1948

NEW ZEALAND

REPORT OF ROYAL COMMISSION

APPOINTED BY HIS EXCELLENCY THE GOVERNOR-GENERAL ON THE 10TH DAY OF DECEMBER, 1947, TO INQUIRE 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.

Presented to Both Houses of the General Assembly by Command of His Excellency

Royal Commission to Inquire into and Report upon Matters concerning the Fire at the Premises of Messrs. J. Ballantyne and Company, Limited, City of Christchurch, on the 18th day of November, 1947

GEORGE THE SIXTH by the Grace of God, of Great Britain, Ireland, and the British Dominions beyond the Seas, King, Defender of the Faith:

To our Trusty and Well-beloved the HONOURABLE SIR HAROLD FEATHERSTON JOHNSTON, King's Counsel, of Wellington, a past Judge of the Supreme Court of New Zealand; ALEXANDER WELLINGTON CROSKERY, Esquire, of Wellington, Secretary; ARTHUR JAMES DICKSON, Esquire, B.E., A.M.I.C.E., M.N.Z.I.E., M.R.San.I., of Auckland, City Engineer; and CHARLES ALEXANDER WOOLLEY, Esquire, of Wellington, Fire-brigade Superintendent: GREETING.

WHEREAS on the eighteenth day of November, one thousand nine hundred and forty-seven, a disastrous fire occurred at the premises of Messrs. J. Ballantyne and Company, Limited, situated in Colombo and Cashel Streets, in the City of Christchurch:

And whereas a number of persons lost their lives and extensive damage to property occurred by reason of the said fire:

And whereas it is expedient that a full inquiry be made into all the circumstances concerning the fire and the resultant loss of life and damage to property:

And whereas it is desirable that inquiry should be made into such other matters arising from the said fire as may be necessary to enable consideration to be given to the adoption in the future of such measures as may be deemed advisable in the public interest:

Now know ye that We, reposing trust and confidence in your integrity, knowledge, and ability, do hereby nominate, constitute, and appoint you, the said—

Sir Harold Featherston Johnston,
Alexander Wellington Croskery,
Arthur James Dickson, and
Charles Alexander Woolley

to be a Commission to inquire into and report upon the following matters:—

(1) The cause and origin of the fire;

(2) Whether all possible means were taken to warn the staff and the members of the public in the premises of the existence and seriousness of the fire, and whether all possible steps were taken to provide for their safety and escape;

(3) Whether any special circumstances contributed to the rapid spread of the fire and, if there were such circumstances, whether the fire hazard could have been reduced by the installation of fire-prevention equipment or by any other means;

(4) Whether the structural design of the building and the fire-protection and egress arrangements complied with all relevant statutes and regulations, and with all relevant by-laws in force in the City of Christchurch;

(5) The adequacy and administration of all existing relevant statutes and regulations and all existing relevant by-laws in force in the City of Christchurch in regard to (*a*) fire protection and fire-prevention in such buildings, and (*b*) the construction and design of such buildings in relation to the safety of the public;

(6) The desirability of applying to existing buildings any present or future statutes, regulations, or by-laws providing for adequate means of egress from buildings in case of fire;

(7) The desirability of occupiers of business premises instructing their staffs in the principles of fire-prevention, evacuation drill, and the elementary principles of fire-fighting;

(8) The effectiveness of the operations conducted and the equipment employed by the Christchurch Fire-brigade to combat the said fire;

(9) Whether, as the result of the evidence submitted, the Commission has any, and if so, what recommendation to make as to the principles which should in the public interest be adopted for protection against fire in existing buildings generally of a type similar to the Ballantyne building;

(10) And generally upon such other matters arising thereout as may come to your notice in the course of your inquiries which you consider should be investigated in connection therewith and upon any matters affecting the premises which you consider should be brought to the attention of the Government;

And We do hereby appoint you, the said

Sir Harold Featherston Johnston

to be Chairman of the said Commission:

And for the better enabling you to carry these presents into effect you are hereby authorized and empowered to make and conduct any inquiry under these presents at such time and place as you deem expedient, with power to adjourn from time to time and place to place as you think fit, and so that these presents shall continue in force, and the inquiry may at any time and place be resumed although not regularly adjourned from time to time or from place to place:

And you are hereby strictly charged and directed that you shall not at any time publish or otherwise disclose save to His Excellency the Governor-General, in pursuance of these presents, or by His Excellency's direction, the contents of any report so made or to be made by you, or any evidence or information obtained by you in the exercise of the powers hereby conferred upon you except such evidence or information as is received in the course of a sitting open to the public:

And it is hereby declared that the powers hereby conferred shall be exercisable notwithstanding the absence at any time of any one or any two of the members hereby appointed so long as the Chairman, or a member deputed by the Chairman to act in his stead, and one other member be present and concur in the exercise of such powers:

And We do further ordain that you have liberty to report your proceedings and findings under this Our Commission from time to time if you shall judge it expedient so to do:

And, using all due diligence, you are required to report to His Excellency the Governor-General in writing under your hands and seals not later than the thirtieth day of April, one thousand nine hundred and forty-eight, your findings and opinions on the matters aforesaid, together with such recommendations as you think fit to make in respect thereof:

And, lastly, it is hereby declared that these presents are issued under the authority of the Letters Patent of His late Majesty dated the eleventh day of May, one thousand nine hundred and seventeen, and under the authority of and subject to the provisions of the Commissions of Inquiry Act, 1908, and with the advice and consent of the Executive Council of the Dominion of New Zealand.

In witness whereof We have caused this Our Commission to be issued and the Seal of Our Dominion of New Zealand to be hereunto affixed at Wellington, this tenth day of December, in the year of Our Lord one thousand nine hundred and forty-seven, and in the eleventh year of Our Reign.

Witness Our Trusty and Well-beloved Sir Bernard Cyril Freyberg, upon whom has been conferred the Decoration of the Victoria Cross, Knight Grand Cross of Our Most Distinguished Order of Saint Michael and Saint George, Knight Commander of our Most Honourable Order of the Bath, Knight Commander of Our Most Excellent Order [L.S.] of the British Empire, Companion of Our Distinguished Service Order, Doctor of Laws, Lieutenant-General in Our Army, Governor-General and Commander-in-Chief in and over Our Dominion of New Zealand and its Dependencies, acting by and with the advice and consent of the Executive Council of the said Dominion.

B. C. FREYBERG, Governor-General.

By His Excellency's Command—

H. G. R. MASON,

For the Minister of Internal Affairs.

Approved in Council—

W. O. HARVEY, Clerk of the Executive Council.

Extending Period within which the Commission appointed to Inquire into and Report upon Matters concerning the Fire at the Premises of Messrs. J. Ballantyne and Company, Limited, City of Christchurch, on the 18th day of November, 1947, shall report

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GEORGE THE SIXTH by the Grace of God, of Great Britain, Ireland, and the British Dominions beyond the Seas, King, Defender of the Faith:

To Our Trusty and Well-beloved the HONOURABLE SIR HAROLD FEATHERSTON JOHNSTON, King's Counsel, of Wellington, a past Judge of the Supreme Court of New Zealand; ALEXANDER WELLINGTON CROSKERY, Esquire, of Wellington, Secretary; ARTHUR JAMES DICKSON, Esquire, B.E., A.M.I.C.E., M.N.Z.I.E., M.R.San.I., of Auckland, City Engineer; and CHARLES ALEXANDER WOOLLEY, Esquire, of Wellington, Fire-brigade Superintendent: GREETING.

WHEREAS by Our Warrant dated the tenth day of December, one thousand nine hundred and forty-seven, you, the said

Sir Harold Featherston Johnston,
Alexander Wellington Croskery,
Arthur James Dickson, and
Charles Alexander Woolley

were appointed under the authority of the Letters Patent of His late Majesty dated the eleventh day of May, one thousand nine hundred and seventeen, and under the authority of the Commissions of Inquiry Act, 1908, and with the advice and consent of the Executive Council, to be a Commission of Inquiry for the purposes in the said Warrant duly set out:

And whereas by Our said Warrant you were required to report not later than the thirtieth day of April, one thousand nine hundred and forty-eight, your findings and opinions on the matters referred to you:

And whereas it is expedient that the time for so reporting should be extended as hereinafter provided:

Now, therefore, We do hereby extend until the thirty-first day of July, one thousand nine hundred and forty-eight, the time within which you are so required to report:

And We do hereby confirm the said Commission and the Warrant hereinbefore referred to except as altered by these presents.

In witness whereof We have caused these presents to be issued and the Seal of Our Dominion of New Zealand to be affixed hereto at Wellington, this twenty-first day of April, in the year of Our Lord one thousand nine hundred and forty-eight, and in the twelfth year of Our Reign.

Witness Our Trusty and Well-beloved Sir Bernard Cyril Freyberg, upon whom has been conferred the Decoration of the Victoria Cross, Knight Grand Cross of Our Most Distinguished Order of Saint Michael and Saint George, Knight Commander of Our Most Honourable Order of the Bath, Knight Commander of Our Most Excellent Order of the British Empire, Companion of Our Distinguished Service Order, Doctor of Laws, Lieutenant-General in Our Army, Governor-General and Commander-in-Chief in and over Our Dominion of New Zealand and its Dependencies, acting by and with the advice and consent of the Executive Council of the said Dominion.

[L.S.]

B. C. FREYBERG, Governor-General.

By His Excellency's Command—

C. F. SKINNER,

For the Minister of Internal Affairs.

Approved in Council—

T. J. SHERRARD,

Clerk of the Executive Council.

Extending Period within which the Commission appointed to Inquire into and Report upon Matters concerning the Fire at the Premises of Messrs. J. Ballantyne and Company, Limited, City of Christchurch, on the 18th day of November, 1947, shall report

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GEORGE THE SIXTH by the Grace of God, of Great Britain, Ireland, and the British Dominions beyond the Seas, King, Defender of the Faith:

To our Trusty and Well-beloved the HONOURABLE SIR HAROLD FEATHERSTON JOHNSTON, King's Counsel, of Wellington, a past Judge of the Supreme Court of New Zealand; ALEXANDER WELLINGTON CROSKERY, Esquire, of Wellington, Secretary; ARTHUR JAMES DICKSON, Esquire, B.E., A.M.I.C.E., M.N.Z.I.E., M.R.San.I., of Auckland, City Engineer; and CHARLES ALEXANDER WOOLLEY, Esquire, of Wellington, Fire-brigade Superintendent: GREETING.

WHEREAS by Our Warrant dated the tenth day of December, one thousand nine hundred and forty-seven, you, the said

Sir Harold Featherston Johnston,
Alexander Wellington Croskery,
Arthur James Dickson, and
Charles Alexander Woolley

were appointed under the authority of the Letters Patent of His late Majesty dated the eleventh day of May, one thousand nine hundred and seventeen, and under the authority of the Commissions of Inquiry Act, 1908, and with the advice and consent of the Executive Council, to be a Commission of Inquiry for the purposes in the said Warrant duly set out:

And whereas by Our said Warrant you were required to report not later than the thirtieth day of April, one thousand nine hundred and forty-eight, your findings and opinions on the matters referred to you:

And whereas by Our further Warrant dated the twenty-first day of April, one thousand nine hundred and forty-eight, the time within which you were so required to report was extended until the thirty-first day of July, one thousand nine hundred and forty-eight:

And whereas it is expedient that the time for so reporting should be further extended as hereinafter provided:

Now, therefore, We do hereby extend until the thirty-first day of August, one thousand nine hundred and forty-eight, the time within which you are so required to report:

And we do hereby confirm the said Commission and the two respective Warrants hereinbefore referred to except as altered by these presents.

In witness whereof We have caused these presents to be issued and the Seal of Our Dominion of New Zealand to be affixed hereto at Wellington, this twenty-eighth day of July, in the year of Our Lord one thousand nine hundred and forty-eight, and in the twelfth year of Our Reign.

Witness Our Trusty and Well-beloved Sir Bernard Cyril Freyberg, upon whom has been conferred the Decoration of the Victoria Cross, Knight Grand Cross of Our Most Distinguished Order of Saint Michael and Saint George, Knight Commander of Our Most Honourable Order of the Bath, Knight Commander of Our Most Excellent Order of the British Empire, Companion of Our Distinguished Service Order, Doctor of Laws, Lieutenant-General in Our Army, Governor-General and Commander-in-Chief in and over Our Dominion of New Zealand and its Dependencies, acting by and with the advice and consent of the Executive Council of the said Dominion.

B. C. FREYBERG, Governor-General.

By His Excellency's Command—

H. G. R. MASON,

For the Minister of Internal Affairs.

Approved in Council—

T. J. SHERRARD, Clerk of the Executive Council.

ROYAL COMMISSION TO INQUIRE 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

REPORT

To His Excellency Sir Bernard Cyril Freyberg, Victoria Cross, Knight Grand Cross of Our Most Distinguished Order of Saint Michael and Saint George, Knight Commander of Our Most Honourable Order of the Bath, Knight Commander of Our Most Excellent Order of the British Empire, Companion of Our Distinguished Service Order, Doctor of Laws, Lieutenant-General in Our Army, Governor-General and Commander-in-chief in and over Our Dominion of New Zealand and its Dependencies, acting by and with the advice and consent of the Executive Council of the said Dominion.

MAY IT PLEASE YOUR EXCELLENCY,—

We, the undersigned Commissioners, appointed by Warrant dated the 10th day of December, 1947, have the honour to present to your Excellency our report under the following terms of reference :—

(1) The cause and origin of the fire :

(2) Whether all possible means were taken to warn the staff and the members of the public in the premises of the existence and seriousness of the fire, and whether all possible steps were taken to provide for their safety and escape :

(3) Whether any special circumstances contributed to the rapid spread of the fire, and, if there were such circumstances, whether the fire hazard could have been reduced by the installation of fire-prevention equipment or by any other means :

(4) Whether the structural design of the building and the fire-protection and egress arrangements complied with all relevant statutes and regulations, and with all relevant by-laws in force in the City of Christchurch :

(5) The adequacy and administration of all existing relevant statutes and regulations and all existing relevant by-laws in force in the City of Christchurch in regard to (*a*) fire protection and fire-prevention in such buildings, and (*b*) the construction and design of such buildings in relation to the safety of the public :

(6) The desirability of applying to existing buildings any present or future statutes, regulations, or by-laws providing for adequate means of egress from buildings in case of fire :

(7) The desirability of occupiers of business premises instructing their staffs in the principles of fire-prevention, evacuation drill, and the elementary principles of fire-fighting :

(8) The effectiveness of the operations conducted and the equipment employed by the Christchurch Fire Brigade to combat the said fire :

(9) Whether, as the result of the evidence submitted, the Commission has any, and, if so, what, recommendation to make as to the principles which should in the public interest be adopted for protection against fire in existing buildings generally of a type similar to the Ballantyne building :

(10) And generally upon such other matters arising thereout as may come to your notice in the course of your inquiries which you consider should be investigated in connection therewith, and upon any matters affecting the premises which you consider should be brought to the attention of the Government.

We have the honour to be,

Your Excellency's most obedient servants,

[SEAL] HAROLD FEATHERSTON JOHNSTON, Chairman.
[SEAL] ALEXANDER WELLINGTON CROSKERY, Member.
[SEAL] ARTHUR JAMES DICKSON, Member.
[SEAL] CHARLES ALEXANDER WOOLLEY, Member.

Dated at Wellington, this 19th day of August, 1948.

By Warrant under the hand of His Excellency the Governor-General dated the tenth day of December, one thousand nine hundred and forty-seven, we were required to report to His Excellency not later than the thirtieth day of April, one thousand nine hundred and forty-eight.

By warrant under the hand of His Excellency the Governor-General dated the twenty-first day of April, one thousand nine hundred and forty-eight, the time within which we were required to present our report was extended to the thirty-first day of July, one thousand nine hundred and forty-eight.

By Warrant under the hand of His Excellency the Governor-General dated the twenty-eighth day of July, one thousand nine hundred and forty-eight, the time within which we were required to present our report was further extended to the thirty-first day of August, one thousand nine hundred and forty-eight.

TABLE OF CONTENTS

PREFACE

THE report of the Commission which we present is the report of all your Commissioners.

1. The general scope and purpose of the inquiry is set out in the preamble to the particular matters to be inquired into, which preamble is as follows :—

Whereas on the 18th day of November, one thousand nine hundred and forty-seven, a disastrous fire occurred at the premises of Messrs. J. Ballantyne and Company, Limited, situated in Colombo and Cashel Streets, in the City of Christchurch :

And whereas a number of persons lost their lives and extensive damage to property occurred by reason of the said fire :

And whereas it is expedient that a full inquiry be made into all the circumstances concerning the fire and the resultant loss of life and damage to property :

And whereas it is desirable that inquiry should be made into such other matters arising from the said fire as may be necessary to enable consideration to be given to the adoption in the future of such measures as may be deemed advisable in the public interest.

2. As it appeared imperative that the Commission should take the earliest opportunity of viewing the ruins of the Ballantyne premises, we proceeded to Christchurch in December, 1947, and a thorough inspection was made of what remained of the buildings. At this stage much debris had been removed, but little demolition had taken place, so that we gained first-hand evidence on the structural elements of the building ; alterations made from time to time, such as lateral and vertical openings ; dividing walls from basement to first-floor level ; and general comprehension of the original layout of the main portions of the premises.

3. A preliminary sitting was held in the Provincial Council Chambers at Christchurch on 17th December, 1947, when counsel representing the Crown and various other interests met the Commission, and arrangements were made to commence public sittings in Christchurch on 27th January, 1948. Since opening, we have held the following public sittings, the dates mentioned in each case being inclusive, and all sittings being in Christchurch :—

27th January to 6th February.
17th February to 27th February.
11th March to 19th March.
6th April to 23rd April.
25th May to 1st July.

In all, we sat for 65 days ; heard 186 witnesses, whose evidence occupies 3,527 pages ; and in addition heard addresses by counsel which added another 900 pages to the notes. Of the witnesses, 67 were either present or past employees, or principals of the firm of Messrs. J. Ballantyne and Co., Ltd. In addition, exhibits numbering 144 were admitted, and many of these consist of lengthy technical reports. A list of the witnesses called on behalf of the Crown and other parties is attached as Appendix A.

4. In view of the scope and purpose of the inquiry and the recommendations called for with a view to preventing, as far as possible, a recurrence of a disaster causing loss of life and destruction of property such as occurred in this fire, we deemed it in the public interest to ensure that all evidence available should be placed before us. All counsel engaged have co-operated in this matter, and have called all witnesses they considered could give evidence relative to the inquiry and, in addition, have called certain further witnesses we desired to hear.

5. The police interviewed every employee of Ballantynes who was in the buildings affected by the fire, and took statements from upwards of three hundred and fifty people in one way or another connected with the fire—some as employees of Ballantynes, and others as customers on the premises during the early stages of the fire, or as witnesses

of the fire. Counsel appointed by the Crown to assist the Commission, Mr. G. G. G. Watson, has assured us that he has been through all these statements, and that all witnesses were called who could give evidence regarding the inception of the fire, its course, measures taken for its control, and the steps taken to save the lives of those in the buildings, whether as principals, employees, or workmen.

6. In addition to these, the Crown has called experts on matters relating to the construction and general layout of the buildings; the materials used for lining internal walls and for partitions; the installation and functioning of the electric-power supply to the premises; the possibility of the formation and accumulation of combustible gases at or near the seat of the fire; and, generally, on such other matters as might be held to be contributing causes to the rapid spread of the fire throughout the buildings.

7. By advertisement in the press we invited evidence from any person who considered he or she could give evidence of assistance to us, and a number of public-spirited citizens came forward and gave evidence. Counsel for the Crown, by advertisement in the daily press on 10th January, also requested persons having any information that might assist the Commission to communicate with counsel, but no person not already interviewed by the police came forward.

8. In addition to formal evidence and exhibits, our attention has been called to various municipal and Fire Board statutory provisions, regulations, and by-laws, and compliance or non-compliance with them has been considered. We have also been referred to various New Zealand and overseas publications regarding fire-fighting and fire grading of buildings, and relevant material in these publications has been discussed and considered.

9. The following counsel appeared to represent interests concerned:—

Mr. G. G. G. Watson, and with him Mr. R. A. Young, appointed by the Crown to assist the Commission.

Mr. T. P. Cleary, and with him Mr. T. A. Gresson, for Messrs. J. Ballantyne and Co., Ltd.

Mr. C. S. Thomas for the accident underwriters.

Mr. E. D. Blundell, and with him Mr. R. Twyneham, for the fire underwriters.

Mr. B. A. Barrer, and with him Mr. A. C. Perry, and, on retirement of Mr. Perry through illness, Mr. A. C. Fraser, for the Clothing-trades' Union, the Retail-Shop Assistants' Union, and the Clerks' and Cashiers' Union.

Mr. W. R. Lascelles, and with him Mr. E. A. Lee, for the Christchurch City Council.

Mr. J. D. Hutchison, and with him Mr. C. G. Penlington, for the Christchurch Fire Board.

Mr. A. C. Fraser for Mrs. Patricia Lovell (widow of fire victim).

Mr. E. S. Bowie for the contractors (Thompson and Dorreen, Ltd.) who installed the electric cable in 1936.

Mr. C. V. Lester for Mr. K. O. Smith (a witness).

Mr. P. P. J. Amodeo for Mrs. I. M. Lough (widow of fire victim).

Mr. W. H. Mathison for the Christchurch Fire Brigades' Employees, Union.

Mr. L. Glover for the Fire Superintendents' and Deputy Superintendents' Union.

10. To assist us to follow the course of the fire, as outlined by the various witnesses, and to enable witnesses to point out their own and the movements of others in and about the building during the fire, the Public Works Department Architect prepared a model of the Ballantyne buildings to a scale of one-eighth of one inch to one foot. This model was of very great assistance to us during the hearing of evidence and the compiling of our report.

INTRODUCTION

11. Messrs. J. Ballantyne and Co., Ltd., have for many years carried on a large general drapery, clothing, and furnishing business in premises with frontages to Colombo and Cashel Streets in the heart of the City of Christchurch. The extent of the business is indicated by the number of employees, which is given as 458.

12. Of the 41 persons who lost their lives in the fire, 38 were employees of Ballantyne and Co., one was an independent representative of the College of Retailing Representatives, and two were auditors engaged on the premises at the time of the fire on examination of the firm's books and records for purposes of audit. No customer or member of the public on the premises at the time of the fire lost his or her life.

13. The number of customers that would normally be on the premises in mid-afternoon, the time the fire started, was given as approximately 250 to 300, and at peak periods 1,500. On special occasions—for instance, at the time of Christmas buying or special sales—the number of customers on the premises, it is estimated, might reach approximately 2,000 or more.

Most of the public would always be on the ground floor, or main selling and display area, the area of that floor being approximately 39,000 square feet.

14. The first floor was, in the main, given over to furniture, tailoring, hairdressing, special display, and tea-rooms for members of the public. Customers would not be there in such numbers as on the ground floor, although at certain times 250 people might be seated in the tea-room. At the time of the fire it seems it was only about one-quarter full.

15. The staff cafeteria was on the second floor, directly over the public tea-room. Customers had access to the second-floor fitting-rooms in Goodman's and would be limited in number.

The second floor of Congreve's, the third floor of Goodman's, and the second floor of Pratt's were devoted principally to the staff.

16. The premises occupied by Ballantyne and Co., consisted of some eight buildings acquired at different times. We are most concerned with Congreve's building fronting Colombo Street; Goodman's building fronting Colombo Street; and Pratt's building fronting Colombo Street and Cashel Street, as in Congreve's building the fire started, and the lives were lost in Goodman's and Pratt's buildings.

17. The premises can be described as a group of buildings, each erected many years ago, converted by openings in one-time party walls into one large establishment. In such cases it is questionable, since weaknesses in an old building from the fire-prevention point of view can become weaknesses of added gravity to the whole of the new layout, whether the whole should not be treated as a new building.

The group had a frontage of 265 ft. to Cashel Street, and 165 ft. to Colombo Street. The Colombo Street depth was 133 ft., and the Cashel Street buildings ran back from Cashel Street to Lichfield Street where the frontage was 69 ft.

Photographs of the model showing the Colombo Street and Cashel Street frontages follow. On them we have marked—

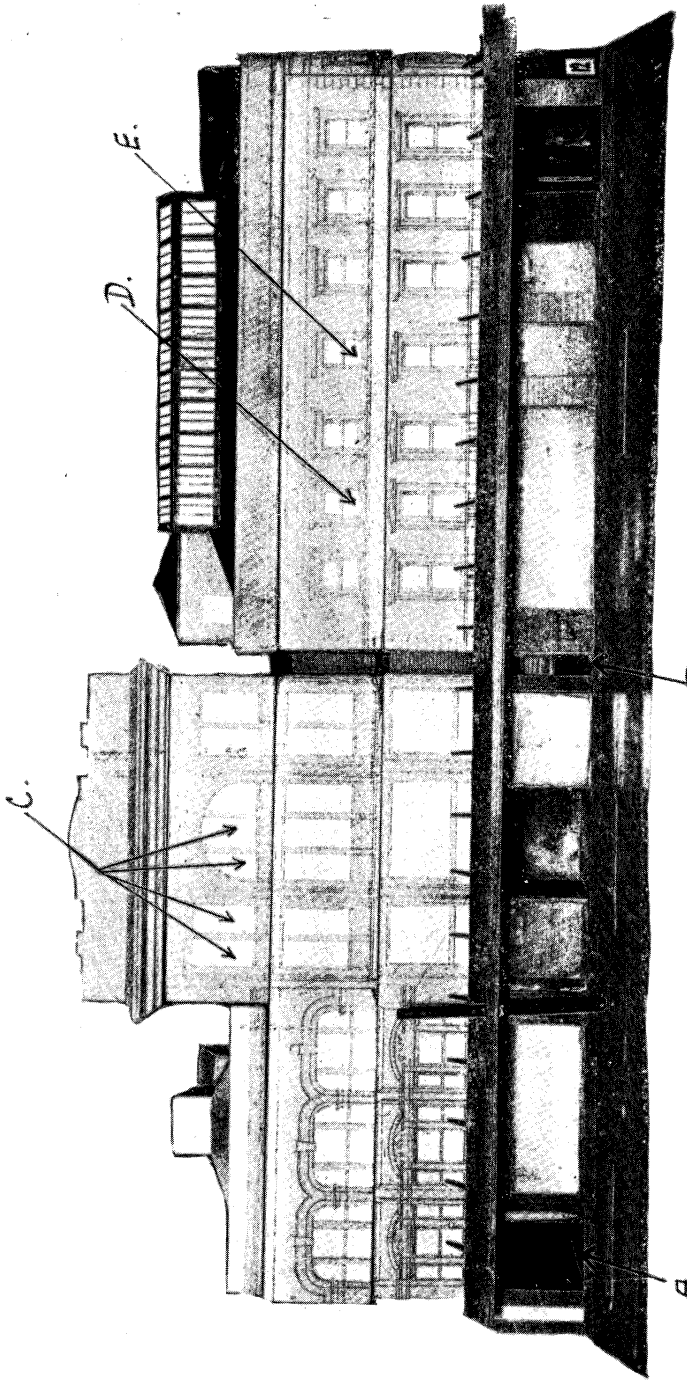
"A" A right-of-way at the south of Congreve's building:

"B" The alleyway between Goodman's and Pratt's buildings:

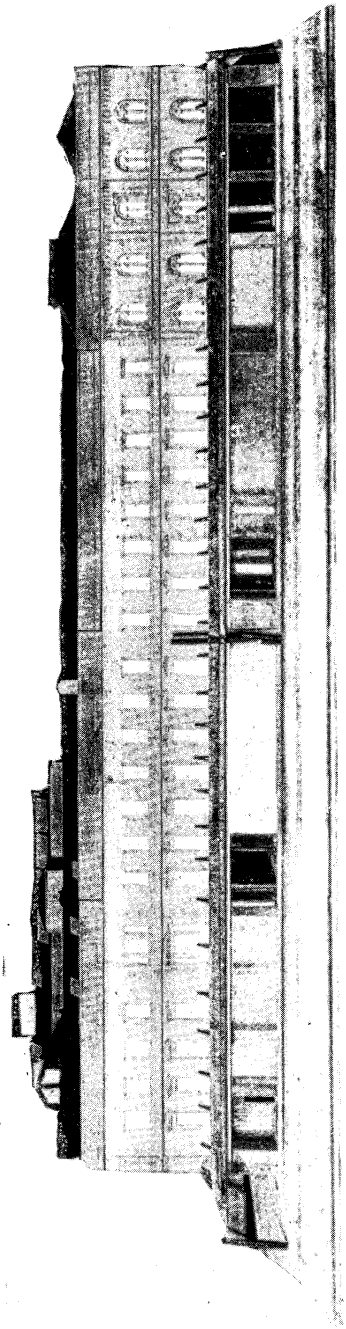
"C" The windows of the millinery workroom in Goodman's building, where seven girls lost their lives:

"D" The window in Pratt's, where two girls jumped to the veranda:

"E" The window from which Mr. Kenneth Ballantyne was rescued.



