UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES
HEALTH AND SAFETY ACTIVITY

HEALTH AND SAFETY REPORT

FINAL REPORT OF MAJOR MINE FIRE DISASTER
SUNSHINE MINE
SUNSHINE MINING COMPANY
KELLOGG, SHOSHONE COUNTY, IDAHO

May 2, 1972

By

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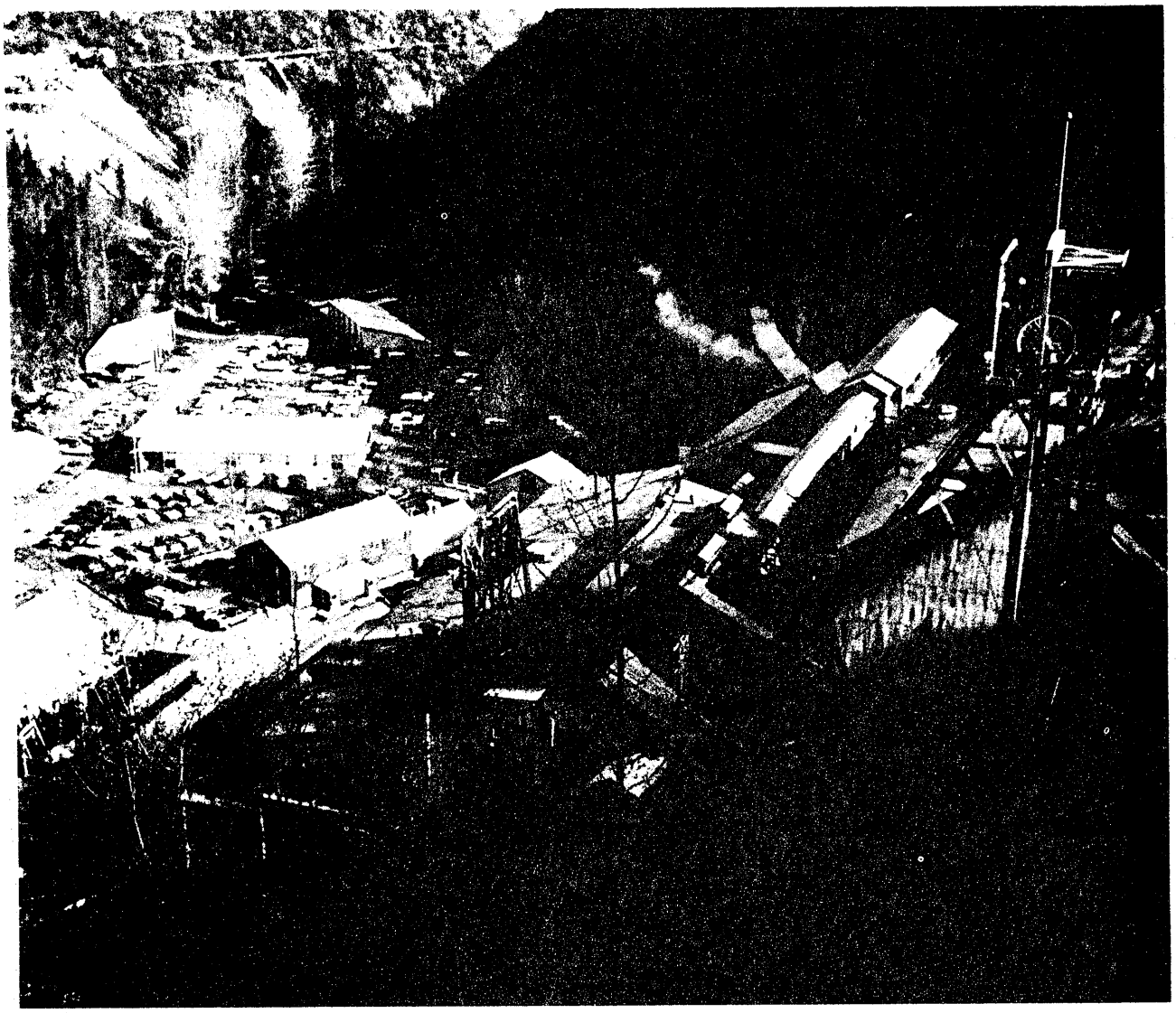

SUNSHINE MINE

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INTRODUCTION

This report is based on an investigation made pursuant to clause (1) of Section 4 of the Federal Metal and Nonmetallic Mine Safety Act (80 Stat. 772).

