

PROJECT REPORT

**"THE BALLANTYNES DEPARTMENT STORE
FIRE DISASTER"**

CHRISTCHURCH

18 NOVEMBER 1947

PREPARED BY

D.C. NORTON AND B. GORDON

April 1992

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*Report very long, but
Excellent description and fascinating reading
Very thorough.*

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SUMMARY

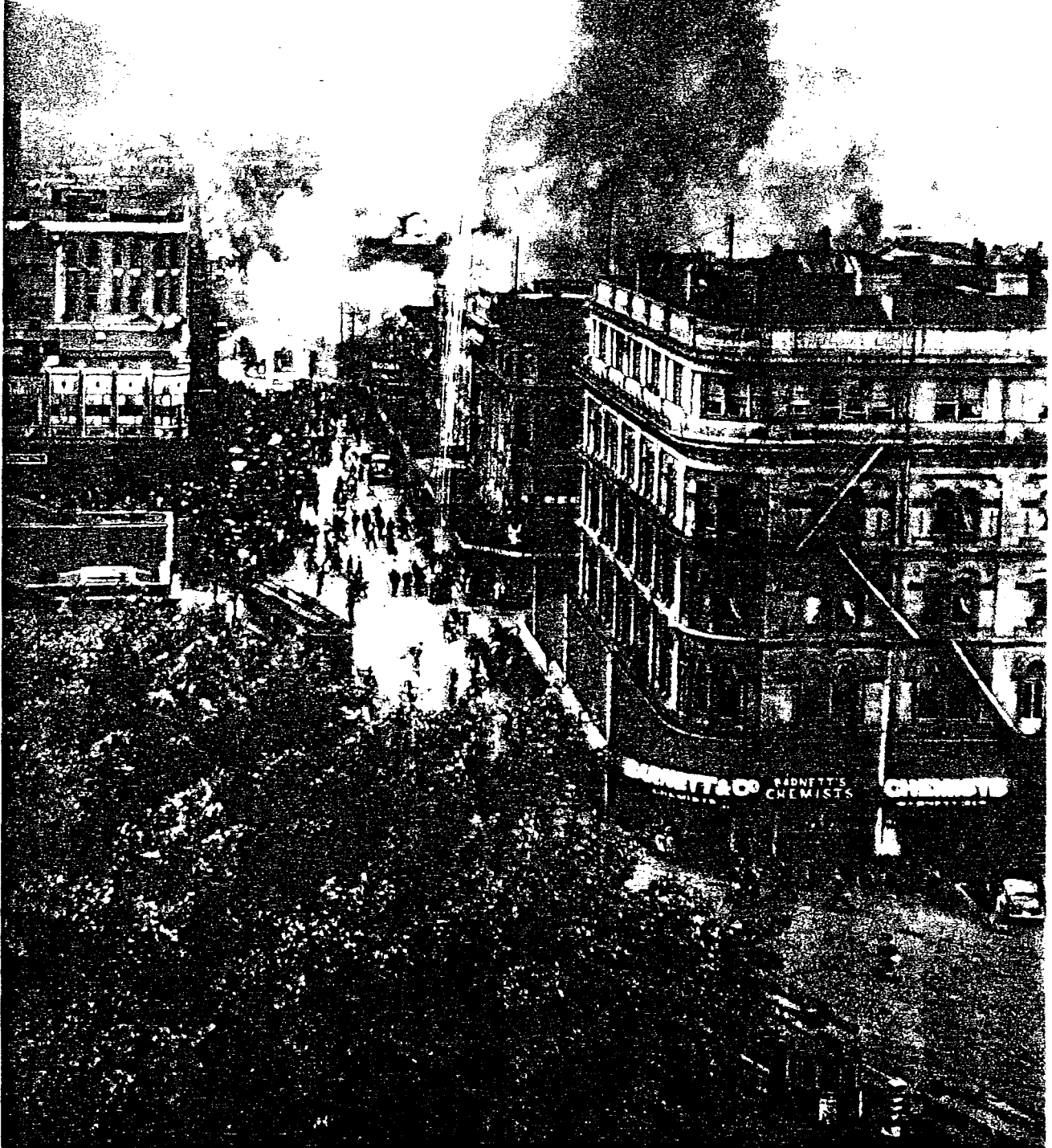
This report presents information regarding the Ballantynes Department Store Fire Disaster, which occurred at Christchurch, New Zealand, on the 18th November 1947. The complex was situated where the present building stands at the intersection of Cashel and Colombo Streets.

The fire was first noticed at 3.31 p.m. approximately and the magnitude of the fire was such that within an hour an acre of building had been gutted by fire. The intensity of the blaze was such that flames were observed leaping 300 feet into the air from the top floors of the building at the height of the fire. Heat could be felt 150 yards from the building. The pall of smoke was estimated to have been a mile wide and rising upwards of four to five thousand feet, and was visible thirty miles away. Over six thousand gallons of water per minute were used to fight the fire with no impact. Witnesses described fire spreading through the building "like a flame thrower".

The report focuses on several aspects of this disaster:

1. Examination of the structural aspects and building features.
2. Occupancy hazards applicable to Ballantynes at the time of the fire.
3. Identification of circumstances as to how the building features contributed to the spread of the fire, and loss of life.
4. By-laws, statutes and codes in force in 1947 relating to fire protection and prevention, safety of staff and safe means of egress and whether Ballantynes complied with such requirements.

In conclusion we discuss how the fire could have been prevented from reaching the magnitude it did and how the tragic loss of life could have been averted. We have not compared the Building and Egress Codes of 1947 with those existing today as our approach has been to demonstrate via the Ballantynes fire the hazards that caused this disaster to occur, with the result of the deaths of 41 people trapped in the building.



Tragedy struck suddenly and swiftly in Christchurch when one of the worst fires in the history of New Zealand swept through the three-storied building of J. Ballantyne and Co., Ltd., one of the biggest and oldest-established clothing-businesses in the country. The large store and workrooms, covering a site of one acre, were quickly engulfed in flames and it was feared that there would be additions to the death-roll of more than 40 which was issued the day after the fire.

HEAVY DEATH-ROLL IN TRAGIC CHRISTCHURCH FIRE

INTRODUCTION

The Ballantynes Department Store Fire, which occurred at Christchurch on Tuesday the 18th November 1947, is one of New Zealand's greatest tragedies and one of the countries most disastrous fires. In the most tragic circumstances 41 persons died and 2 were seriously injured as a result of being trapped in the building at the height of the fire. The fire destroyed an acre of building and caused damage in excess of £500,000, which in today's money terms would equate to over \$6,000,000.00.

FIRE HAZARDS ASSOCIATED WITH RETAIL SHOPS AND DEPARTMENT STORES

The major hazards and fire dangers prevalent in large retail shops and Department Stores, which cause fire or assist the spread of fire are generally recognised as being :

1. Open plan designs tend to increase the general level of fire hazard and assist a rapid spread of fire. Premises are often arranged so that customers can see displays and have ready access and route to them. Sales are encouraged if customers have visual contact from counter to counter, and floor to floor. Lack of compartmentation in sales and display areas is a major hazard.
2. A high proportion of goods sold in shops burn. In sales and display areas fire loads can be high and evenly spread. Fire loading by content can be categorised as :
 - 2.1 Ordinary Combustibles which may not be easily ignited will burn well once ignited. Wood, furniture, electrical goods, and plastic goods come within this category.
 - 2.2 Ordinary Combustibles which are easily ignited and burn rapidly. Clothing, fabrics, decorations, paper goods, fall within this category.
 - 2.3 Foams, Vinyls, Plastics - are easily ignitable and burn rapidly with intense heat producing thick smoke and toxic gases. Upholstered furniture, cushions, pillows, mattresses are examples.
 - 2.4 Flammable Liquids - are volatile, easily ignitable and explosive and add to fire intensity. Examples are nail varnishes and removers, scents, perfumes, spirits, solvents, liquers.
 - 2.5 Gas Containers - will explode when heated and contents may be inflammable. Examples are barbecue gas bottles, aerosols.
 - 2.6 Packaging - Nearly all types of packaging and packaging materials are readily combustible and include plastic, cardboard, paper, and styrene packaging.

Department stores have by content extreme fire loadings because of the varied and diverse range of items sold.

3. Display Areas can often be congested with products that are readily combustible. Large stores are constantly changing their displays, contents and customer density, particularly during sales periods or busy periods, i.e. Christmas, when stock holdings and holdings of bulk goods increase. ✓
4. Stockrooms and Basements are also a major hazard. Research by the British Fire Service revealed that a high proportion of the most damaging fires break out in stockrooms and storage areas, because conditions in stock rooms assist fires to start and spread because of availability of combustible materials. It was found that not all stockrooms and basements are frequently visited, allowing a good opportunity for a fire to outbreak to remain undiscovered for some time. The research also revealed that undisturbed areas may be attractive to surreptitious smokers and provide uninterrupted opportunity for an arsonist to set a fire. Absence of fire warning systems, and prevention systems in these areas was prevalent, particularly the absence of sprinklers in stock room shelving.
5. Occupancy practices relating to smoking rules, keeping flammable goods clear of heat sources, regular maintenance and inspection of electrical and gas systems, clearance and regular disposal of waste packaging and rubbish, safe storage of volatile liquids, gases and chemicals and cooking and kitchen procedures were identified as other major hazards prevalent for retail shops and department stores. ✓

BUILDING DESCRIPTIONS AND CONSTRUCTION ASPECTS

The company of J. Ballantyne and Co. Ltd was founded in 1874 as Milliners and Drapers. At the turn of the 20th Century they occupied premises in Cashel Street - Colombo Street where the present building stands. The company progressively purchased adjacent buildings as the business expanded.

At the time of the fire in 1947, the overall complex consisted of what were formerly eight separate buildings, into which large openings had been made in one time party walls, thereby effectively converting eight buildings into one large establishment and open area.

The total area of the complex was 1,873,600 cubic feet.

The group of buildings which formed the complex had a frontage of 165 feet in Colombo Street, and 265 feet in Cashel Street. The Colombo Street depth was 133 feet, and there was a 69 foot frontage into Lichfield Street.

Plan 1 is a general block plan of the premises prior to the fire. This report focusses on 3 of the buildings outlined in the block plan. (Reference: Ballantynes Fire Disaster, G.G. Walker, p.82).

Building 1	-	Congreves Building
Building 2	-	Goodmans Building
Building 3	-	Pratts Building

Schedule A is a collation in schedule form of the features and construction details of Blocks 1 to 3. The reference used was "The Description of Buildings Comprising the Premises of Messrs J. Ballantyne and Co.Ltd, as at 18th Day of November 1947", presented by Mr P.C. Cornish of the Public Works Department to the Royal Commission of Inquiry. The document "The Ballantynes Fire Disaster" by G.G. Walker, pp.82 to 92 is reproduced as Schedule A.

Schedule B is a collation in schedule form of the egress points and openings in Blocks 1 to 3. The same source is the same as used in Schedule A.

Appendices D to G are the floor plans of Ballantynes Building, pre fire, which were obtained from records of the Christchurch Fire Service and prepared for the Royal Commission of Inquiry Into the Ballantynes Fire, by V.R.J. Hean.

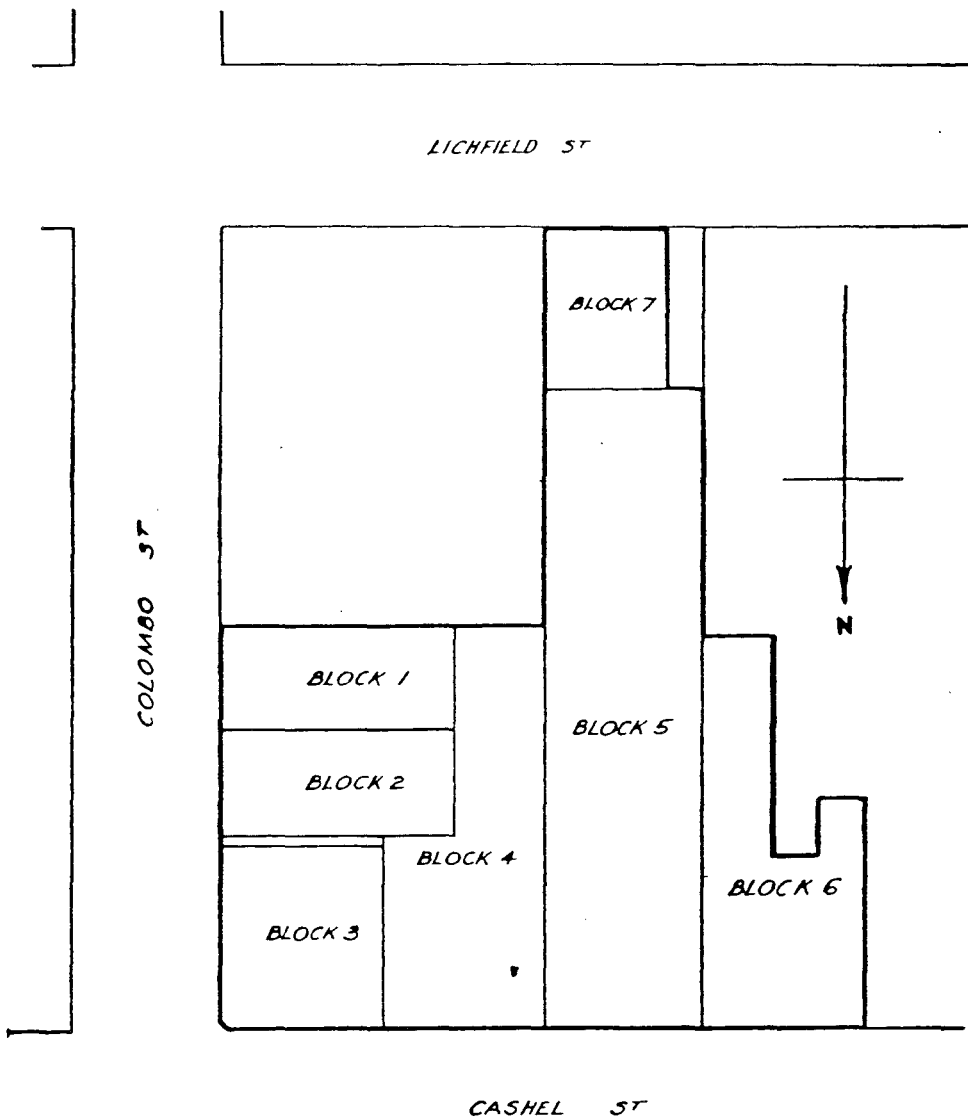
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APPENDIX B.—DESCRIPTION OF BUILDINGS COMPRISING THE PREMISES OF MESSRS. J. BALLANTYNE AND CO., LTD., AS AT 18TH DAY OF NOVEMBER, 1947

Prepared by P. C. CORNISH, A.N.Z.I.A., District Architect, Public Works Department, Christchurch, for the assistance of the Royal Commission inquiring into the fatal fire occurring on the 18th day of November, 1947, in the premises of Messrs. J. Ballantyne and Co., Ltd.