COLOMBO STREET FRONTAGE



Cashel Street Frontage

18. The following description of Congreve's, Goodman's, and Pratt's buildings, their internal construction, entrances, and exits, and the openings made from one to the other is taken from the report of the District Architect of the Public Works Department, Mr. P. C. Cornish :—

BLOCK 1

A three-story block with a basement, situated at the south end of the group in Colombo Street, known as Congreve's building.

Construction

Walls.—Brick with stone facade to Colombo Street; interior strapped and lined with matchlining covered on the first floor with Pinex.

Columns.—Cast iron.

Floors.—Wood on timber joists carried on rolled-steel beams.

Roof.—Timber-framed, covered with corrugated iron, with skylights. Portion of roof over appro room, asphalt.

Ceilings :—

Basement : No ceiling.
Ground Floor : Matchlining. Appro room, Pinex.
First Floor : Matchlining and Pinex.
Second Floor : No ceiling.

Partitions :—

Basement : Wire mesh on wooden framing.
Ground Floor : Brick and timber covered with Pinex with glass above.
First Floor : Pinex and matchlining.
Second Floor : Matchlining.

Stairs :—

Basement to Ground Floor : Timber not enclosed.
Ground to First Floor : Timber not enclosed.
First to Second Floor : Timber, enclosed with timber partition with doors at head and foot of stair.

Fire-escapes.—Nil.

Lifts.—Nil.

BLOCK 2

A four-story block with basement, known as Goodman's building, situated in Colombo Street, immediately to the north of Block 1, from which it was separated by a brick party wall.

Openings

This Block was accessible from Block 1 by means of openings cut in the brick party wall as follows :—

Basement.—One opening 6 ft. 6 in. by 4 ft. 6 in. closed by light wire-mesh grill gate.

Ground Floor :—

One opening 12 ft. by 10 ft. 6 in.
One opening 8 ft. by 8 ft. 3 in.

First Floor :—

One opening 10 ft. 6 in. by 17 ft. 6 in. reported to have been closed temporarily with a Pinex partition, but otherwise unprotected.
One opening 7 ft. by 3 ft. with wooden door.
One opening 7 ft. by 3 ft. with wooden door.

Second Floor.—One opening 7 ft. by 3 ft. 3 in., no door.

Construction

Walls.—Brick with stone facade to Colombo Street. Interior strapped and lined with matchlining, covered with Beaver board on ground floor; matchlining covered with Pinex on first floor; and matchlining on the third floor.

Columns.—Timber posts in basement under ground floor only.

Floors.—Wood on timber joists carried on timber posts and beams under the ground floor. Upper floors timber joists carried on rolled-steel beams spanning full width of building.

Roof.—Timber-framed, covered with corrugated iron, with skylights.

Ceilings :—

Basement : No ceiling.
Ground Floor : Matchlining.
First Floor : Matchlining covered with Pinex.
Second Floor : Matchlining.
Third Floor : No ceiling except over telephone-exchange.

Partitions :—

Basement : Wire mesh on wooden framing.
Ground Floor : Nil.
First Floor : Nil.
Second Floor : Matchlining, Pinex, and glass.
Third Floor : Matchlining and Pinex.

In the basement a dustproof partition of Pinex on wooden framing and fitted with a plywood-covered door had been erected to prevent dust reaching stock from a place where workmen were engaged in cutting an opening in the basement wall.

Fire-escape.—Steel and cast-iron stair with steep flights and landings accessible through sliding metal-clad doors from second and third floors. Also gave access through sliding metal-clad door to second floor of Block 3, and through wooden door to lavatory above strong-room of second floor of Block 3.

Stairs :—

Basement to Ground Floor : Timber enclosed at top with wooden door with spring closer.
Ground to First Floor : Timber stair not enclosed.
First to Second Floor : Timber stair not enclosed.
Second to Third Floor : Timber stair not enclosed.

Lifts :—

——	Shaft.	Doors.
Basement to ground ..	Timber frame enclosed with wire mesh ..	Timber covered with wire mesh.
Ground to first ..	Timber frame enclosed with Pinex to height of 7 ft.	Wood with wire-mesh panel.
First to second ..	Timber frame enclosed with Pinex to 7 ft. high	Wood with wire-mesh panel.
Second to third ..	Timber frame enclosed with Pinex to 7 ft. high	Wood with wire-mesh panel.
Third floor	Pinex hardboard	..

Hoisting-gear in roof; counterweights against south wall; cage, wood-panelled, with telescopic gate.

BLOCK 3 (KNOWN AS PRATT'S BUILDING)

A three-story block with basement, situated at the corner of Colombo Street and Cashel Street, separated from Block 2 by two solid-brick walls with a space of 3 ft., forming an alleyway in between and occupied by the steel and cast iron fire-escape stair mentioned under Block 2.

Openings

This block was accessible from Block 2 through the following openings :—

Basement.—No access, though an opening was being cut and had been pierced between Block 2 and the alleyway enclosing the fire-escape.

Ground Floor.—Indirectly through the alleyway, one window and one door giving access to an otherwise enclosed space under the stair.

First Floor.—A large opening 9 ft. by 17 ft. cut through walls on both sides of alleyway, and boxed around with reinforced-concrete slabs to provide access between buildings. Opening unprotected by fire or smoke-doors. One window opening into alleyway.

Second Floor.—Indirectly through alleyway occupied by fire-escape by means of doors on opposite sides of fire-escape landing. Door, metal-clad, fire-resisting type.

Third Floor.—Indirectly through alleyway occupied by fire-escape. A doorway with a wooden door gave access from the fire-escape to the women's lavatory erected in timber on top of the strong-room.

Further details of window openings into the fire-escape alleyway will be given under "Fire Escapes."

Construction

Walls.—In basement, concrete; above that level, brick with stone facades to street frontages. Interior strapped and lined with matchlining covered with Beaver board on the ground floor, matchlining covered with Pinex on the first floor, and matchlining covered with Celotex on the second floor.

Columns.—Cast iron.

Floors.—Wood on timber joists carried on timber beams.

Roof.—Timber-framed, covered with corrugated iron, and incorporating a large lantern light approximately 45 ft. long and a penthouse over the lift-well.

Partitions :—

Ground Floor: Brick and timber framed, covered with wood panelling and Beaver board.

First Floor: A few partitions brick, but mainly timber-framed and covered with plaster board, matchlining, and plywood.

Second Floor: The accounts and credit rooms separated from remainder of block by a substantial brick wall. Remainder of partitions timber-framed and covered with Celotex. Brick partitions were strapped and lined with matchlining covered with Celotex.

Ceilings :—

Basement: No ceiling.

Ground Floor: Matchlining.

First Floor: Matchlining covered with Pinex.

Second Floor: Celotex only.

Stairs :—

Basement to Ground Floor: Timber not enclosed.

Ground to First Floor: Timber not enclosed.

First to Second Floor: Timber, enclosed on second floor with partitions timber-framed and covered with Celotex.

Second to Third Floor (Lavatory): Timber, enclosed by timber partition covered with Celotex at head of stair.

Fire-escapes.—Access from second floor and third floor (a lavatory only) on to steel and cast-iron fire-escape previously mentioned; no access to fire-escape from first floor.

Lifts.—Ground to second floor, situated in angle of two brick walls. Other walls timber-framed and covered with Beaver board, Pinex, and Celotex, on the different floors :—

——	Shaft.	Doors.
Basement	..	Timber covered with wire mesh.
Ground to first ..	Enclosed with timber; framing covered with Beaver board	Wood with wire-mesh panels.
First to second ..	Pinex and Beaver board	Wood with wire-mesh panels.
Second floor ..	Celotex and Beaver board	Wood with wire-mesh panels.

Hoisting-machinery in basement. Cage, panelled in oak ply, metal roof, and telescopic gate.

BLOCK 4 (ALSO KNOWN AS PRATT'S BUILDING)

A building with a frontage of 66 ft. to Cashel Street and extending as far south as the south side of Block 1. At approximately half this distance the width of this block was reduced to approximately 38 ft. For a distance of approximately 33 ft. back from Cashel Street the building was three stories in height, and beyond that distance, two stories in height. There was a basement at the rear of this block housing the main switchboard and pneumatic-tube equipment, and used for the storage of dress materials.

Openings

This block was accessible from Blocks 1, 2, and 3 through the following openings in the brick walls :—

Basement.—A doorway to the basement of Block 2 fitted with a steel door, which was apparently open at the time of the fire.

Ground Floor :—

(*a*) An opening to the right-of-way at the south of Block 1 (no door).
(*b*) An opening approximately 7 ft. wide to the rear of Block 2 fitted with a sliding door on one side of wall. This door is one of the doors that will be referred to as fireproof doors in evidence.
(*c*) An opening approximately 9 ft. wide at the rear of the art department in Block 4 to the rear of Block 2 (adjacent to the last opening mentioned). Fitted with a pair of sliding doors on one side only. This pair of doors is also referred to as fireproof doors in evidence.
(*d*) An opening approximately 12 ft. wide to Block 3 : unprotected.

First Floor :—

(*a*) Two windows overlooking light area on the ground floor of which the appro office was built, one fitted with metal-clad fire-resisting shutter which was open at the time of the fire ; therefore both openings unprotected.
(*b*) Two door openings at rear of Block 1, fire-door on one ; other filled in with wood partition.
(*c*) One doorway 6 ft. 3 in. by 3 ft. to rear of Block 2 ; fitted with fire-resisting door.
(*d*) One door opening 7 ft. by 3 ft. between display area in Block 4 and cloak-room in Block 3 ; no door.
(*e*) One opening 10 ft. by 14 ft. wide between display area (over art department) and Block 2 unprotected.
(*f*) One doorway ; unprotected.

Second Floor.—One door communicating with Block 3 and provided with a sliding fire-resisting door one side only, in addition to ordinary wooden door. Fire-resisting door was apparently not closed during fire.

Construction

Walls.—Walls were concrete in basement, brickwork elsewhere. Facade to street, stone. The north and south walls of the three-story portion were carried on rolled-steel beams and cast-iron columns, leaving practically the full width of the block clear on the ground floor.

Inside walls were strapped and lined with matchlining covered with Beaver, Pinex, or Gibraltar board. Both outer and inner lounges on the first floor were panelled in polished blackwood to a height of 7 ft. Walls of the second floor were lined with matchlining.

Columns.—Cast iron.

Floors.—Wood on timber joists carried on timber beams on upper floors.

Roof.—Timber-framed, covered with corrugated iron. The first floor of the two-story portion was lighted by continuous skylights on either side of the ridges of the roof.

Partitions.—Timber-framed, covered with Beaver board or plaster board approximately 7 ft. high. Partitions separating small rooms to the south of the main stair on the first floor were 7 ft. high, covered with Beaver board.

Ceilings.—Matchlining and Celotex on timber framing, but ceiling of first floor of two-story portion consisted largely of roof lights.

Stairs.—The main stair was situated in this block and was of timber in an open wall, unprotected.

Fire-escapes.—A hanging ladder giving access to the roof over tailoring workroom.

Lifts.—Nil.

The whole of Mr. Cornish's report is attached as Appendix B.

19. Plans showing the layout of the several floors are attached hereto as Appendix C.

Particular attention must be paid to what has been called the " right-of-way " at the south side of Congreve's building, and the alleyway 3 ft. 3 in. wide between Goodman's buildings, into which ran a fire-escape from Goodman's and Pratt's buildings. The right-of-way at the south side of Congreve's provided the most direct access to the cellar through a door in Congreve's building leading to it, and it was there the brigade made its first attempt to enter the cellar. The door referred to opened almost directly to a stairway leading to the cellar. This right-of-way is 8 ft. wide, and its total length is 89 ft. Double wooden doors crossed it 39 ft. from the Colombo Street footpath. The door leading to the stairway to the cellar, where the fire started, was 64 ft. from the footpath, or 25 ft. from the double doors.

20. The public entrances to the building on the ground floor were—
(*a*) From Colombo Street to the soft furnishing department in Goodman's ;
(*b*) From the corner of Colombo and Cashel Streets to the mercery department in Pratt's :
(*c*) From Cashel Street to the art department in Pratt's :
(*d*) From Cashel Street, from the west, to the hosiery and fancy-goods departments.

The only entrance from the street leading to the first floor was a stairway near the western end of the building in Cashel Street. This entrance led to the cafeteria, but was mostly used by persons attending private functions, and was not the general means of access to the tea-rooms.

21. Despite the detail supplied in Mr. Cornish's report, and what may seem unnecessary repetition, we consider it advisable to emphasize certain features which account for the spread of smoke and fire.

From the cellar, or basement, in Congreve's building there were two exits—one a staircase leading to the ground floor ; and the other an opening in the wall originally dividing Congreve's and Goodman's (which, at the time of the fire, was closed by a wire-mesh door in a wooden frame) leading into the basement of Goodman's block adjoining.

At the south-west end of Congreve's cellar a men's cloak-room was partitioned off by a wire mesh.

The cellar was used as a reserve depository of various goods which were drawn off by the furnishing department as they were required. The material stored was of a varied nature : on the shelves along the north wall stacks of linen and plastic materials ; at the eastern end, deck-chairs, card-tables, and electric cleaners ; in the north-east section, close to the point where the fire originated, lino squares, carpets, and two bundles of backing-material, or cane, for making furniture ; on the south side, electric cleaners, and a cupboard containing moth-preventative materials, tapestries, and linens ; along the south wall, cottage weaves and tapestries ; in the middle, cleaners, rolls of carpets, carpet squares, rugs, and similar goods.

Evidence has been directed to the inflammability of some of the materials, and the colour and the smell of smoke given off when burning. Some tins of naphthalene, which is very inflammable, were on the floor, but the majority of them were found intact after the fire, and subsequently sold.

22. In the north-eastern corner was a gas-meter.

The main alternating-current electrical supply came into the building at power-pole level on the first floor, and from there was led down to this basement. It was enclosed from the point of entry to the basement by wooden boxing of soft fibre board 8 in. square.

23. In the case of a fire starting in the cellar the exits—that is, both the stairway and the cyclone gates into Goodman's cellar—could serve as outlets for smoke. In the absence of any direct entry from Colombo Street to the basement, these entrances were the only ones through which firemen could bring their hoses to the cellar.

Approach to the basement could be made through a door that opened on to the right-of-way running from Colombo Street along the south wall of Congreve's building, or through Goodman's building by staircase or lift-well, and then through Goodman's cellar and the cyclone gates separating Goodman's cellar from Congreve's cellar ; or from the lift-well of the goods-lift in Pratt's building, at the back of the shoe department, that travelled from the basement to the ground floor ; or from the alleyway between Goodman's and Pratt's, where an opening in Goodman's wall, in preparation for an entrance between Pratt's and Goodman's, had been pierced. This has been called Luney's opening and perhaps provided the easiest approach to the cellar.

The stairs from both Congreve's cellar and Goodman's cellar were of wood, and were not enclosed with any fire-resisting material, but the stairway in Goodman's had a self-closing door at ground-floor level. The lift was not fully enclosed.

24. At the time of the fire work was in progress to make an entrance from Goodman's cellar to the adjoining basement in Pratt's building, but was surrounded by a dustproof enclosure of soft-fibre board, and apparently this opening played no great part in the first passage of smoke. The soft-fibre-board covering would, however, when flames broke out, burn rapidly and prove no obstacle to the rapid spread of fire.

A steel door leading from Goodman's cellar to Pratt's cellar, to the west of Congreve's cellar, was found to be open after the fire.

A lift-counterweight shaft extended from the basement in Goodman's building through all floors and was open at the top and encased throughout with soft-wood-fibre board.

25. The main wall separating Congreve's building from Goodman's was of brick, but, on ground-floor level, an entrance between these two buildings had been cut in the dividing wall of some 12 ft. by 10 ft. 6 in. without any fire protection and, on the first floor, an opening in the same wall 10 ft. 6 in. high by 17 ft. 6 in. wide had been made. It also had no fire protection, but at the time of the fire was sealed off by a soft-wood-fibre-board screen.

On second-floor level an opening had been made 7 ft. high and 3 ft. wide. It was provided with a wooden door, but had no fire protection.

26. Congreve's building had, itself, no fire-escape and no lift. Originally it had an entrance to Colombo Street and a door alcove, but this had been permanently closed. Its second floor had a staircase leading to the first floor of Pratt's, but had no exist to its own first floor.

27. Between Goodman's building and Pratt's building there was a fire-escape from the top floor of Goodman's running down to the alleyway that led to Colombo Street. This escape was constructed of cast iron with fairly steep flights of stairs, and landings accessible to both Goodman's and Pratt's. One such landing was available to the credit office in Pratt's building where thirty-three employees were trapped, and another served the third floor of Goodman's building where seven of the employees who lost their lives were trapped.

The fire-escape between the credit office and the third floor of Goodman's building was used as a means of access to a women's convenience constructed above the strong-room in Pratt's building.

28. There are a number of general features which are obviously relevant to, and material to the inquiry, and these can be briefly cited as follows:

(*a*) *Timber Floors.*—Timber floors existed practically throughout the building.

(*b*) *Ceilings and Wall Linings.*—Ceilings and wall linings were matchlining, in many cases overlaid with wood-fibre board, untreated except for painting. Matchlining was fixed to the walls per medium of battens which allowed a clearance between the linings and the brick walls of approximately 1 in.

(*c*) *Partitions.*—There were also numerous partitions constructed of timber, and lined either with matchlining and/or wood-fibre board.

(*d*) *Roof-construction.*—The roofs throughout were timber-framed, frequently with complete absence of fire-breaks.

(*e*) *Unprotected Lateral Openings.*—There were large unprotected openings in the brick walls between the various buildings giving intercommunication between practically all departments. The total area on the ground floor available to the public for shopping purposes was approximately 39,000 square feet. As Congreve's and Goodman's buildings on the ground floor could be separated from the remainder of the premises by fire-doors, the area of these floors, which is approximately 6,000 square feet, may be deducted, leaving 33,000 square feet in which there was no protection and which was, for all practical purposes, one continuous open floor.

On the first floor there were also large lateral openings. The total area contained in this floor by means of lateral openings in the brick walls was 25,000 square feet.

On the second and third floors lateral openings did not exist to the same appreciable extent.

The substantial opening in the basement between Congreve's and Goodman's was closed by a wire-mesh gate padlocked. The opening from the basement of Goodman's to a cellar at the rear of Pratt's had a steel door which it would appear was open at the time of the fire. An opening in the course of being cut in the northern wall of the basement of Goodman's had a soft-fibre-board dust-screen surrounding the opening.

(*f*) *Unprotected Vertical Openings.*—Staircases in all buildings were unenclosed, with the exception of the Goodman basement stair. The lift in Goodman's was virtually unenclosed from the basement to the third floor, and the lift in Pratt's was apparently enclosed with inflammable materials, and, in any case, the doors were of the open-wire-mesh type.

(*g*) *Fire Loading.*—From the point of view of fire loading, taking into account the total combustible contents of the buildings—floors, linings, goods, fittings, &c.—the total number of British thermal units available for the production of heat in the event of fire was very substantial, the following approximate figures being indicative :—

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	..	80,000
Goodmans	65,000	213,000	244,000	224,000	226,000	79,500
Pratts	278,000	200,000	217,000	308,000	..	79,000

It will be observed that, if the roof loading is added to the top floor in each case the position is very substantially worsened. As the above are typical, it is quite unnecessary to state figures for other portions of the building.

(*h*) *Veranda.*—Along the full width of the footpath a suspended veranda existed through the whole of the Colombo Street and Cashel Street frontages of the buildings. This veranda was of an unusual type in that it had a ridge down the centre with slopes at either side pitched at an angle of 30° towards both the road and the building. It was covered with slates and had a gutter at the bottom of the inside and outside slopes. The structural features of this veranda proved a serious obstacle to the attempts of the fire brigade to effect rescues of those trapped above ground floor in both Goodman's and Pratt's buildings.

29. *Supply Services.*—The supply services were electricity, water, and gas—the first two being supplied by the Christchurch City Council, and the latter by the Christchurch Gas, Coal, and Coke Co., Ltd.

(*a*) *Electricity :* The municipal electricity supply in the area of the premises of Messrs. J. Ballantyne and Co., Ltd., was the ordinary, normal, and standard type of three-phase alternating-current overhead supply, controlled from a

substation in Lichfield Street, where the overhead line protective devices were of the cartridge-type fuses, the voltage being 400 volts phase to phase and 230 volts phase to neutral and earth. There were other consumers attached to Ballantyne's circuit. The service to Ballantyne's building is briefly described in Appendix B.

The Municipal Electricity Department service lines were taken to shackle insulators on the Colombo Street frontage of Ballantynes, and joined the service mains of the building at bolted thimble connections prior to entering the galvanized-iron mains entrance pipe which led through the masonry of the front wall of the building, and was fitted at either end with a bell-mouth. The service mains were short lengths of paired V.I.R. conductors, and they terminated at a fuse board where porcelain-clad, back-connected fuses of the rewirable type were mounted. It was stated that a protecting metal cover surrounded the fuse-panel. From the fuse-panel the main supply to the building passed to the main switchboard situated in the basement at the extreme rear of Pratt's building by means of a 0·3 square inch, four core, PILCSTA and S cable. From the main switchboard the supply was laid to various subsidiary circuits throughout the building.

As indicated in Appendix B, there was also a direct-current supply which entered the building from Colombo Street at the south-east corner of Congreve's building. This supply was normal in every way.

There was an arrangement between the Christchurch Fire Brigade and the Municipal Electricity Department regarding power-supply disconnection at fires, whereby it was arranged that the fire brigade should notify the Municipal Electricity Department of fire calls. On the occasion of Ballantyne's fire there is no record of any telephone message having been received from the fire brigade, either from the fire-station or from the seat of the fire. While the arrangement between the Municipal Electricity Department and the fire brigade required the fire brigade to notify the Municipal Electricity Department of all fire calls, it also required a second call from the fire brigade if the fire brigade desired the supply to be disconnected. No such call for disconnection was received from the fire brigade. The initiative for drawing the fuses on Ballantyne's circuit originated with the chief engineer of the Municipal Electricity Department.

(*b*) *Water*: The water-supply consisted of—

(i) 15 in. main in Colombo Street:
(ii) 8 in. main in Cashel Street, east of Colombo Street:
(iii) 6 in. main in Cashel Street, west of Colombo Street:
(iv) 8 in. main in Lichfield Street, east of Colombo Street:
(v) 4 in. main in Lichfield Street, west of Colombo Street:

There were two hydrants close to Ballantyne's building in Colombo Street; four in Cashel Street; two in Lichfield Street; and others at greater distances in the streets named, and also in High Street, Durham Street, and Tuam Street.

At times of heavy draw-off, such as would occur when a fire of this magnitude develops, the supply in the mains is boosted by pumping, and the supply on this occasion was adequate to meet the peak demand.

(*c*) *Gas*: The gas service is outlined in Appendix B, and there was nothing abnormal concerning the various services to the building.

ORDER OF REFERENCE (1)

The Cause and Origin of the Fire

Coming now directly to the exact questions we are directed to inquire into and report upon, the first is the cause and origin of the fire.

30. On the evidence it is conclusive, in our opinion, that the fire started in the basement of Congreve's building.

31. Two main theories have been advanced as to the cause :—

One, that some match or burning cigarette was carelessly thrown down and set fire to some of the material in the basement (a description has already been given of the placement and nature of the materials in the basement. The materials which, if loosely laid out, would be inflammable were in rolls or bolts and, consequently, not readily inflammable).

The other theory was that the electric cable, which ran from the first floor into and through the basement, was in some way the cause of the fire.

32. In regard to the first theory, attention has to be paid to the movements of the one employee regularly employed in the basement, Keith Owen Smith. Like most large establishments of a similar nature to Ballantynes, there were many departments, some directly concerned with the selling of goods ; others concerned with the fitting of clothes, manufacturing, hairdressing, &c. Tea-rooms were set aside for the employees of the firm and the public to take afternoon tea.

33. The evidence of Mr. Smith was to the effect that at or about 3.25 p.m. on the day of the fire he was called by another employee and told that the man with whom he usually went to tea at 3.30 p.m. had requested him to say that his friend was ready to go to tea. After the short time necessary to put on his coat and attend to his personal appearance, he proceeded up the stairs out of the basement, joined his friend, and proceeded to the cafeteria with him.

Immediately prior to leaving the basement for tea he had been working in the eastern end, and he said that there was no sign of burning, or smoke, at the time of his leaving. He further stated that he had never smoked or lit a match in the basement.

The time allowed for afternoon tea was eight minutes, and on the day in question he estimated he would have been in the cafeteria for eight to ten minutes. He said that, after he finished his tea, he proceeded to the soft-furnishing department on the ground floor of Goodman's, and informed his superior (Mr. Irvine) that he was " Going out to the back," meaning by this, that he was going to the conveniences. This was untrue ; his real intention, he said, being to visit the premises of a Mr. Sutherland, who had a shop in the next block to Ballantynes, and there to have a smoke and discuss some matter of private business with the principal.

This evidence contradicts his first statement and, indeed, previous statements made to insurance adjusters and police. Unless corroborated, his evidence at the hearing might well be rejected. But Mr. Sutherland, whose shop he went to, has given evidence that Smith came to see him on that afternoon, and thought the time of the visit would be shortly before 3.30 p.m., and other evidence confirmed Mr. Smith's story that, at the time he went to tea, no smoke was seen coming from the cellar.

