Report on the
Quaker Oats Company Fire

At Peterboro, Ontario

December 11th, 1916

By

CANADIAN FIRE UNDERWRITERS' ASSOCIATION
SPRINKLERED RISK DEPARTMENT
TORONTO, ONTARIO

A. J. Mylrea, *Inspector*

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CONTENTS

Fig. 1. View of the plant before the fire.

Quaker Oats Co. Fire at Peterboro, Ontario,

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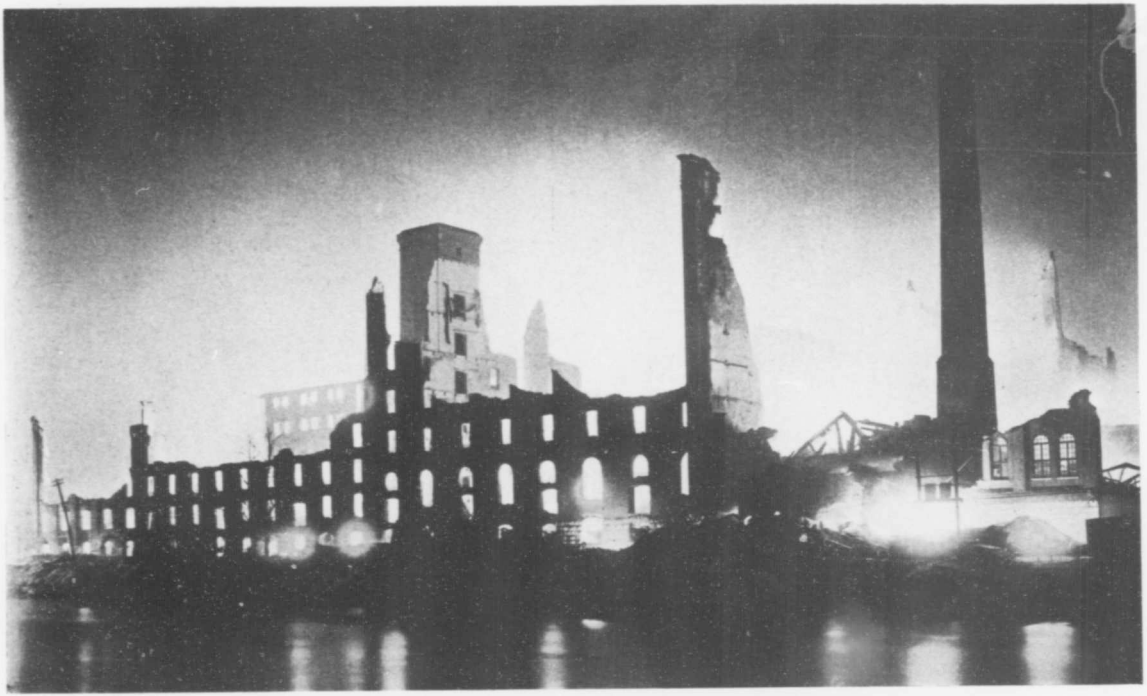
Special Report by Canadian Fire Underwriters' Association, A. J. Mylrea, Inspector.
(Member N. F. P. A.)

History of Plant. In 1900 the Quaker Oats Co., controlling the American Cereal Company, began the erection of a plant at Peterboro, Ontario, which was placed in operation in 1902. The head office of this concern is located in Chicago, Ill. Branch plants are located at Cedar Rapids, Iowa; Fort Dodge, Iowa; Akron, Ohio; Battle Creek, Mich.; Joliet, Ill.; Morris, Ill.; Richford, Vt.; and Saskatoon, Sask. The original Peterboro plant consisted of the basement and first three stories of Warehouse No. 1 and of the Mill, Dry House, Boiler House, Cleaning Mill and Elevator "A", as they existed immediately preceding the fire. In 1907 the fourth story was added to Warehouse No. 1 and Warehouse No. 2 was built.

Fig. 2. View of the plant after the fire.



View of the ruins of the Quaker Oats Plant at Peterboro, Ont., taken at 10 3 p.m. on the night after the disaster.

Elevator "B" and the basement and first four stories of the Concrete Warehouse were erected in 1910, and early in 1916 the 5th and 6th stories were added to the Concrete Warehouse. At the time of the fire there was under construction adjoining the west side of Elevator "A" a reinforced concrete roof, supported by reinforced concrete columns, to shelter the railway weigh scales.

Description of Plant. The major portion of the plant consisted of a row of buildings and several detached ones located on the west bank of the Otonabee River between Hunter and Murray Streets; and a hydro-electric station belonging to the company, which furnished the motive power for the plant, was located at a dam about one-quarter of a mile up stream. (See Fig. 1 and Plate I). The row of buildings, which was located about 60 feet from the water's edge consisted of: 1st—**Warehouse No. 2,** which was of brick and semi-mill construction, basement and four stories in height, and fitted with plain glass windows in wooden sash; 2nd—**Warehouse No. 1,** which was similar in construction; 3rd—the **Mill,** which was brick, semi-mill construction, basement—six, equal to eight, stories high, and provided with plain glass windows in wooden sash on both sides of the building and in the windows overlooking Warehouse No. 1; 4th—the **Dry House** (where the fire started) which had brick walls, 4-inch reinforced concrete floor slabs on unprotected steel beams and columns, semi-mill roof, basement—five, equal to eight, stories in height, and which had plain glass windows in all exterior walls except in that part of the 5th story occupied by the stock tanks and below the Boiler Room roof in the north wall, the windows in the west wall being provided with standard wood tin-clad shutters; 5th—**Boiler House,** having brick walls, one, equal to two, stories in height, plank on steel trussed roof, and with plain glass windows in the exterior walls—all the buildings adjoining from south to north in the order given. The **Pump House** was a low one-story brick building adjoining the northeast corner of the Boiler House. These buildings were all separated by brick fire walls, parapetted two to three feet above the roof; and communicating door openings were protected by standard automatic sliding wood tin-clad fire doors. For further details of construction see Plate II.

Thirty-eight feet west of this row of buildings and extending from a point near the south end of Warehouse No. 2 to a point about even with the middle of the Mill was located the **Reinforced Concrete Warehouse.** This building was basement and six stories in height and was equipped with wired glass windows in metal frames on the exposed east wall, the north wall being blank. The windows in south and west walls were plain glass in wooden sash with the exception of two vertical rows of wired glass metal sash windows in the north bay of the west wall. The Concrete Warehouse communicated with Warehouse No. 2 in the third story by means of an enclosed reinforced concrete bridge equipped with a wood tin-clad fire door on the east end only; and also communicated with the Mill by means of a concrete tunnel provided with a wood tin-clad fire door also at the east end only.

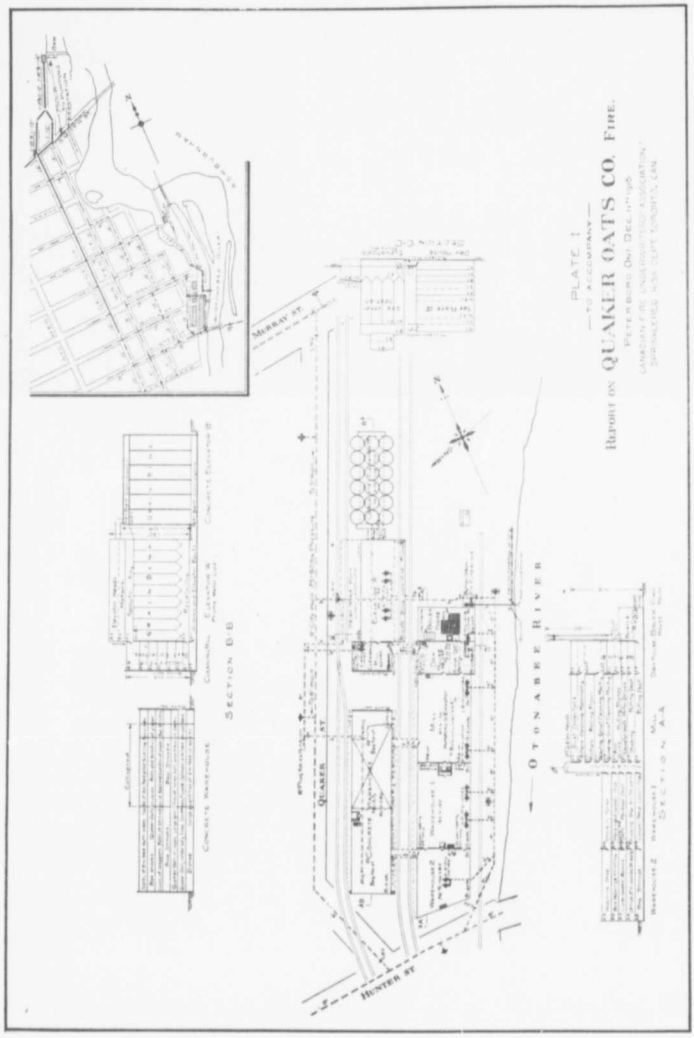
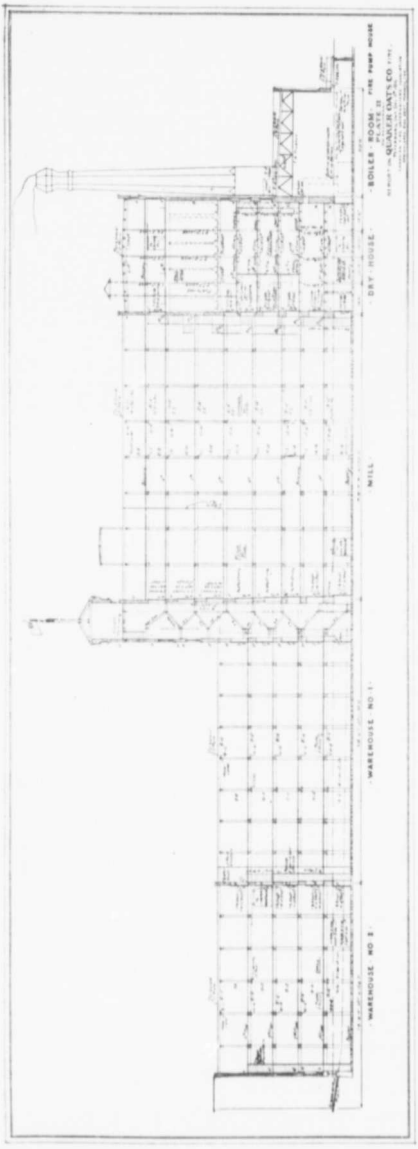