BLOCK PLAN

PREMISES OF J. BALLANTYNE & CO LTD
CHRISTCHURCH

FEATURES	BLOCK 1: CONGREVES BUILDING Colombo Street - Purchased in 1918	BLOCK 2: GOODMAN'S BUILDING Colombo Street Built in 1904	BLOCK 3: PRATTS BUILDING Colombo-Cashel Streets
STORIES	3 Storey Block with Basement	4 Storey Block with Basement separated from Congreves by brick party wall.	3 Storey Block with Basement separated by two solid brick walls.
WALLS	<u>CONSTRUCTION DETAILS</u> Brick with stone facade	<u>CONSTRUCTION DETAILS</u> Brick with stone facade	<u>CONSTRUCTION DETAILS</u> Concrete basement - brick with stone facade
WALL LININGS	Mainly matchlining, pinex board on First Floor	Matchlining, Beaverboard, pinex	Various - matchlining, Beaverboard, pinex and Celotex
FLOORS	Wood on timber joists on rolled steel beams	Wood on timber joists. On upper floors wood on rolled steel beams	Wood on timber joists carried on timber beams.
ROOF	Timber framed - corrugated iron skylights	Timber framed, corrugated iron skylights	Timber framed, corrugated iron, 45 foot long lantern light and penthouse over lift well
CEILINGS			
BASEMENT	No ceiling	No ceiling	No ceiling
GROUND FLOOR	Matchlining, pinex	Matchlining	Matchlining
FIRST FLOOR	Matchlining, pinex	Matchlining with pinex	Matchlining with pinex
SECOND FLOOR			
FLOOR	No ceiling	Matchlining	Celotex only
THIRD FLOOR	-	Only ceiling cover over telephone Exchange	-
PARTITIONS			
BASEMENT	Wire mesh on wooden frames	Wire mesh on wooden frame	-
GROUND FLOOR	Brick, timber covered with pinex	Nil	Brick, timber, wood panelling, Beaverboard

FIRST FLOOR Pinex and Matchlining

Nil

Timber with plywood, matchlining,
Plasterboard

SECOND FLOOR Matchlining
THIRD FLOOR -

Matchlining, pinex, glass
Matchlining, pinex

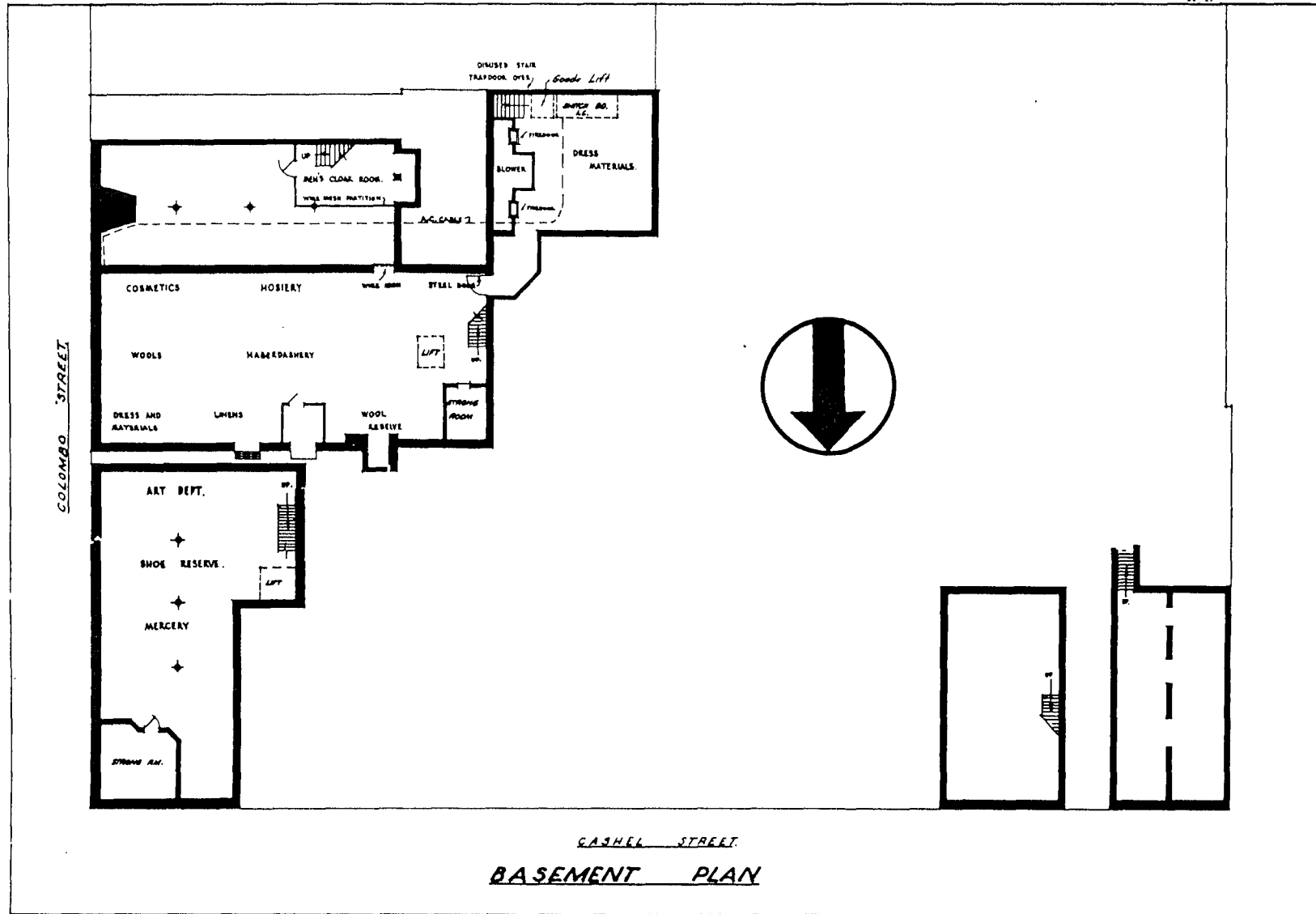
Timber framed with Celotex
-

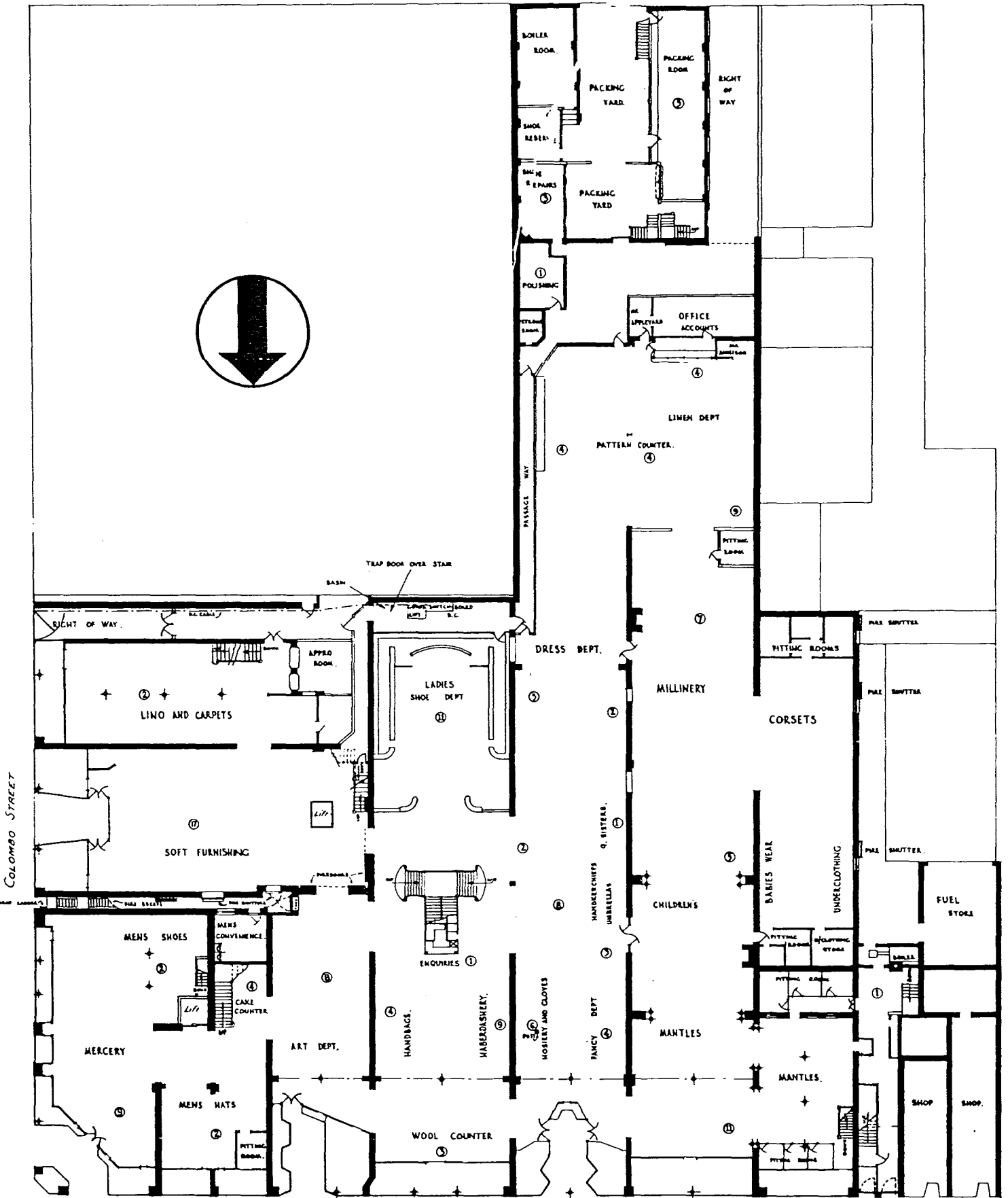
COMMENTS

Accounts and Credit Office on
Second floor separated from the
block by a brick wall

MEANS OF EGRESS AND OPENINGS IN BUILDING

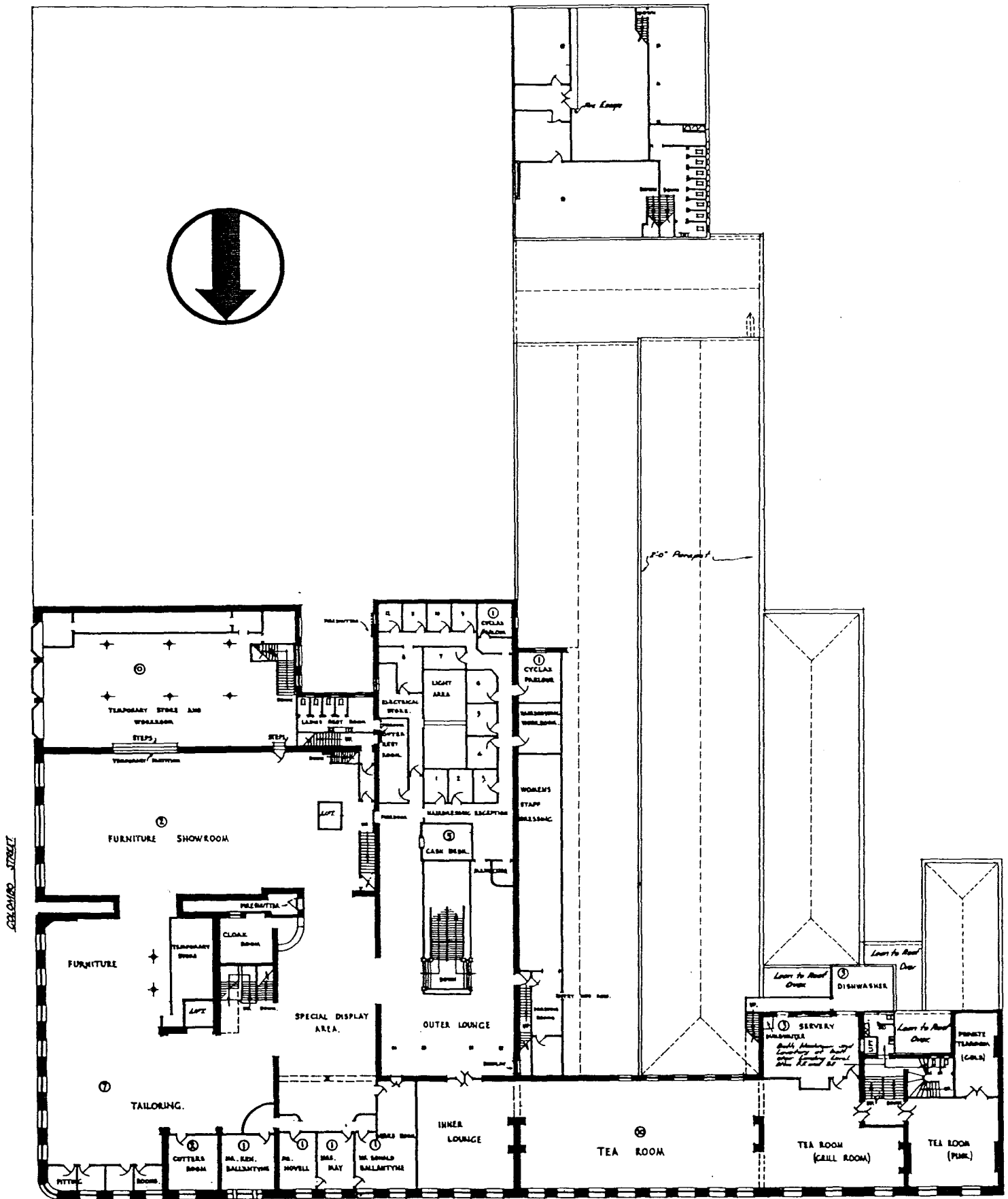
Features	Congreves Building Block 1	Goodmans Building Block 2	Pratts Building Block 3
Fire Escapes	Nil	Steel and caste iron stair with flights and landing accessible from second and third floors, access also available to second floor, Block 3, via sliding metal clad door. Access available to Block 3 via lavatory above strong room in Block 3.	Access from second and third floor (toilet only) to steel and caste iron fire escape on South Wall of building giving access from second and third floors only to a 3 foot wide alleyway between Block 2 and 2. No fire escape for first floor.
Lifts	Nil	Access basement to third floor; shafts ground floor to third floor enclosed with pinex, and third floor shaft enclosed with pinex hardboard. Doors were wood with wire mesh panel.	Ground to second floor lift with shafts of pinex board, beaverboard and celotex. Doors of wood with wire mesh panels.
Stairs	Stairs were all timber and not enclosed from basement to first floor. First to second floor stairs enclosed with timber partitioning with doors at head and foot of stairs.	Stairs were all timber not enclosed from ground to third floor. From basement to ground floor stairs were timber closed at top with wooden door and spring closer.	Basement to first floor were timber and not enclosed. First to third floors were timber enclosed with timber partitions covered with Celotex.
Openings	One basement opening to Block 2. Two ground floor openings to Block 2. Three openings on first floor to Block 2. Smallest opening 6' x 4'6" - basement. Largest opening 12' x 10'6" - ground floor.	Hole cut between basement to Pratts. Access to Block 3 under stairs on alleyway. Opening on 1st floor between Blocks 1 and 3. Fire door access on 2nd floor to Block 3. Indirect access to Block 3 on third floor via alleyway and fire escape.	Refer Goodmans Building.