Mr. Smith went on to say that, by the time he returned to Ballantynes, the fire had been discovered, and he paid no visit to the basement. It was most unfortunate that the witness (Smith) was absent from his post at a time which, in all probability, would have led to an earlier discovery of the fire.

34. Counsel for the Crown, in opening, said that the contradictory statements made by this witness had been examined and that, though they reflected adversely on Smith's reliability as a witness, there was no evidence sufficient to set aside an alibi that was supported by the evidence of Mr. Sutherland, whose independence and reliability have not been questioned.

There was no evidence that the witness had, at any time, been smoking in the basement or in any other part of Ballantynes save the staff tea-room, and, without any such evidence, the Crown had no ground to base a charge that carelessness on the part of Smith was responsible for the fire. In our view, we must accept that conclusion.

35. The theory that the fire originated through defects in the main electricity supply cable, or alleged defects in the installation of the electric equipment supplying current to Ballantynes, has been canvassed at great length by those versed in the supply and installation of electricity, namely :—

Mr. S. M. Nichol, Chartered Electrical Engineer and a Member of the Institute of Electrical Engineers ; Testing Engineer, State Hydro-electric Department.

Mr. E. E. James, Associate Member of the Institute of Electrical Engineers, Electrical Engineer, State Hydro-electric Department.

Mr. J. C. Forsyth, B.Sc. Engineering (Glasgow) ; Associate Member of the Royal Technical College, Glasgow ; Member of the Electrical Institute of Engineers, London ; Member of the New Zealand Institute of Engineers ; Chief Electrical Engineer of the Christchurch City Council.

Mr. J. R. Templin, Registered Engineer ; Fellow of American Institute of Electrical Engineers ; Associate Member of the Institution of Electrical Engineers, London ; Member of New Zealand Institution of Engineers ; Consulting Engineer.

Mr. E. T. Salvesen, Electrician, Christchurch.

Mr. B. R. M. Homersham, Associate Member of the Institute of Electrical Engineers, London ; Associate of the Institute of Mechanical Engineers, London ; Electrical Engineer, Christchurch.

Their reports, which are available, disclose that unquestionably there were defects in the installation.

36. Counsel for the Crown enumerated the defects as follows :—

(1) No oil-circuit breaker at point of entry.

(2) Joints in the V.I.R. conductors.

(3) Roughness of the bell-mouth.

(4) Inadequate clearance behind the fuse panel.

(5) Failure to fill cable end box with bitumen or other sealing compound.

(6) Defective or inadequate bonding and earthing of the cable.

37. It has been found on many occasions that, where buildings have been practically totally destroyed by fire, and inquiry has been made into the cause, it is very difficult to ascertain the truth of allegations that have been made in regard to faulty installations of electric power. Statistics quoted from overseas publications show that relatively few fires have been shown to have originated from, or to be due to, electrical faults. This case presents the same difficulty as always occurs when a building is totally destroyed by fire.

38. In speaking of the electric cable installation, Mr. Cleary, counsel for Ballantynes, suggested that the cable was treated by the Crown and the Municipal Electricity Department engineer as something beyond reproach, but, in his opinion, it must be viewed as an object of grave suspicion because of several proved defects. As to the cable being the cause of the fire Mr. Cleary said—

(1) Fire commenced in Congreve's basement through which the cable passed.

(2) Immediately the fire was discovered, Roger and Ronald Ballantyne diagnosed the cable as being the likely cause.

(3) A number of witnesses (Roger and Ronald Ballantyne, Stringer, Falkingham, Irvine, Novell, and Oakman) spoke of the smoke having a tarry, or pitchy, smell.

(4) Mrs. Mangin (a customer) noticed a flash, which she took to be a fuse blowing in a sub-circuit, which she thought was about 3.40 p.m.

(5) Witness Goodwin (a tailor from Beath's store opposite) noticed smoke oozing out under pressure from the bell-mouth.

(6) Fireman Oakman referred to a square pillar of flame showing up from a position in the vicinity of the third I-bearer, which is the point where the initial combustion of vapour may have taken place.

(7) Patches of bitumen east of the third I-bearer point to internal heating taking place, and bitumen melting and attaching to the concrete floor, before the presence of any quantity of water.

(8) For ten minutes after the arrival of the fire brigade there was a steady increase in the volume and density of smoke in the alleyway and in the vicinity of the basement, indicating that, due to the heating of the cable armouring, vapours were pouring from the cable.

(9) Mr. Roger Ballantyne spoke of observing a fairly bright flash and noise, accompanied by failure of some of the lights and failure of the cash-blower at a time before any significant flames appeared, so that the flash would therefore appear to have taken place well in advance of the falling of any debris.

39. Based upon the reasons adopted in *Adelaide Stevedoring Co.* v. *Frost*, 64 C.L.R. P. 538, he urged that the Commission should look at the facts and, having regard to the fact that the fire occurred in that portion of the building where the main electric cable passed through, and that no other tenable theory for the cause was presented, should, if it was admitted there was an accumulation of faults, set aside the opinion of experts, and come to the conclusion that some of the faulty installation—or the faults as a whole—and perhaps other faults not discoverable owing to the destruction of the premises, were the cause of the fire.

The case cited, however, was a medical case in which Judges might, having some knowledge and experience of the human body, feel able to discard the evidence of medical experts. In this case we do not feel at liberty to adopt that course.

40. Mr. Nicol, who submitted a report, and was in the witness-box for three days, dealt with each fault and, admitting defects as proven, said nevertheless such defects could NOT have been the cause of the fire. His report is attached as Appendix D.

Mr. Nicol submitted that there was no sign of electrical burning throughout the length of the service entrance mains, and that there was no evidence of electrical breakdown either between conductors, or between conductors and their enclosing pipe. He further submitted that, in a cable such as the main electricity supply cable, experience has shown that failure of its insulation, other than at a point where it had been prepared

for connection to apparatus, is extremely unlikely and, in the case of the cable in Ballantynes, there was no evidence of failure of this cable at the two points where it was prepared for connection to apparatus—namely, the service fuses at one extremity, and the oil-filled circuit-breaker at the other.

Mr. Nicol commenced his investigations at the Lichfield Street substation of the Municipal Electricity Department and found no evidence to show that the supply of electricity, the protective devices within the substation on the circuit to the overhead line, or the overhead line, was improper and able to be the cause of the fire on the premises of Ballantynes. He further stated there was no evidence to show that, due to electricity, the fire originated in—

(*a*) The service entrance mains :

(*b*) The service fuses :

(*c*) The electricity mains cable :

(*d*) The main electrical switchboard.

The complete failure of electric lights occurred about 3.58—that is, some considerable time after the fire had been discovered. The cable and the reticulation had been operating satisfactorily since its installation in 1936.

Mr. Nicol's evidence was supported by other experts such as Messrs. J. C. Forsyth and B. H. M. Homersham. The contractors who installed the main electric cable were Messrs. Thompson and Dorreen, Ltd.

41. Mr. Salvesen, the electrician called by counsel for Ballantynes, contended the welding of the armour of the cable took place through the passage of fault current when the main cable broke down, prior to the outbreak of fire, whereas Mr. Nicol gave it as his expert opinion that the welding of the armour was due to external sources, such as falling debris due to the fire, at a time when the cable had been displaced from its original horizontal position in the basement. Mr. Salvesen also propounded the theory that a piece of sheet metal 11 in. by 5 in. which must, in his opinion, have been left by a careless workman on the top of the metal case surrounding the fuse panel, must have fallen so that it made contact between the thimble and the metal cover, thence to the steel armouring of the cable through the cable end-box. In this way he considers the steel-tape armour of the cable may have become heated and caused a breakdown of the cable, and ultimately fire.

This theory presupposes the placing of a piece of metal of a certain size and design on the top of the fuse-panel casing in such a way that it would fall in a certain manner and rest in a position that would create a short circuit, and cause fault current to pass from the thimble through the sheet-metal cover. He said, while searching the debris in the basement after the fire, he found a piece of metal such as he demonstrated would be necessary to prove his theory, but no other person, excepting a labourer employed by him, has admitted seeing such a piece of metal. According to Mr. Salvesen, this piece of metal was despatched to the State Hydro-electric Department workshops, but State Hydro officials deny that it was ever received by them.

In a report to the Fire Underwriters' Association dated 26th January, 1948, Mr. Salvesen spoke of finding a piece of metal 6 in. by 4 in., but, at the hearing, produced a piece of metal which, he said, was similar to what he found at the fire, but measuring 11 in. by 5 in.—the difference in size being explained as a typist's error. At the hearing the labourer produced a sketch of his recollection of the piece of metal, which was quite different in size and design.

Under cross-examination Mr. Salvesen admitted that a piece of metal 6 in. by 4 in. would not support his theory. Under further cross-examination he was presented with an assembly at the back of the fuse panel and was unable to show that the piece of sheet metal in a horizontal position could come in contact with the thimble. He admitted that, without an electrical link between the thimble and the sheet-metal box, his theory must fail. It seemed that, without the electrical link which we think he failed to show, he was unable to contravert Mr. Nicol's opinion that none of the admitted faults in the installation could have caused the fire.

42. Mr. J. R. Templin, an electrician of standing, also called by counsel for Ballantynes, to some degree supported Mr. Salvesen as to the lead sheath and steel-tape armour as a possible conveyer of electricity sufficient to cause extreme heat. He considered the defects in the cable should have been apparent on inspection and should have been rectified, and, in his opinion, the non-earthing of the lead sheath and steel tape armouring could create a hazard which could be either a fire risk or danger to life.

Under cross-examination by the Crown he agreed that, to cause fault current to flow to the armour to enable the fire to be caused electrically, there must be an electrical link between the thimble and the sheet-metal box, so that, unless Mr. Salvesen could, in fact, produce evidence from which it could reasonably be inferred an electric link was made, Mr. Templin was unable to say how fault current could pass to the steel-tape armouring. In answer to a question as to whether, without an electric link between the thimble and the sheet-metal box, he could see how the current could have flowed to the armouring he said: "It must depend on that."

43. A theory based on the suppositions Mr. Salvesen had to make to support his theory is not, in our opinion, taking into consideration all the evidence, sufficient to support a finding that electrical fault was the cause of the fire.

44. The discovery of the fact that joints had been made in the V.I.R. conductors leading to the bell-mouth seemed at first sight somewhat alarming, inasmuch as the joints were, according to Mr. Nicol, the result of very bad workmanship, but none of the expert witnesses suggested that these joints, faulty as they were, could have been the cause of a breakdown in the cable.

45. It was suggested that the armour of the cable had not been properly earthed. There was evidence that at one time a water-pipe may have served as an earth, and been removed. It was urged by counsel for Ballantynes, and indeed other counsel that failure to provide adequate earthing of the lead sheath and steel armour of the cable could have caused such heating of the armour that, given certain circumstances, that heat could have caused the fire. That the earthing was defective was not, in our opinion, established. The supply of power was, from 1936 to the time of the fire, entirely satisfactory. The destruction of the building has prevented examination of the earthing that may have existed.

46. The wisdom of the route taken for the cable, through the basement instead of up the right-of-way, as was the case when the original cable was installed, has been in issue as relevant to unnecessarily increased fire risk in the event of breakdown in the installation.

There was some evidence that the representative for the underwriters objected to the route through the basement, and suggested it should go up the right-of-way. While it is true that the Municipal Electricity Department decided the point of entry of the cable, Ballantynes and their electrical contractors would have the final word as to the route of the cable through their premises, and apparently agreed to the route taken.

47. The State Hydro-electric Department suggested there should be an oil-circuit breaker at the point of entry of the cable to ensure the maximum degree of safety, but it was finally agreed between the State Hydro-electric Department, the Municipal

Electricity Department, and Ballantynes, through their own electrician, to install an oil-circuit breaker at the main switchboard and cut-outs near the point of entry. While there is no evidence that the route taken through the cellar actually increased the fire risk, the weight of evidence in our opinion was to the effect that the better route for the cable would be that previously taken—namely, down the right-of-way outside the building.

48. Every endeavour was made to discover who made the joints in the V.I.R. conductors. In March, 1944, the power-pole outside the premises was replaced, and the workmen who did this work for the Municipal Electricity Department gave evidence, but none of them admitted that the joints were made when they undertook this operation, and, indeed, it appeared that it would have been unnecessary for these workmen to have interfered with the conductors to any extent, so that the result is we have no evidence as to when, or by whom, these joints were made. All we know is that the joints were badly made.

49. The bell-mouth of the galvanized pipe, through which the V.I.R. conductors passed, was found to be rough, and expert electricians agreed that an inspection should have noticed it and directed it be smoothed to prevent chafing of the conductors. In fact, however, the conductors had not been chafed to an extent sufficient to allow fault current to pass from the conductors to the bell-mouth.

50. Two linesmen from the Municipal Electricity Department gave evidence that on 3rd March, 1947, the position of the service mains between the power-pole in the street and the cross-arm on Ballantyne's building was altered and, at that time, at the request of Ballantyne's electrician who was present, a piece of plywood or fibre was placed in the bell-mouth to prevent chafing of the conductors. One of these witnesses thought he remembered seeing black tape on the conductor, but stated further that he did not think there might be a fault in the phase-conductor. Evidence as to the possibility of plywood or fibre being removed a week later was inconclusive.

The defects do not reflect credit on the workmanship of those doing the work, nor does failure to observe them on the inspections reflect credit on the Municipal Electricity Department officials.

51. Mr. Nicol, who speaks with undoubted authority, was faced with the charge that some fault in the cable or installation of electric power was the cause of the fire. Each defect or fault was carefully weighed by him. Without excusing the fault, he examined each with meticulous care, to ascertain its possible effect. He came to his conclusion that none of the faults singly, or together, could have caused the fire. We are satisfied he reached his conclusions not to defend electric energy as a whole, but as an expert whose findings would be scrutinized by able electrical engineers in this country and beyond it.

He was supported by the evidence of other expert witnesses. There was no evidence in respect of the general electrical installation in the building which would lead to the belief that this, in any of its parts, was the cause of the fire. It becomes quite clear in our opinion it is impossible for us, in view of the expert evidence, to determine that electrical fault was the cause of the fire with any degree of certainty.

52. We have already stated that there is no evidence, once the alibi of Smith is accepted, that the fire was occasioned by the carelessness of any employee. Indeed, the evidence showed that Ballantynes strictly enforced this rule against smoking, and there was no evidence to support any suggestion that the fire may have originated from such a cause.

53. We must, therefore, answer the first question by saying that the evidence did not disclose the cause and origin of the fire.

ORDER OF REFERENCE (2)

Whether all possible means were taken to warn the staff and the members of the public in the premises of the existence and seriousness of the fire, and whether all possible steps were taken to provide for their safety and escape.

54. No member of the general public was lost.

The following schedule shows the disposition of the staff at the time of the fire :—

Disposition of Employees at Time of Fire

On the day of the fire there were 432 employees (133 men and 299 women) dispersed in various buildings and floors as follows :—

	Congreves.		Goodmans.		Pratts.		Moules.		Bells.		Lichfield Street.		Total.	
	M.	W.	M.	W.	M.	W.	M.	W.	M.	W.	M.	W.	M.	W.
Basement	1	..	..	..	..	..	..	..	..	..	..	..	1	..
Ground floor	3	2	14	..	13	41	30	46	1	9	2	..	63	98
First floor	..	1	2	..	12	18	7	29	..	8	4	13	25	69
Second floor	..	33	..	12	23	58	..	6	2	10	..	..	25	119
Third floor	..	..	..	12	..	..	..	..	..	..	..	..	..	12
Persons with no fixed position	..	..	..	..	..	..	..	..	..	..	..	..	19	1
Total	4	36	16	24	48	117	37	81	3	27	6	13	133	299
	40		40		165		118		30		19		432	

Of the above persons, 38 lost their lives, the particulars being as follows :—

Department in which Employed.	Department where Perished.	Men.	Women.
Credit office, second floor, Pratts	Accountancy and credit office, second floor, Pratts	4	16
	Jumped from accountancy office window ..		1
Accountancy office, second floor, Pratts ..	Accountancy and credit office	4	3
Display studio, third floor, Goodmans ..	Accountancy and credit office		2
Millinery workroom, third floor, Goodmans	Millinery workroom		7
Telephone-exchange, third floor, Goodmans	Accountancy and credit office		1
Total		8	30

In addition to the above, 2 male auditors, not employees, but working in the audit of the firm's books at the time, and also a female employee of the College of Retailing Representatives, were working in offices adjacent to the accountancy and credit offices, and these persons lost their lives presumably in the accountancy and credit offices.

55. Crown counsel construed the word "possible" as meaning "reasonably possible under the circumstances then obtaining." To take the word "possible" in its literal sense would, according to Crown counsel, be setting a standard such as no man could be expected to achieve, and its construction should have regard to the ordinary standards of the ordinary prudent person.

We agree with these propositions, and approach the question on that construction, paying attention also to the included question as to whether the seriousness of the fire was made known to the staff.

56. Mr. Lascelles, who appeared for the municipal body, pointed out that the members of the public would mostly be on the ground floor, in which so many walls had been opened to enable the public to pass easily from one department to another and, from

what became one large floor, make a more effective display of goods and material. He emphasized that this floor had main entrances which provided easy access to the street. The customers on that floor would be easily herded out, and, indeed, no customers were trapped. It is possible that confidence that customers had ample exit caused the managers of the business to forget that those members of the staff engaged on upper floors had no such ready means of estimating the seriousness of the fire and that their means of egress, by fire-escape or stairs, might be cut off by rising smoke.

57. The Crown conceded that some individual heads of departments, or different groups of workers, on their own initiative, and not under systematic or co-ordinated direction, took prompt and commendable steps for the safety of their own little groups.

On the other hand, the Crown submitted that the evidence of the three Ballantynes, of Mr. Novell, who was general manager, and Mr. Gaffney, a floor-walker having general supervision of staff, disclosed that none of those in any general control took such command as the crisis demanded, or issued directions which could have reached the staff as a whole or even the various subheads of departments. There was no general order, after the fire was discovered, that all should be ready to evacuate as fire was in the building. Omission to prepare a co-ordinated scheme of warning or evacuation found the heads of the firm unable to meet the crises that arose and, without foresight and preparation, it seems likely that the difficulties of sudden, rapid, and efficient improvisation would, in like cases, be beyond the scope of most principals.

58. It is true that members of the staff with any degree of authority may have been under the impression that strict observance of stringent rules against smoking and carrying matches rendered fire risk negligible. The action of the directors in failing to maintain in proper order the automatic Vigilant alarm system, that was at one time installed in Pratt's building, is inexplicable after they had been warned by the firm which installed it that unless it were properly maintained they would have to remove it, and eventually did so. A curious blindness to fire-risk, as far as we can see, can alone explain the failure of the directors to install some warning-device, a fire-sprinkler system, or some alternative fire-prevention method, in addition to the fire-extinguishers on which sole reliance was placed.

If the sprinkler system had been in existence, on the reports which have been submitted to us, the fire would, in all probability, have been put out in the cellar itself, or at least contained there.

Without evacuation drill, without warning-devices, without advice to employees on the steps to be taken in the event of fire, without an automatic connection with the fire brigade, and with employees—many of them young women—numbering some 458, orderly movement, even communication between various departments, can hardly have been expected, and contradictory instructions—some to stay, some to evacuate—took the place of efficient order and movement.

59. There is evidence that one of the staff, in a position of some authority, advised female employees to report back to their departments on the upper floors. Such advice was given, it is said, at a time when the smoke from the fire was spreading through the whole building.

60. There is evidence that some of the employees were so ignorant of the layout of the premises that they were unaware of alternative methods of exit from one department to another.

61. It is quite understandable that, when the fire was first discovered, the information passed casually to members of the staff in various parts of the building remote from the cellar that there was a fire in one of the cellars would not be unduly disturbing, and perhaps the nature of the news that leaked through would induce employees, and indeed the managers, to think that fire in one of the cellars would not be serious.

The volume of smoke, however, coming from the cellar and escaping into the open air, upper floors, and adjoining parts of the premises should have warned executive officers within two or three minutes after the arrival of the fire brigade that the fire was serious and the need for evacuation urgent.

62. In the case of premises as large as those of Ballantyne's, involving the employment of some 458 employees, of whom over 300 were women, it seems clear the provision of a number of fire-extinguishers should not be the only measure taken to prevent and stop the spread of fire. The responsibility for this condition of affairs rests on the controllers and managers of the business. The inevitable result was that, when fire did break out and showed signs of developing into a major fire, the executive officers found themselves not only without adequate equipment to deal with it, but with lack of devices to warn their employees of the existence of fire, or a plan to evacuate them from the building when it became necessary.

Nevertheless, these responsible men had to meet the difficult situation which arose from their lack of foresight, and take all possible steps under those difficult circumstances to ensure the safety of their employees, and the question remains as to whether, though totally unprepared as they were for the crisis which arose, they did take such active steps and give such directions as were required to ensure the safety of all their employees. The answer to this question must be sought by consideration of the activities of the three Ballantynes and Mr. Novell.

63. Mr. Kenneth Ballantyne, a joint managing director of the company, said that, when he opened the door from the credit room leading to the fire-escape and saw the smoke and heat in the alleyway down which the fire-escape ran, he realized the urgency for evacuation on the top floors. He said he heard the call which was effective to the fire brigade being put through. This was at 3.46 ; he was then at the inquiry desk on the ground floor. Putting the discovery of the fire at 3.35, which in our view of the evidence is the latest time at which it can be put, he was at the inquiry desk eleven minutes after the discovery of the fire.

At the same time he learned that the telephone-operator, Miss Hamilton, was possibly in peril. He attempted to communicate with her by telephone. Failing to do so, he went up the main staircase to find out where she was. On the way up he met Mrs. Crew, who was in charge of the millinery workroom, and she informed him she feared her girls in that room were in peril.

Making allowance for the time spent in his effort to communicate with Miss Hamilton by telephone and in talking to Mrs. Crew, he must have arrived at the credit room at the latest at 3.53, and on opening the door to the fire-escape realized, as he said, the gravity of the situation. From that point there was a sharp conflict of evidence. Mr. Ken Ballantyne said immediately—within ten or fifteen seconds—he told the girls in the credit office to make their way down the tailoring stairs by which he had come up.

Miss Kennedy and Mrs. Nash, who were on the credit-office staff and escaped by jumping from the windows, said that he was there for five to six minutes, while the staff, acting on instructions which were believed to have been given by Mr. Hudson, the officer in charge of the credit and accountancy sections (Mr. Hudson was one of those who lost his life), were engaged putting bins and records in the strong-room, and that it was only after that lapse of time that any attempt was made to evacuate the staff from the credit office. In answer to this Mr. Ballantyne said that possibly the staff did not hear his order to evacuate. When he gave the order the staff, he said, left before him and went in the direction of the tailoring stairs, and he had no sooner passed through to the accountancy office when they returned to say that the stairs were impassable because of smoke. That would be, according to him, no more than two and a half minutes from when he had come up these stairs. On investigation he found the stairs, as described, and then realized that the only means of escape was by the windows.

From an open window overlooking Cashel Street he cried for help, expecting that the fire brigade would come to the assistance of those trapped. No assistance being forthcoming in this direction, he endeavoured to reach the Colombo Street frontage. Owing to visibility being practically nil, he was unable to reach the Colombo Street windows, and after describing his attempt to give assistance to a girl who had collapsed, he described how he ultimately found his way to the ledge of a window on Colombo Street. From this position he was rescued at not earlier than 4.10 p.m.—that is, not less than seventeen minutes after his first entry to the credit office. Then the whole area was being enveloped in flame.

64. An important part of the evidence of Miss Kennedy and Mrs. Nash was that, for five or six minutes while Mr. Kenneth Ballantyne was in the credit room, employees were placing books, ledgers, and bins in the strong-room.

Miss Kennedy said she found the stairway clear of smoke as she proceeded to the credit room, where Mr. Ballantyne had entered shortly before.

When she entered the credit room some one whom she thought was Mr. Hudson (officer in charge of the credit and accountancy office, and assistant secretary of the company) said, " We had better put the bins away." The staff then put in the strong-room about twenty-five bins, two typewriters; three or four adding-machines, and a number of boxes of records taking, she thought, about five to six minutes doing so.

After putting these items of equipment and records away she said they were standing around wondering what to do when Mr. Kenneth Ballantyne gave an order to get out by way of the fire-escape. They then moved to the fire-escape. She herself went on to the steps of the fire-escape and found too much smoke to allow egress that way. Some one, whom she thought to be Mr. Ken Ballantyne said, " You can't get down there."

She thought then that the general idea was that they should escape by the stairs and lift, but on reaching the passageway the lights failed, visibility was bad, and it then became the general opinion that escape by that means was impossible. The weight of evidence would show that the lights in the credit office failed at about 3.58, which would be some five minutes after the arrival of Mr. Ken Ballantyne in the credit office.

The girls then passed throught to the accountancy office, which was still free of smoke. Shortly after, Miss Kennedy attempted to return to the credit office with the idea of again endeavouring to escape by the fire-escape, but that proving impossible as its roof was falling in, she made her way to a window and jumped to the veranda in Colombo Street at a time which has been estimated at shortly before 4.5 p.m.

65. Her story was substantially borne out by Mrs. Nash, who said that, when she returned from tea and was at the bottom of the main stairs, she noticed smoke coming from a fire-door. At that time she was with some other employees standing at the foot of the main stairs, and they were told by the floor-walker, Mr. Gaffney, to get back to work as they were getting the fire out. She saw no signs of smoke on the stairs when returning to the credit office.

She confirmed the evidence of Miss Kennedy that Mr. Ken Ballantyne was there; that coats were on the floor; the fact of being told the fire-escape was impassable; and that Mr. Hudson ordered the putting of bins away, which operation took five to six minutes.

Her evidence then conflicted with that of Miss Kennedy in that she said Mr. Ken Ballantyne and Mr. Hudson went to the door leading into the passage which, in turn, led to the stairs, and one of them said, " Everybody out." As she went in the direction of the passageway she heard one of the girls say, " The girls in the millinery are singing out for help." The girl in question and Mrs. Nash opened the door on to the fire-escape and proceeded some distance up towards the top floor of Goodman's, but the intense heat and smoke drove them back.

She then proceeded in the direction of the passage leading to the stairs, and there met the other members of the staff who were returning from the direction of the stairs, having been unable to escape by that means. The lights failed at that moment, producing total darkness.

In her opinion, apart from a command of "All out," there appeared to be no one directing operations or giving directions, and every one appeared to be expecting a command from Mr. Ken Ballantyne and Mr. Hudson, who were two of the principals of the firm. One girl attempted to jump from a window, but was told, "Do not jump yet; there will be some one here."

Mrs. Nash confirmed what Miss Kennedy said about endeavouring to gain access to the credit office with a view to trying again to escape by way of the fire-escape and being prevented from doing so by fire in that office. She said timbers above the lead-lights were falling through. She then followed Miss Kennedy by jumping from a window.