PLATE I
TO ACCOMPANY
REPORT ON QUAKER OATS CO. FIRE.
MURRAY ST.
QUAKER ST.
HUNTER ST.
OTONABEE RIVER
SECTION B-B
SECTION A-A



In line with the Concrete Warehouse and approximately 60 feet north of it was situated the **Cleaning Mill,** a brick basement—six, equal to eight, story building of semi-mill construction. The south wall was blank, as was also that portion of the north wall serving as a division wall between this building and Elevator "A". In the east and west walls, and in the exposed portion of the north wall were a number of plain glass windows in wooden sash. The windows in the east wall were provided with standard wood tin-clad shutters. The Cleaning Mill communicated with the Dry House by means of an enclosed overhead bridge in the top story, which was provided with a fire door at each end. In the basement was a stone tunnel which also communicated with the Dry House and had a fire door at each end.

Adjoining the Cleaning Mill on the north and offset 20 feet to the east was **Elevator "A".** The first story of this building was brick and the remainder wooden crib construction, metal clad. There was a fire wall between this building and the Cleaning Mill. The door openings were protected by fire doors, but there were several unprotected screw conveyor openings. The building was approximately 130 feet high and had plain glass windows overlooking the Cleaning

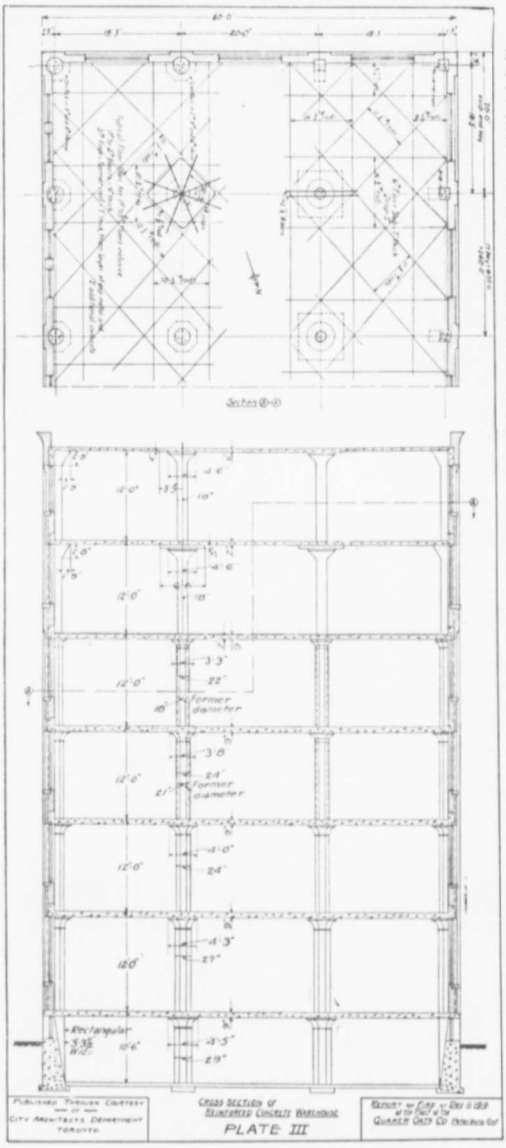
Mill and also in the other three sides above and below the grain bins.

Twenty-four feet north of Elevator "A" was reinforced concrete **Elevator "B"**, which consisted of eighteen circular bins of approximately 22 feet outside diameter by 100 feet high, surmounted by a conveyor passage 9 feet in height. Elevator "B" communicated with Elevator "A" by means of a concrete tunnel in the basement, by an enclosed overhead concrete conveyor passage and by an open steel foot bridge beneath the conveyor passage.

The constructional details of the eastern row of buildings is shown on Plate II. Especial attention is called to the two unprotected package dryer openings, each 18 inches by 48 inches, in the 2nd story between Warehouses No. 2 and No. 1, and to unprotected window openings overlooking Warehouse No. 1 in the south wall of the Mill and also in the south wall of the elevator tower. The balcony between the first and second floors of the Mill was built by degrees as the plant grew until it became a separate floor although still retaining the name "Balcony." Above the sixth floor of the Mill was another balcony covering approximately 70% of the floor area. The elevators in the Mill, Dry House and Cleaning Mill were all unprotected.

Plate III gives the constructional details of the reinforced Concrete Warehouse.

This building was of the "four-way-flat-slab" type, 60 feet by 280 feet; basement and six stories in height. First four stories built in 1910, upper two in 1916. **Walls**: Basement, concrete, 18 inches at top, 36 inches at bottom, battered on inside; remainder 14-inch brick curtain walls, parapetted 3 feet above roof and carried at each floor on 9-inch by 21-inch reinforced concrete spandrel beams which were integral with floor slab and also stiffened exterior edges of same. **Floors**: Basement concrete; 1st, 2nd, 3rd and 4th floors were 9-inch slabs; 5th floor—former roof—was originally a 7-inch slab changed in 1916 to 9-inch; 6th was a 7-inch slab increased to 12 inches in thickness in vicinity of column heads. **Roof**: 6-inch slab with center drainage, covered with tarred felt, no gravel. All floors except basement were reinforced with bands of half-inch round rods running from column to column both directly and diagonally, near the top of the slab in the column head area and near the bottom of the slab between the columns. The 5th floor slab was changed from 7 inches to 9 inches in thickness by laying wire netting on it and pouring on another 2 inches of concrete. **Columns**:. For details of column sizes, see Plate III. When the two upper stories were added, the 3rd story interior columns were increased to 24 inches short diameter, and the 4th story interior columns to 22 inches, short diameter, by wrapping them in expanded metal and pouring around them a grout composed of cement and gravel screened through a half-inch screen. The wall columns in the 5th and 6th stories had brackets to help support the 6th floor and roof slabs. All other columns except basement wall columns had flared heads for the same purpose. Brick pilasters on the outside hid the wall columns from view.



The coarse aggregate used in the concrete was a limestone gravel procured from a neighboring pit; it was clean and fairly well graded, some crushed limestone being mixed with it. The cement used was a first-class, quick-setting, strong cement. In the first four stories medium steel was used and in the 5th and 6th stories steel rolled from the arbitrary discard of munition stock was used, which is somewhat stronger than the medium grade. In general there was about one inch of fireproofing to the slab rods and the class of workmanship on the whole was good.

Openings: Near the west wall, in the 5th bay from the south end was a stairway provided with 2½-inch automatic wood tin-clad trap doors. The stair stringers were steel channels with 2-inch wooden treads. In the 6th bay from the south end, adjoining the west wall was an elevator tower 8 feet 6

Fig. 3. Spalled column and unprotected bag hoist on right.

inches by 10 feet 6 inches, inside measurements, enclosed in 14-inch brick walls, carried on each floor. The doorways to the shaft were equipped with 2½-inch wood tin-clad fire doors in the basement and first four stories and with corrugated steel doors in the 5th and 6th stories. Two bag hoists were provided, basement to 6th floor, in the middle aisle and about one-quarter the distance from each end of the building. These were operated on the endless chain principle and the openings in the floors —3 feet by 6 feet 6 inches, were unprotected, as can be seen from Figure 3. There were four chutes between the 1st and 2nd floors, but as these were not used, the hatches were always closed.

Communications: There was a concrete bridge in the 3rd story in the fourth bay from the south end, leading to Warehouse No. 2 and a concrete tunnel in the basement communicating with the Mill, as described before.

Windows: The north wall was blank. In the east wall in all stories the windows were wired glass. Hollow metal sash was used for the basement and 1st to 4th stories, inclusive, and solid steel sash above. In the south wall and in the west wall, in all stories, plain glass in wooden sash was used, except for two vertical rows of windows in the north bay of the west wall. These windows and sash were similar to those in the east wall.