Reference numbers used in the report identify mine safety standards promulgated in the Federal Register, Vol. 34, No. 145, Thursday, July 31, 1969; Federal Register, Vol. 35, No. 38, Wednesday, February 25, 1970; Federal Register, Vol. 35, No. 237, Tuesday, December 8, 1970; and Federal Register, Vol. 37, No. 139, Wednesday, July 19, 1972.

This report relates all available facts pertaining to conditions prior to discovery of the fire, events immediately thereafter, subsequent rescue and recovery efforts, investigation of the cause of the disaster and analysis of all the foregoing.

This report also includes reasonable conclusions consistent with known conditions and practices at the Sunshine Mine. Conclusions are so identified.

Recommendations are made to prevent recurrence of a similar disaster.

While this report deals with conditions and events at the Sunshine Mine, the information presented may be applied, with little basic adaptation, to many other underground mines.

ABSTRACT

Smoke was detected in the main haulageway near the electric shop on the 3700 level of the Sunshine Mine, Kellogg, Idaho, about 11:40 a.m., May 2, 1972. The volume of smoke, accompanied by carbon monoxide, increased rapidly and was also detected in the 3100 level main haulageway. Both the 3100 level and 3700 level haulage drifts served as main fresh air intakes to the stope area below 3700 level near No. 10 shaft, where most of the 173 men in the mine that shift were assigned. Mine supervisors, after attempting to locate the fire, ordered evacuation of workmen from the mine about 12:03 p.m. Before the evacuation was halted by the death of the No. 10 shaft hoistman, 80 men escaped from the mine. An intensive rescue operation, organized by industry and Bureau of Mines personnel resulted in the rescue of 2 men. The remaining 91 men died of carbon monoxide poisoning. None of the survivors reported seeing fire or flames.

The Bureau of Mines believes the probable cause of the fire was spontaneous combustion of refuse near scrap timber used to backfill worked out stopes. The fire occurred in an abandoned stoping area near the intersection between the 3400 level exhaust airway and the 09 vein. Extensive ground falls and caving occurred in the immediate area when timber supports were consumed, making investigation of the entire fire area impossible.

It is not possible to single out any one fact as the chief cause for the large loss of life. However, the Bureau of Mines believes that the following major factors contributed to the severity of the disaster:

1. The emergency escapeway system from the mine was not adequate for rapid evacuation.
2. Top mine officials were not at the mine on the day of the fire and no person had been designated as being in charge of the entire operation. Individual supervisors were reluctant to order immediate evacuation or to make a major decision such as stopping the 3400 level fans.
3. Company personnel delayed ordering evacuation of the mine for about 20 minutes while they searched for the fire.
4. The series ventilation system used in the mine caused all persons inby the fire, which contaminated the main intake airways, to be exposed to smoke and carbon monoxide.
5. Most of the underground employees had not been trained in the use of the provided self rescuers and had difficulty in using them. Some self rescuers provided by the company had not been maintained in useable condition.

6. Mine survival training, including evacuation procedures, barricading, and hazards of gases, such as carbon monoxide, had not been given mine employees.

7. The emergency fire plan developed by the company was not effective. The company had not conducted evacuation drills.

8. Abandoned areas of the mine had not been sealed to exclude contaminated air from entering the ventilation airstreams.

9. The controls built into the ventilation system did not allow the isolation of No. 10 Shaft and its hoist rooms and service raises or the compartmentalization of the mine. Smoke and gas from this fire was thus able to move unrestricted into almost all workings and travelways.

These and many other factors involved in the disaster are discussed in detail in the Findings and Analysis section of this report.