66. The fact that a substantial portion of the records was placed in the strong-room was borne out by Mr. Ronald Ballantyne, who admitted under cross-examination that virtually all the records of the credit department were saved, and also a part of the accountancy records which were found when the strong-room was opened after the fire.

67. Prior to the arrival of the fire brigade, Mr. Hudson had been to the foot of the main stairs at a time when there was no smoke on the main stairs, and knowing about the fire and the calling of the brigade, inquired of Mr. Ronald Ballantyne, who was at the north-west corner of the inquiry counter, what should be done with the cash. He was told by Mr. Ronald Ballantyne to get the girls and the cash out, and to get every one else out "straight away." By "every one" Mr. Ballantyne said he was referring to every one in Mr. Hudson's area, and he had no doubt that Mr. Hudson understood this.

Mr. Hudson then left in the direction of the main stairs. Mr. Hudson perished in the fire, so that his actions can only be judged by the evidence of others; but it is clear that he was given instructions by Mr. Ronald Ballantyne to take steps to evacuate the staff under his control at a time when the stairs were free of danger for evacuation, but no effective steps for such evacuation were carried out.

It is all the more difficult to understand his failure to evacuate when he must have been aware the telephone operator had been forced out of her bureau and taken to the credit office, and knew of Mrs. Crew's concern for the safety of her staff still on the top floor of Goodman's.

From the evidence of the two girls who were saved it appears likely that some order may have been given to bring the girls' coats from the cloak-room and so prepare to evacuate, but valuable and vital time was used in preserving records of the company at a time when a way of escape was open.

68. When considering the evidence of Mr. Ken Ballantyne, Miss Kennedy, and Mrs. Nash, the times of coming and going, and the words used, we cannot fail to be influenced by what must have been the nervous state of suspense the parties were in at the time—in the last few minutes, at any rate, one of nervous apprehension. Mr. Ken Ballantyne had a miraculous escape. Miss Kennedy and Mrs. Nash saved themselves by jumping from the window of Goodman's building on to the veranda and received injuries—Mrs. Nash severe injuries; Miss Kennedy's injuries were less severe.

We think the sequence of events subsequently related by Miss Kennedy, Mrs. Nash, and Mr. Ken Ballantyne must be subject to the state of mind they were in at the time of occurrence, and to the fact that they were then in no condition to estimate time passing between events in seconds or even, perhaps, in minutes. There was a lapse of some five to eight minutes between Mrs. Nash and Miss Kennedy jumping to the veranda, and the rescue of Mr. Ken Ballantyne from the window of Pratt's.

Mr. Ken Ballantyne, however, was in the credit and accountancy rooms for at least some seventeen minutes, and there was no explanation of what he was actually doing for that period, but the length of time he was there lends credency to the evidence that some time was spent in putting records and equipment away before he ordered evacuation. If, after visiting the fire-escape, he allowed five or six minutes to lapse before insisting upon evacuation, that would indicate grave failure to recognize his obligation to his employees. The time that he arrived at the credit office—namely, at the latest, 3.53—can be ascertained from his own evidence.

Mr. Cleary submitted that, on the evidence as a whole, he was not in the credit office for more than three minutes or so before the breakout, but even were that so, if the stairway was clear of smoke when he arrived, the employees could have got out if they had been bundled out post-haste immediately after he had arrived and seen the smoke filling up the fire-escape alleyway.

It is true that the auditor, Mr. Mawson Stewart, and his assistant auditor, Mr. Mawson Stewart, junior, were in that area. They apparently had no idea of the danger in which they stood, but they were in a separate office outside the credit room.

That Mr. Ken Ballantyne himself, after arrival, ordered the putting away of books and bins is open to doubt. Mr. Hudson was there before him, and one can assume, since his evidence was not available owing to his death, that he had not recoghized the rapidly approaching danger, or that smoke could rise so rapidly and cut off the means of egress.

69. Mr. Thomas, who appeared for the accident underwriters, in speaking of the girls in the millinery department who would have been saved if they had followed Mrs. Crew, said they were part authors of their own misfortune in that they had the opportunity to save themselves, and had it shown to them by Mrs. Crew.

No such charge was advanced in respect of the girls in the credit room.

In our opinion, the girls in the millinery room cannot be deemed part authors of the disaster that overcame them because, under the circumstances, the girls, untrained and untaught as to means of egress and alternative means, were not in a position to come to a decision as to the seriousness of the fire ; as to whether they were safe where they were, or not ; as to whether they should go, or stay. We are of the opinion that they were entitled to expect control and definite leadership, and that the mere giving of a direction in such hurried circumstances, which may not have even been heard by all, and which did not in terms advise them that unless they moved with the greatest possible speed they would lose their lives, was not sufficient. In our opinion, the blame for non-action on their part cannot be imputed to them, nor can they be in any sense described as part authors of their own loss of life because of failure to save themselves.

70. Next we take Mr. Roger Ballantyne's evidence. Mr. Roger Ballantyne was the assistant manager of the firm and, as such, was concerned with the supervision of the staff.

At a very early stage in the fire he was at the entrance to Congreve's basement and unsuccessfully attempted to enter that basement. This attempt was made within a very short time after smoke was first observed coming from the basement about 3.35. After the first abortive efforts to reach the fire he realized the brigade must immediately be called.

A call to the telephone-operator, who was situated on the third floor, was put through. It is not thought the call to her was put through before 3.38. The telephone-operator either could not, or did not, get through to the brigade, probably waiting till she had communicated with Mr. Ronald Ballantyne, and then being prevented by smoke from using the telephone. Mr. Roger Ballantyne could not have known of this

delay. He rightly understood the brigade must be met, and, accompanied by Mr. Falkingham, went down the right-of-way at the south of Congreve's and waited there for the brigade. He was unquestionably there to give the brigade all the information he could. On their arrival he appears to have been concerned with the actions of the firemen in the right-of-way, and later led the officer in charge of the brigade to a rear goods-lift which was an alternative entrance to the basement.

On his visits through the shop, and during the period just prior to the appearance of flame, and later when flame appeared, he apparently advised some hesitant employees to leave the premises, but generally he took no part in any evacuation measures. He said he notified some firemen of the plight of the girls trapped in the upper floor of Goodman's and, even though he saw no attempt being made at rescue, he apparently thought his duty ended by drawing the attention of the firemen to the girls. Although he said that, as assistant manager, he was concerned with the supervision of the staff, in this emergency he took little part in measures to ensure their safety.

He said, after coming out of the right-of-way, Officer Burrows, the officer in charge, asked him if there was any alternative entrance to the basement, and he replied, " Yes, come with me." He said he intended taking him into Goodman's building, and actually veered towards the door, but came up against a number of people in the entrance and, by looking through the display window, it was evident that that part of the building was well filled with smoke.

It never occurred to Mr. Roger Ballantyne to take Officer Burrows into the alleyway where, by means of a hole pierced by Luney's men in the wall between Pratt's and Goodman's, entrance could have been effected through Goodman's cellar to the Congreve cellar. Instead he took him to the lift-shaft, which afforded a way to the cellar. He said, at that time, there was a little smoke in the lift-well. Officer Burrows denied the presence of any smoke ; he decided against using that way. Officer Burrows neither asked nor said anything to him about evacuation of either the staff or customers.

71. Mr. Ronald Ballantyne, a joint managing director of the company, was at afternoon tea at the time the fire in the basement was reported to him. As the electric cable passed through that basement he jumped to the conclusion that the cable was the cause of the trouble.

Finding the smoke in the basement too dense to allow an entry, he knew prompt steps must be taken to confine the fire and warn the staff and customers. Having previously seen a number of employees from the second floor of Congreve's in the vicinity of the cash-desk on the first floor, he mistakenly thought those on the upper floors of Congreve's had come down and an order for evacuation of Congreve's was not needed. He sent an employee, Mr. Philpott, to warn the staff in Goodman's.

Believing electricity to be the cause, he made two attempts to enter the storeroom to draw the fuses. Unable to enter the storeroom (first floor Congreve's), he proceeded to the ground floor to find if the brigade had been called. At that time the smoke was thick at the top of the stairs, but it was clearer on the ground floor. On being told that the fire brigade had been called, he turned his attention to the already apparent smoke on the ground floor of Congreve's and came to the conclusion that steps should be taken for the evacuation of the building.

Finding Mr. Novell, the general manager, at the foot of the main stairway, he said he made it clear to him to get the staff out. He did not consider any other order for evacuation was required, and indeed it is not clear how it could have been communicated other than by Mr. Novell or other departmental heads. He had previously sent Mr. Philpott to the upper floor of Goodman's to see to the staff there, and instructed Mr. Hudson to get every one under his control out straight away. Both of these employees were officers whom he could trust to carry out instructions. These instructions to him

seemed adequate. Mr. Hudson, we know, went to the credit office on the second floor of Pratt's. Mr. Novell apparently confined his attention to the ground floor and the customers there.

When the fire broke through he entered the building and found some twelve to twenty employees on the ground floor. They were still there when he came back after visiting the first floor. When he finally left the building he spoke to Mr. Novell, who told him the last of the employees had left. It was not till some considerable time later that he learned that some of his employees had been trapped on the upper floors.

72. Finally, we take the evidence of Mr. Novell, who was general manager of the company.

When he first heard of the fire, the evidence suggests somewhere between 3.40 and 3.45 p.m., he said he went to the unoccupied portion of the first floor in Congreve's, and then to the ground floor, where he met Mr. Roger Ballantyne. As the fire appeared to be confined to the basement, and he was told the brigade had been called, he did not consider there was any immediate danger or necessity to evacuate the staff.

In evidence he stated that his first reaction was to go to the ground floor to take charge, but, apparently, on finding Messrs. Roger and Kenneth Ballantyne there, he considered there was no necessity for him to do anything. When told of the arrival of the fire brigade he went to the Colombo Street frontage to see what was taking place and for the purpose of giving the fire brigade any information they might require. From that time until flames appeared was apparently a period of inactivity on his part.

Once flames appeared he said he returned to the building and closed the fire-doors in the furnishing department and cleared that department of staff. On returning to Colombo Street he was amazed at the spread of flame, and then realized that a major catastrophe was taking place.

His plan was then to re-enter the building and take control of complete evacuation. On re-entering the building and finding on the ground floor employees from the upper floors, he assumed all those on the upper floors had been warned in some manner, and therefore did not contemplate any necessity to have staff evacuated from the upper portion of the building.

On moving to the centre of the shop to control evacuation he came in contact with Mr. Ronald Ballantyne, whom he thought had attended to what was necessary in the centre of the shop, so he left to view the fire from the street. A further visit to the shop was made, and, after satisfying himself that the ground floor was cleared, he finally left the shop. It was some time later that he first learned that members of the staff had been trapped on the upper floors.

73. The evidence of members of the public who were on the premises was that they heard neither warning nor orders to evacuate, and noticed no sign of organized evacuation.

Although there appear to have been isolated efforts to prevent people from entering the building, nevertheless right up to the time of the break-through, and indeed after the first appearance of flame, there was no real obstacle to prevent customers from entering the shop, at least from the Cashel Street entrances. It was estimated that at the time of the fire there may have been 250 customers on the premises.

74. One witness, a Mr. G. B. McDonald, spoke of entering the premises at the corner of Colombo and Cashel Streets at not earlier than 3.56 p.m., at a time when the lights were off and the fire-doors to the soft furnishing department were closed. He noticed assistants behind the counter and other people in the shop. At the bottom of the main stairs he saw Mr. Novell and Mr. Roger Ballantyne, but he was not prevented from going up the main stairs to the cash-desk and lounge. In the lounge he found other people.

He thought the tea-rooms were about a quarter full. After being in the lounge for only a few minutes, four or five men, whom he took to be assistants from the men's tailoring, came running through the art display space with handkerchiefs to their faces. They were followed by a cloud of smoke. Almost immediately there was an explosion, and everything in that part of the shop burst into flames. The flames appeared to be coming through the arches from the furniture showroom, the arch outside the cash-desk, or the ladies' rest-rooms, and through the arch from the art display.

As he made his way down the stairs there appeared to be burning materials falling from above. His evidence was that, when he went downstairs, he saw no one directing evacuation, and there was no one at the door in Cashel Street by which he left the building.

75. Another witness, Mrs. Elsie Smith, spoke of arriving at the western entrance to Ballantynes in Cashel Street at not earlier than 3.52 and noticing confusion about the corner of Colombo and Cashel Streets. She entered the building and, on her way to the shoe department, noticed a customer being served. On arrival at the shoe department she says the smoke or vapour was terribly bad, and the lights were out. An assistant said there was nothing to worry about; Mrs. Smith collected a parcel she had gone in for, and then hurriedly left the premises. Mrs. Smith thought she was in the building for approximately four minutes, and during that time saw no evacuation measures being taken, and there was no person manning the exit.

76. Then we have the evidence of a Mr. Troup and his son who entered the mercery department shortly after 3.35 p.m., and left the premises just prior to flames breaking out in the building. While in the shop Mr. Troup heard a fire-engine arriving outside, and an assistant remarked, "That will be the fire-engine to our place; there's been a fire going on in our cellar for some time."

During the whole of the time he was in the premises no orders were given regarding evacuation, and the staff appeared to be carrying on their work as usual. Mr. Troup left the premises after his son had viewed the premises from the street, and returned to say the smoke was very bad outside.

77. We also have the evidence of a Mrs. Mangin who was in the vicinity of the basement stairs when the smoke issuing from the basement was first noticed. This customer spoke of the covering of stock and an assistant locking the entrance-doors on to Colombo Street, and then unlocking them to allow her to enter Colombo Street.

78. Ballantynes seemed to have thought fire-risk was negligible; the staff was not instructed where to go, or what to do in event of fire; no preventive measures were taken, and the executive officers who could have been expected to take control had to improvise necessary control.

The Good Housekeeping Scheme, highly regarded by authorities as one of the most effective measures of fire-prevention, involved to those who praised it much more than Ballantynes practised. Properly understood, it is not confined solely to collecting paper, cleaning floors, and emptying rubbish-bins. It involves keeping technical devices in order, and was not carried out when the automatic warning-device was neglected, and on that account was taken out by the firm who installed it. No substitute was installed to take the place of the automatic warning, and even the Klaxon horns, which could have been used for warning and were put in during the E.P.S. period, were taken out. Nor was good housekeeping carried out in allowing flexes and other electric equipment to become worn or frayed.

As a whole the steps taken, after allowing for the difficult situation caused by lack of antecedent prevention measures, cannot on the evidence of the executive officers be regarded as satisfactory. Urgent personal action to see to the evacuation of the staff on the upper floors was required, and, in our opinion, was lacking.

It may well have been that the executive officers acted within the compass of average intelligence in the circumstances as they saw them, in which case the answer is that there should be provided an alarm system with a total coverage of the premises, and staff practices in evacuation drill so that promptitude will be automatically forthcoming, divorced as far as possible from the human factor. For instance, when it was known that girls in the millinery work room were trapped, no member of Ballantynes made it his duty to immediately inform the fire brigade that steps should be taken to rescue them by way of the fire-escape.

79. We must therefore answer this question by saying that in our opinion all steps reasonably possible, under the circumstances then obtaining, were not taken to warn the staff and the members of the public on the premises of the existence and seriousness of the fire, and that all reasonably possible steps, under the circumstances, were not taken to provide for their safety and escape, and we add that, without some warning-apparatus which had been put in practice from time to time so that the staff should realize the significance of warning, it became difficult at the least, without a system of training, to inform the staff in the crisis that arose that a fire was on the premises that danger was imminent and evacuation of all must be made immediately.

80. So far we have dealt with the question as to whether the steps taken by Ballantyne's officers were sufficient, and not dealt with the responsibility of the fire brigade to take steps to see to the safety and escape of employees, or to give them warning. The fire brigade's responsibility as regards rescue operations we will deal with in the question relating to the effectiveness of the fire brigade's operations to combat the fire—that is, Order of Reference (8).

In coming to the conclusion we have that the management of Ballantynes did not, after the outbreak of fire, show control or direction sufficient to say that they took all steps reasonably possible to ensure the safety of the staff, and that they were responsible for not having previously instituted fire-prevention measures, we do not forget that Mr. Roger Ballantyne may have been lulled into a sense of false security when Mr. Burrows, the officer in charge of the fire brigade, failed to ask him whether the staff had been evacuated, and failed to give any direction at all on this point. But Mr. Roger Ballantyne, if he were so affected, did not himself take great part or, so far as the evidence went, himself give any directions in regard to evacuation which should have been given previous to the arrival of the fire brigade.

We do not, however, attempt to apportion responsibility for non-evacuation between the Ballantynes and the fire brigade. Both, it appears to us, had responsibility to see that the occupants were safe, and the principals and executive officers of the Ballantyne Co., despite some scattered partial efforts and directions, failed to shoulder their responsibility of leadership in a way their staff was entitled to expect and rely upon.

It should not be forgotten that, before the brigade arrived, Ballantyne's staff could have been evacuated or prepared for evacuation, and the officer in charge of the fire brigade may have assumed steps had been taken.

81. Nevertheless, the brigade had its statutory obligation to see to the safety of those on the premises. Section 18 (*a*) of the Fire Brigades Act of 1926 says :—

> He shall upon any alarm of fire proceed with all possible speed to the place where such fire has occurred, and endeavour by all practicable means to extinguish the fire and prevent the spreading thereof, and to save lives and property in danger.

We must inquire, therefore, whether the brigade officer in charge should or should not, under the circumstances, have ordered immediate evacuation of every part of the building when he was in the building with Mr. Roger Ballantyne.

82. The officer in charge at that time must, we think, have been aware, or at least apprehensive, that the fire could not be confined to the basement and might develop into a major fire taking the whole building. He should have been the best judge as to whether the fire was serious or not. Under those circumstances it is difficult to understand why he did not ask Mr. Ballantyne if everybody had been evacuated from the building; and, unless he received that assurance, give orders to see to it that all were evacuated, especially those on the upper floors.

83. Mr. Girling-Butcher, writing in the *Trailer Fire Pump Manual*, said :—

It is the first responsibility of the officer in charge to see that every person is clear of the building. If this cannot be established by inquiry he must immediately institute as complete a search of the building as possible, having regard to the state of the fire. The search is carried out at the same time as the fire-fighting arrangements are being organized, but takes precedence of the latter.

In our opinion, this principle is not one which can be varied or neglected by the officer in charge of a fire. If it is to be left to the discretion of the officer in charge as to whether the principle should be observed or not, then, as a principle of fire-brigade operations, it is undermined.

84. The officer in charge himself, when questioned as to the steps the brigade should take, said :—

During the daytime, had it been an old people's home or a hospital, it would be the duty of a fire-brigade officer to see that every one was out. At night-time, in the case of residential quarters, boardinghouses, hotels, &c., it is our duty to make sure everybody had left the building. But at four o'clock in the afternoon, when everybody is awake to the fact that there is a fire in the building, it did not come to me to ask them to evacuate the building at that time.

85. The Superintendent of the fire brigade, when questioned on this point, said :—

Q. . . . do you think he (Burrows) was justified in having given no order to evacuate right up until the time of the brigade call, with all the trust that you have in him as an officer ?

A. When he returned from the goods-lift round to the front, and if the position was as I pictured it, then that was the time he should have given the order to evacuate.

Q. So at least you will agree he should have given the order some time prior to the brigade call ?

A. Yes, just prior to the call.

86. It appears to us that, with a fire in a large building where there is normally a large staff, it should have been apparent to the officer that inquiry must be made that satisfied him complete evacuation had taken place, or else steps taken to see that evacuation in fact had taken place.

In the case of a fire at night when the business was closed, he might reasonably assume that none of the staff were in the building, but when a fire takes place at a time when he knows the business is in full swing and staff on the premises, the obligation to see to evacuation is, in our opinion, imperative.

We think that failure to satisfy himself that evacuation had taken place, or to give orders for immediate evacuation, or actually send firemen to see that evacuation had taken place, was a departure from a principle of fire-fighting that should be observed by every brigade.

ORDER OF REFERENCE (3)

Whether any special circumstances contributed to the rapid spread of the fire, and, if there were such circumstances, whether the fire hazard could have been reduced by the installation of fire-prevention equipment or by any other means.

87. We have referred in the Introduction to the wall-linings of soft fibre boards: the unenclosed lifts and stairways; the lateral openings in walls that had become internal walls; and the absence of sufficient fireproof doors. Each of these factors, and other factors which we will refer to, separately promoted the rapid spread of smoke and fire.

Undoubtedly the fire hazard could have been reduced by the sealing-off of all vertical openings; the use of fire-resistant material for lining in lieu of soft board and matchlining; the installation of fireproof doors in all lateral openings; the installation of certain fire-prevention equipment, such as sprinklers; or by ordinary water-supply pipes fitted with hoses, in the event of sprinkler equipment being unobtainable.

It appears from the evidence, and from experience of other countries, the sprinkler system is the most efficient method of dealing with fire when it breaks out. The system operates an automatic call to the fire-station and avoids the danger of a late call.

88. In his opening address counsel for the Crown said that Messrs. J. Ballantyne and Co., Ltd., found it expedient from time to time to make alterations in their buildings. To improve means of communication between departments and give scope for an impressive display, large openings were made in walls, once party walls of the once separate buildings. In most cases these openings were not provided with fire-doors. Had such doors been provided the spread of fire or smoke from department to department, and floor to floor, would have been retarded.

The building, in the basement of which the fire started, was a three-story brick building lined chiefly with matchlining and soft fibre board. There were no fire-escapes and no lifts.

89. The fire was discovered by an employee, a Mr. Stringer. He said that when he first entered the basement to investigate he was able to proceed about half-way along the basement on the south side. He noticed hot, billowing smoke, but no flame, and concluded the seat of the fire was on the north side of the basement. He then returned to the head of the stairs, seized a fire-extinguisher from the archway leading from the carpet department into the soft furnishing, and, after removing his coat and tying a handkerchief over his mouth, he returned to the basement. On this visit to the basement the smoke was appreciably more dense and hot, and he heard a muffled crackling noise coming from well forward on the north side.

The next move by this employee was to enter Goodman's basement by the basement stairs at the western end. While there was smoke in this basement it was not as heavy in volume as in Congreves, and was mostly in the western end and close to the ceiling, but showing evidence of descending. By this time the lino and carpet sections were beginning to fill with smoke, and smoke was drifting into the soft furnishing section.

90. According to the Crown, the first great concentration of smoke was on the first floor of Congreve's building, which was used as a workshop. It was held there for a time because the opening from there to the furnishing showroom was temporarily blocked with a soft fibre board covering. The smoke, however, could rise higher and ascend to the top of the building by means of an open stairway leading from where the fire started to the ground floor, and an open doorway to the adjoining basement of the next building—that is, Goodman's. From Goodmans it could ascend through a lift-well to the third floor, where the top of the lift was unenclosed.

Several theories were put forward as to the way in which the smoke must have travelled.

The Crown suggested there would have been three courses that could have been taken:—

(1) Following the stairway from the basement in Congreves up the stairway and through the basement door, close to what is called the appro office at the head of the stairway.

(2) Up the casing round the main electric-supply main, thus by-passing the ground floor. The casing referred to extended from the basement to the first floor, and the smoke would easily flow into the workshop on the first floor.

(3) It could pass through the cyclone-wire gate between Congreve's and Goodman's basements.

91. Mr. Girling-Butcher, Inspector of Fire Brigades, elaborated his idea of the way in which the smoke must have travelled. He said that the break-through from Congreves occurred at approximately 3.58 p.m. and was not a small fire. He then put the questions :—

Where did it build up to these proportions, and why was the build-up not seen by the brigade and those persons in the building up to the time of the break-through ?

In his opinion both questions are answered by the theory that, up to this time, the major part of the smoke and heat from the fire in the basement was finding a vent in the concealed light-well behind Congreve's building. He thinks that, when the fire brigade arrived, smoke was coming from the first-floor window in addition to the right-of-way, and that the line of travel of the smoke must have been—firstly, from the basement by the basement stairs to the ground floor; then by the stairway opening to the first floor. As the first floor was completely enclosed, the smoke would flow out of the front window. Secondly, the smoke would travel through the lantern windows in the roof of the appro room, and at a later stage through the back windows in the first floor above the stairway. When the break-through occurred, the soft fibre board covering of the large opening on the first floor would collapse.

92. He supported this theory by reference to the evidence of the rest-room attendant, who was working in the ladies' rest-room at the rear of Congreve's first floor on the day of the fire.

She said that, while sitting in her corner at about 3.40 p.m., she noticed volumes of smoke coming through the floor of her department. She said that, when she got out of the corner she was sitting in she went to the window, and, looking out, could see nothing but volumes of black smoke, and the evidence of Miss E. N. Smith, who was at the cash-desk at the top of the stairs near the lounge, bears this out. Her room was closed with only one door, and she saw the attendant (Mrs. Johnston) come into her room, and told her she could not stand the smoke in the rest-room.

Mrs. Johnston left her purse in the rest-room, and when Miss Smith went back to get it she found the rest-room was very thick with smoke. She also found the window at the back of the rest-room was open, and looking through it saw thick smoke passing out of the skylight—that is, on the roof of the appro room. She said smoke was pouring out of all the ventilators and skylights.

Later, she said, a Mr. McKay, assistant electrician for Ballantynes, came to her asking where the smoke was coming from, and she took him through to the rest-room and showed him the window where it was pouring out of the skylight.

93. Mr. V. J. Hean, a registered architect employed by the Public Works Department at Christchurch, furnished us with plans he had prepared showing the assumed spread of smoke and fire in three stages. These plans are attached hereto as Appendix E.

94. Other theories were advanced, and a Mr. P. J. Alley, a Lecturer in Civil Engineering at Canterbury College and a Member of the New Zealand Institution of Engineers, came before us with a scale model of the Ballantyne buildings, and by the introduction of smoke from a blower demonstrated his conception of the way the smoke would travel through the building. We found this exhibition of not much value, in so far as the course of the smoke was to a great extent directed by the pressure applied to the blower and the point to which it was directed.

95. We think our task, however, is not to be too particular about the detailed course of the smoke since the construction of the buildings and the numerous vents and flues provided by the lateral and vertical openings amply show that the smoke could readily and quickly make its appearance in ever-increasing volume throughout practically the whole of Congreve's, Goodman's, and ultimately Pratt's buildings.

Added to the many draughts running laterally and vertically through the buildings, when the gases given off by heated materials reached combustion point and flame broke through, a fire could spread with remarkable rapidity throughout the whole of the building. When the inflammable nature of the linings used throughout the buildings is added to these draughts, and when, too, the inflammable nature of a great portion of the goods displayed is taken into account, one can readily understand that after ignition of the gases Ballantyne's buildings would become practically a raging inferno which could not be quelled by the efforts of any fire brigade.

It is important, therefore, to depart from theories and take account of the evidence of those in the building at the time, who encountered smoke in the various departments, and those from outside the building who saw smoke coming from it.

We have already referred to the evidence of the employee Stringer, who first noticed the smoke and went down to the basement where it came from.