Since the Hydro Electric Power House, owing to its distance from the rest of the plant, was not affected by the fire, it will not be considered further in this report.

On the west side of Quaker Street the ground rose sharply to a height of about 35 feet and then sloped upward more gently. At a distance of from 200 feet to 500 feet from the plant were located a number of frame and brick residences and the Court House, as may be seen in Figure 2.

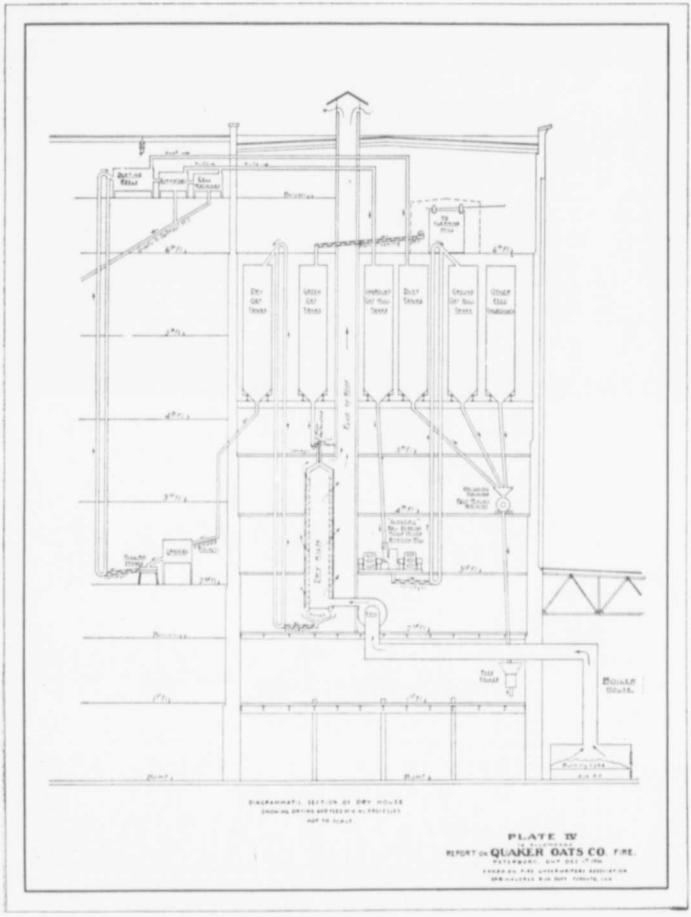
Occupancy and Processes: The plant as a whole was occupied for the storage of grains, manufacture of flour and various cereal products such as rolled oats, oat meal, puffed rice, puffed wheat and corn puffs, with their attendant by-products, manufacture of barrels, boxes, cartons and paper packages used as containers for the finished article and for the storage and shipping of finished goods. The sections on Plate I accompanying this report show the occupancy of the various buildings. It will be noted, upon referring to Plate II, that the Flour Mill was simply a portion of the Mill partitioned off from the Oat Meal Mill by a 7/8-inch board partition.

The grain was received in Elevator "A", stored either in this building or in Elevator "B", whence it was sent to the Cleaning Mill where it was cleaned and separated. The wheat was taken direct from the Cleaning Mill to the Flour Mill while the oats went through a special process in the Dry House before going to the Oat Meal Mill. The manufactured product from the Flour Mill, Oat Meal Mill and Puffing Departments were sent to the Warehouses for packing and shipment.

The concrete building was used solely for storage purposes, shipment from storage being conducted on the 1st floor. In the basement were dishes for premiums, some bales of scrap paper and north of the elevator a large quantity of "Vim" feed. The 1st and 2nd floors were heavily piled with sacks of rolled oats, flour and feed. The 3rd and 4th floors were used to store supplies for the Package Department, the 3rd story being nearly filled with piles of collapsed wooden boxes—"box shooks" as they were called—and the 4th floor having box shooks, cases of wrappers, bundles of paper, rolls of straw board and rolls of paper. The 5th floor was but partly filled, containing some box-shooks, rolls of paper, and cases of Quaker Oats. North of the elevator and down both side aisles south of the elevator, the 6th floor was piled full of sacked "Vim" feed.

The floors were designed for 200 lbs. per square foot of live load, but piled to the ceiling as they were with bags of hulled oats and flour the load on the 1st and 2nd floors varied from 247 lbs. to 340 lbs. per square foot, and on the 4th and 5th floors several panels containing rolls of paper had a load of 258 lbs. per square foot. The loaded area of the 6th floor carried about 175 lbs. per square foot of live load. On all floors, but the 6th, a 10-foot trucking space was reserved down the center of the building, putting the heaviest strain on the wall panels; and according to the testimony of the stock checker, the bulk of the stock, on all floors but the 1st, was in the north end of the building.

The diagrammatic sketch, Plate No. IV, shows more in detail the Dry House process and part of the process in connection with the Oat Meal Mill. The grain coming from the Cleaning Mill entered



the green oat tanks and from there was spouted to the Drying Kilns. As it entered the dryer it was moistened by steam and passed downward by gravity over a series of veins to a collecting trough at the bottom. The gas from the coke furnaces was forced upward into the perforated sheet-iron tube to which these veins were fastened, passed through these perforations, through the descending grain and out through openings in the outer tile wall of the dryer to the open space of the kiln room. Thence it passed through tile flues to the open air above the roof. The dried oats in the collecting trough

were collected by a sweep and conveyed to an elevator which delivered them to the dry oat tanks. From these tanks the grain was drawn, as required, through magnetic separators to remove any bits of steel, then through various sizers and graders to the hulling stones in which the hulls were split ready for removal from the groats. Another elevator then conveyed them to the dusting reels located on the upper balcony of the Mill, where the dust was removed. The dust was carried over to dust tanks located in the Dry House while the hulls and groats passed on to aspirators and cell machines which removed the hulls from the groats. The groats were then put through the regular milling processes while the hulls were conveyed to unground hull tanks in the Dry House. From here the hulls were spouted to the attrition grinders located on the 3rd floor of the Dry House. A fan was connected with these grinders for the purpose of drawing away dust that might otherwise have accumulated and deposited it in a dust bin on the roof of the Boiler House. The ground hulls passed from the grinder through the floor to an elevator which deposited them in the ground hull tanks. These attrition grinders were the ones in which "puffs" frequently occurred.

Various feed ingredients such as ground corn, ground barley, cotton seed meal, which were stored in other tanks were drawn to the same automatic weighing device as the dust and ground hulls and after being weighed out in the proper proportions would go to the mixing conveyor on the 4th floor and from there to the feed packers located on the 1st or shipping floor.

Fire Protection.

Inside Protection.

Automatic Sprinklers: Except as noted below, Warehouses No. 1 and No. 2, the Mill, Dry House, Boiler House, Cleaning Mill and Elevator "A" including tops of all elevator legs throughout the plant, were equipped with Grinnell 1901 and 1906 automatic sprinklers. The two frame, tin-lined package dryers, each 18 inches by 48 inches by 80 feet in the second story of Warehouse No. 1, the walkways over stock tanks and grillage under them in the Dry House, the substation in the basement of the Dry House, the dust bin over the Boiler House roof and concrete platform inside Boiler Room, Fire Pump House, concrete bridge in 3rd story between Warehouse No. 2 and the Concrete Warehouse, tunnels between the Mill and Concrete Warehouse and between the Dry House and Cleaning Mill, the floor of elevator "A" over the grain bins, and concrete weigh scale adjoining Elevator "A" on the west (under construction at the time of the fire) were unsprinklered. The Concrete Warehouse and concrete Elevator "B" were entirely unsprinklered. The Boiler House was protected by a wet pipe sprinkler system; the remainder of the sprinklered portions of the plant were dry pipe, fifteen 6-inch and two 4-inch Grinnell Differential dry valves being used. The dry valves in Warehouses No. 1 and No. 2, Mill and Cleaning Mill were installed in pairs, each pair being supplied by a 6-inch connection from the 8-inch underground yard main, while in Elevator "A"

there were four dry valves on one header supplied by one 6-inch connection, and in the Boiler House there was one 6-inch connection for the wet pipe sprinklers in this building and for the dry valve which controlled the sprinklers in the Dry House. Each dry valve could be shut off by a gate valve directly underneath it, and in every underground connection to the dry valves from the private yard main there was an indicator post gate located approximately thirty-five feet from the building supplied. As may be seen in Plate No. II absolute pockets were formed in all ceilings except the roofs of the two Warehouses, the Mill and Cleaning Mill. These pockets varied from four to five feet in width and from fourteen to sixteen feet in length. There were two sprinklers in each pocket, each head thus covering an area of 28 to 40 square feet per head. The following list gives the number of heads on each dry pipe system.