GENERAL INFORMATION

The Sunshine silver mine, which also produces copper and antimony, is in Big Creek Canyon about 8 miles east of Kellogg, Shoshone County, Idaho. It was first opened in the late 19th century and is operated by Sunshine Mining Company.

Irwin P. Underweiser was president; Marvin C. Chase, vice president and general manager; Al Walkup, mine superintendent; Leon Barr, mill superintendent; James Farris, personnel and safety director; and Robert Launhardt, safety engineer.

Employment totaled 522 persons, 429 of whom worked underground. The mine was operated three shifts daily, 5 days weekly. Main access to the mine was through a 200-foot long adit to the Jewell Shaft, at the western edge of the mine, down that shaft to the 3100 and 3700 levels, eastward through 5,000-foot long drifts to the No. 10 Shaft, which was collared at the 3100 level, and down that shaft to the active working levels. No. 10

winze and several other vertical openings in the mine were sunk as winzes, but were locally referred to as shafts. (Local terminology is used in this report).

The No. 10 shaft was bottomed just below the 6000 level. Ore was produced from the 4000, 4200, 4400, 4600, 4800, 5000, and 5200 levels. Level development work was in progress on the 5400 level; shaft station development work was in progress on the 5600 and 5800 levels. Surface elevation at the collar of the Jewell shaft was about 2,700 feet above sea level. Level designations represent distances in feet below the Jewell shaft collar. For references, maps are included in the appendix. In December 1945 an underground fire caused extensive property damage, but no loss of life. That fire was started by a short circuit in the 2900 level storage-battery-charging station and was extinguished by sealing and flooding the lower levels.

Large mined out square-set stopes reportedly were above the 3700 level and west of No. 10 shaft. The general condition of the mine was dry. The last regular Federal inspection of the mine was made November 9-12, 1971, and subsequent spot inspections were made January 12 and March 22, 1972. Copies of these reports are available for inspection at the Bureau of Mines Offices, Washington, D. C., and at the following Metal and Nonmetal Mine Health and Safety Offices:

Western District Office
620 Central Avenue
Alameda, California

Seattle Subdistrict Office
Federal Office Building
Seattle, Washington

Spokane Field Office
Seattle Subdistrict
Post Office Building
Spokane, Washington

MINING METHODS, CONDITIONS, AND EQUIPMENT

Mining Methods

Steeply dipping fissure veins were mined by the horizontal cut and sand-fill method by either breasting down or back stoping. The principal ore mineral was tetrahedrite. The stopes were developed a maximum of 100 feet along the strike of the vein. Level intervals were 200 feet. A raise climber was used to drive 6- by 6-foot raises between levels. Ore was concentrated in the mill adjoining the mine.

Ground was controlled in drifts by steel mats and 3/4-inch-diameter rock-bolts 4 and 6 feet in length. The mats and bolts were used alone or in conjunction with drift timber. Similar rock-bolts with or without head-boards were used in the stopes. Stulls and three-piece timber sets with squeeze caps were used in combination with rock-bolts and headboards to support incompetent ground in stopes. While waste rock had been used to backfill stopes above 3700 level, sand-fill with cement capping was used to stabilize the mined-out sections of stopes below 3700 level.

Ventilation

Air flow for the Sunshine mine was dependent upon pressures developed by fans located underground. A diagram of the overall ventilation system for the mine is included on the mine map in Appendix J. All of the intake air for the ventilation of the mine was coursed down the Jewell Shaft to the 3100 and 3700 levels. The air was split between those two levels and traveled laterally to the No. 10 Shaft. About 2,000 cfm of air on the 3700 level was coursed through the No. 12 borehole to the 4800 level and then laterally to No. 10 Shaft. Also on the 3700 level, some air was diverted through the Sun Con crosscut.