96. We now take the evidence of those who were working in the millinery workroom and accountancy and credit offices.

There was evidence that the lady in charge of the millinery workroom on the top floor of Goodmans (Mrs. Crew) proceeded from the cafeteria to the millinery room shortly after 3.30 p.m. and did not then notice any sign of smoke. On leaving there to return downstairs at approximately 3.40 p.m. she encountered smoke, which appeared to come from the top of the lift in Goodman's building and appeared to increase very suddenly. She opened the door of the display studio, also on this floor, and after calling to the two female employees to "get out," went to her own millinery workroom and told her girls to leave by way of the fire-escape. Almost immediately she led the way to the fire-escape and encountered very thick yellow smoke in the passageway.

From the evidence of Mrs. Crew it seems that smoke penetrated in considerable quantity to the upper floor of Goodmans at a great speed. She immediately left the millinery room and proceeded down the fire-escape to the credit office. Smoke there prevented her return to the millinery workroom. Her evidence shows the speed with which smoke travelled to the upper floors, as Mrs. Crew's movements were made not later than approximately 3.40 p.m.

97. The telephone-operator, Miss Hamilton, was stationed on the upper floor of Goodmans. She was overcome at an early stage, and was rescued and brought down to the credit office.

98. Mr. Kenneth Ballantyne went to the credit and accountancy offices at from 3.52 p.m. to 3.53 p.m. and, at that time, he found the main stairway and the tailoring stairs comparatively free from smoke. He went directly to the doorway leading from the credit office to the fire-escape and found it impassable because of smoke and intense heat.

99. In our view there is ample evidence that heated smoke and gases advanced up and through the buildings at great speed. It is supported by many photographs which were exhibited, showing the volume of smoke issuing from the buildings at about 4 o'clock, and the evidence of the firemen in the right-of-way at the south of Congreve's building. The speed and spread of smoke, and subsequently flame, was undoubtedly accelerated by the many draughts through vertical and lateral openings, the inflammable nature of the goods and wall and ceiling linings.

Other contributory factors were—

(*a*) The very large fire areas, or fire compartments created in the building by the cutting of lateral openings in the several external walls to the various buildings. The size of the fire areas so created is set out in the Introduction to this report. Such large fire areas quickly lead to development of fire of such heat and ferocity that it is difficult of control by any fire-fighting force :

(*b*) The high fire load in Ballantyne's building when related to the class of construction. The building had wooden floors and partitions; linings of tinder-dry matchlining and soft fibre board; the ceilings were similarly lined. The class of occupancy or business carried on was, in itself, a considerable fire load, and the combined result was to create a very considerable fire hazard. The fire loads are also set out in the Introduction to this report:

(*c*) In a secondary sense, the delayed call to the fire brigade contributed to the rapid spread of fire, in that it allowed the inflammable gases of combustion to accumulate on the first floor of Congreve's building, thus creating an imminent and dangerous possibility of explosive ignition:

(*d*) Likewise, in a secondary sense, the failure of the fire brigade to effectively attack the fire in the first ten minutes after its arrival also allowed the accumulation of dangerous explosive gases, as referred to in the last paragraph.

100. It is clear from the evidence that the first visible sign of the rapid deterioration in the changing fire situation shortly before 4 p.m. was followed almost immediately by a sudden rush of flame, emanating from the first floor of Congreve's building along the Colombo Street frontage and spreading throughout the premises with amazing rapidity. The evidence disclosed by expert technical witnesses elicited the following factors which resulted, in the first place, in an unusually rapid burning cellar fire and, in the second place, in an almost incredible fire situation developing within less than thirty minutes following its initial discovery:—

(*a*) The unusually rapid development of the fire, considered as a cellar fire, resulted in a large measure from the presence of an unprotected opening in the dividing wall of the adjoining cellar which permitted free access of air:

(*b*) The fact that the open stairway from the cellar where the fire originated in Congreve's building was not fire-stopped permitted the transmission of heated products of combustion to the first floor in increasing proportions as the fire conditions deteriorated:

(*c*) The presence of large openings entirely unprotected against the ravages of heat and smoke between Congreve's, Goodman's, and Pratt's buildings on the first floor was the important factor which accounted for the rapid spread of fire throughout the buildings:

(*d*) The fibre-board screen enclosing the lateral opening between Congreve's and Goodman's buildings on the first floor permitted a dangerous condition to build up in Congreve's building.

101. We are of the opinion that the fire hazard could have been reduced by the following means:—

(1) The installation of an automatic sprinkler fire-alarm system. This was the most obvious solution, and, as it was demonstrated in evidence, it is difficult to understand why Ballantynes did not have such a system installed:

(2) An automatic fire-alarm system directly connected to the fire-station. This type of alarm, while it does not attack the incipient fire, does immediately bring it to the notice of the fire brigade, and, in this instance, the fire brigade would have arrived at the scene without delay, and at a time when there would have been no obstruction to entering the basement, by reason of heavy smoke conditions:

(3) The use of fire-doors to the specification requirements of the Fire Underwriters' Association on all openings cut between the various buildings which comprised the group of buildings forming Ballantyne's premises. This would have meant that a number of the openings must be reduced in size, but, in view of the risks involved, the disadvantages would have been more than outweighed by the gain in protection, and adopting several smaller openings in lieu of individual large openings:

(4) The total prohibition of the use of wood-fibre board on the premises :
(5) The use of a system of standpipes throughout the building with hoses attached. These would have enabled the staff to attack the seat of the fire, immediately it was discovered, with a substantial stream of water :
(6) The enclosure of all lift-shafts and stairways by suitable smoke-stop partitions.

As a matter of comment, we think it can be fairly said that, of these measures which have been enumerated, No. 1 of itself, or No. 2 of itself, the application of Nos. 3 and 4 to Congreve's building only, and possibly the installation of a hose in the vicinity of Congreve's ground floor in accordance with Nos. 3 and 6, would have prevented the catastrophe from taking place.

ORDER OF REFERENCE (4)

Whether the structural design of the building and the fire-protection and egress arrangements complied with all relevant statutes and regulations, and with all relevant by-laws in force in the City of Christchurch.

102. It is obvious, in view of our previous findings, that the condition of Ballantyne's building with its lateral and vertical openings, its unenclosed lift-shafts and staircases, even if not prohibited by statute or regulation, rendered the buildings unsafe for employees.

103. Counsel for the Crown has told us the only statute to be considered in dealing with this question is the Factories Act, and regulations made under it ; and the only by-laws the Christchurch Fire Brigade's Fire Escape By-law, and the Christchurch City Council's Building By-law No. 15 made in 1930.

104. So far as the Factories Act and its regulations are concerned, he said, quite apart from whether adequate or not, he agreed with Mr. Cleary, counsel for Ballantynes, that he could see no breach of the Factories Act or its regulations by the Ballantynes.

Mr. Lascelles, counsel for the City Council, however, has submitted that the egress arrangements from certain rooms on the second floor of Congreve's building did not appear to comply with the Factories Act, 1946, section 53 (1) which reads :—

> Efficient fire-escapes shall be provided for every workroom situate on any floor above the ground floor,

or with the Factories Consolidating Regulations 1937, Regulation 7, which requires :—

> . . . a fire-escape stairway, not being a stairway ordinarily used for ingress and egress, shall be provided for every floor of a factory above the ground floor . . .

He said that the absence of a fire escape stairway from those rooms was not excused under Regulation 14, as the ordinary stair was not of fire-resisting material. We think this contention would need clarification beyond that given to it by Mr. Lascelles, if it were to be adopted.

The fact is, however, that the building was completely inspected in 1943 by the Labour Department to see whether it complied with the regulations, and, although it has since been at times inspected by that Department, they have on no occasion complained that in any respect there had been a breach of the Regulations or the statute.

105. The only other by-law that arises concerning the structural design of the building, and fire-protection and egress arrangements, is the City Council Building By-law No. 15 of 1930. It is the only building by-law that had local application to Ballantyne's premises at the time of the fire. The various buildings constituting Ballantynes did, it is assumed by every one, comply with the Christchurch by-laws then in force on the erection of buildings.

The particular question that arises here is whether, under this By-law No. 15 of 1930, subsequent alterations to the building complied with the by-laws existing at the time the alterations were made. The alterations were made at different times, some probably under the earlier by-law of 1916, and others under By-law No. 15 of 1930.

Counsel said it was somewhat difficult to determine whether breaches of either by-law were made, as the by-laws were unfortunately worded.

106. Mr. Somers, the city engineer, told us it was difficult for the staff, and possibly more difficult for outsiders, to understand. The difficulty, as we understood it, caused doubts in the minds of the staff as to whether or not the Council could withhold permits for alterations by way of cutting entrances in walls between one department and another. The difficulty is, in part at least, caused by the precise significance of the term "party wall." That difficulty is removed if adequate definition is contained in the proposed Standard Institute's Fire Prevention By-law.

107. We think the Christchurch by-law, creating doubt as to its scope, is in part at any rate responsible for the casual way in which the contractor employed to make these entrances applied for and, in some instances, failed to apply for a permit for the proposed work. In so far as permits were not obtained the execution of the work was, on one construction of the by-law, obviously a breach of the by-law. On the other hand, on another construction the breach, since a permit could not be refused, would be technical only.

Even in those cases where no permit was granted it is suggested some officers of the City Council must have noticed, from the rubble and bricks being removed, that alterations of some kind or other were taking place. Obviously the scope of the by-law, if it is to stand, should be set out in plain language.

108. There is one instance which was plainly a clear breach of a by-law. The breach was the use of soft-wood-fibre board for partitions and wall coverings. Clauses (A) and (B) of By-law 40 are as follows :—

(A) All internal walls and all partitions and ceilings which may hereafter be constructed either wholly or partially of wood, shall be covered with metal, fibrous plaster or asbestos sheets, or else with plaster laid on laths, or other substances which may be approved from time to time, and all such coverings of internal walls and partitions shall be carried down from the ceiling to the level of the floor. Dado can be seven feet high with glazed sashes above.

(B) No wood or other material capable of taking fire and burning shall be used as a lining in the construction of internal walls or partitions. Provided that, in the case of warehouses and offices, $\frac{3}{8}$ in. wooden linings may be allowed to the height of seven feet from the floor if the studs are first covered with non-inflammable material to that height.

The extent to which soft-fibre board was used in Ballantyne's building has been shown in the description of the buildings by Mr. Cornish, which we have already set out. The City Council overrode its own by-law, and granted dispensation from compliance with it, by granting permits to use this soft wood fibre board. No part of the by-law, in express terms, says that compliance with it can be dispensed with, and the City Council can hardly be excused for allowing such a departure from a provision clearly intended to minimize fire-risk. Nor again are Ballantynes or their architect in this matter entirely exempted from responsibility, considering that the use of such lining has been condemned for many years past as a feature responsible for the rapid spread of fire and the consequent danger to life and property.

109. So far as egress arrangements are concerned, there has been no suggestion there was any breach of any statute, regulation, or by-law in force in the City of Christchurch. The City Council of Christchurch, while approving of the Standards Institute Egress Code, had not adopted it, and their inaction in this matter we will deal with later.

110. It cannot be said that there was a breach of the Christchurch Fire Board Fire Escapes By-law, 1930. It seems to us likely that on inspection by the Superintendent of Fire Brigades, if such inspection had been made, a requisition might have been served on Ballantynes to provide better access to fire-escapes than was made. Inasmuch, however, as no inspection—or at any rate no requisition—was served on Ballantynes, it cannot be said that there was an actual breach of this regulation.

ORDER OF REFERENCE (5)

The adequacy and administration of all existing relevant statutes and regulations and all existing relevant by-laws in force in the City of Christchurch in regard to (a) *fire protection and fire-prevention in such buildings, and* (b) *the construction and design of such buildings in relation to the safety of the public.*

111. The Factories Act and its regulations seem inadequate since the Act and the regulations under it set a standard of protection against fire very far below that set in standards approved by expert opinion and adopted in other countries.

First, they sanction the use of external fire-escapes, as distinct from protected external stairways.

Second, they do not require internal protected stairways and lift-wells of the enclosed type.

No provision is made for fire-doors.

Modern informed opinion does not favour, or consider it safe to rely on, vertical external ladders as a mode of egress from factories.

The regulations make no provision for the number of occupants that might be forced to use the fire-escapes required by the Act. Under the present statute and regulations a fire-escape giving access to each floor complies with the provisions of the Act. Obviously a regulation that covers the modern view that the number of fire-escapes should be related to the number of occupants who might have to use them is more effective.

The same considerations apply to the position of fire-escapes, which again should relate to the position of the employees who may be called upon to use them. Unless the adequacy of fire-escapes is related to the number and position of employees by regulations, the test of adequacy without a guide is apt to be uncertain, and the appearance of safety illusory. No provision is made for necessary alternative means of escape nor for hazardous occupancy, and no consideration is given to the installation of protective devices.

112. The same criticisms apply to the existing Fire Board by-law dealing with escape. It, too, regards external fire-escapes as adequate and, so far as existing buildings are concerned, the by-law is practically inoperative, inasmuch as it provides that, in the case of existing buildings, nothing need be done unless the Superintendent of the Brigade, after inspection, serves a notice on the owner setting out what he is required to do. The number of existing buildings that has been inspected under this by-law has been so small that the problem of ensuring the minimum of fire risk and risk to life in existing buildings in Christchurch has, for some years, been hardly touched. The number of notices sent out as recorded was not more than 36 in the period May, 1945, to December, 1947.

113. Since the introduction of the 1938 Amendment of the Municipal Corporations Act the Christchurch City Council has been in a position to replace the Fire Board's by-law. Despite that they must have been aware of the unsatisfactory position relating to many existing buildings in Christchurch and the danger that lurks in those buildings in the event of fire, they have taken no steps to combat the danger. Their inactivity and failure to take some effective action seems inexplicable, since the machinery to do so existed and the Standards Institute Egress by-law has been available since 1944.

114. In our opinion, the Christchurch by-laws are inadequate, the administration of the by-laws and regulations has been irregular and ill administered. Some excuse for apparent weaknesses in administration has been the ambiguity of the language used in framing certain by-laws, and the difficulty of interpreting them. In our opinion, it should have been compulsory that applications for permits be signed by the owner as well as by the builder. Granting a permit to Ballantynes to line their building with soft wood fibre board and over-riding their own by-law is an example of administrative laxity that cannot be excused.

It is admitted there is no sufficient statutory or municipal regulation covering, to sufficient extent, the construction and design of building in relation to the safety of the public. In particular, there were no regulations framed to regulate construction in relation to floor areas and occupancy as are adopted in other countries.

The only by-laws which deal with the general construction of buildings are By-laws No. 1 made in 1916 and No. 15 made in 1930. These provide for provision of fire resistance and prevention in a general way, but do not cover specific matters now considered necessary in overseas countries in respect of the situation of a building in relation to other buildings; the manner of construction in reference to spread of fire; the occupancy of the building, and the manner in which the building is used; the limiting of fire areas or fire loads.

ORDER OF REFERENCE (6)

The desirability of applying to existing buildings any present or future statutes, regulations, or by-laws providing for adequate means of egress from buildings in case of fire.

115. The Egress Code, as prepared by the New Zealand Standards Institute, makes, in our opinion, proper and efficient provision for egress, and should be made compulsory throughout New Zealand to all buildings except private residential property.

Whether under the Standards Institute statute the Minister has power to make it compulsory or not is not a question for us. If legislation is required to make it compulsory, then, in our opinion, legislation should be passed immediately to make its adoption compulsory.

116. Despite approval of the Egress Code by the Christchurch City Council, it has not been adopted by it, and of the two hundred municipalities in New Zealand we are informed no more than some fifty-two have adopted it. It has been adopted in Auckland, Wellington, and Dunedin, and, in our opinion, its adoption should be made compulsory throughout New Zealand and applied to existing buildings as well as new buildings, with the exception of those specifically exempted in clause 704 of the Code itself.

We were not in a position to take evidence regarding any particular buildings in Christchurch which it was alleged would, in the event of fire, owing to the absence of proper egress, prove perilous to staff or customers on the premises, as the admission of such evidence would have entailed the owners of such premises being represented before the Commission, and it would be invidious to choose a few buildings as examples when it was obvious many other buildings would be in the same category.

117. We have come to our conclusions on this question knowing full well that considerable expense will be thrown on to the owners of existing buildings if the Egress Code is applied to them. We are also aware that so many buildings will require structural alterations and installations of schemes for fire-prevention that delay may be expected from shortage of materials and labour, but these questions have to be faced, and we think the Egress Code so important that all owners of buildings should at once be made subject to it. It may be priority for labour and materials in administration should be given to buildings within inner or brick areas and to other commercial, industrial, institutional, and educational buildings wherever they may be located.

118. We think it advisable that the scope and purpose of the Egress Code should be more generally appreciated. We think it best to quote some extracts from its author's view, as set out in the Preface to the Code. After stating that the Egress Code, as we have already pointed out, applies to new buildings save private dwellinghouses and

buildings used for public meetings, and not to existing buildings except where the engineer of the local body and an officer of the local fire brigade consider the egress provisions for safety are inadequate, it says :—

The requirements of the Code are based upon the fundamental principle that, in general, a building should be so designed that in the event of an emergency the occupants may leave it by one of two or more properly constructed means of egress, remotely separate from each other, free from obstruction, and protected throughout their length by adequately fire resistant materials. Special requirements are included in respect of boardinghouses, hotels, and similar premises, hospitals and shops. The required means of egress for which the Code provides consists of protected passageways, stairways, horizontal exits, ramps, and similar arrangements. The vertical and steep ladders and narrow platforms commonly known as " fire-escapes " are not regarded as satisfactory means of egress. Indeed, such so-called " escapes " are considered by competent opinion to be a source of danger rather than a safety measure. Experience has shown that, under the stress of emergency, people will seek to leave a building by the means by which they entered. The requirements have therefore been so framed that, wherever practicable, the required means of egress will also constitute the normal means of ingress. In the case of fire, the most likely cause of panic, the required means of egress will therefore be the safest portions of the buildings and will provide complete protection for the occupants until they reach the open air or other place of safety.

This part of the Standard Code is not a complete fire protection code, but when read in conjunction with the parts relating to structural stability, already issued, and those dealing with fire-resistant construction and the provision of fire-fighting appliances, yet to be published, it will constitute a comprehensive code of practice, adherence to which will afford to the occupants of a building adequate protection against the dangers of fire and other hazards. While these hazards have, in the past, resulted in some loss of life, New Zealand has fortunately been free from disasters of any great magnitude. Overseas experience, however, emphasizes the need for adequate precautions, and it would be unwise to the point of gross negligence not to heed this experience until major disasters occur in the Dominion. The Code will therefore be welcomed by Government Departments, local authorities, engineers, architects, builders, and the general public, all of whom have repeatedly emphasized the need for proper attention to this aspect of the planning and construction of buildings.

It will be seen, therefore, that the Code in its entirety does not apply to existing buildings, but clause 704 reads as follows :

Every building heretofore erected which is not provided with means of egress as prescribed in this part of this by-law for new buildings, and in which the existing means of egress are, in the opinion of the engineer and an officer of the local fire brigade appointed by the Council for this purpose, inadequate for the safety of the occupants, shall be provided with such means of egress as will comply with this Part of this by-law or, alternatively, as shall be directed in written order by the engineer.

119. It was submitted by the Crown that the clause needed amendment to prevent possible legal controversy as to the powers of the engineer. As the clause stands, it seems that the engineer has power only to require complete compliance with the Code, or direct such means of egress as he thinks fit. Further egress may not best ensure the safety of occupants. It may be action with an old building would be greatly assisted by the installation of, say, a sprinkler system or fireproof doors, as the case may be, and we agree that more flexibility should be given to the engineer and the extent of his powers clarified.

The main controversy that has arisen before us has been as to whether the onus of sufficient compliance with the Code should be thrust upon the owner, and not left to the city engineer. It was said that the city engineer had not sufficient staff to carry out the numerous inspections that would be required, but it seemed to us that, even if the onus were thrown on the owner, and owners made application to the city council to approve steps they proposed taking, the engineer, without sufficient staff, would be unable to make the necessary inspections. It would also place upon him the burden of examining the plans for compliance that would be submitted.

It seemed to us futile to attempt to escape inspections that are needed if buildings are to be safe, and if a body of inspectors has to be set up in each city and priority is given as suggested, a real move towards safety will have been made.

Throwing the onus on the owner is not, in our opinion, a solution that would be effective. The remedy would be sought in most cases after the fire. The remedy then would be damages against the owner. In many cases the owner would not be able to discharge his liability, either in restoration of property lost or lives lost.

120. Fire is best fought by preventing fire. Half-measures are not sufficient, and in the wider case—that is, the case of fire in one building spreading to other buildings—it will be found that the enormous loss cannot be borne by the owner, who from lack of preventive measures has really caused the fire. Prevention is the only remedy, not damages after the event.

In our opinion, if the Code is made compulsory to all buildings, including existing buildings, subject to the qualification that the engineer can qualify strict compliance with the requirements of the Code, owners will be alive to their responsibilities and more readily approach the engineer and ask him to inspect their premises if he has not already done so, than under the present system under which experience shows no active steps at all have been taken.

ORDER OF REFERENCE (7)

The desirability of occupiers of business premises instructing their staffs in the principles of fire-prevention, evacuation drill, and the elementary principles of fire fighting.

121. During the war period thirty men and twenty-four women on the staff of Ballantynes were members of the E.P.S., and as such received instruction in fire-prevention. Of this number but seven men and three women remained on the staff of Ballantynes at the time of the fire.

122. In England, we believe, all E.P.S. men and women were trained in the elementary principles of fire-prevention, including, amongst other matters, the way to pass through smoke, that is to say, keeping close to the ground and walls when moving through it, so as to get clearer atmosphere and avoid the weakest part of a floor in case of fire, that is, the centre where supporting members are most likely to snap.

It is usually safe to travel by both passageways and fire-escapes or other stairways so long as the smoke is not too hot to breathe. It may be unpleasant and frightening to the uninitiated, but it is better to put up with discomfort than to stay trapped.

123. Mr. Blundell, who appeared for the fire underwriters, said that, in their opinion, without presuming to be dogmatic, evacuation drill in any of our big stores would not be effective, and to the extent that it was defective it might create a false sense of security, because members of a staff might move, in case of emergency, to exits they were accustomed to go in their drill, and if those exits were blocked, material for a panic would arise. He said that he thought it preferable that there be an obligation to ensure that every member of the staff knew every exit and means of getting to that exit in the particular building.

We think, in answer to that, that evacuation drill would ensure that members of the staff knew all exits and the means of getting to those exits.

124. In our opinion, despite all preventive measures, including, for example, the sprinkler system, intelligent evacuation practice should be compulsory in all cases where workers are employed. In Ballantynes we were told that the whole building could, with proper organization, be evacuated in three and a half to four minutes.

Mechanical means of warning and mechanical devices such as fire-sprinklers may and do from unpredictable causes—such, for instance, as a break in supply of water or electric power—prove ineffective. So far no absolutely fireproof building has been designed. Disastrous fires have occurred in modern buildings which have been advertised as fireproof.

In our opinion, all members of the staff should be instructed how they should move in the event of fire and, in a large organization, there should be detailed men or women who could take positions and have authority to direct members of the staff to the positions they should take up on warning of fire, and move those who attempted to pass down one exit to another exit in the event of the first exit becoming impassable.

125. Notices should be placed giving advice of the position of exits.

Pamphlets should be printed on fire-prevention and means of escape, and handed to every member of the staff. The pamphlets should give the elementary principles of fire-drill, and should be handed to every new employee on his entering the service. The employee should, at the same time, be taken over at least that part of the building where he is employed and shown the means of exit in case of fire. The actual drill should take place in working-hours, and need not disturb the business or customers if the instructions, when tests of efficiency were made, were that each and all went to their appropriate positions and the manager made a round of inspection.

126. At least once a year the drill should be supervised by an officer of the fire brigade appointed for the purpose. Manuals are available suggesting modes of conducting these drills.

ORDER OF REFERENCE (8)

The effectiveness of the operations conducted and the equipment employed by the Christchurch Fire Brigade to combat the said fire.

We deal with question number (8) under three headings :—

(A) The effectiveness of the fire brigade in attacking the fire ;
(B) The effectiveness of the fire brigade in attempts at rescue ;
(C) The equipment employed to combat the fire.

(A) The Effectiveness of the Fire Brigade in Attacking the Fire

127. Dealing first with subclause (A), we have already under clause (1) of our order of reference stated our conclusion that, in view of conflicting evidence as to the time of the discovery of the fire, and the method of calculating the time of events by reference to the time at which particular employees went to tea, or came out of the tea-room, smoke from the basement was first noticed at approximately 3.35 p.m. Considering the volume of smoke in the basement at that time, it is obvious that smouldering or heating had been in progress for some time prior to 3.35.

128. This appears from the evidence of Mr. Stringer, who immediately entered the basement when smoke was first noticed. Remaining there for but a minute or so, he went straight to the ground floor for a fire-extinguisher. Having obtained it, he again went down the stairs and entered the basement. He found the smoke appreciably more dense, and being unable to see flame, thought the extinguisher could not be used effectively.

129. Stringer in evidence said that, after his first visit, he called to some employees standing in the vicinity of the head of the basement stairway to call the brigade and notify the principals. Considering the estimate of time given by an employee (Mr. Dawson) and other circumstances, we think this instruction, if given at all, was given by Mr. Stringer after his second visit to the basement.

130. Instead of ringing direct to the brigade, an employee made a call on the internal telephone system to a Miss Hamilton, who was in charge of the company's internal exchange, and notified her that there was a fire in the basement and that she was to ring the fire brigade and notify the bosses.

131. The call to the telephone-operator, Miss Hamilton, would not, we think, have been given much earlier than 3.39. She was told to ring the brigade and notify the principals. As the brigade did not recieve a call until 3.46, it seems likely that Miss Hamilton thought it her duty to notify her principals before putting it through. There is evidence that she attempted to communicate with Mr. Ronald Ballantyne, but was unable to find where he was.

As she unfortunately was amongst those who lost their lives, what she actually did is uncertain. It may be that she eventually got a call through to the fire brigade, as a call was received by the brigade, according to fireman Hahn, who was in the watchroom at the fire-station, at 3.47 in a female voice. That may have been hers.

It is perhaps more likely that, in the time spent in trying to get in touch with Mr. Ronald Ballantyne, or some of the other directors, smoke had reached her telephone bureau, and she was unable to put a call through to the brigade. What, however, is certain is that the Occurrence Book at the fire-station shows the first call received, that a fire had broken out in the cellar at Ballantynes, did not reach the brigade until 3.46 p.m. We must take the Occurrence Book time as accurate.

132. The Superintendent of the Christchurch Fire Brigade told us that a call not given to the brigade within two or three minutes of the discovery of a fire was a late call and a heavy initial handicap to the brigade. We are of the opinion that the fire in the cellar had reached disturbing dimensions at approximately 3.48, the time of the brigade's arrival, and a call at 3.46—that is, eleven minutes after the fire was discovered—was lamentably late, so late that the task set the brigade, in the case of a building constructed as Ballantynes, was bound to prove one of great difficulty.

It seems clear only by prompt and vigorous action could the building be saved. It was unfortunate Mr. Stringer's request for a call to the brigade at what we think was approximately 3.38 was not put through directly to the brigade, and it is only fair to say Mr. Dawson could not foresee the breakdown of the internal telephone system.