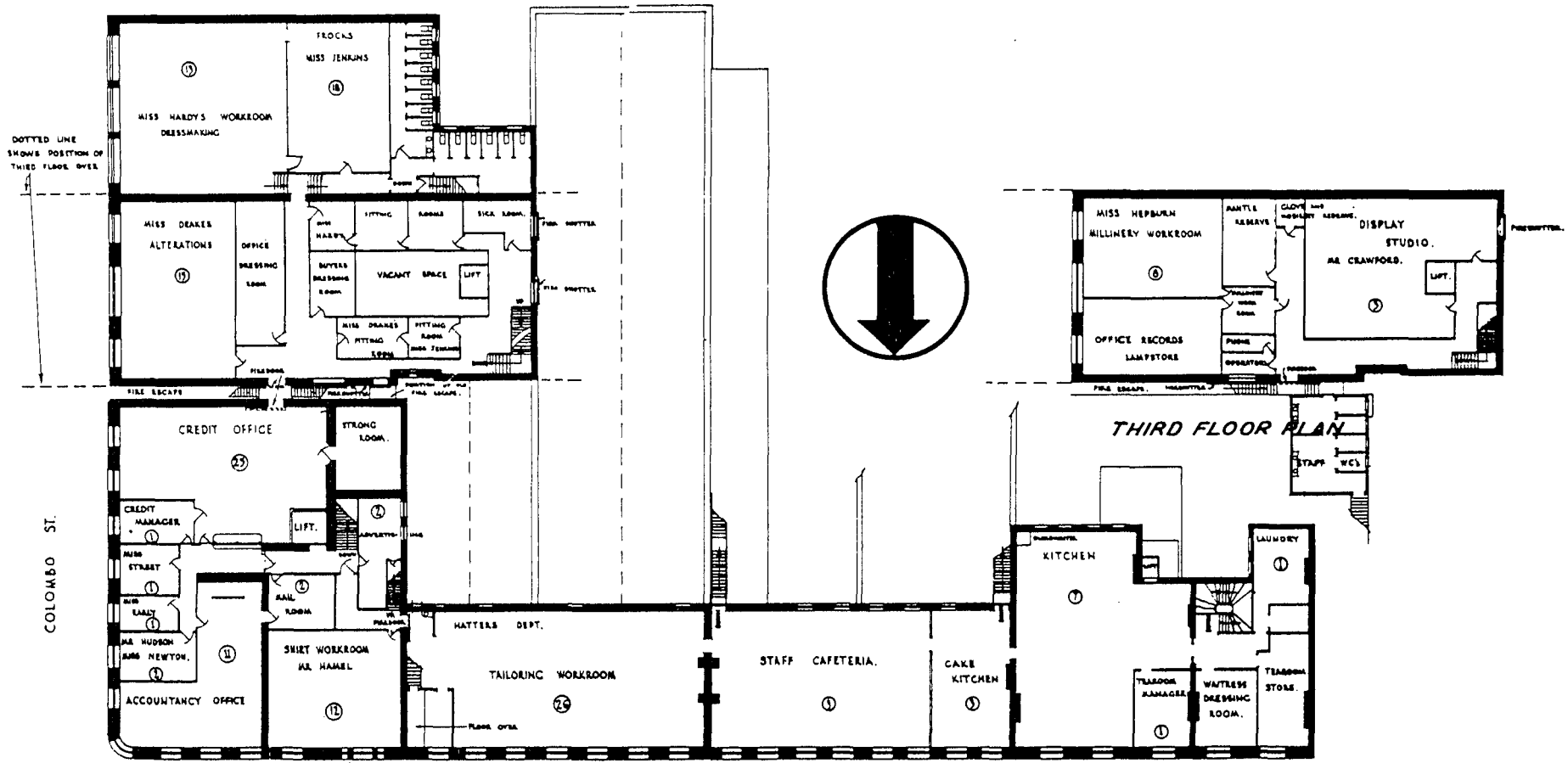
CASHEL STREET
GROUND FLOOR PLAN

LEGEND
 NUMBER IN CIRCLE INDICATES NUMBER OF OCCUPANTS.



CASHMERE STREET
CASHEL STREET
FIRST FLOOR PLAN

LEGEND
NUMBER IN CIRCLE INDICATES NUMBER OF OCCUPANTS



CASHEL ST.
SECOND FLOOR PLAN

LEGEND
NUMBER IN CIRCLE INDICATES NUMBER OF OCCUPANTS

BUILDING FEATURES

The predominant features obvious from the Plans 1 to 5, and Schedules A and B are :

1. The high fire load by way of wooden construction and partitioning.
2. The unprotected vertical openings of stairways and liftwells.
3. The absence of fire breaks in the roof.
4. The lack of compartmentation on all floors.
5. Unprotected lateral openings in brick separation walls, giving access between the blocks 1, 2 and 3.
6. The high fire load by content evident from the floor plans showing the sales areas, workrooms and administration areas.
7. The high density of staff on the upper floors.
8. The absence of fire escapes on the Colombo and Cashel Street frontages.
9. The absence of fire doors and fire walls in the buildings.
10. No protected external stairways.
11. Much of the internal partitioning and some linings were untreated soft wood fibre.
12. Unprotected openings on the first floor between all three blocks.
13. Open stairway to basement in Congreves Building had no Fire Stop.
14. Unprotected opening in the dividing wall of the basement between Congreves and Goodmans building.
15. Plan 4 - Temporary partitions on first floor separating Goodmans from Congreves building.
16. Plan 4 - No partitioning between Pratts and Goodmans on first floor thus large open display area.
17. Plan 5 - Fire doors onto the alley fire escape between Pratts and Goodmans buildings.
18. Plan 4 - First floor of Congreves Building was a temporary store and workroom and no staff were employed on that floor.

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FIRE LOADING OF BALLANTYNES BUILDING

Based on evidence presented at the Royal Commission of Inquiry into the disaster, it was concluded that the total number of British Thermal Units available for the production of heat in the event of fire, was substantial. Approximations of British Thermal Units per square foot were.

BRITISH THERMAL UNITS PER SQUARE FOOT

	Basement	Ground Floor	First Floor	Second Floor	Third Floor	Roof
Congreves	200,000	108,000	249,000	237,000	-	89,000
Goodmans	65,000	213,000	244,000	224,000	226,000	79,500
Pratts	278,000	200,000	217,000	308,000	-	79,000

The total combustible contents of the building were taken into account and included floors, linings, fittings, furnishings, stock and plant.

*Convert to
MJ/m²*

Note: A British Thermal Unit is defined as "One British Thermal Unit is the amount of heat required to raise the temperature of one pound of water 1 degree Fahrenheit (when the measurement is performed at 60°F).

THE ORIGIN AREA OF THE FIRE

The origin area of the fire, was by later examination and investigation, determined to be in the basement of Congreves Building, which was where the smoke was first noticed.

The basement was used as a storage area and contained bolts and rolls of carpet, furniture, wooden shelving and packaging. Its services included electrical wiring and cables, fuse boxes and gas mains and pipes. The staff employee who worked in the area, Mr K. Smith was a smoker.

The basement was situated at the Southern end of Congreves Building and services were at the southern end of the basement. Access to the basement was available via an unprotected stairway from the ground floor in Congreves Building. Access to a basement in Goodmans was obtainable from the Congreves basement via an opening closed by a light wire mesh grille gate.

An alleyway 3 foot wide separated Goodmans Building and Pratts Building. The basement of Goodmans building had an opening being cut out onto this alleyway which enclosed the fire escape from Pratts Building (refer floor plans).

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CIRCUMSTANCES OF THE FIRE

With reference to the Report of the Commission of Enquiry for the Ballantynes Fire, extracts from the Christchurch Fire Service Watchroom Occurrence Book of the 18th November 1947, and eye witness accounts reported in the Christchurch Star Sun and Christchurch Press Newspapers, a chronology of events in respect of the fire has been reconstructed.

<u>TIME</u>	<u>EVENT</u>
3.25 p.m.	K. Smith, Basement Worker in Congreves Building goes to afternoon tea. There is no sign of fire in the basement on his departure.
3.30 p.m.	K. Smith does not return to the basement, but leaves building to visit a friend.
3.31 p.m.	The first wisps of smoke are noticed coming from the cellar by a staff member who draws this to the attention of another employee, who visits the cellar to find hot smoke by the south wall. No flame or sound of fire is observed by the employee. It was noticed that lights in the basement were surging. The employee returned to the ground floor asking if staff had advised the Fire Brigade and Management of the fire.
3.33 p.m. approx	Mr Stringer, the employee involved, returned to the cellar with a fire extinguisher to find the smoke was more dense and he could hear the fire crackling. The smoke was described as having a "tarry" smell by Mr Stringer. Another staff member arrived in the cellar to assist, at which time the lights in the cellar failed. Both returned to the ground floor. Management were also arriving at the area and a principal Roger Ballantyne asked if the Fire Service had been called. He was told they had been. Ballantyne instructed a staff member to advise the Fire Service, to ensure that they had been alerted. He and other staff went to the cellar with fire extinguishers to attempt to contain the fire.
3.46 p.m.	Christchurch Fire Brigade receive the fire call from Mr Boon who advises there is a fire in the cellar. Fire Brigade despatch two fire units and a salvage van to the scene.
3.48 p.m.	Fire Brigade units arrive at scene. Fire Brigade prepare one hose to attack the fire. Management is advised by executives to clear staff and customers but they confined that activity to ground floor only.

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3.49 p.m. Fire Brigade ingress to the cellar is impeded by persons vacating the building and an alternative route to the cellar is sought by management and the officer in charge of the Fire Brigade.

An employee on the 3rd Floor of Pratts Building noticed smoke in the fire escape area between Goodmans and Pratts building, estimated at 6 feet below level of the third floor.

3.50 p.m. Ken Ballantyne arrives at Credit Office, on 3rd Floor of Pratts Building, and opened the fire escape finding intense heat and smoke.

3.50 p.m. to 3.53 p.m. Lights start failing on upper floors of Pratts and Goodmans building.

3.53 p.m. Credit Office staff are instructed to put records away.

Customers are observed still entering premises via the Cashel Street ground floor doors in Pratts Building.

3.56 p.m. A staff supervisor leads out 8 millinery room employees from the Millinery Department on the 3rd floor of Goodmans Building. Only she and one staff member obtain safe passage, the rest are overcome by smoke inhalation. First known casualties.

3.57 p.m. Fire has "blown" and the first water is applied on the fire, at the windows of Congreves Building.

3.58 p.m. Staff employed in the shirt room on 3rd Floor of Pratts Building evacuate via the tailoring department at which time the floor is becoming heavily smoke logged. They reach safety.

3.59 p.m. Flames break through on the 3rd Floor of Pratts Building. Witnesses described it as a pillar of fire travelling at running speed accompanied by explosions. Flashover has occurred in this area and fire becomes fully developed on third floors of Pratts and Goodmans Building.

4.00 p.m. Fire Service extension ladder arrives at scene.

Fire Service turn out units from suburban fire stations.

Credit Office stairway in Pratts Building is cut off by fire. 19 staff are trapped inside.

