopsies were not performed on the driver or the other deceased.

Survival Aspects

The busdriver was not using his seatbelt; none of the passengers were provided with occupant restraints. The occupants were ejected either through the open front or the open emergency door at the rear of the bus. One body remained in the bus and was found between seats on the right side of the bus near the initial impact point.

All of the fatalities sustained severe head or neck fractures. The survivors suffered from fractures, lacerations, and concussion. The sources of the injuries were not determined.

Other Information

At the time of the accident the busdriver's 52-inch-tall son was standing in the doorwell of the bus, 10 inches below floor level. The bus occupants were singing and none of the survivors recall hearing the train horn or seeing the approaching train.

ANALYSIS

At the time of the accident, the sun's position was 21° above the horizon and 86° east of north. Motorists driving east on Railway Street were looking directly into the sun. The witness noticed that the bus' sunvisor was down as the bus was traveling east on Railway Street. If the busdriver did not raise the sunvisor after turning to the south onto Beaver Avenue, the sunvisor might have obscured his view of the wigwag signal.

Investigators later developed the data necessary to determine the horizontal and vertical fields of vision available to the busdriver as he approached the crossing by taking measurements in a 1968 Wayne schoolbus, which is similar to the accident bus. Of significant concern were:

(1) the possible forward vision obstruction posed by the sunvisor in the down position; (2) the possible vision obstruction to the right in the direction of the approaching train by the body frame's right "A-pillar" and right outside-mounted rearview mirror; and (3) the possible vision obstruction caused by the boy standing on the first step below floor level in the doorwell.

The bottom of the sunvisor in the down position was 48 inches above the floor level. The eye level of a 71-inch-tall driver in a seated position was 47 inches above floor level, 83 inches above the street level, and 20 inches back from the sunvisor. It was calculated that this relationship of levels could have obscured the driver's vision of the 12-foot 2-inch-high wigwag signal after the bus was within 75 feet of the crossing. After turning onto Beaver Avenue the busdriver was involved in shifting the transmission and probably did not raise the sunvisor. The busdriver could have traversed the last 75 feet to impact without observing the wigwag signal if it was obscured by the sunvisor. This is based on the assumption that the driver did not lower his eye level.

As the bus first turned onto Beaver Avenue a tree located north of the tracks and west of Beaver Avenue might have created for the busdriver a brief, partial view obstruction of the headlights and diagonal white stripes on the front of the lead locomotive while the rest of the train blended into the green foliage in the background.

The right A-pillar and outside-mounted rearview mirror were within a 66.8° to 78.3° segment of the seated driver's field of vision to the right. As the accelerating bus and train moving at a constant speed approached the crossing, the mirror and A-pillar provided a potential partial visual obstruction. The A-pillar, outside-mounted rearview mirror, and the tree in the field may have combined to obstruct the driver's field of view of the lead locomotive unit with its attention-getting diagonal white stripes and illuminated headlights, and of some of the following freight cars. However, if the driver had been alert and observing, he should have seen the train.

The measurements determined that the boy in the bus doorwell was below and to the right of the driver's field of vision and would not have obstructed the driver's view of the train.

The busdriver may not have expected to encounter the train because it was scheduled to pass this crossing around 8:30 a.m. Consequently, he may not have looked for a train as carefully as he normally would have.

The combination of sound from the singing occupants and the probable increase in engine and drive line noise as the bus accelerated might have obscured the sound of the train horn.

Following its investigation of a grade crossing accident near Waterloo, Nebraska 1/ on October 2, 1967, the National Transportation Safety Board recommended that the Federal Highway Administration (FHWA) and the Federal Railroad Administration (FRA) study the audibility of external sound signals within motor vehicles. Upon completion of the recommended study, the FRA published a report in May 1971, "The Visibility and Audibility of Trains Approaching Rail-Highway Grade Crossings."

The FRA report concluded that "... present railroad horns cannot warn motorists reliably when either the train or the motor vehicle is going very fast. To 'warn' a motorist, the sound must penetrate into his vehicle and override ambient noise to alert him, while the vehicle is far enough away from the crossing to still be able to stop. It is not suggested that horns are seldom heard by motorists, but rather, that they fail to reach some motorists and are thus questionable as primary warning devices."

The train in this accident was traveling at a constant rate of 83.6 feet per second (57 mph) while the bus was accelerating at a calculated rate of 2.26 ft/sec^2. The train was 800 to 1,000 feet from the crossing when the bus turned onto Beaver Avenue. According to the FRA report, the range at which the warning must alert the motorist is "that distance from the train to the vehicle at which the motorist must be alerted if he is to stop on time." An interpolation of the report data indicates that a range of 300 feet was more than ample in this case.

When the train was 300 feet from the crossing and well within the range for the horn to be audible, the busdriver was still 84 feet or about 3.6 seconds from the crossing. This permitted enough time for the busdriver to hear, perceive, react, and stop the bus. Investigators could not determine why the busdriver did not hear the horn.

All of these events and related factors, which occurred in the 12 seconds, before the accident, could have interfered with the driver's perception of the approaching train.