133. There is no reason to doubt that, after receipt of the call, the brigade moved rapidly. The brigade put down the time of its arrival at 3.47½, and although the time of arrival is an estimate only, as it has no means of clocking the time of arrival, we think it did arrive shortly before 3.48. Independent evidence supports this claim. The first machine to arrive travelled a route covering a distance of 34½ chains, and the second a route covering 36 chains.

134. Unfortunately, both the Superintendent and the Deputy Superintendent were absent from the station when the call came through. The Superintendent and Deputy Superintendent were both on leave—the latter on extended leave. Their absence was not due to lack of duty on the part of those officers, but due to the system under which the officers are entitled to take leave.

135. Under the present system there is a lack of facilities for the training of officers to make them fitted to take control, but we deal with this question of the adequate training of officers, their selection, and promotion under clause (10) of the order of reference.

136. According to Station Standing Orders, the appliances to be turned out to city calls (and Ballantynes was within this area) are the first and second turnout appliances, the electric ladder, and the salvage van; but the senior officer present may cancel the turnout of the electric ladder if he considers it advisable during business hours, or to a call outside the high-building area.

On the day of the fire the Superintendent and Deputy Superintendent being absent, the Third Officer (Mr. Burrows) was the senior officer in charge. The Duty Officer, Station Officer Thomson, on his own initiative, without reference to Third Officer Burrows or the Fourth Officer, and without authority, cancelled the turnout of the electric ladder. The reason he gave for cancelling the turnout of the electric ladder was because the fire was a "cellar job," and he did not think it would be required. Although he appeared to think he had a discretion in the matter, it is clear from the Standing Orders that he had no such discretion, and he exceeded the scope of his authority.

On the day of the fire the officer assigned to take charge of the electric-ladder — namely, Senior Station Officer Shield—was temporarily absent on duty when the call came. He returned to the station at 3.57 p.m. and then immediately left for the fire with the electric ladder. As the electric ladder left for the fire before the brigade call was received at 4 p.m., some weight might be attached to the suggestion that, in the first turnout, the electric ladder was held at the station because of the absence of the officer assigned to that appliance.

137. When the first call came through there were available at the Central Station, in addition to the Duty Officer and watchroom-duty fireman, four officers and seventeen firemen, of whom three officers and eleven firemen with Nos. 1 and 11 appliances and the salvage van left at once for the call. On the return of Senior Station Officer Shield at 3.57 p.m. he and a driver left with the Tilling-Stevens electric ladder.

138. When the brigade call was received at 4 p.m. an officer and five firemen left with the No. 9 appliance, leaving No. 6 appliance and a combination hose-laying van unmanned by duty men. As leave personnel became available the combination unit left for the fire at 4.18 p.m. with two officers and one fireman, and this was followed at 4.39 p.m. by the No. 6 appliance carrying three firemen.

As a consequence of the brigade call the duty officer, in addition to turning out the No. 6 appliance from central station, gave orders for the turnout of the brigades at Sydenham, St. Albans, Sumner, New Brighton, Islington, Belfast, and Woolston—the latter brigade reporting at the central station at 4.5 p.m., where it was retained in the event of an emergency call from another area. Assistance was later received from the Air Force Station at Wigram and the Army at Burnham. A large number of ex-E.F.S. personnel and a number of men of the Navy and Army, as well as members of the general public, rendered assistance to the brigade.

139. The first appliance to arrive at the fire was No. 11 engine with Senior Station Officer Stevenson in charge of a crew of one driver and four firemen. It stopped close to the right-of-way to the south of Congreves.

The second appliance to arrive was No. 1 engine with Third Officer Burrows and a junior officer in charge of a crew consisting of a driver and four firemen. It stopped on the east side of Colombo Street, north of the right-of-way. The salvage van had a driver only, and it pulled up behind No. 1.

Neither of the officers in charge of No. 11 and No. 1 appliances was aware that the electric ladder was not accompanying them.

140. On the way to the fire Officer Burrows, knowing that he was proceeding to a cellar fire, gave orders to a fireman to prepare to don a breathing-apparatus. No such order was given by Officer Stevenson, who arrived first and pulled up at the entrance to the right-of-way.

141. Although much of the evidence was unsatisfactory, and to a great measure contradictory, we think there was a considerable volume of smoke issuing from the right-of-way to the street when the brigade arrived. Nevertheless, while breathing-apparatus was essential to enable the firemen to reach the basement, we believe, considering the whole of the evidence, it was possible for a person to penetrate to the double doors in the right-of-way, a distance of 39 ft. from the street frontage, without the use of such apparatus.

142. On arrival the brigade was met by Mr. Roger Ballantyne and an employee (Mr. Falkingham) and, although brigade officer Stevenson apparently asked no questions, he was told that the fire was in the basement, access to which could be gained from a door on the right-hand side of the right-of-way, this basement entrance being some 25 ft. beyond the double doors. Mr. Falkingham, who went with Mr. Roger Ballantyne to meet the brigade, said he actually led the way to the double doors, being followed by a fireman, whom we think must have been Officer Stevenson.

Officer Stevenson denied that he was told how to enter the basement. He said all he was told was, " It's in the cellar, a cable's fused." He apparently made no request for further information, and said that no one preceded him into the right-of-way. After passing through the double doors, according to Mr. Falkingham, Officer Stevenson returned to the street for a respirator.

We find it difficult to reject the evidence of Mr. Roger Ballantyne and Mr. Falkingham that they were both beyond the double doors when Officer Stevenson made his first journey into the right-of-way. Undoubtedly Mr. Roger Ballantyne, shortly before meeting Officer Stevenson, had walked from the appro office out of the door leading to the right-of-way through which it was hoped the brigade would put a lead into the cellar. Mr. Ballantyne said he told Officer Stevenson, or a fireman, that there was no sign of flame, and that he thought an extinguisher might be sufficient.

143. When No. 1 machine arrived Officer Burrows, like Officer Stevenson, went directly to the right-of-way, where he, too, was met by Mr. Roger Ballantyne and was informed that the fire was in the cellar, had been caused by a cable, and that the door leading to the cellar was on the right-hand side of the right-of-way. Officer Burrows then donned a smoke-mask and followed Officer Stevenson and Branchman Thompson up the right-of-way. According to his own evidence, he went on his hands and knees when 8 ft. to 10 ft. up the right-of-way.

144. From Officer Burrows' own account it seems he did not ask Mr. Roger Ballantyne the position of the doors across the right-of-way, the position of the door leading into the basement, or whether there was an access by internal stairway from the ground floor. According to him, he went a considerable distance up the right-of-way, finding no difference in the volume of smoke. He crawled up the centre of the right-of-way and, although the smoke-mask would have prevented his seeing the door leading to the basement, he expected to be able to see the red glow of the fire. Not finding any such red glow, he returned to the street for the purpose of making further investigations.

145. Officer Stevenson and Branchman Thompson, with a charged hose, were left in the right-of-way. At the time he entered, Officer Stevenson said he did not anticipate any difficulty in finding the entrance to the cellar. When giving evidence he agreed that it would have been wiser to have asked for further information before he started. Officer Stevenson described the smoke as so dense that the electric lamp he carried was of no use. After going some 15 ft. to 20 ft. in, he and the branchman were forced to crawl—the branchman close to the north wall, and he farther out.

His one object, he said, was to locate the fire, and he anticipated no difficulty in doing so as he thought the volume of smoke would readily show where the fire was. From his account it appears he lost contact with the branchman and went up the right-of-way beyond the door leading into the basement. On retracing his steps he discovered the branchman in a doorway, which he sensed to be the door leading to the basement.

He passed the branchman and went a short distance into the building. Finding no ramp or stairway leading to the basement, but only heat and smoke, and being in an exhausted condition, he decided to withdraw with the intention of planning a further movement or getting fresh men to effect an entry. When, however, he moved into the right-of-way he heard a low roar, and on reaching the street he found that there was a break-through of flame. No further effort was made to use the right-of-way.

146. On the brigade's own evidence Officer Stevenson was shown the right-of-way as a means, through a door, of reaching the cellar. Officer Stevenson and Branchman Thompson, with a loaded hose, entered the right-of-way shortly after 3.48. Flames broke through the building at 3.58.

If Branchman Thompson first, and then Officer Stevenson, found the door, it is surprising they did not locate the steps leading to the cellar, as the entrance from the right-of-way leads on to the landing at the top of the basement stairs. It is surprising, as they then felt the heat of the fire, that a lead was not played down the stairs. Did they in fact find the door? Their first statements made to the member of the Fire Board, who took statements from them, did not mention that they found the door and actually went through it. It is difficult to understand how they could have neglected to recall an actual entry through the door when first giving their statements. It is also difficult to understand how they could have been in the position as described, in view of the obvious heat conditions that must have existed in the vicinity of the basement stairs, which must have been in the path of heated products of combustion escaping from the cellar to the upper floors.

147. For the vital period of about ten minutes after their arrival the only action of the brigade (apart from Officer Burrows' visit to the building with Mr. Roger Ballantyne to inspect another means of access to the cellar) was this abortive attempt to enter through the right-of-way. In our opinion, inactivity during these vital ten minutes removed such chance as there was of confining the fire to the cellar, or Congreve's building. The remaining members of the brigade stood by awaiting orders. The propriety of this apparent inaction we discuss later on.

On the evidence there could not have been much difficulty in reaching the double doors. The remaining 25 ft. to the door leading to the cellar undoubtedly would have more difficult.

148. Counsel for the Crown naturally commented somewhat severely on the omission by Officer Stevenson and Fireman Thompson, from their statements to the Fire Board officer shortly after the fire, of the fact as stated by them in evidence of having discovered and actually entered the door from the right-of-way into Congreves. It may be the firemen in question did not realize the importance of the statements they were making, but it does, considering the importance of ascertaining what the brigade did during the first vital ten minutes after its arrival, seem strange that, having described the purpose of their entry into the right-of-way and their progress up it, they could omit to say that they achieved their object by finding the door and actually entering through it.

They knew, or it was their own fault if they did not know, what they were looking for and where to find it. If they found the door and entered it with a loaded hose in their hands, it becomes still more difficult to understand why they did not operate it since they must have been, on their own account, practically at the head of the stairs.

The time they took, assuming as they said in evidence they found the doorway and entered, in reaching the door and failure to take advantage of the position they reached and to use the hose have been the subject of strong criticism by counsel for the Crown, counsel for Ballantynes, and counsel for the accident insurance underwriters.

149. Mr. Hutchison, who represented the Fire Board, said that the only criticism of Officer Stevenson that could fairly be made was that he did not inquire for more information from the man who spoke to him at the entrance to the right-of-way. What he had been told was :—

It's in the cellar, a cables fused.

To the question put to Stevenson :—

Q. Well, do you think that if you had got some further information from this man that would have enabled you to save time on that mission ?

His answer was—

A. Yes, sir. Looking back over the events now, it would have saved time and might have been wiser to have got more instructions from the person standing there. At the same time, he didn't volunteer any more information than what I have spoken of, and I didn't stop. Looking back on it now, I do agree that it might have been wiser to have got more instructions from him.

Later on, to the question :—

Q. Well, wouldn't it have been very much better if you had spent a few seconds just obtaining the information that would have helped you, which you say the man didn't volunteer ?

He answered—

A. Yes, sir. At the time I didn't anticipate any difficulty, but I do agree with that now.

Commenting on these questions, Mr. Hutchison said :—

Stevenson was the officer in charge of the first motor, and it was his job to find the fire as quickly as possible. We can now see, as Stevenson says, that if he had had more information it might have enabled him to have found the cellar-entrance. This is a case where one can be wise after the event, but to the officer in charge of the first motor, arriving at this alleyway (right-of-way) and receiving this information, it was, I submit, quite reasonable that he should go in expecting that he would find the cellar-entrance.

It is suggested that, when he was at the entrance to the door into Congreves, he might in some way have directed the use of the lead that the branchman had. There was no fire visible ; there was considerable heat and considerable smoke ; and the whole place appeared to be filled with this heat and this smoke, with no apparent place from which it was coming. There was no fire on which water could be directed. It was suggested to him that he might have used it to cool down the first floor, but that was not Stevenson's function. His function was to locate the fire, and after he located the fire to direct his hose on it.

In our opinion it is amazing that, if more information was wanted from Mr. Roger Ballantyne or Mr. Falkingham, it was not asked for. Officer Burrows was there as well as Officer Stevenson and Branchman Thompson. He knew the importance of getting water to the cellar as quickly as possible. Mr. Roger Ballantyne and Mr. Falkingham were there to give the brigade information, and no one has suggested they were not ready to answer any questions that might be put to them.

Officer Burrows, who was in charge of the operations, on his own account said hardly a word to Mr. Ballantyne. He made no inquiries as to whether the building had been evacuated and, after rejecting the entrance from the goods-lift as a possible means of reaching the cellar, sought no information at all as to other means of reaching the cellar. He did not even notice the alleyway between Pratts and Goodmans down which the fire-escape ran, which his own Superintendent said he should have done.

In our opinion, if it was, as Officer Stevenson admits, lack of information about the whereabouts of the door in the right-of-way and the staircase leading from the door to the cellar, and the seat of the fire, that delayed or even prevented the success of the attempt to reach the cellar from the door in the right-of-way, the blame must fall on the fire brigade.

150. In our opinion, the loss of the ten minutes spent in that right-or-way, and Officer Burrows' absence unaccompanied by a fireman to whom he could have given orders, led to almost total inactivity on the part of the whole brigade till flame burst out at approximately 3.58. The loss of ten or eleven minutes in the attempt to use the entrance through the right-of-way rendered such steps as could have been taken to confine the fire to the cellar impossible.

151. On returning from the right-of-way, where he had been for approximately two minutes, Officer Burrows inquired from Mr. Roger Ballantyne if there was an alternative entrance to the basement. Mr. Roger Ballantyne then took him to the goods-lift well, from where there was an entrance to Goodman's cellar.

According to Mr. Roger Ballantyne, he intended taking him into Goodmans through the Colombo Street entrance, which, of course, was the most sensible route. When opposite this entrance he veered towards the doorway, but, coming up against a number of people in the entrance, and noticing through the display window that the building was filled with smoke, he decided to proceed to the corner of Colombo and Cashel Street, enter that way, and then proceed to the goods-lift to the south of the shoe department and a short distance from the western end of the right-of-way, from where the smoke was issuing and Officer Stevenson and a fireman were endeavouring to locate the fire.

From this lift-well it was possible to pass through Goodman's basement, and from there entrance could be gained to Congreve's basement. Mr. Roger Ballantyne stated there was some smoke in this lift-well, but Officer Burrows said he did not see any smoke, and concluded that if the lift-well had any connection with the seat of the fire it must be very distant and, furthermore, he could see no possibility of operating a delivery down that way, so that to investigate further would in his opinion be a waste of time.

152. The difficult part to understand is that Officer Burrows, apparently without any inquiry from Mr. Roger Ballantyne as to why he was brought to the goods-lift, retraced his steps through the shop to Colombo Street.

We have given the reason Mr. Roger Ballantyne gave as to why he took the course he did. Counsel for the fire brigade laid great stress on the waste of time incurred in taking this route. No doubt valuable minutes were wasted and, more important still, Officer Burrows did not have an opportunity of estimating the value of attacking the fire through Goodman's cellar by way of the stairway from Goodman's first floor. At the time, however, Burrows made no complaint, and, after rejecting the lift-well approach, made no inquiry as to whether there were other means of access.

153. Leaving the lift-well, intending to return to the right-of-way, on his way through the shop to the entrance on the corner of Cashel and Colombo Streets he neither saw nor smelt smoke, but on arrival outside Congreves noticed that the smoke had greatly increased in volume, but even at that stage he did not envisage a major outbreak.

154. Noticing smoke coming in some volume from a window on the first floor of Congreves, he gave an order for a substantial lead of water to be directed through that window. Up to that time no lead of hose, other than that entering the right-of-way, had in any way been prepared for use. The purpose of directing a lead of water through this first floor window was, according to Officer Burrows, to provide a cooling down lead, but it is difficult to understand a cooling lead being played into the first floor in preference to the ground floor.

After giving this order Officer Burrows entered the right-of-way and encountered Officer Stevenson and his branchman withdrawing, and on reaching the street discovered the fire had broken through.

155. In answer to questions by counsel for the Crown, Officer Burrows agreed that he should have made an inspection of the ground floor immediately above Congreve's basement with a view to hacking a hole in the floor, if necessary, and attacking the fire in that manner. He said that this would have been his next move after investigating the position in the right-of-way.

156. On observing flame in Goodman's and Pratt's buildings Burrows appears to have realized, for the first time, that he was confronted with a major fire, and, in fact, up to this time had not envisaged the possibility of the fire becoming other than a cellar outbreak.

157. On being faced with a fire of the first magnitude Officer Burrows ordered the firemen to operate as many leads as possible, including the coverage of Cashel Street frontage, and instructed that a brigade call be sent to the station and, from the Occurrence Book at the fire-station, we know that this brigade call was received at 4 p.m. From shortly after that time brigades and appliances arrived until ultimately the whole of the central and suburban strength, with the exception of one suburban unit kept at headquarters for emergency purposes, was available to fight the fire.

158. The Deputy Superintendent (Mr. Barnes) reported back to the fire-station at 4.15 p.m. and arrived at the fire at approximately 4.20 p.m., and, although not reporting his arrival to Officer Burrows, he assumed control on the Cashel Street frontage.

159. The Superintendent (Mr. Morrison) arrived at the fire at approximately 4.40 p.m. and assumed control.

160. Considering the magnitude of the fire within a short time after the first appearance of flame, it was generally conceded that the brigade are entitled to credit for confining the conflagration to the Ballantyne blocks, and from then on we pay tribute to the brigadesmen, civilians, and servicemen who fought the fire.

161. Junior Station Officer Oakman, who arrived at the fire on the machine under the control of Third Officer Burrows, has been criticized for lack of initiative and not making an inspection of Goodman's building while Officer Burrows was at the rear of the premises.

Officer Burrows, in evidence, stated that he considered there was an onus on Officer Oakman to carry out an investigation of the area adjacent to the seat of the fire while he (Burrows) was in another portion of the building. It must be remembered that Officer Oakman was a junior station officer who arrived on a machine with his senior officer who, immediately upon arriving at the fire, went to investigate. He would also know that another officer, senior to himself, had already arrived at the fire, and he could therefore reasonably, and we think rightly, assume that he should await instructions from his seniors, and indeed this is what he appears to have done.

In evidence he said that he had no knowledge whatever of what he was expected to do while the senior officers were insp cting, and had never received instructions for that contingency. Nevertheless, he considered himself in charge of operations in the street when Officers Burrows and Stevenson were inspecting on other fronts.

When Officer Burrows first left his machine to go to the right-of-way he did not issue any instructions to other waiting members of the brigade. When Officer Oakman followed him to the right-of-way, to see if he had any instructions for him, he was left without orders. The first order Officer Oakman received was from Officer Burrows to put a lead in the first floor of Congreves.

162. It seems to us that chaotic conditions would soon arise if every officer dispersed his crew and conducted operations as he saw fit, without instructions from the superior officers, so we cannot agree he acted unwisely during the period his superior officer was absent on inspection, so far as his non-attack on the fire was concerned, but some criticism of his actions is made under the second heading of this reference. As a junior officer he was entitled to expect instructions from his senior officer.

163. We have so far confined our remarks and criticism to officers of the brigade, but it is necessary to discuss the actions of one fireman who, at a fairly early stage in the operations of the brigade, was taken into Goodman's ground floor and shown an alternative entrance to Congreve's basement.

Evidence that he took a fireman to a point where the stairway to Goodman's basement could be seen was given by Mr. Falkingham. There was a conflict of evidence as to whether a fireman was, in fact, taken to a point near the stairway to Goodman's basement, but the evidence was corroborated by witnesses and must, we think, be accepted. All firemen, except Fireman Dobson, denied that they had ever entered Goodman's building with or without Mr. Falkingham.

164. Fireman Dobson stated that, while standing at his machine in Colombo Street, he was approached by a man who said something to the effect that there was smoke, and might be fire, in the furnishing department, and that he (Dobson) with another fireman (Stockwell) crossed to the Colombo Street entrance to Goodman's ground floor. Fireman Dobson, wearing a Salvus breathing-apparatus, said he went about one pace into Goodman's, and then returned as the smoke was very thick and visibility was nil.

165. Fireman Stockwell confirmed Fireman Dobson's evidence regarding being approached by some one, but said that something was said about being shown an alternative entrance. He did not know how far Fireman Dobson went into the building, but he said no person showed the way.

166. It matters little who the fireman was, but it is clear that he should have either investigated the entrance to Goodman's basement and alternative entrance to Congreve's, or immediately reported the matter to a brigade officer, and this failure to do so is inexcusable.

167. While we have found it proper to criticize certain aspects of the activity or non-activity of officers of the brigade, we do so bearing in mind the standard of service that might reasonably be expected of a city brigade such as Christchurch. The fact that the call was to a cellar appeared to register on the brigade officers that it was something to be taken lightly, and there was a complete failure on their part, after arrival at the fire, to appreciate the potential danger, and an equal failure to take prompt and adequate steps to prevent that potential danger materializing.

168. This was the first occasion on which Officer Burrows took command of operations at a major fire, and he failed to take up the position of a leader and to work to any co-ordinated plan.

169. It was established during the hearing that the first duty of fire brigade officers on arrival at a fire is to locate the fire, and immediately thereafter take steps to cover and surround. It is true that, on arrival, the brigade took steps to locate the fire—ineffective though they were—but nothing was done to cover and surround.

The covering and surrounding involves the making of inspections of areas immedaitely adjacent to the site of the fire. In the case of this fire the adjacent areas would have been at least Congreve's ground and first floors and Goodman's basement and ground floor.

Knowing that Officer Stevenson had gone up the right-of-way with a branchman and a lead of hose, Officer Burrows should have taken covering and surrounding action. If he thought Officer Stevenson required assistance, he had Officer Oakman and a number of firemen awaiting orders. Had Officer Burrows made the inspections we think he ought to have made, he would have discovered that there was an alternative entrance to Congreve's cellar through which combustible gases and smoke were pouring; that there was an archway that gave direct access into Congreve's building; and that, having gone through that archway, he was then at the head of the stairs leading to Congreve's cellar; and, if he had been unable to use that stairway leading to the basement, he could have done what Superintendent Morrison said was the common-sense thing to do—namely, hack a hole in the floor and attack the fire by that means.

170. We believe Mr. Roger Ballantyne lacked judgment in taking Officer Burrows on a long route to the rear of the cellar, but as officer in charge Burrows could have been expected to inquire why they were going past what he should have observed as an entrance to the building next to the seat of the fire. This large entrance leading to a ground floor of an adjacent building should have been seen by him, and likewise, had he used ordinary powers of observation, he should have seen the alleyway between Goodmans and Pratts.

If the alleyway had been examined, the fire-escape leading to higher levels, and what has been referred to as Luney's hole giving access from the alleyway to Goodman's basement, would have been seen and the opportunities they afforded appreciated. The failure to make an examination or investigation of the surrounding buildings resulted in a failure to appreciate the danger spots and plan accordingly.

171. There was considerable evidence that smoke was seen to be increasing on the first floor of Congreves, but no brigade officer inspected this floor. Had Officer Burrows instructed one of his officers to investigate this floor he would have discovered the potential danger that existed, and would have realized the whole building was in jeopardy.

We have the evidence of Officer Burrows that he intended to carry out these inspections after returning from the right-of-way for the second time, but was prevented from doing so by the break-through of flames. This was after a lapse of ten minutes from his arrival at the fire, and, while conceding the fact that the brigade was acting under a severe handicap through a very late call, we believe the failure to take effective action to cover and surround the fire was an important omission which contributed largely to the ultimate disaster.

172. We have been asked not to judge by after events. It is true it is easy to be wise after the event, but the evidence of the Superintendent of the Christchurch Fire Brigade, who was naturally anxious to protect his officers and men, is in itself some justification for, at any rate, conclusions adverse to the brigade. We set out some questions put to him in cross examination, and his answers :

Q. Knowing, as they must have known, that there was a great volume of smoke building up on the first floor of Congreve's building—that being plainly visible to everybody—are you satisfied with no officer at any stage investigating the position on the first floor of Congreve's building ?

A. No.

Q. Somebody should have, should they not ?

A. Yes, that is so.

Q. Are you satisfied that no officer entered the ground floor of Goodman's building to investigate the possibility of attacking the fire from that approach ?

A. I am not satisfied.

Q. Had the investigation of the first floor that I referred to been carried out, the dangerous condition up there would have been discovered, would it not ?

A. I was not there, but from the evidence I think that that was a reasonable way of finding out the position . . .

Q. I will come back to the ground floor now. You agree that some one should have gone in through the doorway of Goodman's building and investigated the position on the ground floor ?

A. Yes, and there was a reason why that was not done. (The reason being that Burrows was led on by Roger Ballantyne.)

Q. Has that been done by some officer, they must have discovered the entrance to Congreve's cellar through the archway ?

A. Yes . . .

Q. That is to say, if any officer had gone in that way and got into Goodman's ground floor or Congreve's ground floor, the chances are he would have hacked a hole in the floor and attacked the fire through that hole ?

The Chairman : I may be wrong, but I think the evidence is that some of the staff were in there. Is that not so ?

Mr. Watson : I was reserving that for comment at a later stage.

Q. At any rate, you will say that, had an officer gone in there and got on to the ground floor, the probability is that he would have hacked a hole in the floor and attacked the fire through that hole ?

A. Yes, that probably would have been done.

Q. And that probably would have saved the calamity of Ballantyne's fire ?

A. No, I don't think so.

Q. That is what you would have done if you had been there yourself ?

A. I certainly would have gone in through Goodman's building.

Q. And if you could not have gone down into the cellar, you would have hacked a hole in the floor ?

A. Certainly.

Q. That is what you would have done yourself ?

A. Yes.

Q. And that is the ordinary practice for attacking such a cellar fire ?

A. That is so.

Q. Coming back to the point that the Chairman mentioned, and which I was reserving for comment later, I put it to you this way : If the evidence shows that laymen without respirators were present on that ground floor at the very time I am suggesting you could have got down the stairway into either cellar—Goodman's or Congreve's—you will agree that officers and men of the fire brigade could and should have gone down those stairways ?

A. Yes, definitely.

Q. And been able to have attacked the fire in the basement itself ?

A. I am not quite certain on that point.

Q. Would you have gone down those stairways and attacked the fire in that way had you been in charge ?

A. I would have gone down. If there was evidence that laymen were there, I would have gone down there and seen if there was reasonable chance of attacking the fire.

Q. Coming back to your statement that you are satisfied with the conduct of the three officers, and again asking you not to particularize, should not some officer during those twelve minutes, and preferably at the beginning of the twelve minutes, have made sufficient investigation to disclose the existence of that fire-escape ?

A. Yes, I really cannot understand how that was missed.

Q. You cannot understand how that was not discovered ?

A. No.

Q. But had it been discovered, and knowing as we do know that two women were able to come down the upper portion of that escape, would it not have been perfectly possible for trained fire-brigadesmen to have rescued every girl on that top floor ?