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4.04 p.m.	Two staff members jump from window of 3rd floor of Pratts Building and are seriously injured. A third staff member jumps and later dies of injuries.
4.10 p.m.	Ken Ballantyne rescued by ladder from 3rd Floor of Pratts Building. He is the last person to leave the building alive.
4.15 p.m.	Top floors of Pratts, Goodmans Building collapse to ground level.
5.29 p.m.	Fire is surrounded and brought under control.

Evident from the sequence of events are :

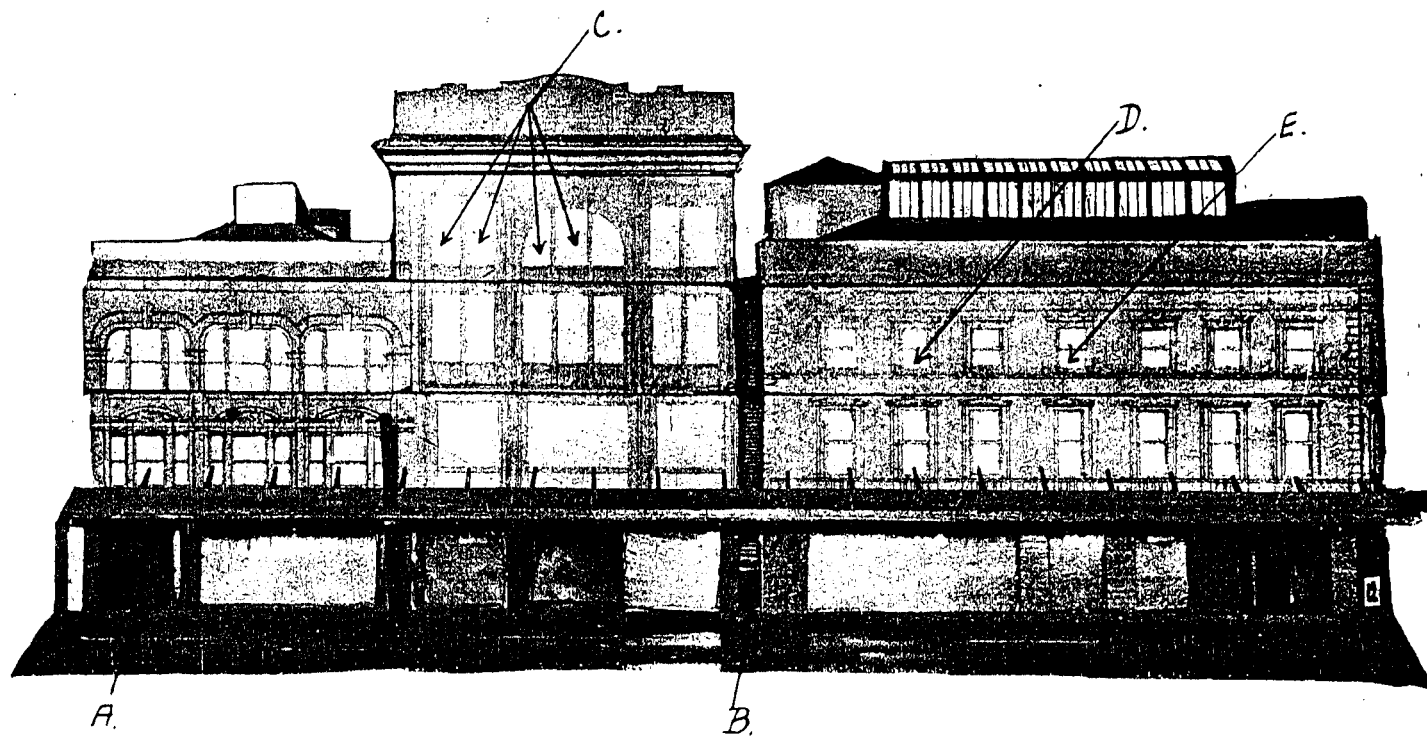
1. First fire call is made 15 minutes after fire was discovered.
2. First evacuation order given 17 minutes after fire discovery but confined to ground floor only.
3. The first water is applied to the fire 11 minutes after brigade arrival and 26 minutes after fire was discovered.
4. Approximately 40 minutes after the fire discovery, the top floors of Pratts and Goodmans Building have collapsed.
5. Flashover has occurred on the 3rd floor of Pratts building approximately 28 minutes after the fire was discovered.

The attached Plan 6, is a reproduction of the Colombo Street frontage of Ballantynes building. The following features are shown :

- A. Basement in Congreves building where fire started.
- B. Enclosed alley and fire escapes between Goodmans building and Pratts building.
- C. Millinery room windows where staff were trapped and died.
- D. The Credit Office window where most staff died.
- E. Window from which last rescue was made.

The photograph is a model of the building made to assist the Royal Commission that investigated the circumstances of the fire in 1948.



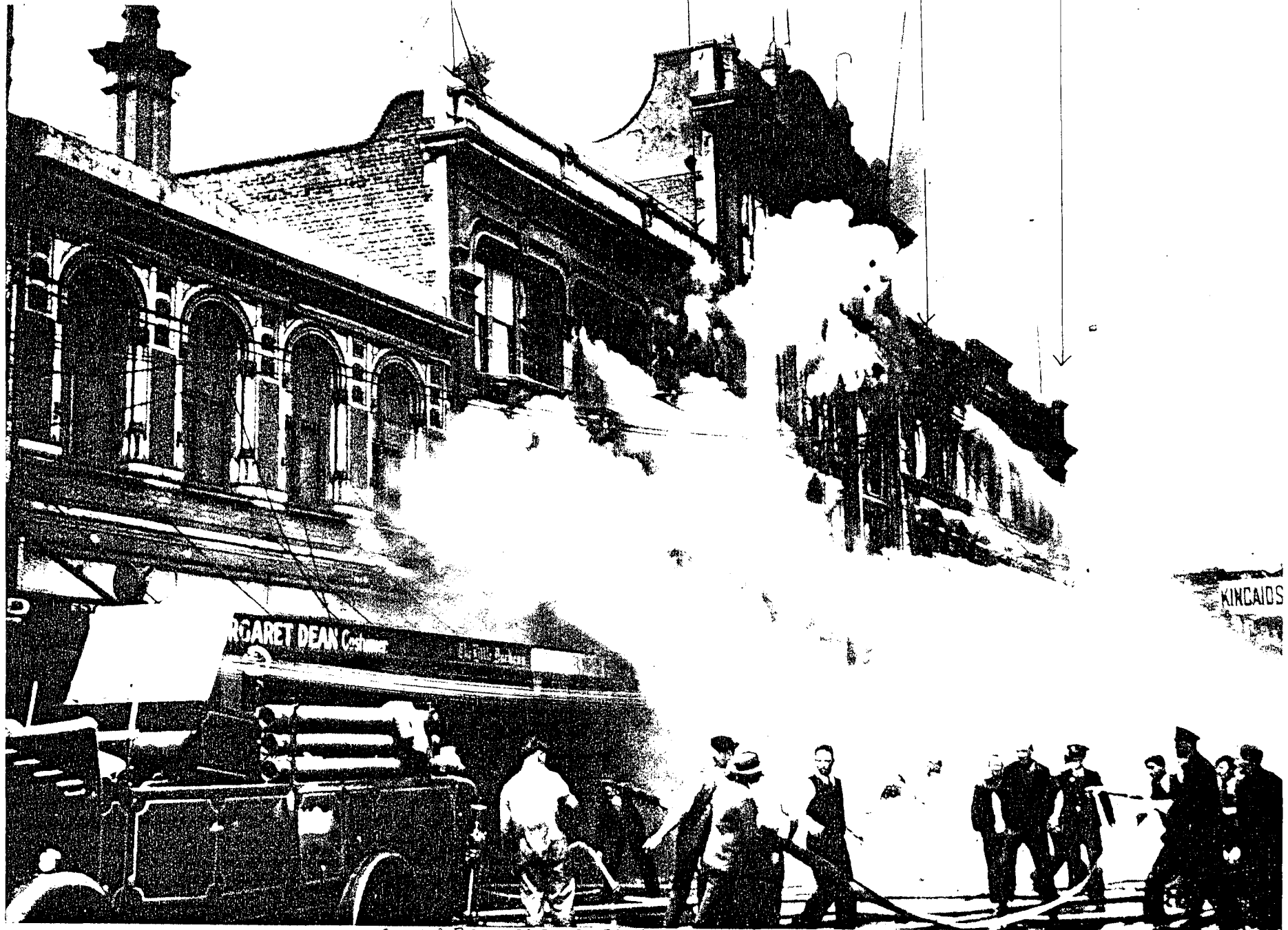


COLOMBO STREET FRONTAGE

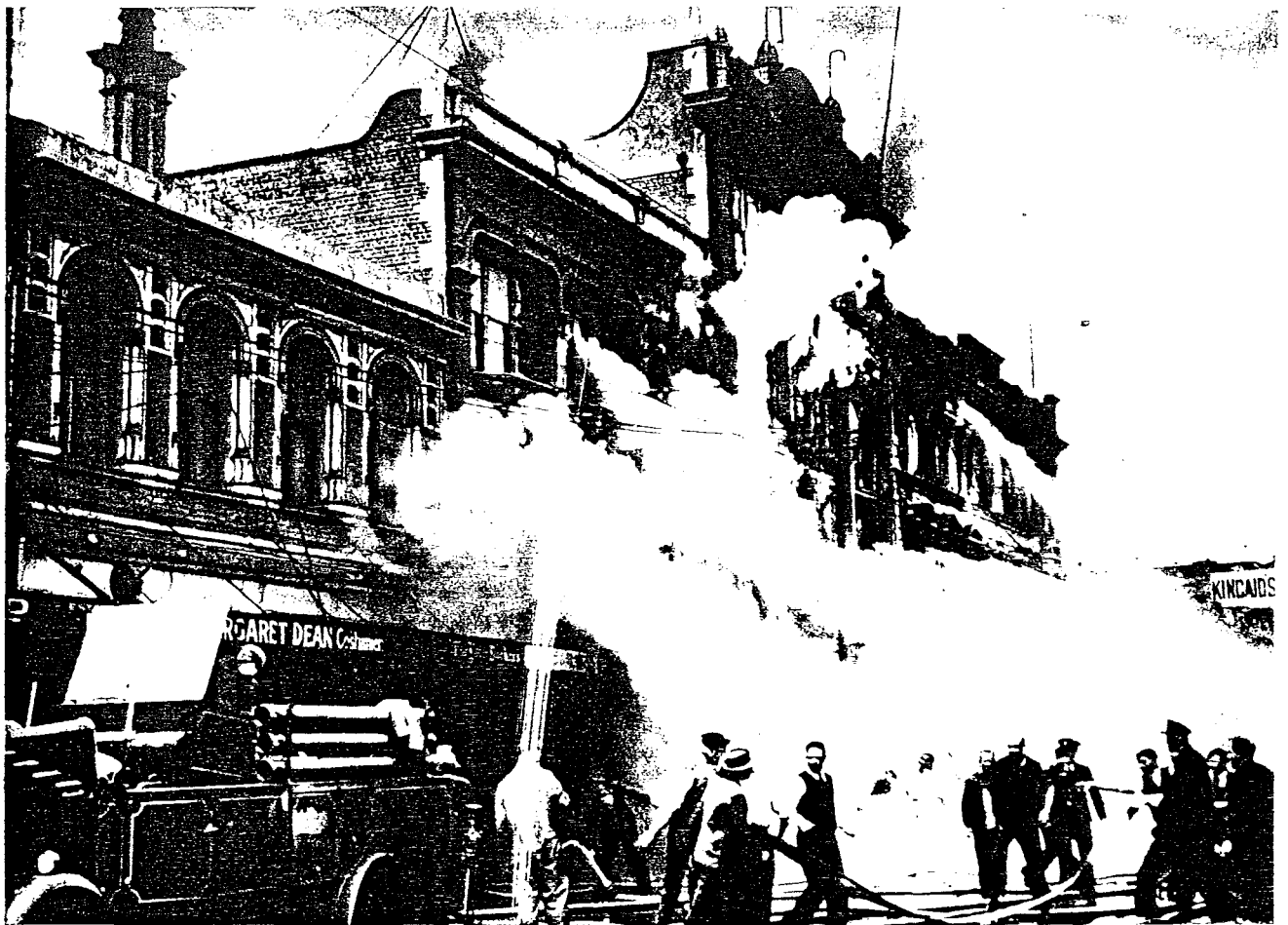
PHOTOGRAPHS

- Photo 1 - Depicts the Colombo Street frontage of the buildings at the height of the fire. The 3 buildings are identified. The smoke from the first and second floor of Congreves building is substantial, as it is on the first floor of Goodmans building. The second floor of Goodmans is fully involved in fire. 7 staff members died directly above on the third floor of Goodmans building via smoke inhalation when their path to the stairway was blocked by smoke before flames impinged that area.
- Photo 2 - Reduced photo version of 1 above.
- Photo 3 - The cashel Street frontage of the building is shown. The magnitude of the fire is evident from the size of the building complex shown in the photo.
- ✓

CONCRETE BUILDING | GOVERNMENT BUILDING | PRINTS BUILDING



COLOMBO STREET FRONTAGE.
"Like a scene from the London blitz," said one spectator as firemen and helpers played 6,000 gallons of water a minute into the inferno. A graphic shot of the section of the building in Colombo Street in which the fire is believed to have started.



"Like a scene from the London blitz," said one spectator as firemen and helpers played 6,000 gallons of water a minute into the inferno. A graphic shot of the section of the building in Colombo Street in which the fire is believed to have started.

PHOTO 3.



The Cashel Street frontage, with water flooding the street as hoses are played on the windows from which many people trapped in the blazing building were rescued. The heat was so intense that in parts of the building the Oamaru stone facing turned into lime.

SCENES ON THE TWO FRONTAGES AS THE FIRE IS FOUGHT

FATALITIES AND STAFF DISPERSIONS

432 staff were working in the eight buildings which made up the Ballantynes complex on the day of the fire. 40 staff were employed in both the Congreves and Goodmans building respectively and a further 165 in Pratts building, for a total dispersion of 245 in the three main buildings.