Intake air from the 3100, 3700 and 4800 levels joined at the No. 10 shaft and coursed down to the 5200 level. Air flow was split on the 5200 level into east and west laterals and was then moved upward through the working stopes to the 4400 level. Up to 16,000 cfm of air was added to the system by the use of compressed air powered equipment. From the 4400 level, ventilation raises located approximately 400 feet to the east of No. 10 shaft provided the airways for upward flow to the 3400 level. Less than 5,000 cfm of the return air flow was passed to the 3100 level, then eastward through the interconnected Silver Summit mine to the surface. The balance of the return air moved westward along the 3400 level exhaust airway to the No. 3 ventilation raise, through which it passed to the 1900 level. An air split was made on the 1900 level where 12,000 cfm of air moved through the Big Hole ventilation shaft to the surface, and the remainder coursed up the inclined shaft and out the Sunshine tunnel. Measurements made April 24, 1972, indicated 95,300 cfm of air travelled across the 3400 level exhaust airway. About 2,000 cfm of air leaked from the 3700 level pipe shop area upward through No. 8 Shaft to the 3550 level and then to the intake side of the 3400 level exhaust fans.

Main fans were located on the 5200, 3400, and 1900 levels and in the Sunshine adit, in a series system. The fan controls were located near the fans.

Methane or other flammable strata gases were not emitted into the mine. A flame safety lamp was available for testing for oxygen deficiency. Two carbon monoxide detectors were available at the mine safety office.

Refrigeration air-conditioning units were installed in the mine to cool the high ambient air temperatures on the lower levels.

Additional information concerning air quantities, fan installations, the effect of natural ventilation, and resistance to air flow is given in the Bureau of Mines report "Ventilation Survey, Sunshine mine, Sunshine Mining Company, Kellogg, Shoshone County, Idaho, September 14 to October 4, 1971, by R. K. Foster and J. W. Andrews," and in the report of "Supplemental Ventilation Survey, April 24, 1972," by the above individuals. Copies of the reports are available for inspection at the Bureau of Mines in Washington, D. C., and at the following Metal and Nonmetal Mine Health and Safety Offices:

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Seattle Subdistrict
Post Office Building
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Shafts and Hoisting

The Jewell and No. 10 shafts were each provided with electric-powered double-drum hoists, and electric-powered single-drum "chippy" hoists.

The Jewell Shaft was originally sunk to a depth of 3860 feet as a four-compartment shaft. Later, two of the four compartments were extended to 45 feet below the 4000 level. The double-drum hoist at the Jewell shaft was used to hoist ore from the 3700 level and for hoisting ore and waste from the 3100 level. The "chippy" hoist at the Jewell shaft was used for moving men and materials to all levels as far down as the 4000 level and for hoisting ore from the 4000 level to the 3100 level.

The No. 10 shaft was a three-compartment shaft from the 3100 level down to 90 feet below 4400 level. From there it was three-and-a-half compartments down to 48 feet below the 4600 level. From that point, it continued to the 6000 level as a four-compartment shaft. The No. 10 double-drum hoist on the 3100 level was used primarily for hoisting ore and waste from mine production and development work. Ore was dumped into a pocket on 3700 and was transferred by train to the Jewell shaft for hoisting to the surface. Waste rock was hoisted to the 3100 level and was similarly transferred for hoisting to the surface at the Jewell shaft. A single-deck 9-man capacity man cage was suspended below the skip in each of the two compartments served by the double-drum hoist. The No. 10 "chippy" hoist was on the 3700 level and was equipped with a four-deck man cage with a total capacity of 48 men. It was used for servicing all levels below 3700.

Escapeways

Escapeways from the mine consisted of raise ladderways from stopes to main levels, drifts and crosscuts to the shafts, No. 10 shaft, Jewell shaft, service raises paralleling No. 10 shaft from 4600 level to 3700 level, and the drift to Silver Summit shaft. Escapeways from the various working areas of the mine are illustrated in Appendix J.

Electricity

Electricity from two surface substations was conducted down the Jewell shaft at 13,800 volts and 2,300 volts, alternating current, by armored borehole cables.