A. A trained fireman would have definitely got up into that millinery workroom under those conditions.

Q. And brought the girls down ?

A. Yes.

Q. At any rate you have gone that far with me—it is very difficult to say why no officer did discover that fire-escape ?

A. Yes.

Q. When Mr. Burrows was led on that stupid errand to the back of the building, should he not have used his own power of observation going and coming in order to see the entrance to Goodman's building and the entrance to the fire-escape ?

A. I agree he should have.

Q. Any ordinary observant fireman, or fire officer, would have seen the entrance to Goodman's building and the entrance to the fire-escape alleyway ?

A. They would have seen the entrance to Goodman's building anyway.

Q. You would have expected him to say, "Can't I get in that way ?" when he went past Goodman's door ?

A. That is the way I would view it.

Q. And you would have expected him to see the entrance to the fire-escape, coming or going ?

A. He must have seen the entrance between the two buildings, but whether he saw the fire-escape I do not know.

Q. Having seen the entrance between the two buildings, even if he did not see the actual fire-escape, wouldn't you have expected him to investigate what was in the entrance ?

A. Yes, and I would expect Mr. Ballantyne to take him down that opening to give ready access.

Q. Had he investigated this opening between the buildings, he would have found not only the fire-escape but the Luney hole ?

A. Yes.

Q. And that would have given him another access to the fire ?

A. That was the best access.

Q. Can you excuse his failure to use his own powers of observation to the extent where he would have seen first the entrance to Goodman's building and secondly the entrance to the fire-escape alleyway ?

A. I have no explanation for that.

In regard to Officer Burrows not going down the lift-shaft at the back of Pratt's building, Mr. Morrison was asked :—

Q. You cannot yourself see any justification for not going down there ?

A. No . . .

Q. What effective action was taken by way of covering or surrounding the fire ?

A. There was no effective action . . .

Q. You have told me they could have found the fire-escape and girls could be brought down the fire-escape ?

A. Yes, that surprised me.

Q. Do you consider—I think you do from an answer given to Mr. Thomas—that, had the electric ladder been despatched at the original call, the girls from Goodman's building could have been rescued with it ?

A. I concede that . . .

Q. Do you think that every possible use was made of the Ajax ladders in connection with the rescue in Pratt's building ?

A. I was not present.

Q. You have heard the evidence ?

A. Yes, and I have not been satisfied in my own mind whether those extension ladders had been fully extended at the time of the attempted rescue.

Q. Are you referring to Goodman's ?

A. No, Pratt's.

Q. Do you think that, had those ladders been fully extended to their maximum length, they could have been effectively used to get at least some girls out of Pratt's windows ?

A. According to measurements and calculations they should have.

Q. If they had reached those windows, at least some of the girls could have been brought down ?

A. Yes, but the time factor must be taken into consideration.

Q. If the 30 ft. Ajax ladders had been fully extended, firemen could have gone in through the windows to see who else was there ?

A. Yes, if conditions would allow it.

Q. There is at least a probability that other girls might have been rescued, had these ladders been fully extended and used against the windows in Pratt's ?

A. Probably (they would have been rescued).

(We think Goodman's building and not Pratt's was being referred to.)

(B) The Effectiveness of the Fire Brigade in Attempts at Rescue

173. We commence this question with the knowledge that forty persons lost their lives not earlier than thirty minutes after the fire was first discovered, and not earlier than seventeen minutes after the arrival of the fire brigade, and in favourable weather conditions.

Under clause 2 of the order of reference we found it necessary to criticize the management of Ballantynes for the lack of organized evacuation, and now we make comment on certain aspects of the operations of the fire brigade in attempts to effect rescues when first Ballantynes and then the brigade failed to organize a complete evacuation.

174. Mr. Girling-Butcher, Inspector of Fire Brigades, set out the brigade's responsibility to ensure the safety of human life as follows :—

> It is the first responsibility of the officer in charge to see that every person is clear of the building. If this cannot be established by inquiry, he must immediately institute as complete a search of the building as possible, having regard to the state of the fire. The search is carried out at the same time as the fire-fighting arrangements are being organized, but takes precedence over the latter.

175. The first question must be : At what time did any officer or fireman of the brigade or the officer in charge (Mr. Burrows) become aware that occupants of the building in, first, Goodman's and then Pratt's were trapped and in danger, because that enables us to determine whether, in the time left, effective steps could have been taken to rescue them if these steps had been taken promptly.

176. Counsel for the Crown laid great stress on the fact that no officers of the brigade at any time made any examination or investigation of the surrounding buildings for those purposes, with the result that the implications necessarily arising in connection with the accumulation of smoke in Congreve's building, and the inflammability of the temporary soft fibre board partition between Congreve's and Goodman's first floors would break into flame and immediately place all in the building in serious danger. He said that the failure to make inspection, and the failure to take effective action in the way of covering and surrounding, was the cardinal and most important omission on the part of the brigade, and contributed to a great extent to the ultimate disaster.

After making this general comment he went on to say that, on the evidence, the brigade showed a lack of initiative and enterprise in the conduct of the rescue operations.

177. In the opinion of counsel for the Crown the most serious feature of these operations was the absence of the Tilling-Stevens electric ladder which had not been sent when the first unit left the fire-station. Unquestionably this omission, caused as it was by the indiscretion of an officer who had not the power to make the decision, reflects on the discipline and conduct of the brigade. That it would have enabled the girls who

lost their lives to be rescued cannot be stated with certainty, but the Superintendent of the brigade himself said that had the Tilling-Stevens ladder been promptly despatched and properly used, notwithstanding its cumbersome nature and unwieldy and clumsy operation, there was at least the possibility that by it two of the girls in the millinery room could have been saved.

Even when it did arrive and drove past the windows where those girls were in peril, and the attention of the driver was drawn by one of the firemen to the peril of those girls, because the officer in charge of the ladder gave no instructions to stop, the driver drove on without drawing this officer's attention to the need to stop. Although the driver failed in his duty, we accept the officer's explanation that he did not hear any message to the driver, and was unaware of the need to rescue any one in Goodman's building.

Mr. Thomas, counsel for the accident underwriters, has severely criticized this action, and coming on top of the delay in sending the ladder it indicates lack of central control and co-ordinated action.

178. Though several witnesses not in the brigade have given evidence of drawing firemen's attention to the girls at the upper windows, the exact time at which they were noticed is difficult to ascertain. It seems the difficulty is accentuated by the fact that when first seen, and this must have been well before the actual outbreak of flame, the girls gave no indication of being in peril but adopted an attitude which indicated they were not in danger, and this can be readily understood because they could not at that period, which must have been at the time of or immediately after the arrival of the brigade, see that they could be cut off by an ascending volume of smoke.

179. The number of brigadesmen present was three officers and eleven firemen. Of these fourteen, Officer Stevenson and Firemen Thompson and Shaw were in the right-of-way. There must have been some one at the lead in the street, and another with the life-line of Fireman Thompson. Officer Burrows, after being at the right-of-way, walked along under the veranda with Mr. Roger Ballantyne into the building, so that leaves an officer (Oakman) and seven brigadesmen awaiting orders in the middle of the street.

We find it hard to believe that, having the same opportunity of seeing the upper windows in Goodman's and Pratts, they did not see the girls as soon as members of the public saw them.

180. Mr. Falkingham said he noticed the girls at the second or third floors of Goodmans and drew the firemen's attention to them. Mr. Roger Ballantyne, after returning from the goods-lift with Officer Burrows, said he noticed the girls in the millinery room on the third floor of Goodman's, asked a fireman for the chief, and was told he was not there. He said he then told a fireman about the girls. There was then no flame, and he saw no reason why the girls could not have been rescued if the necessary equipment was available.

181. Sergeant Walsh, of the Police Force, said he first saw girls at the windows of Goodman's third floor shortly after the arrival of the fire brigade. At a later stage a bystander drew his attention to the girls in the building, and he told a fireman there were some girls on the upper floor.

182. We think it unnecessary to detail further evidence, but perhaps it is well to refer to the evidence of a Mr. Kelly, who is the manager of Messrs. Whitcombe and Tombs, Ltd. He said he heard the fire-engine and then went into a position directly opposite Goodmans. He noticed the girls at the top of Goodmans a few seconds after arrival. The girls were within the view of firemen at the engine at Beaths. He saw water played into Congreves in seven to ten minutes after he first saw the girls. When the water was played in, the girls were still at the window. He saw girls in Goodmans raise the window and call for help on three occasions.

Other witnesses heard the girls scream and put handkerchiefs over their faces.

183. Of the firemen, Campbell and Breitmeyer saw the girls when they first arrived. Barson, another fireman, said he saw them just before the brigade call. Officer Burrows apparently did not see them until the break-through, nor was his attention directed to them.

184. Taking the evidence as a whole we cannot help thinking that, had there been some one in charge who understood that he was the person to command, direct, and keep in touch with the members of his brigade by runner or otherwise when he was perhaps on a tour of inspection, the possibility of the position the girls were in becoming dangerous would have been the subject of conference and action.

Owing to the way this fire was fought we have the absurd position of the officer in charge remaining ignorant of the fact that part of the staff was on the premises, while some brigadesmen in the road were aware that the staff was not evacuated from the top stories.

The officer (Oakman) who was the only officer left in the street, took no steps and made no preparations to prepare a rescue squad. He said he did not know of the girls' plight. He immobilized himself by taking charge of a branch of hose, thereby depriving himself of the opportunity of initiating rescue efforts or directing the men under him at the very time when there was an urgent demand to effect rescues.

185. Mr. Morrison, when asked if he could see any reason why Officer Oakman and other firemen who were standing with their engine for some seven to ten minutes did not notice the girls at the top screaming and calling out, his answer was, "I can't."

Then to the question, "It is almost incredible that they didn't, isn't it?" answered, "It is."

Closely allied with this blindness and seeming ignorance of the value of time at the beginning of the fire, which is unquestionably one of the disturbing features of the operation, is the blindness that enabled the brigade to say that no one noticed the fire-escape in the alleyway between Goodman's and Pratt's buildings. The Superintendent said Officer Burrows should have noticed it when going with Mr. Roger Ballantyne to be shown an alternative way to the cellar. If he had noticed it, he should have inquired what parts of the building it served, because at that time it cannot have been filled with smoke.

186. Of the men working to pierce a hole between Goodman's and Pratt's cellars, one went up the stairway to the first floor of Goodman's and came out that way. The other came out in the hole pierced into the alleyway without being inconvenienced by smoke.

187. If Officer Burrows failed to notice the alleyway containing the fire-escape because he was intent on following Mr. Roger Ballantyne, no like reason prevented firemen in the street who had seen the girls from seeing the alleyway and the fire-escape, and ascertaining whether the girls could come down that way from the windows where they had been seen or whether, if smoke obscured the top of the fire-escape, firemen with masks could have gone up and rescued them.

Referring to the fire brigade, Superintendent Morrison was asked:—

Q. Do you think that Oakman might have displayed a little more initiative than he did?
A. I do.
Q. It has been suggested that some one or more of the brigade personnel might have attempted a rescue of the girls in Goodman's building by utilizing the fire-escape, you heard that suggested?
A. Yes.
Q. But if these girls, knowing of the existence of the fire-escape, were unable to use it, would you assume that equal difficulties would be presented to the officers and men of the fire brigade?
A. No.
Q. They could have got up when the girls could not have got down?
A. That is so.

188. Taking the evidence as a whole, the only conclusion that can be adduced is that, whether or not the girls could have been saved, no such organized attempt was made as one would expect from a competent brigade under competent leadership.

189. Mr. Thomas submitted eight propositions :—

1. Girls were at windows in top floors of Goodman's and Pratt's when the brigade first arrived and stayed there until after the break-through.
2. These girls were in full view of those standing in Colombo Street outside Beaths.
3. Their cries were audible to those standing in the street.
4. The attention of firemen was drawn to the presence of the girls.
5. No immediate action was taken to effect a rescue.
6. When attempt to rescue was made, the ladder was found to be too short.
7. If proper appliances had been available and used in the early stages, the members of the staff in both buildings should have been saved.
8. It was admitted that no investigation or use was made of the fire-escape, and if an investigation had been made, and as a result the fire-escape had been discovered, the whole forty-one persons could have been saved.

The first six of these propositions can be agreed to. The seventh,—

If proper appliances had been available and used in the early stages, the members of the staff in both buildings should have been saved,

can be agreed to if the word " should " is struck out ; and the words : " some, if not all, would possibly " are put in its place. The eighth proposition can be agreed to if the same process is adopted, and for the word " could " the words " would possibly " are substituted.

190. Giving evidence, Mr. Williamson, a printer, said he drew a fireman's attention to the girls in Goodmans, and the fireman answered that his idea was to put the fire out below and the girls upstairs would be quite all right.

191. Mr. Holmes, a crane-driver and a man who had previous fire-drill experience in a Wellington volunteer fire brigade and also in the Air Force, described the rescue attempts as a " bad show." He said that when he drew a fireman's attention to the girls in peril the answer was, " Leave it to us : we have got it under control ; we will do the job."

192. If any attention is paid to a suggestion that members of the brigade could not see the top floors by reason of smoke the answer is that, whatever may have been the impression of Officer Burrows in the building about the seriousness of the fire, the volume of smoke pouring out from the building for some time prior to flame breaking through could hardly have failed to warn any experienced fireman that the girls, whom they knew were in the top story of Goodman's building, might soon be in a position of grave peril and should be got away at once.

193. When efforts were made to place ladders, first to the girls in the millinery room at the top of Goodmans, and subsequently to the credit and accountancy rooms windows in Pratt's building, the initiative seems to have come from one or two firemen. Civilian help was readily offered.

The first ladder erected to Goodman's building was a 30 ft. Ajax, the longest ladder that had come with the first appliances. It is admitted the shape of the veranda prevented getting a good footing, except on the outside guttering. That footing did not enable the ladder to reach the window. The Superintendent expressed the opinion that it should have reached the window in Goodman's, and he went on to say he thought the ladder could not have been fully extended. From measurements we have made the ladder could have reached only to the projecting sill, making it necessary to clamber over the ledge before using the ladder, a matter of some difficulty.

One fireman went up the ladder and found it was 4 ft to 5 ft. short of the window. When he was at the top flame burst out below him and he had to retreat. Another fireman made an attempt to go up, but he, too, was forced back. No further attempt at rescue could be made from Goodman's building.

194. At about that time two of those trapped in Pratt's building jumped from the second window from the alleyway on the Colombo Street frontage of Pratt's on to the veranda. Both were injured and taken to hospital. About a minute later an employee (Mrs. Cody) jumped from a second-story window in Pratt's building facing Cashel Street, and was so injured that she later died in hospital. Some five minutes later Mr. Kenneth Ballantyne was seen sitting on a ledge of the centre Colombo Street window of the second story of Pratt's building.

195. The attempted rescue of the two girls who jumped from the second-floor windows of Pratt's building in Colombo Street was due to the initiative of two civilians (Messrs. Molineaux and Williamson), the leading part being taken by the former.

His evidence was to the effect that he was appalled to see two girls, at a time when flames were appearing in many parts of the buildings, on the window-ledge in Pratt's building, and it seems to him these girls would perish. He said he crossed the street and ascended by a carpenters' ladder to the veranda and appealed to the girls to jump, which they did.

Both Molineaux and Williamson said no member of the fire brigade was on the veranda when the girls jumped, but three members of the brigade gave evidence that they were present. The weight of independent evidence supported the accounts given by Molineaux and Williamson, but the spectacular nature of the rescues, we think, might well have distracted the attention of the independent witnesses so that it is likely that, ultimately, there were both firemen and civilians on the veranda. Nevertheless, we feel that the major part in the rescue, as far as operations on the veranda were concerned, was carried out by these two civilians. Firemen may have assisted to drop the girls from the veranda into the jumping-sheet held on the street.

From evidence given it appears clear that the unusual gable roof construction of the veranda precluded the possibility of a jumping-sheet being used on the veranda.

196. It is to be remembered that, immediately prior to this rescue, firemen had been engaged in an abortive attempt at rescue from Goodmans and in view of this and the break-through of the fire, unexpected as it was by brigadesmen, there would be a certain amount of disorganization and dispersal of brigadesmen.

197. The rescue of Mr. Kenneth Ballantyne from a second-floor window in the Colombo Street frontage of Pratt's building took place not earlier than 4.10, and probably not earlier than six minutes after the girls jumped, and has been described as a miracle. The witness (Mr. Molineaux) said it seemed incredible, at that stage of the fire, that a person could be up there and still alive.

Although a Mr. Agass, a civilian, deposed to having taken some part in the rescue of Mr. Ballantyne, we think his must have been a very minor part. This rescue was effected under most difficult and hazardous conditions. In this rescue an Ajax ladder was used to reach the veranda, and a builders' ladder was used for the actual rescue. The rescue was carried out at great personal risk while firemen directed leads of water to make the rescue possible in the face of considerable smoke, heat, and flame, and we think no criticism can be levelled at the brigade in this instance.

198. The only other person who left the upper floor of the building after the break-through of the fire was a Mrs. Cody, who jumped from a second-story window of Pratt's building in Cashel Street, and was so injured in her fall that she died later in hospital. No person actually saw her make the jump, but a fireman who was operating a hose from the top of the Tilling-Stevens ladder on the corner of Cashel and Colombo Streets heard a whirr and a moan, and noticed the body of a person lying in the roadway.

199. We have no reason to doubt either the ability or the courage of the members of the fire brigade. We have no doubt they would have been willing to take all the risks firemen know are dependent upon fire-fighting, and if they had had leadership which

pointed out to them their various tasks would have acquitted themselves well. Without leadership all the weaknesses that characterize lack of organization in fire-fighting, as in other difficult attacks of a different kind, were likely to be present.

In our opinion, the absence of sufficient well-trained officers resulted in a lack of organization and absence of plan and direction which are so essentially needed to successfully fight a difficult fire, involving as it did unexpected need to effect rescues.

(C) The Equipment Employed to Combat the Fire

200. With the exception of ladder equipment, which proved inadequate only so far as rescue operations were concerned, we consider the equipment employed by the Christchurch Fire Brigade to combat the fire was adequate in quantity and quality.

201. The Tilling-Stevens electric ladder used at the fire, and the only ladder of its type possessed by the Christchurch brigade, is obsolete and well below the standard of efficiency of modern units, and should be replaced as soon as possible. This ladder is operated manually, and requires at least four men to handle it, whereas the modern ladder such as that possessed by the Dunedin brigade is mechanical, requires only one person to operate it, and is capable of being extended in less than half the time taken to manœuvre the Christchurch ladder.

Whereas doubt exists as to whether the Tilling-Stevens ladder could have been effectively used for rescue purposes at this fire, we do think there can be little doubt that, had a modern ladder such as that possessed by the Dunedin brigade been available and turned out with the first appliances, it could have been used to rescue girls in peril in Goodman's building, if not in Pratt's.

Until the time of this fire, the Superintendent had not made representations to the Fire Board for replacement of the Tilling-Stevens ladder, but realizes the necessity for replacement.

202. We think the brigade should also have been supplied with a wheeled escape-ladder of the type which is standard equipment in Great Britain and forms part of the equipment of a number of the larger secondary and major city brigades. Such ladders have proved of great value in rescue operations.

203. The first two appliances to arrive at the fire carried 30 ft. Ajax ladders, and the 35 ft. Ajax ladders did not arrive until after the brigade call. Although the 30 ft. Ajax used in an attempt to make a rescue from Goodmans was said to be 4 ft. to 5 ft. short, we think that, owing to the extreme difficulties presented by the veranda roof, this ladder was not fully extended at the time, and this fact, and not its inadequate length, was the reason that it did not reach the required height. Nevertheless, a 35 ft. ladder should have accompanied the first appliances, and, as stated previously, the Tilling-Stevens ladder should have been despatched to the fire as one of the first appliances.

204. It is not thought that hook ladders would have assisted the brigade in either fighting the fire or in rescue operations, but these ladders are now considered an essential part of standard equipment and should be possessed by the Christchurch brigade.

205. We heard expert evidence on thread and instantaneous hose couplings, but witnesses were unable to say that the instantaneous type would have been more advantageous than the thread type used by the Christchurch brigade. There was no evidence of difficulty with couplings at the fire.

206. We have seen that any attempt at rescue by the Tilling-Stevens ladder would have been obstructed by the electric-power lines, and the question has arisen as to whether brigadesmen should be equipped with tools to deal with high-tension power-lines.

In Christchurch there is a standing instruction in the fire brigade to the effect that the Municipal Electricity Department must be notified of every fire call, and that the officer in charge at a fire is to be responsible for a second call to the Municipal Electricity Department if it becomes necessary to deal with high-tension wires as distinct from electrical house services.

The Municipal Electricity Department denied having received any advice of the fire from the fire brigade, whereas the brigade stated a first call was given, but admitted no subsequent call for disconnection of the mains was made.

The Superintendent of the brigade considered that, even if the brigade had the equipment, the cutting of the high-tension wires would be beyond the ability of the brigade to handle safely. This question needs investigation, we think.

SHORT SUMMARY OF FINDINGS

Orders of Reference (1) to (8)

1. We have been unable to find the cause and origin of the fire.

2. In our opinion, all steps reasonably possible, under the circumstances then obtaining, were not taken to warn the staff and the members of the public on the premises of the existence and seriousness of the fire, and that all reasonably possible steps under the circumstances were not taken to provide for their safety and escape, firstly by the management of Ballantynes and later by the fire brigade.

3. Special circumstances contributing to the rapid spread of the fire were :

(*a*) The very large fire areas with large unprotected vertical and lateral openings :
(*b*) The high fire load in relation to the construction of the building :
(*c*) The late call to the fire brigade which allowed inflammable gases to accumulate before the arrival of the brigade :
(*d*) The failure of the fire brigade to take effective action to attack the fire in the first ten minutes after its arrival, thereby allowing a further accumulation of dangerous and explosive gases :
(*e*) The inflammable nature of much of the stock and soft fibre board used throughout the building.

The fire hazard could have been reduced by—

(i) The installation of an automatic sprinkler fire-alarm system :
(ii) An automatic fire-alarm system directly connected to the fire-station :
(iii) The provision of adequate fire-doors :
(iv) The total prohibition of the use of untreated soft wood fibre board :
(v) The provision of standpipes throughout the building with hoses attached :
(vi) The enclosure of lift-shafts and stairways by smoke-stop partitions.

4. In our opinion, there was a breach of the Christchurch City By-laws in so far as permits were not obtained for the execution of certain works, such as the making of openings in interior walls and the use of soft wood fibre board for partitions and wall coverings. Inasmuch as no requisition was served on Messrs. Ballantynes by the fire brigade, it cannot be said that there was a breach of the Christchurch Fire Board Fire Escapes By-law, 1930. We think the use of soft fibre board in Ballantynes was a breach of the by-law forbidding its use, and the breach was not cured by the consent given.

5. In our opinion, the Factories Act and its regulations are inadequate in so far as they set a standard of protection against fire very far below that set in standards approved by expert opinion and adopted in other countries.

We think the Fire Board Fire Escapes By-law is similarly defective, and so far as existing buildings are concerned the by-law has been practically inoperative, inasmuch as it provides that nothing need be done unless the Superintendent of the Brigade, after inspection, serves a notice on the owner setting out what he is required to do.

Since the 1938 amendment of the Municipal Corporations Act, the Christchurch City Council has been in a position to replace the Fire Board's By-law, but nothing has been done. We believe the Christchurch City By-laws are inadequate and that the administration of the by-laws and regulations has been irregular and ill administered. There appears to us to be no justification for the Council's over-riding its own by-law and granting permission to Ballantynes to make extensive use of untreated soft wood fibre board.

We draw attention to the absence of regulations framed to regulate construction in relation to floor areas.

6. We believe the adoption of the New Zealand Standard Code of Building By-laws, Part VII (Means of Egress), as prepared by the New Zealand Standards Institute, should be made compulsory to all buildings in New Zealand.

7. We recommend the instruction of staffs in the principles of fire-prevention, evacuation drill, and elementary principles of fire-fighting. We advocate that all floors above ground floor be immediately evacuated on alarm of fire being given.

8. We find that, after arrival at the fire, there was failure on the part of the brigade officers to appreciate the potential danger and take adequate steps to meet that contingency.

We find the attempt made to rescue those trapped suffered from lack of competent leadership.

We find the equipment employed by the brigade to combat the fire was, in general, sufficient save that the Tilling-Stevens electric ladder was obsolete.

We propose, in putting forward our recommendations as desired by clauses (9) and (10) of the order of reference, to deal with those two clauses together as the matter of them is closely interwoven. They are—

ORDER OF REFERENCE (9)

Whether, as the result of the evidence submitted, the Commission has any, and if so, what, recommendation to make as to the principles which should in the public interest be adopted for protection against fire in existing buildings generally of a type similar to the Ballantyne building.

ORDER OF REFERENCE (10)

And generally upon such other matters arising thereout as may come to your notice in the course of your inquiries which you consider should be investigated in connection therewith and upon any matters affecting the premises which you consider should be brought to the attention of the Government.

207. A number of buildings used for large stores are new buildings which are fitted with automatic alarm systems, sprinkler systems, or some other preventive system against fire constructed with a view to reducing fire-risk to a minimum. To such buildings the Standard Egress Code applies where adopted. Generally speaking, fire-proof doors are attached to entrances from one compartment to another.

If most of the municipalities have a by-law similar to the Christchurch City Council By-law prohibiting the use of soft fibre board for wall coverings, one would not expect to find that City Councils as a rule have, like the Christchurch City Council, over-ridden their own by-law and permitted the use of such material either for partition walls, ceilings, or for covering other walls. These buildings, when a new standard fire-prevention by-law is promulgated, will become existing buildings, and the question will then arise, as in this case the question of the application of the Egress Code has arisen.

208. The question we are asked is what principles should, in the public interest, be adopted for protection against fire in existing buildings of a type similar to Ballantyne's Building. It was pressed by counsel for Ballantynes that many buildings of the same type as Ballantynes, in so far as adjoining buildings have come under the same ownership and been converted into one building, exist in New Zealand, and that Ballantynes are no more to blame than others in like case who have taken no further precautions than Ballantynes have taken.

209. In our opinion, when adjoining buildings are turned from the modest requirements they were built for, to become part of a large store housing a staff of hundreds, the conversion that then takes place should be regarded as a new building and the by-laws applicable to a new building should apply to them.

We do not accede to the view that new regulations proposed in the light of the invention of fresh prevention devices and greater knowledge and appreciation of what can be and has been proved to be a potential fire risk, should not be applied to existing buildings. If the owners of existing buildings are exempt from the necessity of moving with the times, it merely means that avoidable risks to property and life are being accepted in the hope that a fire will not, by good chance, take place.

In other directions, such as, for instance, the guarding and care of moving machinery, such an attitude has not been allowed, and we cannot understand why existing buildings should be allowed to continue without adequate protection measures against fire and loss of life. That considerable expense will be incurred is undoubted.

210. The loss of property in New Zealand through fire has been estimated for the period 1918–1944 at something like £1,125,000 per annum. In more densely populated countries the loss of property incurred by fire has been assessed at many times that figure, and it can safely be said that the bulk of that loss arises from the destruction of buildings that have been erected for many years. There is no way to prevent this loss save by preventive measures.