Warehouse No. 2.	South valve (Controlling south half of building)		598
	North valve (Controlling north half of building)		528
Warehouse No. 1.	South pair	North valve — Basement, 1st and 2nd floors .	416
		South valve — 3rd and 4th floors, 288 + 64 (for 44 feet of 6-inch pipe)	352
	North pair	North valve — Basement, 1st and 2nd floors .	484
		South valve — 3rd and 4th floors, 336 + 64 (for 44 feet of 6-inch pipe)	400
Mill	South pair	North valve — Basement to 3rd floor . . .	722
		South valve — 4th to 6th floors, 530 + 82 (for 56 feet of 6-inch pipe)	612
	North pair	North valve — Basement to 3rd floor . . .	672
		South valve — 4th to 6th floors, 516 + 82 (for 56 feet of 6-inch pipe)	598
Dry House . .	One valve only		593
Cleaning Mill . .	North valve — Basement to 3rd floor		342
	South valve — 4th to 6th floors, 231 + 44 (for 68 feet of 4-inch pipe)		275
Elevator "A" . .	South pair	South valve — Basement and 1st floor . .	242
		North valve — Top floors, 227 + 154 (for 105 feet of 6-inch pipe)	381
	North pair	South valve — Basement and 1st floor . .	238
		North valve — Top floors, 210 + 154 (for 105 feet of 6-inch pipe)	364
Boiler House . .	On wet pipe system.		

It will be noted from the above that an excessive number of sprinklers was installed, and that many of the dry valves were badly overloaded. A circuit closer on each dry valve was connected to an electric bell and annunciator situated in the Boiler Room. No hydraulic gongs were provided. Although the system was mainly installed in 1901, the pipe sizes above the dry valves were equal to the 1905 standard.

Standpipes: There were two 2-inch standpipes in the Dry House, with outlets on each floor provided with 1¼-inch linen hose and half-inch nozzles. These standpipes were supplied by a 4-inch underground connection from the 8-inch city main in Quaker Street.

Warehouses No. 1 and No. 2, the Mill, Cleaning Mill and Elevator "A" were provided with 4-inch standpipes and roof hydrants with outlets on each floor and roof, equipped with 2½-inch cotton rubber-lined hose and 1⅛-inch play-pipes. These standpipes were ordinarily dry and were provided with siamese connections at the base for the city fire engine to pump into.

Chemical Extinguishers and Water Pails: A good supply of unapproved chemical extinguishers and bucket tanks were distributed throughout the plant.

Outside Protection.

Private: There were two 2-way hydrants situated to the east of the plant between the Mill and the Otonabee River, and another just west of the concrete weigh scale, all connected to the 8-inch private underground yard main. The fire pump at the north of the Boiler House was provided with four 2½-inch hose connections. A hose house was erected over each hydrant and supplied with 250 feet of 2⅝-inch cotton rubber-lined hose, 2 Underwriters' playpipes and other miscellaneous equipment. Some 450 feet of spare hose and several extra playpipes were kept in the pump house.

Note: Both private and public hydrants are of the frostproof type and not provided with independent gates unless specifically mentioned.

Public: One 2-way hydrant was situated on the south side of Hunter Street directly opposite Warehouse No. 2, another was located approximately 80 feet west of the north end of the Concrete Warehouse, a four-way hydrant, provided with independent gates was situated about 70 feet west of the north end of Elevator "B" and another 2-way hydrant was placed at the northwest corner of Quaker and Murray Streets, approximately 365 feet north of Elevator "A" or 620 feet from the north end of the Concrete Warehouse.

Since the greater portion of Peterboro is situated to the west of the Otonabee River the plant was located on the eastern fringe of the Municipal "gridiron" waterworks system, there being no other source of supply to that portion of the town on the east side of the river than the 8-inch main in Hunter Street. The 8-inch main in Quaker Street was connected to the 5-inch dead end main in Murray Street and to the Hunter Street main just mentioned; the private yard main connected to the Hunter Street and Quaker Street mains forming a loop around the plant.

During the early stages of the fire the three private hydrants previously mentioned and the two public hydrants in Quaker Street at the west of the plant were of practically no use, as there was not enough water pressure for a proper hose stream; and all were absolutely put out of commission when several Municipal gates were shut a short time later in order to raise the City pressure. (*See* "Progress of Fire").

Water Supply.

Private: The automatic sprinklers and private hydrants were supplied by an 8-inch yard main which ran from the 8-inch Hunter Street main along the east side of the plant, turning west just to the north of the Boiler House and after passing under Elevator "A" connected to the 8-inch City main in Quaker Street. This private yard main was valved and checked off at each end. To the west of Elevator "A" an 8-inch branch of the yard main ran south, supplying a 2-way hydrant and the sprinkler system of the Cleaning Mill, and terminated in a dead end opposite the Concrete Warehouse. A connection was made at the dead end of this branch main for the proposed sprinkler system in the Concrete Warehouse. The private pumping supply consisted of a 1,000 gallon (18-inch by 10-inch by 12-inch) steam pump, the steam for which was taken direct from the header connecting the three 150 H.P. boilers in the Boiler House. These boilers were not used for power, but for the fire pump and for manufacturing processes only. A governor, automatic, starting at 65 lbs. was installed on a by-pass around the throttle valve in the steam pipe to the pump. The pump took suction either under a 16-foot head from a 12-inch pipe fed by a 10-inch pipe running to a forebay some 750 feet distant, or by direct 12-foot lift from the Otonabee River through a 12-inch pipe provided with a foot valve and strainer. There were Indicator Post Gates in both suction pipes. Eight-inch check and gate valves were connected direct to the pump discharge, and Indicator Post Gates controlled the underground main just outside the east and west ends of the Pump House. Under normal conditions with this arrangement water could be supplied either to the east or west rows of buildings separately or to both at the same time, and should the underground main be entirely out of commission, four hose lines could be attached direct to the pump.

Public: The supplies to the City hydrants in the vicinity of the risk and to the private hydrants and sprinkler system on the premises consisted of an 8-inch main in Hunter Street supplied by a 10-inch main in George Street some 1200 feet from the plant. This 10-inch main increased to 12 inches approximately 450 feet from George and Hunter Streets and after running for about 3,000 feet connected with 12-inch and 18-inch mains running direct to the City pumping station some 8,000 feet distant. There was a 5-inch main in Murray Street which was connected to the 8-inch main in Hunter Street by the 8-inch main in Quaker Street. This Murray Street main was supplied by two 5-inch connections from the 12-inch main in George Street, which connections were 1900 or 2350 feet distant respectively.

At the Municipal pumping station there were two 3-throw horizontal single acting 18-inch by 30-inch pumps of 2,700,000 U. S. gallons capacity per 24 hours, one 3-throw horizontal single acting 21-inch by 30-inch pump of 3,600,000 U. S. gallons capacity, one 3-stage vertical centrifugal pump of 3,600,000 U. S. gallons capacity and one single-stage centrifugal pump of 7,200,000 U. S. gallons capacity. The 18-inch by 30-inch pumps were each driven by 62-inch

turbines working under a head of from 10 to 11 feet, the 21-inch by 30-inch pump and the smaller centrifugal were driven by 68-inch turbines while the larger centrifugal was driven by a steam turbine. The steam-driven centrifugal was used only at times during the winter months when the ice interfered with the water supply to the other pumps, and on the day of the fire was not in operation. All pumps took suction from the Otonabee River which furnished a practically inexhaustible supply. The regular pressure maintained at the Pump House is 80 lbs. which is raised to 100 lbs. on the receipt of the first fire alarm and is increased to 120 lbs. on receipt of telephone orders from the Chief. The normal water pressure at the Quaker Oats plant, on account of its low location, is approximately the same as that at the pumping station. The average domestic consumption per day for the year ending June, 1916, was 3,832,000 U. S. gallons while the largest amount pumped in any one day under normal conditions was 5,136,000 U. S. gallons.

Fire Brigades.

Peterboro: The public fire brigade comprised a Chief and sixteen men, all fully paid, without other duties and who are in constant attendance at the Fire Hall located 2700 feet from the Quaker Oats plant. The fire fighting apparatus consisted of a 1,000 U. S. gallon steam fire engine, two hose carts, one exercise wagon (used as a spare hose cart) and one hook and ladder truck. The fire department had the following equipment: 5,400 feet of 2½-inch rubber-lined hose and a good supply of playpipes, chemical extinguishers, salvage apparatus and miscellaneous equipment. Fire alarm telegraph system having non-interfering metal boxes, the keys being kept under glass.

Lindsay: In response to a call, a hose truck and company were dispatched from Lindsay some 23 miles distant. While the Peterboro brigade was fighting the Quaker Oats fire, the Lindsay company was stationed at the Fire Hall to answer any other calls and they responded to two such calls during the time they were on duty. Although the threads on the hose couplings belonging to the Lindsay brigade would not fit the Peterboro hydrants, their hose was made serviceable by cutting off the couplings and attaching new ones by means of an hydraulic hose expander kept in reserve for just such emergencies.

Miscellaneous Help: In addition to the two trained brigades the Fire Chief had at his disposal, and accepted the services of several of the police force, a number of the Quaker Oats employees, some ex-firemen and other volunteers. As much hose as could be spared from local manufacturing plants was borrowed and used.

Origin and Progress of the Fire.