At the Strand substation on 3700 level, the 13,800 volts electricity was transformed to 2,300 volts alternating current. Four individual cables conducted electricity from the Strand substation to 3100 level No. 10 shaft hoist, 3400 level main ventilation fans, 3700 level F-19 switch station, and 3700 level No. 10 shaft service hoist. From F-19 switch station, electricity was conducted to substations on 3700, 4200, 4400, 4600, 4800, 5000, 5200, 5400, and 5800 levels. At the individual level substations the 2,300-volt power was transformed to 440, 220, and 110 volts, alternating current, to power auxiliary fans, slusher hoists, other mining equipment, and for mine illumination.

Grounding grids were buried in the earth at the utility company substations, company surface substations, and adjacent to the Jewell shaft collar. The ground network was extended into the mine upon the armor sheath of the borehole-type cables installed in the mine shafts and upon messenger cables used to suspend cables throughout the mine. Grounding of portable mine equipment was provided through a ground conductor in the equipment cable which was connected to the messenger wire system.

Overload protection, short-circuit protection, and individual disconnect switches were provided at the individual mine equipment, switch stations and substations. Diagrams of the mine substations and switch stations were on file at the mine electric shop.

Communications

A single telephone circuit was provided for normal communications between underground shaft stations, hoistroom, shops and the mine surface. An emergency system was provided with telephones in the safety engineer's office on the surface and the underground first-aid room on 3700 level.

Illumination and Smoking

Individual cap lamps were provided for the mine personnel. Shaft stations were illuminated by 110-volt incandescent lamps, as were shops and maintenance areas.

Smoking was prohibited underground near shafts and explosives-magazine areas, in the 3400 level ventilation return drift and in such areas as oil-storage and battery-charging stations. These areas were posted with signs prohibiting smoking.

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Safety Program

The company personnel director, who reported to the general manager, was responsible for the safety program. A full-time safety engineer was employed. The safety engineer's duties included coordinating safety efforts, conducting safety inspections, and inspection and maintenance of safety equipment. Biweekly labor-management safety committee meetings were held. In addition to regular daily inspections conducted by the company safety engineer, a monthly inspection was conducted by the safety engineer with a union safety committeeman, in an area of the mine selected by the union. First-aid classes were conducted once a year. Use of self rescue devices was included in the first-aid training. A total of 46 persons received training in the class conducted during March 1971. Employees attended the classes on a voluntary basis and were compensated for class time. Even though the company provided training, those attending training sessions represented a small percentage of the work force.

Mine Rescue

Fourteen men were trained in mine resuce in May 1971. Nine other men had received training the year before. The company had a program of retraining at maximum intervals of 1 year, but had held retraining classes twice a year during the past few years. Ten sets of 2-hour McCaa self-contained oxygen breathing apparatus were available on the surface. The apparatus were tested every Thursday by a representative of the Central Mine Rescue Station in Wallace, and records were kept of the tests. The self rescuers were stored in locked wooden boxes at various No. 10 shaft stations, the No. 10 shaft hoistroom on 3100 level and in the first-aid

room on 3700 level. Locks had been installed on the boxes to prevent pilferage.

Firefighting Facilities and Organization

Water was available at all working places underground at 60 psi, through 1- and 2-inch lines. Water deluge systems had been installed in both the Jewell shaft and in the No. 10 shaft. The water supply included a 50,000-gallon tank reserved for firefighting. A 60,000-gallon mine and mill supply tank and a 30,000-gallon tank used for the sandfill system could also be valved into the fire-fighting system. Water could also be pumped directly into the system from a creek on the property by two pumps capable of furnishing 1,200 gpm at 180 psi. The pumps were checked weekly and records were kept. Water from the mine supply was delivered underground through a 4-inch-diameter pipeline to a small surge sump on the 1900 level. A 4-inch-diameter pipeline carried water from the 1900 level sump to a 25,000-gallon-capacity sump on 3100 level near No. 10 shaft. Water flow to these sumps was controlled by solenoid valves. All underground water lines had 1-inch valves and connections at 150-foot intervals.

A foam generator capable of being moved on rails or on rubber tires was kept on the surface. About 600 feet of polyethylene roll-out tubing and 1,200 gallons of high expansion foam were kept on hand.