Staff dispersement on the day of the fire, by floor locations was :

	Congreves	Goodmans	Pratts	Total
Basement	1	-	-	1
Ground Floor	5	14	54	73
First Floor	1	2	30	33
Second Floor	33	12	81	126
Third Floor	-	12	-	12
Total	40	40	165	245

41 persons perished in the fire of which 38 were employees, 2 were visiting auditors and the final fatality being an employee of the College of Retailing who occupied an office in the building. 171 staff were employed on floors above ground level, in the three buildings.

Of the 38 staff members who lost their lives, 10 were employed on the 3rd floor of Goodmans Building and 28 on the second floor of Pratts Building.

Floor Employed On	Location Where Perished	Number
Credit Office - 2nd Floor - Pratts	Accounts/Credit Office - 2nd Floor - Pratts	20
Accounts Office - 2nd Floor - Pratts	Accounts/Credit Office - 2nd Floor - Pratts	7
Display Studio - 3rd Floor - Goodmans	Accounts/Credit Office - 2nd Floor - Pratts	2
Millinery Dept - 3rd Floor - Goodmans	Millinery Workroom - 3rd Floor - Goodmans	7
Telephone Exchange - 3rd Floor - Goodmans	Accounts/Credit Office - 2nd Floor - Pratts	1
Accounts Office - 2nd Floor - Pratts	Jumped from window of accounts office	1

✓

THE SPREAD OF SMOKE AND FLAME

Propagation of fire generally means the spreading, extension or continued burning of fire by vertical, horizontal or downward directions.

The general principles of Fire Behaviour are

1. That fire spreads upwards and outwards.
2. That it follows the path of least resistance.
3. Fire spreads vertically and will spread horizontally when vertically its path is blocked.

Vertical spread of fire is caused by the updraft of heated air and gasses through open stairways, elevator shafts, vertical openings, ducts, service penetrations, and hidden gaps in wall linings and ceilings and via external windows.

Horizontal spread of fire at the same levels is caused by reason of air currents, confinement of fire to that level and adjacent combustible fuel. Open doors, concealed spaces, ceiling cavities, service openings and barrier failure will allow unimpeded horizontal fire spread.

The spread of fire will occur via one or more means of heat transfer, namely radiation, convection and conduction.

Applying these principles to Ballantynes Fire a reconstruction of the spread of heat, flame and smoke has been researched.

The fire origin area was the basement of Congreves Building. A vertical spread of fire and smoke from the source area has occurred via the stairway of the basement to the ground floor, this stairway not being fire stopped. Progression of the fire has also been vertical at an early stage via the non fire protected wire mesh door giving access to the basement under Goodmans building. The Goodmans basement has also provided a means of air access to further propagate the fire in the basement, allowing heated products of combustion in increasing proportions to rise vertically from Goodmans basement into the lift shaft of that building. The lift shaft was enclosed with pinex and the doors of wood with wire mesh. Vertical heat transfer has been by way of convection at this stage.

Fuelled by the heavy fire loading available and the large openings on the first floor giving access between all three buildings, the products of combustion (heat, smoke, gases) has ascended via unprotected stairs and liftwells to the upper floors of the buildings. As the fire has increased in growth it has created a rapid rise of combustion gases and heated air producing a partial vacuum thereby pulling surrounding air to flow into the base of the fire resulting in a rapid updraft.

The presence of non fire resistance wall partitioning particularly pinex, plywood and match lining on all floors has allowed a rapid growth of fire, causing barrier failure allowing the fire to become unconfined very quickly. Further spread has occurred via the roofs which had no fire breaks. Wall linings over timber battens

with 1 inch gaps also assisted the spread of fire and smoke. Surface flame spread over partitioning has been rapid as the fire has intensified.

Further smoke spread occurred via the opening cut in the northern wall of Goodmans basement once the soft fibre board surrounding the hole had been breached. This smoke spread up the narrow 3 foot alley and was described by witnesses as dense and thick.

Flashover on the third floor of Pratts Building has occurred at 3.58 p.m., approximately 28 minutes after the fire was discovered.

A dangerous and undetected heat and smoke build up occurred on the unoccupied first floor of Congreves Building due to a fibre board screen closing a lateral opening giving access to Goodmans Building. Once the fibre board temporary partition had been breached unimpeded rapid development and spread of fire has occurred.

The rapid build up and spread of smoke, heat and fire rendered fire escapes and stairs ineffective because staff were unable to obtain access to them and they were blocked by the intensity of the fire, and accumulation of carbon monoxide gasses and smoke, particularly on the second and third floors where the majority of deaths occurred. Smoke from the hole in Goodmans basement has filled the alley between Pratts Building and obstructed the fire escape as it has risen and intensified.


Open windows on the north eastern end of Pratts Building first floor also contributed to the rapid growth and spread of fire in that building.

Perhaps the most significant feature responsible for the rapid build up and explosive spread of fire, was the build up of inflammable gases and smoke at an early stage on the first floor of Congreves Building. Explosive ignition of these gasses would have breached the temporary soft board partition between Congreves and Goodmans Building and at that point the fire has blown and was beyond control.

Plans 6 to 9 illustrate in stages the spread of smoke and fire. Plan 6 is a sectionalised plan of the buildings, and plans 7 to 9, are floor plans. (Source - NZ Fire Service, from Report of Commission of Enquiry - prepared by V.R.J. Hean and presented as evidence to the Commission).

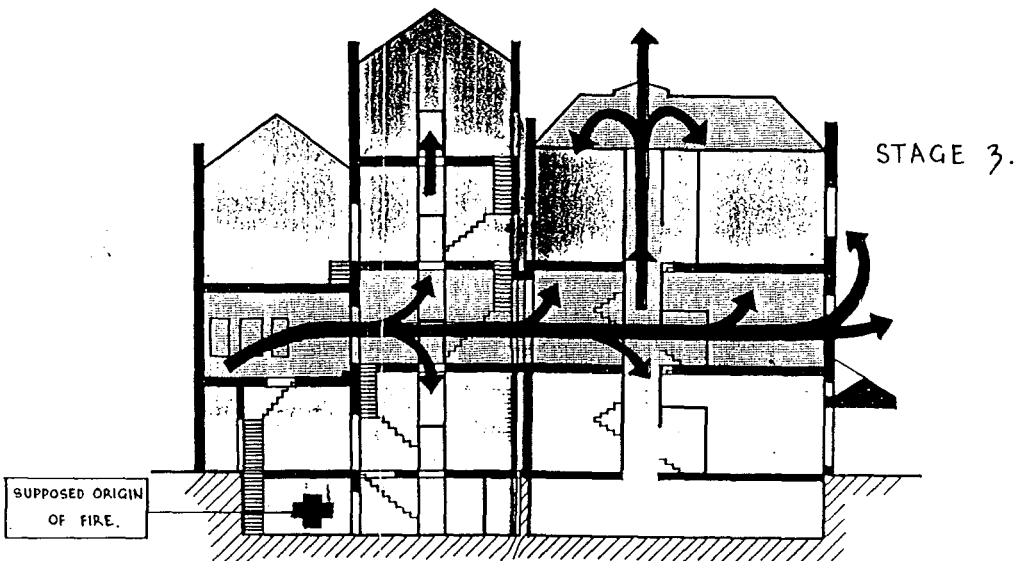
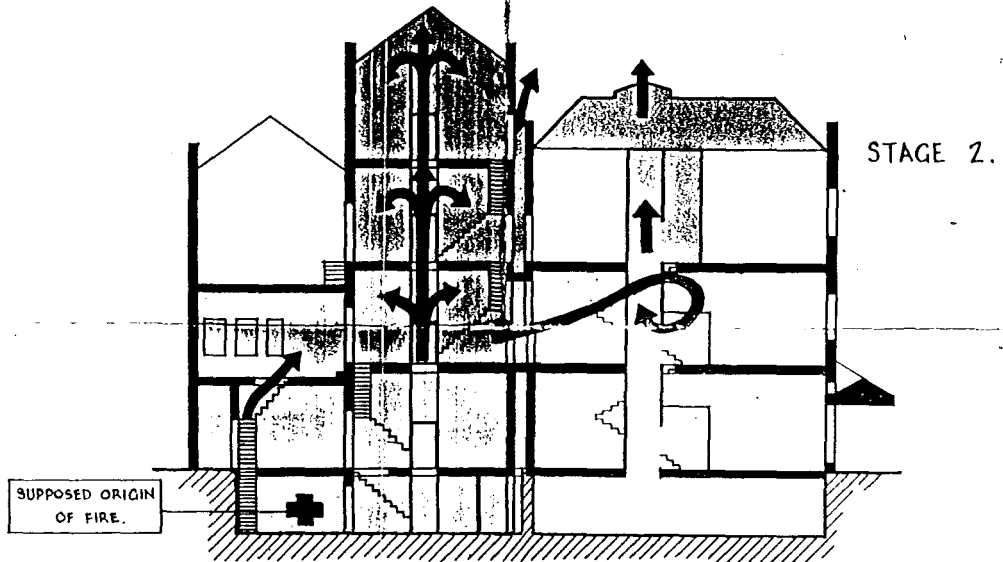
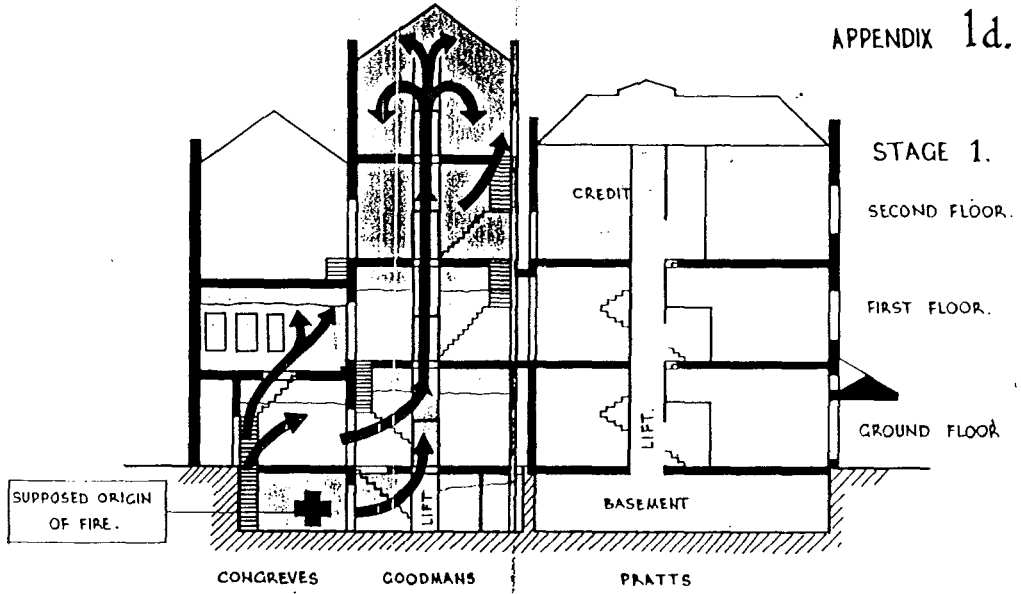
The extent of the fire is evident in the photographs. (Sources - NZ Free Lance Magazine, Christchurch Star Sun, Christchurch Press).

Photos 4 and 5 are photographs taken at the time of the fire, defining the intensity and size of the fire in the buildings.



ASSUMED SPREAD OF SMOKE AND FIRE.

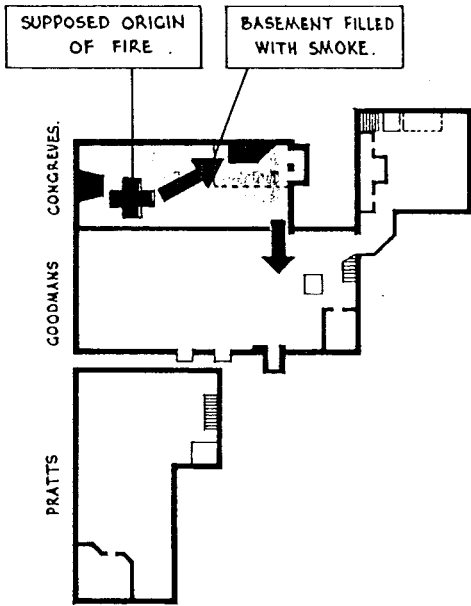
APPENDIX 1d.



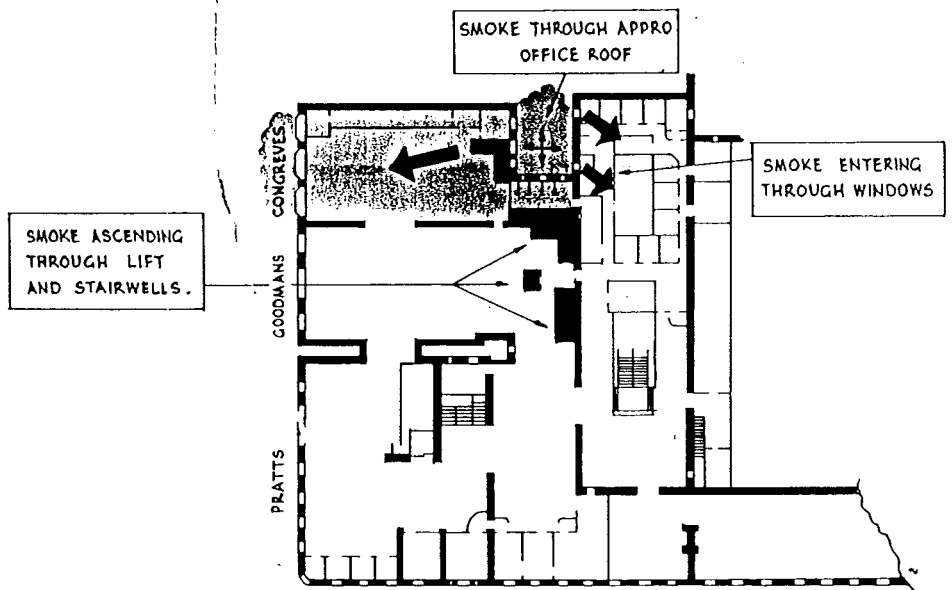
SECTIONS - SOUTH TO NORTH - LOOKING FROM COLOMBO STREET.