Since Beaver Avenue is the only paved thoroughfare carrying highway traffic south out of Stratton, elimination of the grade crossing is not feasible. Because of this accident and the important role of the crossing in the local transportation system, the crossing should be protected by an improved warning system. Consideration should be given to highway traffic lights which have a history of outstanding compliance by most motorists.

The wigwag signal installed at this grade crossing is obsolete. The wigwag pendulum is 12 feet 2 inches above the ground, the red light

1/ NTSB Report: "Waterloo, Nebraska, Public School Schoolbus and Union Pacific Railroad Company Freight Train Accident, Waterloo, Nebraska, October 2, 1967" (NTSB SS-R/H-3).

is neither bright enough nor was it designed to be effective during daylight, and the signal bell is neither loud enough nor was it designed to be heard for any appreciable distance from the signal, especially within an approaching motor vehicle.

During the last 6 months of 1976, the Safety Board was notified of 394 railroad/highway grade crossing accidents involving 517 fatalities. In 1975, the National Safety Council reported 1,000 grade crossing fatalities. 2/ This number is more than the total of all other railroad (564), air carrier (124), and pipeline (30) accident fatalities for 1975.

Accident data show that: (1) a majority of those persons involved in grade crossing accidents are familiar with the crossing; (2) in spite of a driver's perception of a potential hazard at the crossing, a habit of inattention is formed after repeated crossings without the presence of a train; (3) many of the accidents occur at crossings equipped with warning devices that are considered adequate; and (4) while crossings with active protection devices constitute 22 percent of the crossings, 41 percent of the fatalities and injuries occur at these crossings. 3/ Since these percentages do not reflect exposure levels, they should not be interpreted to mean that active protection devices are not superior to the obsolete ones involved in this accident. Currently, approved active protection devices have considerably more alerting value. For that reason the Board favors the installation of protection systems in accordance with the Standard Procedures of the Association of American Railroads. At the same time, accident experience involving active protection devices proves the need for continued efforts to develop and implement a uniform and superior system of warnings.

CONCLUSIONS

Findings

1. The investigation did not find evidence that suggested mechanical difficulty with the bus before the collision.

2. The bus accelerated at an average rate of speed from a stopped position on Railway Street to a calculated speed of 18 mph at the point of impact, 163 feet away.

3. The busdriver made no apparent effort to stop the bus short of the crossing.

4. The busdriver might not have expected to encounter the train because it usually passed the Beaver Avenue crossing about 8:30 a.m. every day.

2/ Accident Facts, 1976 Edition, National Safety Council.
3/ "Human Factors Countermeasures to Improve Highway-Railway Intersection Safety" DOT HS-190-2-300, July 1973, Final Report.

5. Once the bus was within 75 feet of the crossing, the sunvisor in the down position could have obscured the driver's view of the 12-foot 2-inch-high wigwag signal.

6. The location of the right A-pillar and the outside-mounted rearview mirror on the bus might have prevented the busdriver from seeing momentarily the lead locomotive and part of the approaching train.

7. The warning systems were actively announcing the approach of the train to the crossing:

   - o The wigwag signal pendulum was working.
   - o The wigwag signal light was illuminated, although it was not bright enough to attract the attention of a motor vehicle driver under daylight conditions.
   - o The signal bell was working, although it was not loud enough to attract the attention of a motor vehicle driver approaching the crossing.
   - o The locomotive headlights were illuminated.
   - o The locomotive horn was being operated.

8. When the train was within 300 feet of the crossing, the horn audibility was of such intensity that it should have been heard by the busdriver.

9. When the train was within 300 feet of the crossing, the bus was an estimated 84 feet from the crossing. At this point the busdriver could have stopped the bus short of the crossing.

10. The bus engine, drive line, and road noise together with the singing by the bus occupants might have interfered with the driver's ability to hear and identify the audible signals from the train and crossing warning device.

11. There is no evidence to suggest physiological failure of the driver or that he intentionally drove into the path of the train.

12. The railroad/highway grade crossing warning system installed at this crossing is obsolete and does not conform with current recommended practices of the Association of American Railroads.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the failure of the busdriver to perceive the

approaching train and to stop his vehicle short of the tracks. Contributing to the accident was the inadequacy of the grade crossing's obsolete wigwag warning signal as a warning device, the visual obstruction of the signal and partial obstruction of the train by parts of the bus, and the inadequacy of the train's horn as a reliable warning system.

RECOMMENDATIONS

As a result of its investigation of this accident the National Transportation Safety Board made the following recommendations:

-- to the Federal Highway Administration and Federal Railroad Administration:

"Combine efforts to develop and implement a uniform system of warning devices to attract the attention of motor vehicle drivers approaching railroad/highway grade crossings. (Class III, Longer Term Followup) (H-77-9)"

-- to the city of Stratton, Nebraska:

"In cooperation with the Burlington Northern Railroad, Inc., install an improved railroad/highway grade crossing protection system on Beaver Avenue in accordance with the Recommended Practices of the Association of American Railroads (1974). (Class II, Priority Followup) (H-77-10)"

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ KAY BAILEY
Vice Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ PHILIP A. HOGUE
Member

WEBSTER B. TODD, JR., Chairman, and WILLIAM R. HALEY, Member, did not participate in the adoption of this report.

August 11, 1977