Each shaft station was equipped with a 20-pound multipurpose, dry chemical fire extinguisher, and hoistrooms, pump rooms, battery-charging

stations, underground shops, and most transformer stations were equipped with 10- or 20-pound dry-chemical extinguishers, while 5-pound dry-chemical extinguishers were installed on portable welding equipment. Also, battery-charging stations were equipped with 5-pound CO_2 extinguishers. Company officials stated that extinguishers were checked at regular intervals. Records of underground inspections were not kept.

Automatic fire doors equipped with carbon-monoxide sensors had been installed as an additional precaution on the 3100- and 3700-foot levels, about 300 feet from the Jewell shaft. The doors were designed to close automatically within 45 seconds of sensing carbon monoxide, preceded by a light and whistle for warning workers to clear the door. These doors were designed to protect the workers in the event of a fire occurred in the main (Jewell) shaft.

A stench-warning system to warn underground workers was located in the main compressor building on the surface. The warning system consisted of two containers, each with a 500-gram vial of ethanethiol (C_2H_5SH) 15 percent in trichlorofluoro-methane. The vials could be ruptured and the contents injected into the main compressed air supply to the mine. Instructions for its use were posted at the installation.

The "Fire Protection and Escape Plan" and "Procedure to Follow in Case of Mine Fire," included as Appendix I, were issued to each supervisor and were posted along with a ventilation map at shaft stations on 3100 and 3700 levels for the information of underground workers.

STORY OF THE FIRE AND RESCUE AND RECOVERY OPERATIONS

The following description of the events related to the major disaster at the Sunshine silver mine is based on records maintained by the mine operator, interviews with mine officials and workers, depositions taken by Department of the Interior attorneys from survivors of the catastrophe and others, Federal mine inspection reports, and observations made by Bureau of Mines personnel.

Times stated are based on evaluation of the above sources of information. Although conflicts exist, the Bureau of Mines believes the times used are accurate.

Evidence of Activities and Story of Fire

On May 2, 1972, a total of 173 men making up a normal day shift (7 a.m. to 3 p.m.) crew entered the mine and proceeded to perform their regular duties until the time they learned of the fire. The work locations of these men are shown in Appendix B. The principal operating officials of the Sunshine Mining Company were in Coeur d'Alene, Idaho, about 45 miles away, attending their annual stockholders' meeting. During their absence, surface and underground foremen were responsible for the activities of their own crews, with no designated individual in charge of the entire operation.

Most of the salaried and day's pay personnel who normally ate their lunch from 11 a.m. to 11:30 a.m. did so at their regular work locations.

During the morning, miners Custer Keough and William Walty were engaged in enlarging the 3400 ventilation drift to decrease ventilation resistance in the main exhaust airway. Their work consisted of drilling and blasting along the back and ribs, mucking, and rock bolting. An underground mechanic, Homer Benson, also reported to the 3400 level with an oxygen-acetylene cutting torch which was needed to remove old rockbolts along the drift. The cutting torch was transported to the worksite about 340 feet west of the 09 vein bulkhead, with a small battery-powered locomotive. Benson completed the cutting of the old rockbolts and arrived back at the 3700 level station with his equipment at 10:35 a.m. Keough and Walty probably ate lunch on the 3400 level No. 10 shaft station, as was their practice.

Floyd Strand, chief electrician; Kenneth Ross, geologist; Larry Hawkins, sampler; and John Reardon, pumpman, completed their morning activities at the No. 10 shaft area and at 11:30 a.m., departed the No. 10 shaft station on the 3700 level enroute to the Jewell Shaft on a man coach. Their route took them past the Strand substation, 910 raise, No. 5 shaft, and No. 4 shaft. They arrived at the Jewell station shortly after 11:40 a.m. and did not report any unusual conditions enroute.

Shortly after lunch, about 11:40 a.m., Norman Ulrich and Arnold Anderson, electricians, stepped out of the electric shop, smelled smoke, and shouted a warning. Harvey Dionne and Bob Bush, foremen, came out of the Blue Room (underground foremen's office) and the four men started in the direction of the smoke. The smoke was discovered to be coming down the