TO ACCOMPANY REPORT V.R.J. HEAN

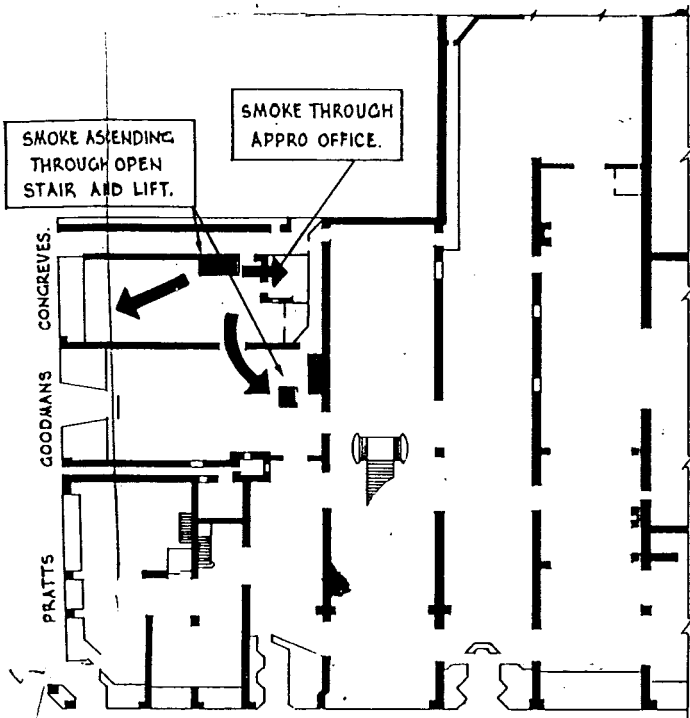
PLANS SHEWING ASSUMED SPREAD OF SMOKE AND FIRE STAGE 1



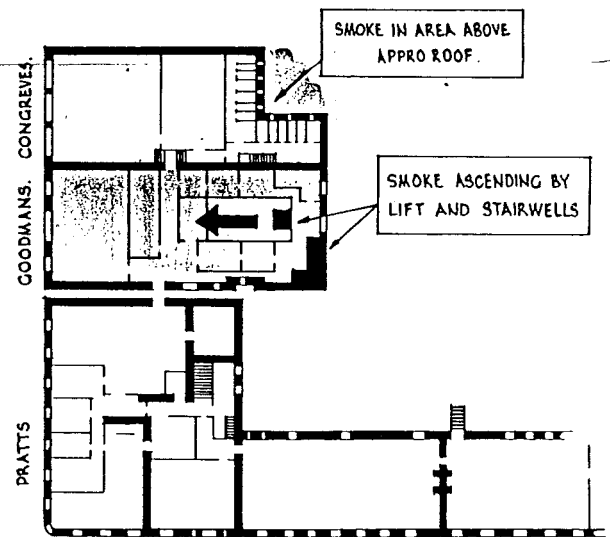
BASEMENT PLAN.



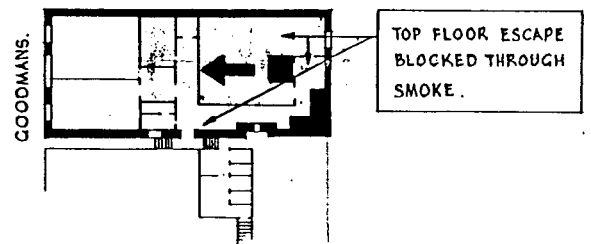
FIRST FLOOR PLAN.



GROUND FLOOR PLAN.

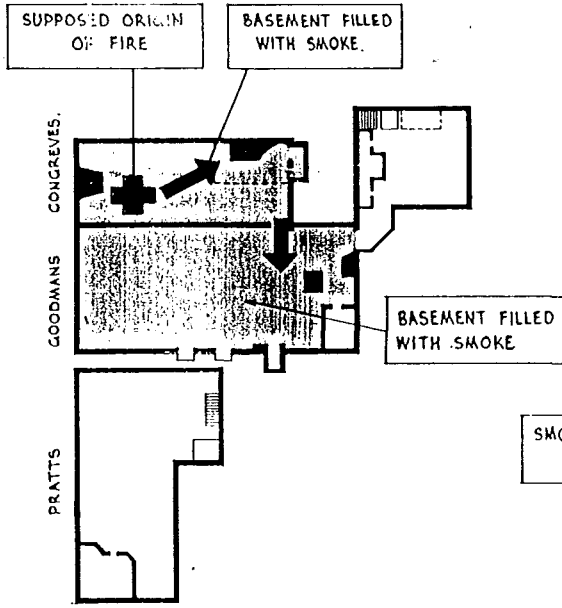


SECOND FLOOR PLAN

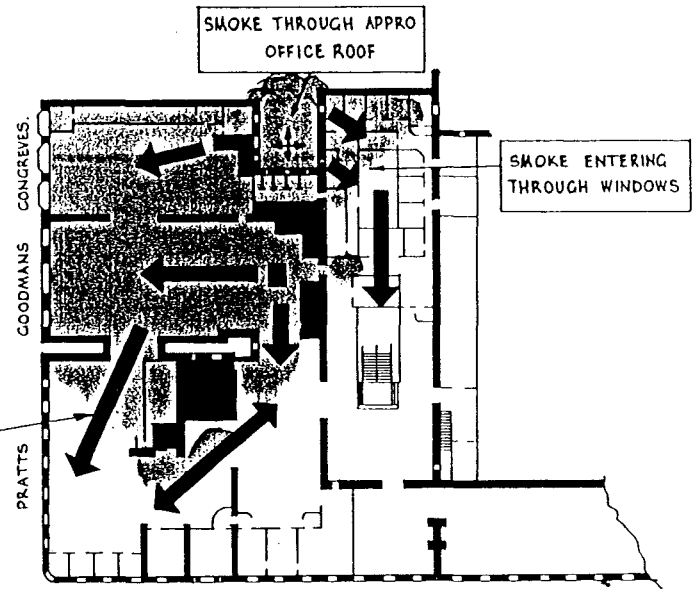


THIRD FLOOR PLAN.

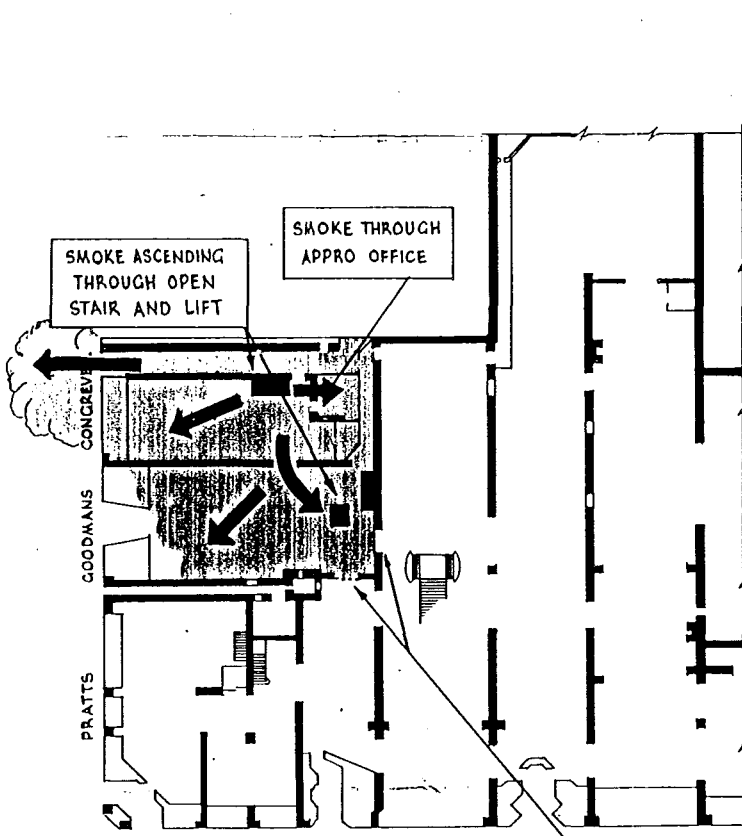
PLANS SHEWING ASSUMED SPREAD OF SMOKE AND FIRE STAGE 2



BASEMENT PLAN.

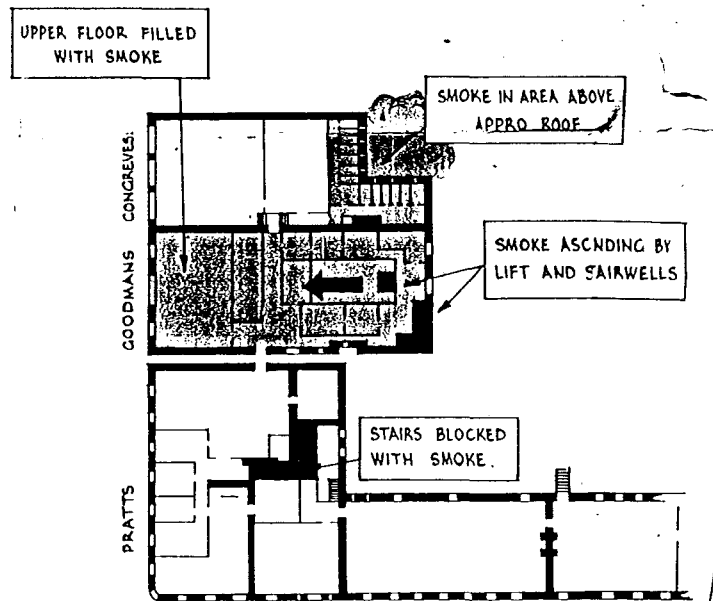


FIRST FLOOR PLAN

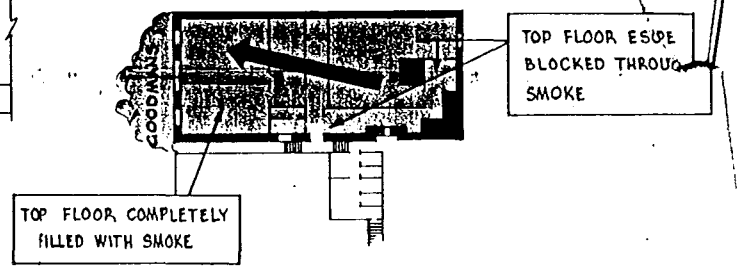


GROUND FLOOR PLAN.

SMOKE CHECKED BY FIRE DOORS.