On Monday, December the 11th, 1916, about 10.15 a. m., while the plant was in full operation, the odor of burning Vim feed was noticed by some employees in the Dry House. Orders were immediately given by the foreman of the department to shut down the

feed grinders and to locate and extinguish the blaze; but before a sufficient time had elapsed to permit the full execution of these orders, an explosion of terrific violence occurred. The explosion was of such intensity that it blew out the north and east walls of the Dry House, ripped the fire doors off the openings between the Dry House and the Mill and in spite of the fact that these openings were small, had sufficient force to tear off their hinges several small doors at the far end of the 1st and 2nd stories of the Mill, 130 feet distant. At the time of the explosion there were 30 or 40 men at work in and about the Dry House and to them the loss of life was chiefly confined. Many rescues and deeds of almost unbelievable heroism were performed by those who were fortunate enough to escape. The conditions in a Flour Mill are always conducive to the rapid spread of a fire and consequently it was only a few minutes before the whole Mill was enveloped in flames.

In the minute or two that elapsed before the fire completely filled the Mill, some of the employees of the company, under the direction of the superintendent, managed to close the fire doors at the south end of the Mill. Some of these fire doors would not have closed automatically because of the small wooden doors which had been installed to prevent drafts through the elevator shaft and which had been ripped from their hinges by the explosion, as was mentioned before. The rapidity with which the fire spread through the Mill may be judged from the experience of the man who operated the elevator in the tower at the south end of the Mill. One of the standing orders of the plant was that, should the power go off on any occasion, each employee should open the switch controlling the motor of which he was in charge. This elevator was in one of the upper stories and, following his instructions, the operator ran up to the pent house to shut down his motor, but before he could return to his elevator the shaft was so full of smoke that his only way of escape was through one of the upper windows overlooking the roof of Warehouse No. 1. He climbed out of the window and as the smoke became more dense he was forced to hang from a hinge imbedded in the brickwork for a proposed fire shutter, until the firemen rescued him.

When the north wall of the Dry House fell, it crashed through the roof of the Boiler House and broke all steam connections from the boilers, thus putting the fire pump out of commission. As the east wall fell it took with it a 6-inch sprinkler riser and buried the indicator post gate valve controlling this riser, which valve was located 26 feet distant from the walls of the building. Deprived of the assistance of the fire pump, with the 6-inch riser broken off, and with the great excess of sprinklers in the lower floors of the mill, being fused by the first blast of flame, the street mains leading to the plant were utterly inadequate to maintain any pressure against such a draft; nor could it ever have been anticipated that they would be subjected to such a demand.

There was a moderate wind blowing from the northeast which drove the fire slightly out of the line of the Cleaning Mill, and for a

Fig. 4. Shows collapse of grain tank and dry house; also fire gaining headway in frame metal clad grain elevator.

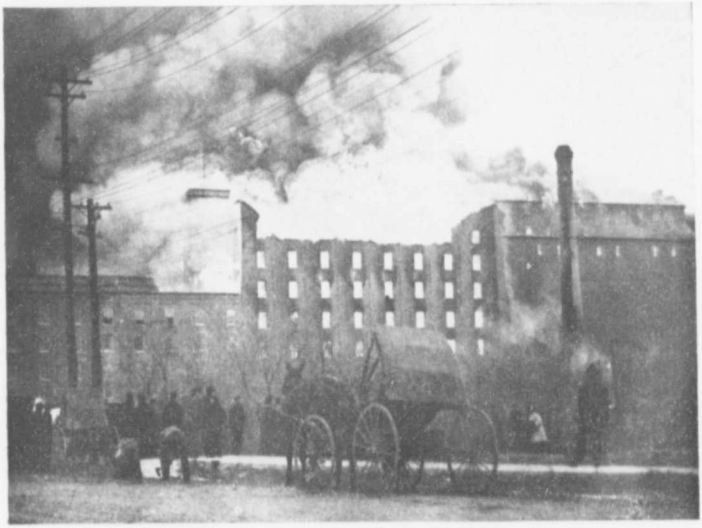


Fig. 5. Photo taken shortly after Fig. 4 above.

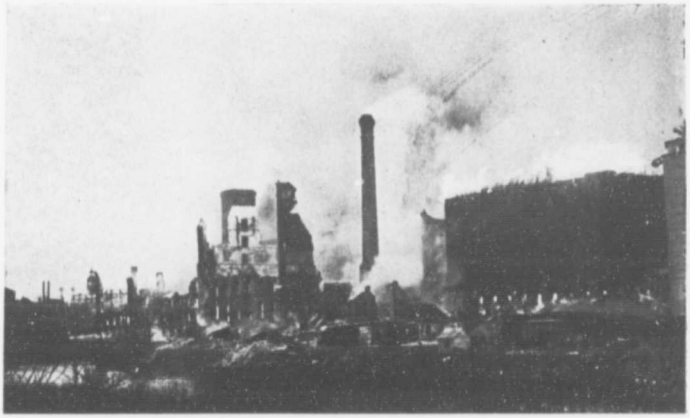


Fig. 6. Photograph taken at noon. Illustrates rapidity of fire.

time it was hoped that fire would not reach it. But when the west wall of the Dry House collapsed, the exposure was too great and the Cleaning Mill began to blaze. From there it worked through the fire doors above and below the grain bins into Elevator "A".

At the fire wall between the Mill and Warehouse No. 1 there were no door openings in the 2nd, 3rd and 4th stories, except through the elevator tower, owing to the difference in floor levels, and as the openings into this tower from both Mill and Warehouse were equipped with fire doors, it afforded a double barrier to the progress of the fire. As may be seen from Figures 4 and 5, fire did not enter Warehouse No. 1 until the Mill was practically gutted, and then probably due to the fact that falling walls or floors tore the fire doors from their fastenings. During the time that the fire was held up at this point, some of the office employees began to remove fixtures and records to a place of safety. Some thought that they were premature in their action, but when the fire got into Warehouse No. 1, it travelled through this building and Warehouse No. 2 with such rapidity that had not the records already been saved, they never could have been.

The fire spread rapidly from Warehouse No. 1 to Warehouse No. 2, for in the 2nd story were two large unprotected dryer openings (18 inches by 48 inches) and only single fire doors at all other openings.

Figure 6 taken at noon shows how rapidly the plant was reduced to ruins, although Elevator "A", because of its wooden crib construction, continued to stand and burn for some time until it finally collapsed. The burning grain was heaped against the south end of Elevator "B" and the concrete was considerably spalled; but beyond this the Elevator suffered no material damage at this time. Some six weeks afterwards, however, as a result of the corn in the

south bins of Elevator "B" being heated and generating a large quantity of gas, there was an explosion, which blew off the roof of the southeast bin and made a small hole in the side wall but did no further damage. The Concrete Warehouse which was located to the west of the Mill is obscured from view in this picture by the smoke. It was still standing, however, although fire had entered it about half an hour previously.

From the very start of the fire, the Concrete Warehouse was subjected to a terrific exposure from the burning Mill and Warehouses, but although the windows were not equipped with shutters, it was not until about the time of the collapse of the other buildings that fire entered—as may be seen in Fig. 7. The fire first gained admittance through an open window ventilator near the north end of the 4th floor at about 11.30 a. m. Owing to the radiation of heat through the wired glass windows, numerous other blazes followed almost immediately and in a few minutes the fire had spread throughout the whole building.

At the time of the fire the Concrete Warehouse was heavily loaded on all floors but the fifth, with a great quantity of combustible material which, fanned by the wind from the east, burned with all the fierceness of a coke fire until 6.00 p. m., when practically all that portion north of the elevator shaft suddenly collapsed. The loosen-

Fig. 7. Shows how concrete warehouse, equipped with wired glass windows, withstood exposure until other buildings collapsed.

Fig. 8. View looking North from Hunter Street. Note stock piled high in concrete warehouse. Ruins of mill buildings on right.

ing up of the combustible material, while falling, greatly augmented the heat, and flames shot up for hundreds of feet into the air. The heat liberated by the collapse drove the spectators blocks away from the place and it was only by a most strenuous effort on the part of the Fire Department that a general conflagration of the city was avoided. After the collapse, the fire continued to rage until everything combustible was entirely consumed; even the ashes being fused on the second floor of the part still standing. In the collapsed portion the fire continued to burn for more than two months afterwards.

How the Fire was Fought.