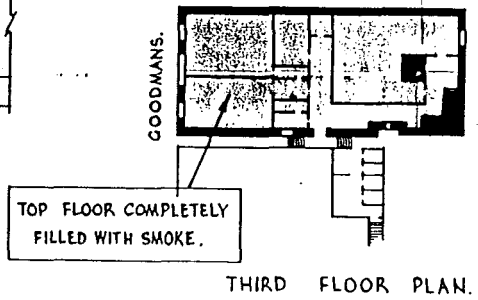
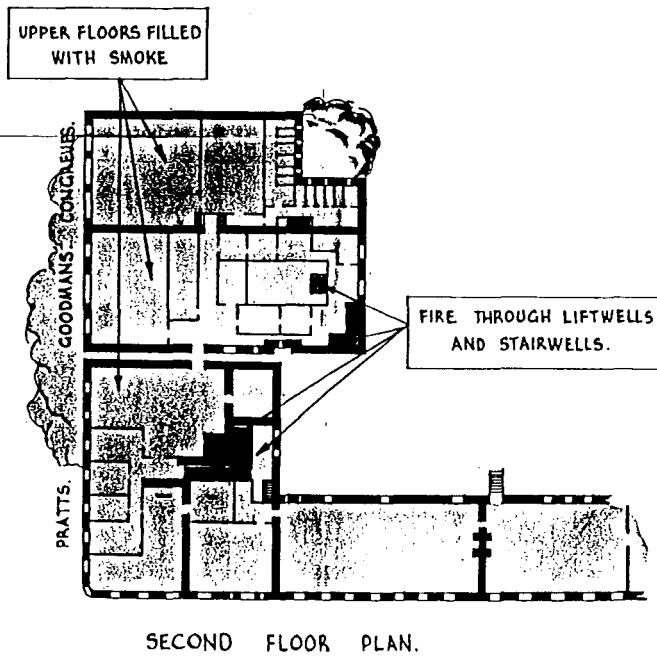
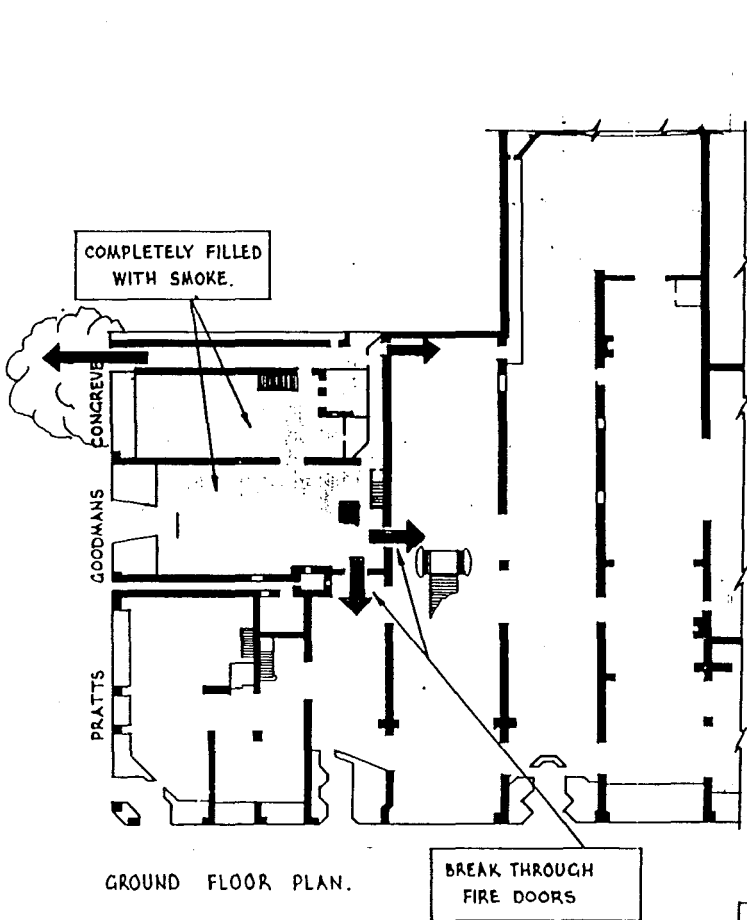
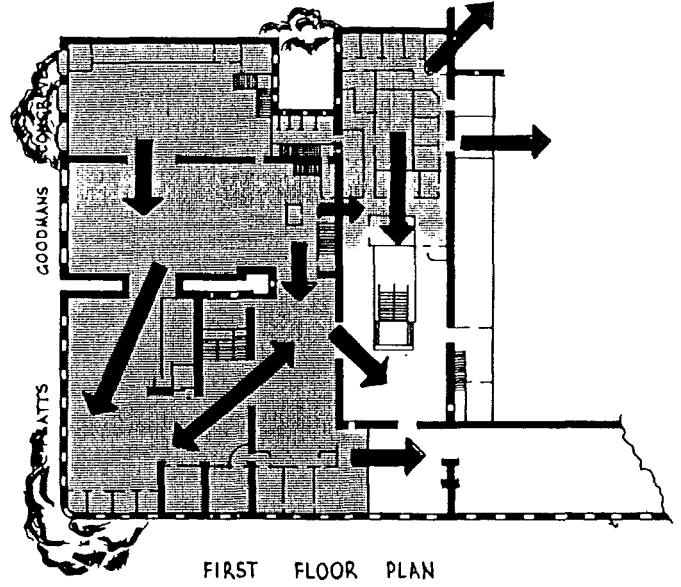
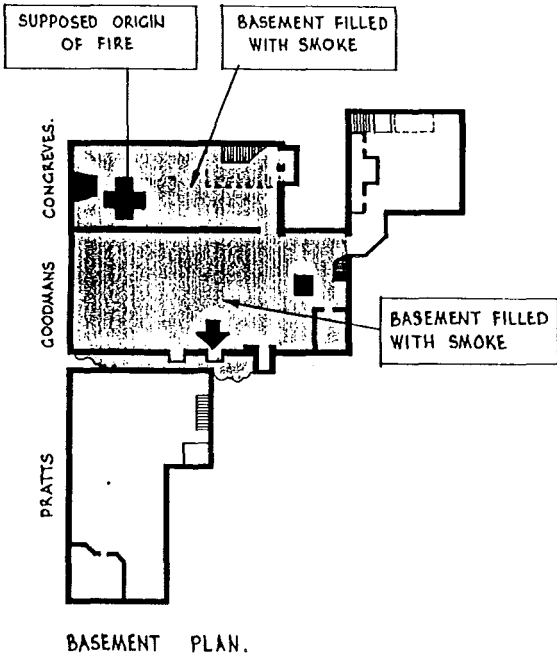


SECOND FLOOR PLAN



THIRD FLOOR PLAN

PLANS SHEWING ASSUMED SPREAD OF SMOKE AND FIRE STAGE 3.



PHOTOGRAPH

THE PRESS, WEDNESDAY, NOVEMBER 19, 1947.

DISASTROUS FIRE IN HEART OF BUSINESS AREA OF CHRISTCHURCH



HALLANTYNE'S BUILDING WHEN YESTERDAY'S FIRE WAS AT ITS HEIGHT: A PANORAMIC PHOTOGRAPH SHOWING THE COLOMBO STREET FRONTAGE ON THE LEFT AND THE CASHEL STREET FRONTAGE ON THE RIGHT

BURNING IN HOUSE

PHOTO 5



'Like Flame-Thrower'

When the fire started, it was noticed.

AS THE FIRE GAINED IMPETUS, flames leapt from the Colombo Street frontage. Firemen can be seen playing their hoses on the blaze while the mass of flame on the left shows where the fire was first noticed.

FIRE PREVENTION AND FIRE SAFETY ASPECTS

The Ballantynes Complex had a total cubic capacity of 1,873,600 cubic feet and the group of buildings occupied an area of approximately one acre. Walker in his book, "the Ballantynes Fire Disaster" refers to building codes and by-laws applicable in London during the same period when Ballantynes fire occurred. At that time, all commercial buildings in London over 250,000 cubic feet capacity, by law, were required to have sprinkler systems installed. Walker refers to the fact that Ballantynes complex was 7 times greater in size than the buildings in London which were required to have sprinkler systems installed.

Ballantynes complex had no sprinkler system or automatic fire alarm system installed in the complex. The benefit of sprinkler systems in Department stores is evident from the 1945 USA fire statistics obtained from N.F.P.A. figures, "Effect of Sprinklers by Calls of Occupancy". These figures revealed the following:

Total number of fires in sprinklered department stores in 1945	-	1416
Number extinguished by sprinklers	-	1144
Number of fires held in check by sprinklers	-	239
Total fires extinguished/controlled	-	1383
Total fires not held in check by sprinklers	-	33

Of all fires in department stores that had sprinklers installed 97.8% were extinguished or checked. It was of interest to note in 1945 statistics that out of the 224 occupancy classes listed, that department stores were 11th on the list for the occupancy class having the most number of fires.

Ballantynes management ran no regular fire drills and fire safety training for staff. They had no effective evacuation plan and strategy in the event of fire.

Management admitted that no emergency fire evacuation plan for staff existed at the time of the fire.

An automatic fire alarm system installed in Pratts building was ineffective, poorly maintained and unreliable and fell into disuse and was dismantled in 1928 and removed. An improved system was never installed. None of the other buildings had alarm systems.

50 fire extinguishers were distributed throughout the complex served by the Fire Service at 6 monthly intervals.

Pratts, Congreves and Goodmans Buildings had fire hoses on the roofs of the those buildings with there being a further two hoses in the balance of the complex. No hoses were in ground floor or storage areas.

No manual fire alarm bells to warn staff and customers of fire were installed in the complex.

BUILDINGS BY-LAWS AND MEANS OF EGRESS CODES

Existing at the time of the fire was a New Zealand Standard Code of Building By-law, Part VII, Means of Egress, which had been prepared by the N.Z. Standards Institute. The code contained provisions relating to buildings being designed and constructed to provide proper means of egress free of obstructions, separate from each other and protected by fire resistant materials, namely protected stairways, passage ways and horizontal exists. Fire escape ladders of the type existing at Ballantynes were no considered safe under the Code as they did not provide complete protection which was what the Code was designed for. The Standard was instituted in 1944.

The Code did not apply to existing buildings but Clause 704 of the Code contained provisions that any existing buildings where the means of egress in the opinion of an engineer or Fire Officer, were inadequate for safety, then such buildings should provide safe means of egress in compliance with the Code. The by-law gave Council Engineers authority to instruct compliance only in respect of means of egress.

The Factories Act, also had certain provisions relating to egress, but those provisions sanctioned use of external fire escapes, made no provision for fire doors and did not require protected stairways and liftwells. The Act and its regulations did not allow for installation of protective devices, hazardous occupancy or alternative means of egress. It was entirely inadequate in terms of safe egress and fire protection.

The Christchurch City Fire Board also had a by-law relating to escape from buildings. The by-law allowed for external fire escapes as being adequate, and in the case of then existing buildings that no improvements to safety were necessary unless the Fire Superintendant conducted an inspection and served notice on a building owner of what was required.

Between 1945 and 1947 the Fire Board conducted only 36 inspections and Ballantynes was not one of them. The City Council was in a position via the Municipal Corporations Act to replace the Fire Board By-law with the Code but did not do so, thus the Fire Boards By-law was inferior to the Code.

The only Council by-laws relating to general construction of buildings were made in 1916 and 1930 and did not provide for safe construction in reference to fire spread, occupancy hazards of the building, and limiting of fire, and fire loads.

From by-laws and statutes in existence there were no satisfactory provisions in respect of construction and design of buildings for public safety or floor areas and occupancy.

The Christchurch City Council had by-law number 40 which provided that "no wood or other materials capable of taking fire and burning shall be used as lining in the construction of internal walls or partitions", but it did allow 7/8inch wooden linings to a height of 7 feet from the floor if the studs were covered with non inflammable material to that height. The by-law further stipulated that all internal walls, partitions and ceilings constructed wholly or partially of wood, be

covered with metal, fibrous plaster or asbestos sheets or plaster on lathe.

The making of openings in Ballantynes Buildings, without permit was admitted by two building contractors at the Royal Commission Hearings on 20.4.48. At the time of the fire C.S. Luney Ltd were constructing an opening between the Goodmans and Pratts Cellar. An opening had been made without a permit and earth removed creating a hole onto the alleyway between Goodmans and Pratts building. In 1945 an opening was made in the walls between the first floor of Pratts and Goodmans building. In both instances alterations were made on existing buildings without the necessary permits required by Christchurch City Council By-laws.

Further alteration work to existing buildings; without permits was done by another contractor in 1944 when openings were made in Pratts Building and in 1945 with further openings in party walls on Congreves, Goodmans and Pratts buildings. Existing openings were also widened. Both contractors admitted that at the time they made the openings, they did not give consideration to the question of fire hazards being created.

It was ascertained by the Commission, that in some instances where openings were made or enlarged that existing fire doors were removed and not replaced with larger ones when work was completed.

A statement made to the Royal Commission, by Ballantynes architect is reproduced from the Christchurch Press, 20-4-48. The architect told the Commission that he realised that openings made in the buildings would allow the spread of fire "But fire was never uppermost in our thoughts and I must say we did not give a great deal of attention to it". This witness did say he was aware of the dangers of vertical and lateral openings and unenclosed stairways and lift wells and he admitted more attention should have been given to those dangers and the question of fire.

The City Council issued permits for other alteration work in the buildings and much of this work consisted of partitioning. The Council approved the use of soft board partitioning and granted dispensation from its own by-laws.

The Royal Commission found that this soft board was untreated and non fire retardent.

Soft boards used were substantial quantities of pinex, beaverboard, and unprotected match lining. These soft boards allowed for rapid surface flame spread, being extremely combustible. Many wall linings were also painted, and tests done in 1947 and 1948 determined the painted surfaces burned fiercely.

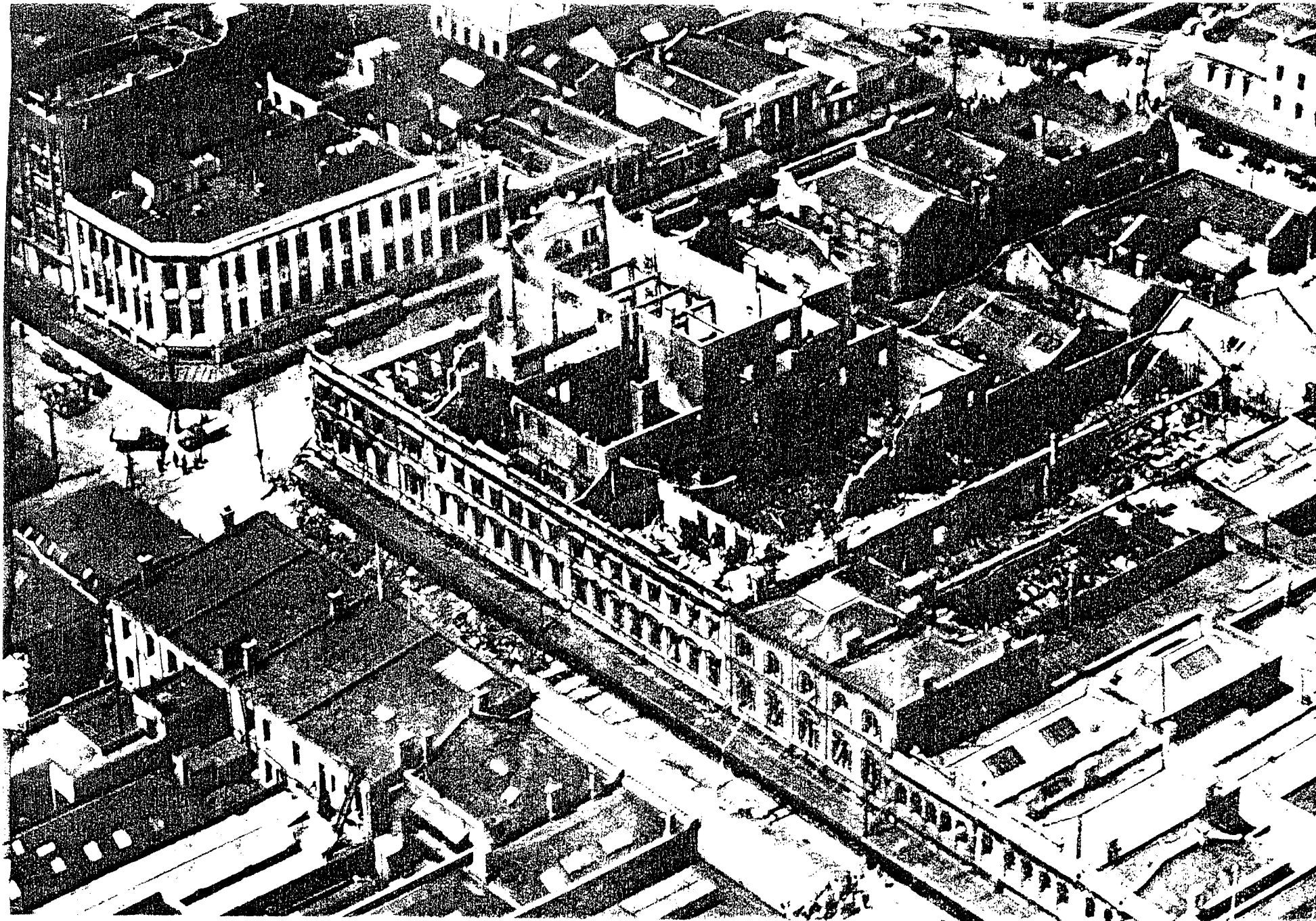
PHOTOGRAPHS

Photo 6 - Is an aerial view of the Ballantynes complex taken a day after the fire. The following aspects are noted.