The noise of the explosion in the Dry House was distinctly heard at the Fire Hall and the firemen who knew that something had happened immediately hitched their teams and as soon as the alarm came in, simultaneously by telephone and fire signal, were on their way to the scene of the fire. When they arrived, they found the officials and employees of the Quaker Oats Co. working desperately in an effort to get the girls who were working in the Package Department in the 2nd story of Warehouse No. 1, out of the building, to close all accessible fire doors and to rescue the men who were known to have been working in the Dry House, many of whom could be seen en-

veloped in the flames and endeavoring to escape. This rescue work took considerable time at the start, which would have been valuable had the water pressure been up to normal, and it is to the credit of all concerned that the emphasis was laid first on the saving of life. While some members of the brigade were attending to the injured, others attached hose lines to the hydrants in the immediate vicinity; when it was first found that there was no available pressure. With the east wall of the Dry House down and knowing that a sprinkler riser was located there, the cause of the low pressure was beyond question. The Waterworks Superintendent, who was in his office at the time of the explosion, heard the report and rushing out saw the dense cloud of smoke in the direction of the Quaker Oats plant and on looking at his pressure gauge noticed that the water pressure had dropped very low. He immediately telephoned to the pumping station for 100 lbs. pressure and taking several waterworks employees with him, went to the fire in a Corporation motor truck. Upon his arrival at the plant, he found there was no pressure and after ascertaining the cause, shut the valve in the Hunter Street end of the yard main in order to try and improve the pressure. He then consulted with the Superintendent and the Fire Chief as to the advisability of shutting off the valve in the yard main just west of Elevator "A." They concluded that for a time at least it would be well to leave this valve open as there might be a chance of the sprinklers doing some good. After waiting a short time and seeing that the whole east row of buildings was doomed, and that the pressure had not improved, he decided on his own responsibility to close this second valve, but owing to new construction work was unable to locate it. With the help of some of the waterworks employees he thereupon closed the valves at both ends of the Quaker Street main, which, although it cut off completely the water supply to the plant, at once improved the general pressure and made it possible to prevent the spread of the fire to adjacent property. It will be noted from Plate I that there was a valve in the yard main on each side of the Pump house. If, instead of shutting off the entire Quaker Street main, either one of these valves had been closed in addition to the valve near the Hunter Street end, the broken sprinkler riser would have been isolated and at the same time full city pressure would have been made available for the sprinkler systems in the Cleaning Mill and Elevator "A", as well as for the three hydrants on Quaker Street. That it would have been possible to have reached either of these valves near the Pump House may be inferred from the testimony of a witness in the investigation conducted by Provincial Fire Marshal Heaton, in which it was stated that right after the explosion the witness ran back to the Boiler Room where he knew several men were working, broke a window and crawled in to see if he could find any trace of these men. Figure 6 shows that even after the Cleaning Mill and Elevator "A" were a total wreck these valves were still available.

However, owing to the extreme severity of the fire, it is doubtful whether the sprinkler systems in the Cleaning Mill and Elevator "A"

Fig. 9. Shows ruins of Dry House and other buildings.

could have prevented the fire from entering, in which case it would soon have been necessary to cut off the Quaker Street main.

During the period of low pressure, fire started among some of the box shooks in the 4th story of the Concrete Warehouse and an attempt was made to extinguish it. A line of hose was carried through the front door and up the stairs but had to be abandoned because of lack of water. So rapidly did the fire spread through the Warehouse that several of the men who had taken in the hose barely managed to escape. When the pressure came back to normal, the fire had reached such proportions that it was realized that to try and save the plant was useless. From this time on all efforts were directed to the saving of surrounding property and with this end in view fifteen or more lines of hose were laid from all the hydrants in the neighborhood.

Thus it will be seen that from start to finish the fire was allowed to burn unrestricted. But in spite of the best efforts of the firemen, when the wood crib elevator collapsed, flying brands set fire to the roof of the Court House. Before they could disconnect their long lines of hose and bring their streams to play upon the Court House, the roof was burned off. When the Concrete Warehouse collapsed, such a quantity of burning material was carried by the wind that the firemen had to redouble their efforts in putting out scores of little blazes. As soon as it was seen that the danger of a general conflagration of the town was past, the Lindsay brigade was allowed to return home and as soon as conditions would permit, that part of the plant in which bodies were supposed to be buried, was deluged with water, and all available help was set to work to try and locate the missing.

Discussion of Possible Causes of the Explosion.

The question of the possible cause of the explosion presents a subject worthy of most careful consideration. It will be noted from the diagrammatic sketch Plate IV that the processes of drying the green oats involved the use of the direct products of combustion of coke. The gas from the burning coke after passing from the inner perforated tube of the kiln through the oats filled the entire enclosed space in which the kilns were located and drifted upwards through two large flues to the roof. It is said that only those accustomed to doing so, could go into the kiln room because of the gases, and it is certain that there must have been considerable quantities of carbon monoxide there. When mixed with air in the proportions of between 13 and 75% of carbon monoxide the mixture is explosive and human beings can exist in an atmosphere in which as much as 5% of carbon monoxide is present. There is the possibility of a mixture richer than 5% being formed on the occasion of fresh firing and there is also the possibility of "water gas" being formed near the upper part of the kiln room from the mixture of the carbon monoxide with the steam from the humidifying device located at the point where the oats entered the dryer. It is therefore possible that there could have been an explosive mixture in this room. As an evidence that the

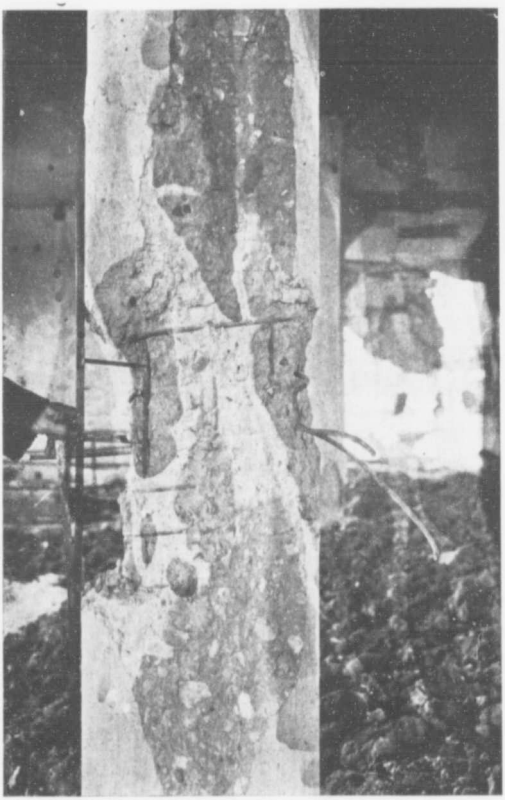


Fig. 10. Column examined to ascertain depth of dehydration. (See page 32)

explosion might have occurred here, it may be pointed out that the direction of the blast was such that it could have originated here; the floors of the Mill on the opposite side of the division wall bracing this wall against failure.

The distribution of the debris shows that the north and east walls were pushed out near the bottom, which could only have occurred with an explosion in the lower part of the building. Had the explosion occurred either in the basement or top story, the fire would have been blown into the Cleaning Mill at once through the tunnel or the bridge, but we know that for some time it was hoped to save this building. It can be seen therefore, that there is a possibility of the explosion being due to the free gas process of drying the grain.

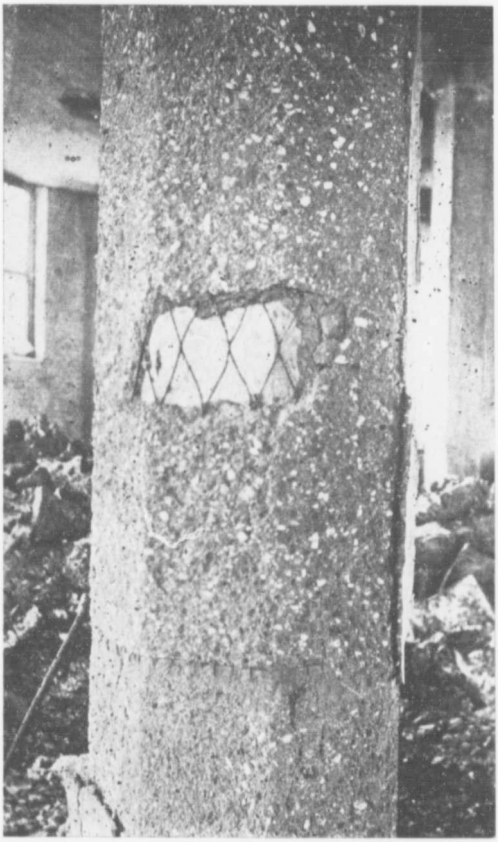


Fig. 11. Column which had been thickened by pouring of additional concrete. (See page 32)

The only other plausible explanation is that there was some form of dust explosion. Slight explosions or "puffs", as the men called them, were of common occurrence and attracted no more attention than was required to locate the smouldering material that had been scattered about and extinguish it. The management appreciated the danger incidental to dust explosions and, to avoid the possibility of one, connected a fan to the attrition grinders to reduce the accumulation of dust to a minimum. This fan exhausted into a dust bin located on the roof of the Boiler House. Since small explosions sometimes occurred in this dust bin, the sides were hung on hinges

so that at no time would there be any danger of such an explosion flashing back into the Dry House.

The seat of most of the "puffs" was located in the attrition grinders and when such a puff occurred it was in the grinders that the trouble was first sought. Although the oat hulls before reaching the grinders had passed through magnetic separators, aspirators and other cleaning devices, foreign substances sometimes reached the grinders and caused the sparks which set the ground hulls on fire. Often the first indication that there was any fire in the grinder would be the pungent smell of burning hulls.

These attrition grinders, with the exception of one that was belt driven and which was not in use on the day of the fire, were individual induction motor driven and had outside ball bearings.

On one occasion such a "puff" spread the fire through an elevator leg into a ground hull tank where a more violent explosion ensued, sufficiently powerful to lift the roof about two feet into the air. The roof then dropped back into place.

Dust has always been recognized as dangerous from the explosion standpoint, but with the development of modern dust collecting machinery, dust explosions in flour mills have largely been eliminated and are now chiefly confined to mills handling grain other than wheat.

The table on page 29 taken from a pamphlet entitled "The Explosibility of Grain Dusts" prepared by "The Millers' Committee of Buffalo, N. Y.," shows conclusively the real and terrible danger from dust explosions.

It is not possible to tell from this table whether drying operations were carried on at the above plants in a manner similar to that used at Peterboro, but it will be seen that explosions Nos. 1, 5, 8, 9, 10 and 11 were probably caused by sparks in grinding machines. In at least three of these instances the grinding machines mentioned were attrition mills, and it is probable that they were in the other cases also. In explosions Nos. 2, 12 and 13, neither drying nor grinding operations were carried on, so that it would appear that in the dust itself lies the cause of the explosion, sparks only being necessary to ignite it, whether from naked lights, static electricity from belts, friction, or other local causes.

The attrition grinders which appear to have furnished the spark needed in so many of the foregoing explosions and which we know caused most of the "puffs" at the Peterboro plant, appear also to have been responsible for the ignition of the explosive mixture in the atmosphere of the Dry House on December 11th.

As stated in the testimony taken before Fire Marshal Heaton, one of the employees working on the upper floor of the Dry House smelled smoke, and went down stairs and notified the foreman of the department, who immediately sent his assistant to see if the fire could be in the elevator boot into which the grinding machine discharged, while he himself went to the grinding floor and shut off the grinders and "opened up the cover and saw fire." These few words muttered in the hospital before he died prove conclusively that it was

GRAIN DUST EXPLOSIONS IN UNITED STATES SINCE 1905

Date	Location	Nature of Business	Nature of Occurrence	Supposed Cause	Number Killed	Number Injured	Property Damage	Extent of Damage
Mar. 5, 1905	Iowa	Cereal mill	Fire following explosion	Sparks from grind-machine	2	3	$1,000,000	Nearly complete
Oct. 7, 1908	Vermont	Elevator	Explosion	Unknown	17	3	139,000	Complete
Jan. 4, 1910	Western New York	Cereal Mill	Explosion	Unknown	5	7	118,000	Partial
Mar. 7, 1910	Indiana	Starch factory	Explosion and Fire	Unknown	4	10	30,000	Partial
Aug. 7, 1910	Illinois	Glucose factory	Explosion	Sparks from grind-machine	2	7	40,000	Partial in elevator building
Nov. 25, 1912	Illinois	Starch factory	Explosion	Unknown	14	19	100,000	Partial
June 25, 1913	Western New York	Feed mill	Explosion and Fire	Unknown	33	60	465,428	Partial
Sept. 11, 1913	Iowa	Cereal mill	Explosion and Fire	Sparks from grind-machine	—	—	42,500	
Sept. 12, 1913	Western New York	Feed mill	Inflammation	Sparks from grind-machine	1	7	180,000	Partial
Nov. 1, 1913	Kansas	Flour mill	Explosion	Sparks from grind-machine	—	—	Not exc. 100	Slight explosion; confined to limited area
Nov. 6, 1913	Iowa	Cereal mill	Explosion	Sparks from grind-machine	3	—	1,200	Partial
Dec. 2, 1913	Ohio	Elevator	Explosion	Unknown	—	—	Slight	Partial
Mar. 30, 1914	Texas	Grain Elevator	Explosion	Unknown	—	—	6,500	Partial: valuation $250,000

Fig. 12. A column failure.

in the grinders that the fire which caused the explosion originated. The assistant ran to the floor below, taking a chemical extinguisher with him, and just as he opened a small slide in the elevator leg the explosion occurred. From this it would appear that the opening of one or both of these covers admitted enough air to permit the smouldering ground feed to burst into a blaze which ignited the explosive material in the air. It is very likely that the coke gas in the kiln room did not cause the explosion, although it may have added greatly to its intensity.

The first explanation offered for an explosion of this intensity was that it must have occurred in one or more of the ground oat hull tanks located near the top of the building, into which the elevator leading from the attrition grinder discharged, but owing to the facts that all but one of these tanks remained standing for some little time after the explosion, that the walls appeared to have been blown out near the bottom and that fire was not driven across the bridge to the Cleaning Mill, it is evident that the explosion must have taken place in the lower floors of the building where both the attrition grinders and kilns were located.

Damage to Buildings.

Owing to the direction of the wind, the Pump House was damaged but little, part of the roof being smashed. The Boiler House roof was crushed and the boilers put out of commission when the north wall of the Dry House fell. This was the extent of the damage until the Dry House floors and tanks collapsed at 10.50 a. m., as shown in Figure 4, which completed the ruin of the building. Curiously enough the smoke stack survived. Throughout the re-

Fig. 13. A column which forced its way through ceiling.

maining buildings in this row the ruin was complete. As is graphically shown in Figure 9 nothing but hopelessly tangled masses of machinery and a few stumps of walls are left. Beyond the spalling of the lower 15 feet of the three south bins of Concrete Elevator "B," this was scarcely damaged, which may be largely attributed to the direction of the wind. Elevator "A" and the Cleaning Mill were as completely ruined as the Mill, the only things of a combustible nature that were left being a large quantity of grain which was partly salvaged during the next couple of months, before burning completely through, and the bottoms of some wooden columns that were buried in this grain.

The Concrete Warehouse after standing for over six hours, with a fire of almost unparalleled intensity on all floors simultaneously, suddenly collapsed to the extent of six and two-thirds bays north of

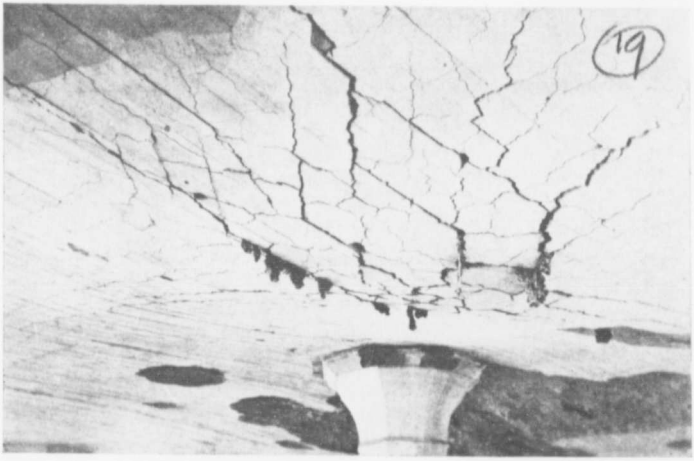
the elevator. In the remaining standing portions destruction is practically complete and if not razed before long these portions will collapse of themselves; progressive disintegration is rapidly going on. In these standing portions lessons of great value as to the fire-resisting qualities of different materials and appliances may be learned. From their appearance in the photographs, the columns do not seem to have sustained much damage, but upon examination it was found that the surface of the concrete had been calcined to a depth of from half an inch to an inch and beyond this, dehydration of the cement extended inward to an undetermined distance. In an endeavor to ascertain the exact depth of this dehydration, the concrete on one column was removed until the reinforcement was reached when two of the spiral bands were cut. Upon proceeding to cut one of the longitudinal rods with a hack saw, it suddenly pulled apart when the saw had cut only about two-thirds the way through, indicating that stresses of unknown magnitude existed. Although a depth of 5 inches from the surface had been reached and sound concrete not yet discovered, it was considered advisable to abandon any further effort. This column is shown in Figure 10 where a pencil may be seen in the saw cut mentioned.

In the third and fourth stories, where the original columns had been thickened by pouring an additional 2 inches of concrete around them, the difference in damage is quite marked. Beneath this 2-inch coat the concrete of the original column appeared to be in a better condition than in those columns that were entirely exposed to the fire. One of these is shown in Figure 11. On account of the condition of the building it was unsafe to ascertain the exact condition of these columns.

There is no doubt, however, as to the condition of the floors for they sagged in practically every panel as may be seen in Figures 14 and 15. Here, as in the columns, all surfaces have been calcined and large patches of the ceiling surface have fallen to the floor and crumbled into heaps of air-slacked lime. Upon examination of the concrete in numerous places on all stories, the floors were found to have been dehydrated completely through. This is entirely at variance with the experiences of the "Edison Fire" where it was found that the concrete was seldom injured more than an inch and a half to two inches in depth except at the corners where it was first thrown off by expansion of the concrete and later by the reinforcing bars. It is also at variance with the experience at the "Far Rockaway Fire" where a quartz aggregate caused serious disintegration of the concrete.

On removing some of the concrete from the slab rods it was found that although in some cases there was but half an inch of fireproofing between the surface of the rod and surface of the slab, there was no sign of oxidation.

The testimony taken before Fire Marshal Heaton shows that the bulk of the stock was piled to the north of the elevator on all floors, and it has been shown that in many places the actual floor loads were in excess of the designed live loads. With the reduction in strength of the floors, due to the long sustained heat and with such



Figs. 14 and 15. Sagging of floors.

loads upon them, it is surprising that the building did not collapse long before it did. The standing portions of the building show that the floors must have failed first and thus caused the collapse of the building. The wall panels in the standing portion sag much more than do the centre panels. This is probably due to the fact that a ten-foot trucking space was reserved down the centre of the building.