1. The 8 individual buildings forming the complex are outlined by the party walls, which in most instances have withstood the fire and not collapsed.
2. The top floors have collapsed in most of the buildings, particularly Pratts building.
3. Beams still evident in Goodmans building. These are the ceiling beams for the second and first floors.
4. Beams for the second and first floor ceilings in Pratts Building are also evident.

Photo 6A - This photo is the same aerial shot with certain features identified as shown.

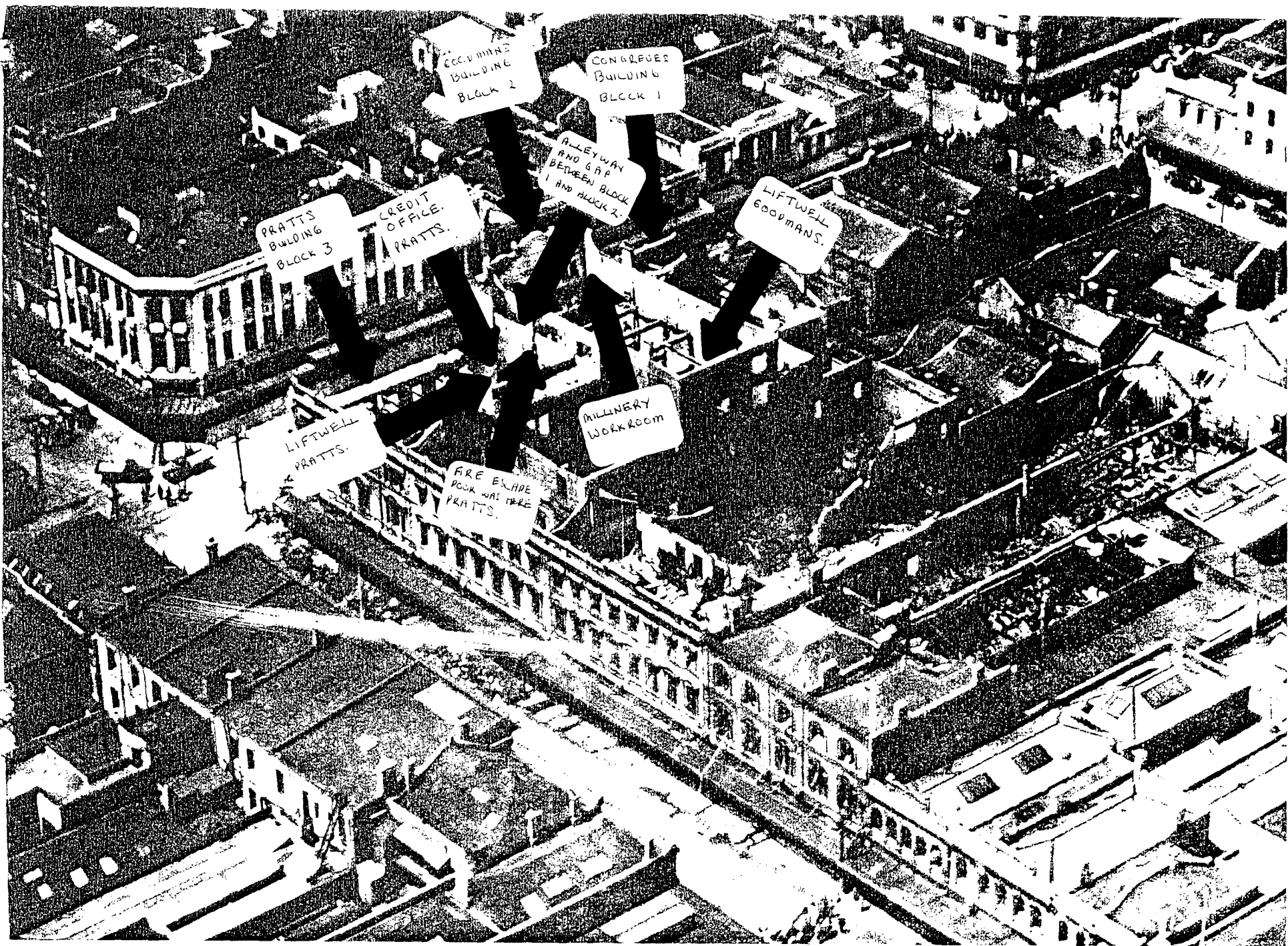
Where are photos from?



the Most Disastrous Fire in the History of Christchurch

girls leaped to the veranda. LOWER LEFT: the top of a main wall falling into Colombo Street. It was pulled down as a safety-precaution.

LOWER RIGHT: an aerial view on the day after the fire, showing the extent of the destruction in the buildings.



the Most Disastrous Fire in the History of Christchurch

girls leaped to the veranda. LOWER LEFT: the top of a main wall falling into Colombo Street. It was pulled down as a safety-precaution.

LOWER RIGHT: an aerial view on the day after the fire, showing the extent of the destruction in the buildings.

CONCLUSIONS

The Ballantynes Disaster occurred as it did because of several factors, which if addressed prior to the fire would have significantly reduced the impact of the fire.

1. That there were no active fire controls and prevention systems in the building :
 - 1.1 No sprinkler systems were installed in a complex with a high fire load by construction and content, in a complex of 1,873,600 cubic feet. A correctly installed sprinkler system may have doused or controlled the initial outbreak of fire in the basement, or confined it whilst in its incipient stage. ✓
 - 1.2 No automatic fire warning system was installed which could have given earlier warning of the fire and direct warning to the Fire Service. No smoke detectors were in the buildings. ✓
 - 1.3 No manual warning bells prevented an alert to all staff being given. ✓
2. The major contributory factors for the disaster reaching the extent it did was the construction and alterations to the buildings.
 - 2.1 Had lifts and stairs been enclosed in concrete, brick or tilewalls cut off from the rest of the building by metal clad and self closing fire doors on each floor, the effects of fire would have been contained and sectionalised, and confined to the floor on which it started. Vertical spread of fire would have been curtailed. ✓
 - 2.2 Unprotected, non fire retardent and non fire stopped lateral openings between all the buildings promoted the rapid spread of smoke and fire. ✓
 - 2.3 The absence of sufficient fire proof doors assisted the spread of smoke and fire. ✓
 - 2.4 Vertical openings were not properly sealed. ✓
 - 2.5 Wall linings were non fire resistant and promoted rapid surface spread of flame. ✓
 - 2.6 No installation of fireproof doors at lateral openings prevented the fire affected sections being isolated from the remainder of the complex, particularly the soft wood temporary partition between Congreves and Goodmans Building on the first floor, which was probably one of the major contributory factors allowing unimpeded spread throughout the complex, and massive breakthrough of fire. ✓
 - 2.7 The electric mains casing was not effectively sealed to prevent heat transfer. ✓

- 2.8 The large size of compartments allowed quick development of fire and intense heat build up which would have been exceedingly difficult to bring under control. ✓
- 2.9 The Building Codes and By-laws of the day had no provisions for compliance with such codes or by-laws in respect of existing buildings. Some work in extending existing openings and creating new openings was done without City Council permits. ✓
- 2.10 No inspections were carried out on the building by City Council staff or Fire Service personnel and thus the inherent dangers outlined were never identified or rectified. ✓
- 2.11 In conducting building alteration work Ballantynes and the contractors gave little consideration to fire safety. ✓
- 2.12 The verandahs surrounding Ballantynes were angled and sloped and this prevented effective use of fire rescue ladders. ✓
- 2.13 Sloping roofs could not facilitate erection of fire ladders in a safe manner to reach upper floors. ✓
3. No general evacuation order was given to staff. Staff left on their own initiative. Many did not realise the dangers. There was no systematic or co-ordinated effort to ensure staff safety at the time of the fire and staff were left to their own devices. Many did not appreciate the danger they were in, particularly the staff in the Credit and Account offices of Pratts Building. The lack of staff awareness, fire drills and evacuation procedures contributed to the death toll. The staff were untrained and totally unprepared in the event of fire. ✓
4. That the means of egress did not comply with the Egress Code existing at the time, namely NZSS95, Part VII, namely : ✓
 - 4.1 Some means of egress were not adequately protected by fire resistant materials. ✓
 - 4.2 Stairways, passageways and horizontal exists were not protected. ✓
 - 4.3 No portions of the building provided sufficient protection by egress means on the first, second and third floors. ✓
 - 4.4 Lack of inspection in respect of egress means by the Christchurch City Council or Fire Service. Had such inspections been carried out, the dangers existing in means of egress points may have been identified. ✓
 - 4.5 Lack of smoke stop partitioning or enclosures at egress points. ✓
 - 4.6 Insufficient fire escapes installed given the size and capacity of the complex. ✓

- 4.7 Some egress points were obstructed or blocked preventing access to them or use of them.
- 4.8 Egress points were unprotected against obstruction by smoke and there was no emergency lighting to identify those points where smoke blocked visibility.
- 4.9 Egresses were of combustible construction.
- 4.10 There were a number of pockets in the building where there was insufficient egress distribution.
- 4.11 There were no alternative means of egress when other points became blocked or inaccessible.
- 4.12 Staff were not familiar with all egress points.

In summary this fire could have been reduced in severity and the tragedy averted by :

1. Installation of sprinkler system to extinguish/contain fire.
2. Automatic fire alarm to give earlier warning of fire.
3. Staff training on fire and safe evacuation plan.
4. Inspection by Fire Board and Council staff of the building in which hazards could have been identified and rectified.
5. Provision of safe means of egress.
6. Provision of fire stops, and fire doors to compartmentise the complex into fire blocks on all floors in all buildings.
7. Better constructed and more effective by-laws and regulations and compliance with same in respect of alterations to existing buildings.
8. As alterations were made to the buildings at the complex, such alterations should have been classed as new construction to bring the alterations under the gambit of the Code and not rated as an existing structure.
9. All vertical openings enclosed and protected.
10. The non use of highly combustible soft boards for linings and partitionings.

We have not traversed the cause of the fire which was suspected to be either electrical or careless disposal of a cigarette butt. Nor have we examined the role of the Fire Brigade in respect of their actions at the scene. We have not examined the Fire Brigade role as we believe that if Items 1 to 10 existed in part or in full on the date of the fire, the fire would not have been the disaster it was and the Fire Brigade would not have been placed in the situation it found itself in.

ACKNOWLEDGEMENTS

Information was obtained from the Canterbury Public Library Newspaper Room/Reference Room, the University of Canterbury Engineering Library, N.Z.I. Insurance Library in Auckland, Mr C. Duthie, Retired Loss Prevention Officer for South British Insurance, Mr Joe Hefford, Divisional Officer for the Fire Safety Division of the New Zealand Fire Service, Christchurch and the Building Inspectors Office of the Christchurch City Council. ✓

REFERENCES:

- "*The Ballantynes Fire Disaster*". G.G. Walker, 1983 edition.
- "*Fire Dangers in Shops and Stores*". Fire Prevention Journal, U.K. No.174, December 1984, pp. 33-36.
- "*Survey of Fire Hazards In Retail Premises*". Fire Prevention Journal, U.K., No.181, August 1985, pp.23-27.
- "*Report of the Royal Commission Inquiry Into and Report Upon Matters Concerning the Fire at the Premises of Messrs J. Ballantyne and Co.Ltd, City of Christchurch, on the 18th Day of November 1947*". N.Z. Government Printer, 1948.
- "*New Zealand Disasters*". Eugene C. Grayland, 1974 edition.
- "*Christchurch Star Sun Newspapers*". November 19th 1947 to August 1948.
- "*Christchurch Press Newspapers*". November 19th 1947 to August 1948.
- "*N.Z. Free Lance Magazine*". December 3rd 1947 issue.
- "*Fire Resisting Construction and Means of Egress and Amendments 1 to 13*". New Zealand Standard, Model Building Bylaw NZSS 1900. Chpt 5, 1963.
- "*Element of Combustion and Extinction*". Manual of Firemanship, Book 1, Home Office Fire Department, U.K. 1984 edition.
- "*Fire Resistance*". New Zealand Timber Manual, Section D3.
- "*Piped Services*". Fire Prevention Journal, U.K. No.150, pp.27-30.
- "*An Introduction to Fire Dynamics*". Dougal Drysdale, 1985. John Wiley & Sons, New York.
- "*Fire Protection Handbook*". National Fire Protection Association, 16th edition, 1986.
- "*Forgotten Hazards - Services in Warehouses*". Fire Prevention Journal, No.182, September 1985, U.K. pp 19-21.
- "*Kirks Fire Investigation Manual*". John De Haan, second edition 1983.
- "*Fire Investigators Handbook*". State Attorneys Office, State of California, 1982.
- New Zealand Statute Lawbooks*. Various, NZI Library, Auckland.
- 1945 USA NFPA National Fire Statistics "*Effect of Sprinklers By Class of Occupancy*" reproduced on pages 1031 to 1035 "*Fire Inspection and Underwriting*" by Charles C. Dominge and Walter O. Lincoln, 6th edition, 1948. ✓✓