During the afternoon there were a number of minor explosions in the piles of blazing material in this building, which in one or two

Fig. 16. Corrugated steel doors in elevator shaft. Note also condition of wood tin-clad trap at stair opening on left,

places damaged the weakened floors. Evidence of one such explosion is shown in Figure 16, where the broken concrete may be seen around the opening instead of having dropped to the floor below.

With the terrific exposure to which they were subjected the wired glass windows withstood the fire remarkably well and it was largely due to radiation of heat through them rather than to their failure that the fire gained admittance to the building. The metal frames, both hollow and solid, gave an excellent demonstration of their value.

It is interesting to compare the condition of the wood tin-clad fire doors in Figure 17 with the corrugated steel doors in Figure 16 which were on different floors in the same shaft and probably had to withstand about the same temperature. The remains of a wood tin-clad trap door can be seen near the centre of Figure 16. On all other floors these traps were in the same or even worse condition.

Temperatures Developed During the Fire.

There was such a volume of fire throughout the entire plant at the same time that exceedingly high temperatures were developed, which were not confined to isolated spots, but existed throughout the buildings and in numerous places outside. Outside the buildings there were a number of box cars on the different sidings—nothing is left but the metal parts of these cars and in several instances the chilled iron wheels were melted and in one case at least the wheel and the rail upon which it was standing were melted together. In clearing up the ruins of the Dry House much difficulty was encountered because of the fact that structural steel beams, columns and tanks were fused into one mass. In the Mill and Warehouses No. 1

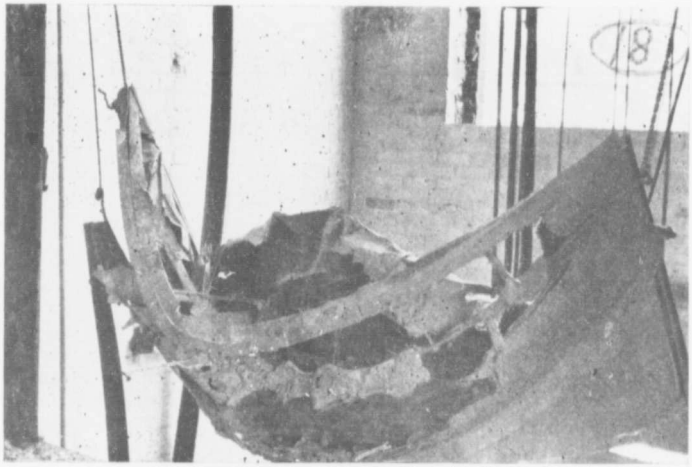


Fig. 17. Wood tin-clad fire door in elevator shaft.

and No. 2, many melted pieces of cast iron were found that were originally machine frames. On all the standing walls there are large patches of melted brick work. In Elevator "A" and the Cleaning Mill practically all the visible inside area was affected in this manner. Figure 18, showing a portion of the elevator shaft in the Concrete Warehouse, gives an excellent illustration of this condition and Figure 19 shows one place in the Concrete Warehouse where the brick was melted to a depth of over 4½ inches. This was not because of the inferior quality of the brick, for in all buildings, well-made machine-moulded clay brick was used. In the second and third story windows of the Concrete Warehouse, quite a number of completely melted cast-iron sash weights were found, while in other places in this building the heat was so intense that the ash from the burned cereals was melted into a phosphatic glass. Some of this material may be seen hanging from the ceiling in Figure 15. The roof drain which ran about two-thirds the length of the building was expanded by the heat and on cooling contracted, leaving the swing joint connection as an evidence of the amount of expansion.

On account of concrete having fused at the "Edison Fire," particular care was taken to see if any of the concrete had fused here, but nowhere throughout the plant was there evidence of fusion having occurred. The only effect of the heat on the limestone aggregate was to calcine those stones near the surface.

The complete dehydration of the 9-inch floor slabs together with the other items just mentioned proves that the fire at the Quaker Oats plant was of at least equal intensity and of far longer duration than the fire at the Edison plant.

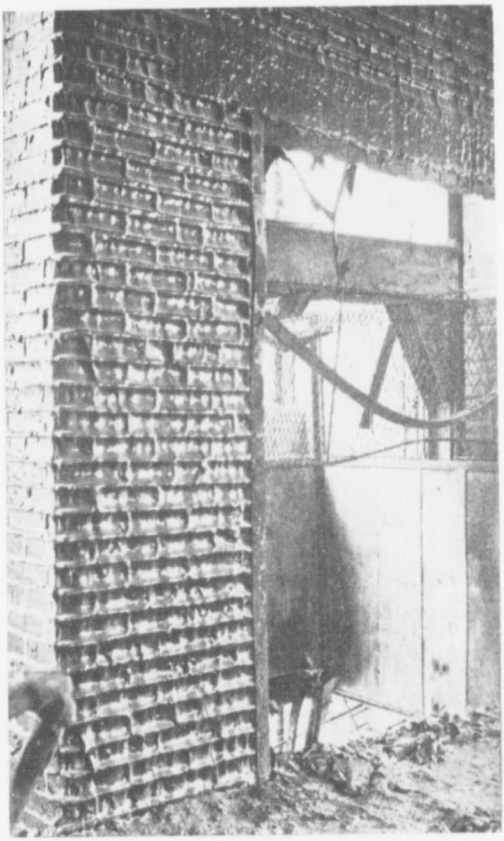


Fig. 18. Melted brickwork at an elevator shaft.

Property Loss.

Accurate figures as to the value of the property at the time of the fire and salvage are not available at the present time. Roughly speaking, however, it may be stated that at the time of the fire the plant was worth approximately $2,250,000. The concrete grain bins and their contents are practically uninjured and there was partial salvage of grain from Elevator "A," but the remainder of the plant is a total loss.

Loss of Life.

The most tragic feature of the conflagration was the appalling loss of life. Owing to the open gratings in the floors of the Dry House the explosion blew the fire into all stories, enveloping the

Fig. 19. Melted brickwork in concrete warehouse.

workmen in flames. Some of these men were able to make their own way out and even to assist in the rescue of the less fortunate ones. All the men in the Boiler House were killed when the north wall of the Dry House crashed through the roof. A car checker who was just outside the Boiler House was caught by the falling wall. One man who was wheeling coke was buried by the falling east wall. Of the thirty men who were taken to the hospital, twelve died of their injuries. These twelve together with the four in the Boiler House, the two killed outside and four missing make a total of 22 fatalities. Of those taken to the hospital and who recovered many are maimed for life.

It is a fortunate thing that there were stairways at the south ends of both warehouses, for if the more than two hundred girls at

work in the package department had been obliged to depend on the stairway in the elevator tower, loss of life would have undoubtedly been much larger; or if the fire had occurred at night the panic that would have ensued when the power went off and lights went out, might have resulted in a much larger loss of life.

Lessons of the Fire.

Once again the importance of isolating hazardous processes is emphasized and it is suggested in order to secure a minimum damage from any possible explosion, a means for the explosion to vent itself be provided either by making the exterior walls of light curtain wall construction or providing large plain glass areas. It would seem advisable also to locate control valves at a safe distance from the buildings where such hazardous processes are carried on.

If in any way it can be ascertained that the coke gases in the Dry Kiln Room contributed to the intensity of the explosion, such methods of grain drying should be abandoned and some safer method such as steam drying adopted.

The complete failure of the Concrete Building shows the necessity of providing automatic sprinkler protection wherever the contents of a building are combustible, irrespective of the construction of the building; and the folly of constructing an otherwise fire-resistive building and then leaving large unprotected openings, such as the bag hoist openings in the Concrete Warehouse, is demonstrated.

The value of being prepared to utilize the equipment of a neighboring Fire Department even though the hose couplings had different threads is demonstrated by the way in which Peterboro was enabled to use the services of the Lindsay Fire Brigade.

Acknowledgment.

This report was made possible through the courtesy and cheerful co-operation of the Quaker Oats Company local officials; W. A. Howard, Fire Chief of Peterboro; Ross Dobbin, Waterworks Superintendent of Peterboro; Provincial Fire Marshal E. P. Heaton; E. H. Sigison, Manager, Buffalo Association of Fire Underwriters; David J. Price, Engineer, U. S. Bureau of Agriculture; Prof. I. H. Woolson, Consulting Engineer, National Board of Fire Underwriters; W. W. Pearse, City Architect, City of Toronto and T. D. Mylrea, Engineer of Tests, City Architect's Department, City of Toronto. The Quaker Oats Co. local officials gave permission to examine the ruins and with Fire Chief Howard and Waterworks Superintendent Dobbin answered various inquiries. Provincial Fire Marshal E. P. Heaton allowed our representatives to study the various exhibits filed with him at the time of the investigation. Mr. E. H. Sigison and David J. Price forwarded bulletins on the "Explosibility of Grain Dusts," Prof. Woolson took the trouble to ask a series of suggestive questions, the answering of which would tend to bring out many points of interest. W. W. Pearse granted permission to incorporate in the report a cut of the Concrete Warehouse and numerous photos taken by Mr. T. D. Mylrea who gave much valuable information, especially in connection with the Concrete Building.