211. From the evidence it has become apparent to us that there does not exist, either in the lay mind or the professional mind, an adequate knowledge and understanding of fire-precaution principles. There is ample evidence that this state of affairs is not peculiar to New Zealand, although some communities are very much more advanced in their thinking and action on such matters. There are many building codes to be found, particularly in America, which include far-reaching provisions for fire-prevention. Unquestionably the loss of life and property by fire is exercising the authorities in many countries.

In Great Britain the Building Research Board has recently had before it a valuable report from a joint committee of technical experts which was constituted for the purpose of considering and making recommendations on the fire grading of buildings. The deliberations of this committee extended over a considerable number of years.

The President of the United States called a conference in May of this year of all organizations interested in this problem, and we have had forwarded to us the published proceedings of the conference. There is also available a considerable volume of literature from abroad which stresses the increasing notice being taken by Governments and representative community organizations on the subject of fire-prevention.

212. We appreciate and stress that the Means of Egress Code prepared by the Standards Institute will be of the greatest value in its application to existing buildings for the purpose of making them safe, but at the same time we are convinced that the Egress Code will need supplementary provisions such as those of the Fire Prevention By-law now being prepared by the New Zealand Standards Institute.

It will not be possible to apply all the provisions of the fire-prevention by-law to existing buildings, but at the same time there are some which must receive consideration, and allowance must be made for discretion in their application to existing buildings. We refer to such matters as the installation of sprinkler systems; the control and limiting of fire areas; the control of the nature of the occupancy, having regard to the class of construction of the building; the use of standpipes and fire hoses; the use of fire-retardant materials on otherwise combustible substances; the protection of exposures; the control of smoking; and safeguards against carelessness.

213. We are compelled to discuss generally some important principles of fire-prevention, the objects of which are—

(*a*) Providing for the safe egress of people in a building:

(*b*) Preventing or reducing the number of outbreaks of fire:

(*c*) Confining the magnitude and reducing the spread of a fire when it breaks out.

It is of paramount importance that every endeavour be made to reduce the number of outbreaks of fire, and in this regard the responsibilities have to be shared by all parties interested, and not only by the authorities controlling buildings and various supply services, such as electricity.

A large share of the responsibility to adopt adequate safeguards must devolve upon building owners and occupiers, and also upon individual persons, for it appears from records that a substantial proportion of fires is attributable to carelessness. This important factor, *inter alia*, makes it necessary to introduce minimum standards for the structural elements of a building as well as providing fire-fighting forces. It makes it necessary to ensure that large buildings are subdivided by walls and floors of adequate fire-resistance. It has to take into account the structural design of the load-carrying elements of the building in order that in the event of fire they can carry the consequent strain. It necessitates the provision of means whereby firemen can obtain reasonable access to attack fires. The subject of exposure of one part of a building to another, or one whole building to another, has to be controlled so as to reduce the risk of fire spreading. There are other factors that have already been mentioned.

214. Apart from the paramount question of proper means of egress with fire-alarms and necessary evacuation drill, the balance to be struck between passive defence measures and active fire-fighting is one of the broad economics. Unfortunately, there does not appear to be any detailed statistical data on the subject, and regulations in existence seem to be based largely upon judgment as a result of experience.

215. We are of the opinion, however, that there is ample scope and great need for increasing passive defence measures in New Zealand, and that there is no need to set up greatly increased fire-fighting forces. What is required with regard to the latter is an overhaul of the fire-brigade-control system and methods of training so as to promote the highest possible efficiency in actual fire-fighting operations. This question we deal with later.

216. We are impressed by the fact that there seems to have been an absence of a rational approach to the fire-precautions problem on the technical side. On this matter a committee of the British Building Research Board of the Department of Scientific and Industrial Research, Great Britain, has given a useful lead.

The technical evidence submitted on behalf of the Crown recommended advantage should be taken of this research. The British committee's store of information and experience was greatly added to by its wartime studies of fire problems.

In the development of a rational system of fire precautions, it conveniently subdivided the subject of fire hazard into three categories—namely, personal hazard; damage hazard; and exposure hazard. As the subject of personal hazard is principally one concerning the planning, construction, and protection of means of escape which are dealt with in the Means of Egress Code, no further elaboration is needed. We confine ourselves, therefore, to the damage hazard and exposure hazard and the principles that should be incorporated in the fire-prevention by-law now being prepared. As previously stated, it will be necessary to include a clause making the provisions of the Code applicable to existing buildings as was done in clause 704 of the Means of Egress Code.

Precautions against fire should be designed according to the fire hazard arising from the contents of the building as well as its structural character. There has always been difficulty in expressing the measure of the fire hazard of a building, but the difficulty seems to be met by recommendations of the British Committee which introduce the term " fire load " which is broadly related to different kinds of occupancies.

" Fire load " applied to a building means the amount of heat measured in British thermal units which could be liberated per square foot of floor area by the combustion of the contents of the building and any combustible parts of the building itself. The understanding of this term should not be beyond the capacity of average people, and it will be readily understood by architects and engineers. We recommend its adoption in a manner bearing relationship to classification of occupancies, as recommended by the British committee.

217. If this principle is adopted consequential consideration must be given to the distribution of fire load in the building, the fire-resistance of the elements of the building, and the subdivision of buildings into compartments so as to limit the extent of damage and reduce the risk of general conflagration.

In addition to necessary estimation of fire loading in relation to the classification of building-construction types, by-laws must take into account the height factor, particularly in the case of buildings having wooden interiors, since in such case there is risk of internal collapse, and reliance must rest largely on external fire-fighting.

218. The Secretary of the Standards Institute has indicated that the fire-prevention by-law could be completed within six months. The subject is one of such urgency that we recommend to the Government that they take all steps to see that the by-law be completed within six months from the time of the receipt of this report, and that the Minister advise all local authorities that it must be adopted by them within three months of its date of completion. The Municipal Corporations Amendment Act, 1938, gives the necessary authority. If additional staff is required by the Standards Institute, we think such staff should be made available.

219. While we have discussed the proposed new fire-prevention by-law and made recommendations with regard thereto, including provision for dealing with existing buildings, the question of existing buildings still needs some consideration in detail. Many existing buildings, because of their manner of construction, their location, and their occupancy, fall much short of the standards of safety which by-laws such as that just discussed would require.

Paramountly, such buildings have to be brought into compliance with the Means of Egress Code, but there will remain many complex problems fraught with difficulties and requiring considerable expense. The problems in the present post-war years are more than ordinarily acute owing to the shortages of labour and materials, and the unprecedented demands made upon the building industry for housing purposes.

220. Having regard to the staff which will be available, as well as these difficult factors, it is not likely that general action in respect of all buildings will be possible for a considerable time to come. This must, of necessity, introduce the factor of priorities because those buildings carrying the greatest risk and danger to life should receive first consideration. Undoubtedly some improvisation will be necessary, but this should be easy of accommodation under the discretion of the engineer of the local authority, as is provided for in clause 704 of the Means of Egress Code.

221. We have recommended that the Minister compel the immediate adoption of the Standard Egress By-law by all local authorities. The problem requires urgent attention, and it is felt that the local authorities should receive material assistance from the owners and occupiers of buildings in assessing the quality of their buildings as regards compliance with the Means of Egress By-law.

For this purpose the local authorities should, we think, be given authority to call upon the building owners and occupiers for reports in terms of the Means of Egress By-law. To assist in this direction the local authorities could prepare standard report and questionnaire forms for completion by owners or their architects within a specified period. The Chief Inspector of Fire Brigades submitted a form for such purposes in his evidence to the Commission. The design of such a form must have regard to the size and class of buildings within the individual local authority's area.

222. Because of the impossibility of making many existing buildings comply with a modern fire-prevention code, although in the great majority of cases there should be no undue difficulty in making them comply reasonably with the Means of Egress Code, special consideration has to be given to existing buildings generally of a type similar to the Ballantyne building. This building had masonry exterior walls, was three to four stories in height, and had wooden floors throughout. The floor areas, because of the cutting of large openings in dividing walls, were extensive, and a great deal of readily combustible material was used in lining walls, ceilings, and partitions.

We consider that fire-alarms should forthwith be installed in all such buildings. A system of fire-drill and evacuation drill should be adopted for all such buildings.

223. We consider that local authority engineers should be given adequate power to insist upon the installation of fire-alarms and the adoption of fire-drill and evacuation drill immediately, where it is not possible, due to prevailing shortages, to bring about full compliance with by-laws.

There are sufficient examples of workable codes available covering the subject of fire-drill and evacuation drill.

224. There are also many cases where the installation of standpipes and hoses throughout a building would materially reduce fire-hazard. We advocate introduction of automatic sprinkler alarms on the widest possible scale, as with such installations greater latitude can be allowed in respect of means of egress provision and the maximum capacity of individual fire compartments.

The evidence was that insurers allow a 42½ per cent. reduction on premiums with automatic sprinklers conforming to the specifications of the Fire Underwriters' Association. The local authority engineers should be given powers of discretion concerning the introduction of both automatic sprinkler alarms and automatic alarm systems until such time as these particular subjects are covered by by-laws in course of preparation.

225. We recommend that soft fibre board, even if treated so as to be fire-resistant, should not be used under any circumstances in buildings of timber-frame construction, or in buildings with wooden floors except in dwellings where an approved treated board might be allowed. Even in so-called "fireproof" buildings untreated board should not be used. It is recommended that such board be not used in "fireproof" buildings

unless it is treated in an approved manner. The subject of making soft fibre boards fire-resistant is one which should, we think be submitted to the Department of Scientific and Industrial Research as a matter of urgency.

226. We consider that no openings should be cut in concrete and brick walls between compartments of buildings or adjoining buildings unless such openings are provided with fire doors complying with the fire underwriters' specification, and, furthermore, we consider that, in the class of building under consideration where such openings have been cut and are not provided with such fire-doors, the fire-doors should be provided forthwith. Compensating factors in the case of individual buildings where automatic sprinklers are installed can, as we have suggested, only be left to the discretion of the local authority engineer.

227. Since records show that a large number of major fires arise from carelessness, it is felt that publicity should be given to the question of fire-prevention and that the means of ensuring publicity under Government control be made available for this purpose.

This policy has been adopted in overseas countries and is conducted through the usual channels open to such a purpose. In particular, the dangers of smoking and the improper uses of electrical appliances have been stressed. Careful housekeeping on premises is of the utmost importance as it eliminates undue collections of rubbish, and enables easy inspection and movement within the premises.

228. In our report we have drawn attention to the difficulties of the type of veranda over the footpath on Ballantyne's building at the time of the fire. It is recommended that all new verandas should be constructed of the flat suspended type without any undue obstructions thereon. They should be free of signs on their roof so as to permit free movement. All signs which would, in the opinion of the engineer, be a source of obstruction on existing verandas, having regard to the construction of the building and means of egress, should be removed. All existing verandas which do not conform to the flat-roofed type should be examined and altered where necessary to make them suitable for escape purposes. As these verandas are suspended over the streets of the municipality there should be no difficulty in asking the owner to do what is necessary.

229. Of all the professional people connected with the construction of buildings, the architect is in a unique position for advising the owner, and it is surprising that he has not exerted greater influence towards bringing about better fire-prevention practice in the construction of existing buildings.

230. Special mention of basements is necessary as they are recognized as being a frequent and particularly difficult source of fires. Basements usually contain large quantities of materials in storage, and a fire is difficult of location and difficult to attack because of obstruction by smoke. A basement is particularly dangerous at night-time because the fire can proceed tc a considerable size before discovery, but in Ballantyne's fire we have a fire which occurred in the daytime in a building occupied throughout, and yet it defeated any steps which were taken to control it, and developed into a major conflagration with dire and disastrous results.

231. The fact that this was a concealed fire seems to have been one of the greatest factors operating against the realization of its potentialities. Because of the heavy fire loads in basements, and because fire often spreads undetected therein until smoke or flame burst through to street-level, and because of the difficulty in locating and attacking fires therein, we are of the opinion that special protection should be given preferably by the installation of automatic sprinkler alarm systems in every case.

There can be cases for making an exception, as, for instance, when the building is designed throughout of reinforced concrete and is constructed in accordance with the Means of Egress Code and the basement has alternative means of egress opening to the outside of the building.

232. We have dealt with preventive measures at some length. In New Zealand there seems to be a fatal acquiescence in the present neglect of fire-prevention measures. The greatest possible emphasis must be placed on the fact that the best way of fighting fire is to prevent it, and that prevention can be ensured by regulations making measures approved in those countries that have given careful consideration to the loss of life and property caused by preventable fire, imperative.

233. Our inquiry into the cause of the fire was hampered by the confusion and difficulty arising out of the removal from Congreve's basement of the electrical cable before it had been thoroughly examined by the supply authority. We think that it would be in the public interest, where major electrical installations are concerned, if it were made compulsory for any person intending to dismantle, remove, or interfere with it to obtain the prior consent of the electricity supply authority for the district.

234. We think a recommendation upon the conditions of service and the organization of the fire brigades is forced upon us. The question of the organization of the fire brigades we consider a major matter demanding instant attention. We have had to criticize the lack of organization that characterized the efforts of the brigade in the case of Ballantyne's fire, and in the course of doing so criticize the lack of leadership and command exhibited by the officer in charge at the time.

235. The officer in charge was neither a Superintendent nor a Deputy Superintendent; He was the Third Officer. He had no distinguishing uniform known by the public to show his rank. Our criticism of the officer in charge is not intended to question in any way his quality as a fireman, so far as he had been instructed.

It is really the lack of system and teaching that is at fault. There is no school; there are no necessary examinations in New Zealand; and the method of promotion has depended almost entirely on length of service in the brigade. The officer in charge had never previously been in charge of a major fire. He had not been attached to a Superintendent as officer linking the Superintendent in charge with the whole body of firemen.

No officer in the Armed Forces can take command of any considerable body of men without intense training in the duties of command, and without understanding of the necessity of a discipline that demands almost automatic and prompt response to orders. Without some college, school, and refresher courses the qualities necessary to command in the fire brigade cannot be tested and weighed.

236. We had the evidence of the Chairman of the Christchurch Fire Board as to the procedure adopted by his Board in dealing with the appointment of officers. The recommendation of the Superintendent and length of service seem to have been the deciding factors. The Chairman referred to examinations, both written and oral, as having assumedly taken place. He was unaware of the fact that examinations were not held or considered necessary. His recollection of the matters contained in the files of the Board and the Superintendent's reports was vague. We were left with the impression that no sufficient consideration was given to the vital question of the real qualifications of executive appointees.

The selection of officers is in the hands of the Board. It must accept full responsibility if it appears men not fully qualified have been appointed to senior positions in the brigade.

237. Mr. Glover, who appeared for the Superintendents' and Deputy Superintendents' Union, forcibly advocated a brigade 100 per cent. efficient, and to attain that efficiency stressed the necessity of some school for training. He also stressed the necessity of a disciplined force if the brigade is to be efficient. He submitted that the Superintendent should have power to hire and fire.

In support of his claims for efficiency, he put in for our consideration pamphlets and reports that are of great use when considering the efficiency of the brigade and the conditions of service in the brigade.

238. A pensions scheme for brigadesmen and officers seems to be regarded as necessary for a brigade as it is for any branch of the civil service or the Armed Forces, and we agree that a pension scheme should immediately be put in force and a revision of salaries taken in hand.

In England a number of different pensions schemes for fire brigades were in existence before the war, but it appears that under the Fire Services Act of last year one central pensions scheme for all brigades is to be set up.

From a report of an international conference of firemen held at Westminster on 19th September last year, put in by Mr. Glover, it appears the conference demanded the fire-brigades scheme should, in the interest of efficiency and justice to firemen, provide for speedier retirement and at an earlier age than normally applies to other groups of local-government employees.

239. There is, we think, reason for that resolution in that the work of a fireman needs not only mental alertness, but physical condition and alertness. To ensure efficiency, the physical condition of firemen has to be carefully guarded, and after a certain age the necessary physical condition for the activity required cannot be obtained. All fire-brigade drills should be done at the double.

There must therefore be, if men after a certain age are to be retained in the service, some outlet of employment—clerical work, or work as inspectors—which does not require the same physical activity that younger men have to display in quelling fires of any dimension.

This international conference affirmed that the nature of the fireman's job is entitled to recognition as a highly skilled and professional worker, and that this recognition should be reflected in the salary and wage rates established in the respective countries. It rejected the conception of a fireman's duty as requiring him to perform longer hours of work than those generally applied in professional and industrial occupations, and it demanded that fire-brigade pensions should, in the interest of efficiency and in justice to firemen, provide for speedier retirement and at an earlier age than normally applies to other groups of local-government employees.

240. So much literature is available concerning various aspects of fire-brigade organization and training that it is somewhat astonishing that the principles of organization and fire-fighting have not more thoroughly permeated through to all Fire Boards, officers, and men of the fire brigades in New Zealand than seems to be the case.

241. In our opinion, the present system of giving to each municipality a brigade to itself should be abolished, and there should be one Fire Service for New Zealand, and a controlling body should be responsible for the brigades in all localities. The present system prevents opportunity for promotion and renders the service unattractive.

All Superintendents informed us that they have difficulties in obtaining suitable recruits and that is not to be wondered at under present conditions. Unless opportunities for promotion and conditions of service are made as attractive as conditions in other services it is not to be wondered at that young men of ability and education are loath to join it. At present the conditions of service are such that one can only expect that applicants to join it come mainly from those who are not really fit for skilled work.

If fire-prevention and fire-fighting came within the scope of a unified fire brigade there would be opportunity for promotion and advancement, including variety in the nature of the work undertaken, that would render the service attractive to young men of ability.

242. If advancement and lack of pensions scheme obtain as they do now, there seems no prospect of obtaining either the necessary equipment or the necessary recruits. Under unified control the distribution of equipment according to the necessities of the district could be made more economically and efficiently than under the present system.

We are, of course, aware of the difficulties attendant upon control of such a service, and aware that there may be hostility on the part of local bodies to legislation that would deprive them of control.

For the Crown, counsel said that perhaps the ideal in a State brigade and State control through a Government Department. In New South Wales control is vested in Commissioners. In England during the war fire-control was vested in a central Government authority, but has now reverted to municipal control.

In our opinion, State control or commissioner control is advisable.

243. In a draft Bill submitted, we understand, to the Minister in charge it is proposed to vest the control in a body comprised of some eleven persons representing various interests—municipal representatives, insurance representatives, and representatives of the Superintendents of fire brigades and firemen. In our opinion, it is the public interest that should be considered, and the public interest in our view will be best served by fully-paid Commissioners who have a knowledge of the subject, and not by people who represent special interests, some of whom may have no real knowledge of the requisites of fire-prevention and fire-control.

244. The present system of administration seems top-heavy and, so far at least as regards training and care of personnel, seems ineffective. There are 100 municipal brigades and 60 Fire Boards. There are 479 permanent firemen in 22 brigades, and there are 252 members of Fire Boards. There has been so far no evidence that these 60 Boards have any common policy affecting welfare of the fire-brigadesmen of New Zealand, or the measures to be taken to prevent fire throughout New Zealand.

245. A Commission of three qualified men appointed for a term at a full-time salary could competently supervise and control fire-fighting, technical, and administrative work of the organization. One member should be thoroughly experienced in fire-fighting. The task such a Commission would face would take all its time to discharge. From them there could be an appeal to the Minister. Their duties would necessitate setting up and supervision of a school or college for training and, until that is possible, inauguration of a system of lectures and examinations under qualified men.

It might be desirable to seek the services of a qualified official of the English College for Firemen to sit with the Commission for a period and render advice.

Supervision of all brigades would be undertaken by the Commission, and all promotion would be made by them after scrutiny of the candidate's record in examinations and courses of instruction and training taken.

246. It has been suggested that the question of finance might prove a stumbling-block to such a complete change in the organization controlling fire-prevention and fire brigades. At the international conference it was suggested that insurance companies should pay the whole of the charges concerned. If this suggestion were adopted, the charge on rates would be abolished.

Mr. Blundell, counsel speaking for the fire underwriters, said that they were prepared, and always had been prepared, to meet additions to expenditure required by Fire Boards.

Counsel for the Crown replied to the seeming generosity of this gesture that the insurance companies regulated their premiums in relation to the contribution they made—that is, practically 50 per cent. of the total brigade cost (leaving out the small Government contribution)—and in their internal accounts debited their contribution to expenses.

If the Crown contention is correct, it seems those who foot the bill—*i.e.*, the insurers—are entitled to have the administration of the brigade in the hands of independent managers and not in the hands of those with separate and distinct interests. The Crown at present contributes some £4,883 per annum, a sum entirely disproportionate to the number of large buildings and institutions it has in its hands or under its control, and on which it does not pay rates.

Counsel for the Crown also said that any compulsory regulations to safeguard the public against fire danger and risk of life should be binding on the Crown. If the Crown took the view that payments should be made by insurance companies or by levy on premiums, it seems only just that to the fund the Crown, whether it insures or not, should contribute an amount equal to the premiums they would have paid if they insured.

247. In making our recommendations we have endeavoured to set out the requisites for efficiency. If the Government is satisfied, as we think they should be satisfied, that there are in New Zealand a great number of buildings which members of the public are invited to serve in, or to occupy, and that their construction constitutes a real danger to both property and life, it cannot in the public interest afford to rest content with the present measures of prevention and the present organization of our fire-fighting service.

248. If legislation is passed, whatever form it takes and whatever measures are taken to secure efficiency, they will necessarily be revolutionary. But such measures are, in our opinion, urgently needed if loss by fire is to be minimized and the lives of occupants, when fire breaks out, are to be efficiently safeguarded.

SUMMARY OF RECOMMENDATIONS

1. That the Means of Egress Code be made compulsory throughout New Zealand.

2. Immediate installation of fire-prevention devices and alarms.

3. That evacuation drill be compulsory.

4. That the New Zealand Standards Institute be given facilities to complete its Fire Prevention By-law within six months, and that it be made to apply throughout New Zealand within three months of its coming into force.

5. That the fire brigade be instituted as one service throughout New Zealand, and brought under the control of Commissioners. That a scheme of instruction, examination, classification, and promotion be instituted. That a superannuation scheme be set up for members of fire brigades and their salaries adjusted.

249. *Costs.*—An application was made by Mr. Barrer, counsel for the Clothing-trades' Union, the Retail-shop Assistants' Union, and the Clerks' and Cashiers' Union, for costs. We have not before us parties to a suit or claim. We have no claim before us and are of the opinion that, in the circumstances, we have no power to make such an order, and that there are no special circumstances to warrant such an order, if it could be made.

We have the honour to be,

Your Excellency's most obedient servants,

[SEAL] HAROLD FEATHERSTON JOHNSTON, Chairman.

[SEAL] ALEXANDER WELLINGTON CROSKERY, Member.

[SEAL] ARTHUR JAMES DICKSON, Member.

[SEAL] CHARLES ALEXANDER WOOLLEY, Member.

Dated at Wellington, this 19th day of August, 1948.

APPENDIX A.—ALPHABETICAL INDEX TO WITNESSES

Witness.	Called by
Adams, Derek James	Crown.
Adams, Reginald Dobson	City Council.
Agass, Alfred William	Crown.
Alcorn, Norman Patrick	Crown.
Alley, Philip John	Unions.
Alty, George Walter	Crown.
Appleyard, Victor Stanley	Crown.
	Crown.
	Crown.
	Ballantynes.
Bacon, Judith de la Mere	Crown.
Ballantyne, Kenneth	Crown.
	Ballantynes.
Ballantyne, Roger Fairbairn	Crown.
	Crown.
Ballantyne, Ronald Haynes	Crown.
	Ballantynes.
	Ballantynes.
Barnes, George	Crown.
Barson, Reginald Royce	Crown.
Beck, Rose Georgina	Crown.
Bedwell, Albert Vernon	Crown.
Berryman, William	Crown.
Biggart, Ngaire Phyllis	Crown.
Blackburn, Arthur	Crown.
Boon, Eric Selwyn	Crown.
Bowles, Norman Burwood	Crown.
Breach, Clifford Percival	City Council.
Breitmeyer, John Maxwell	Fire Board.
Brewer, Godfrey Arthur	Crown.
Brown, Bertie Charles	Crown.
Burke, John Michael	Crown.
Burns, Rosemary Anne	Crown.
Burrows, James Thomas	Crown.
Butcher, Roy Girling-	Crown.
Campbell, Hector Adair	Crown.
Chapman, Arthur	Crown.
Charles, Victor Edward	Crown.
Charters, Thomas Murray	Fire Board.
	Fire Board.
Checkley, John Leonard	Crown.
Christie, Jean Frances	Crown.
Clements, Arthur John Tremelan	Crown.
Coburn, Baden Trevor	Crown.
Coburn, Pauline	Crown.
Coles, Myrtle Elizabeth	Unions.
Cornish, Percy Claude	Crown.
	Crown.
Craig, Mary Natalie	Crown.
Crawford, Clarence Gore	Crown.
Crew, Lola Marie	Crown.

APPENDIX A—*continued*

Witness.	Called by
Crookbain, Howard Stanley	Crown.
Dalley, Nola Phyllis	Unions.
Dawson, Clement Bayne	Crown.
Dick, Beverley Mary	Unions.
Dick, Robert Smith	Unions.
Doak, James Donald	Crown.
Dobson, Thomas	Crown.
Dorreen, Meredith	Thompson and Dorreen.
Drake, Edith	Crown.
Drake, Eva Gladys	Crown.
Duthie, Charles Ernest	Crown.
Ellwood, Elizabeth Sarah	Unions.
Fairthorne, Lucy	Crown.
Falkingham, Harold	Crown.
Fisk, Reginald George	Crown.
Foote, John Edmond	Crown.
Ford, Herbert Raymond	Crown.
Forsyth, John Cossar	Crown.
	City Council.
Gaffney, William Adrian Davis	Crown.
Gee, Edmund Charles	City Council.
Gibson, Walter Beckingham	City Council.
Gilchrist, Walter Shaw	Crown.
Gilmore, Forbes Finlay	Unions.
Girling-Butcher, Roy	Crown.
Glover, Gertrude	Crown.
Glue, William Percy	City Council.
Goodwin, Raymond Eric	Crown.
Gorman, Eric Frederick	Crown.
Green, Horace Richmond	Crown.
Green, Samuel George	Thompson and Dorreen.
Hahn, William Frederick Charles	Crown.
Hamel, Maurice Alfred James.	Crown.
Hardy, Ellen	Crown.
Hassall, Hubert Cunningham	Unions.
Hayman, Robert Henry	Unions.
Hean, Victor Robert John	Crown.
	Crown.
	Crown.
	Fire Board.
Hocking, Richard Charles	Unions.
Hodge, William Henry	City Council.
Holmes, Herbert Edward	Crown.
Homersham, Brian Ryder McClintock	Thompson and Dorreen.
Hungerford, George David Dudley	Crown.
Hurst, Herbert Irvine	Crown.
Inwood, James Noel	Crown.
Irvine, Frederick James	Crown.
Jacobsen, Herbert Olaf	Unions.
James, Eric Edward	Crown.
Jecks, Arthur Horsey	Crown.

APPENDIX A—*continued*

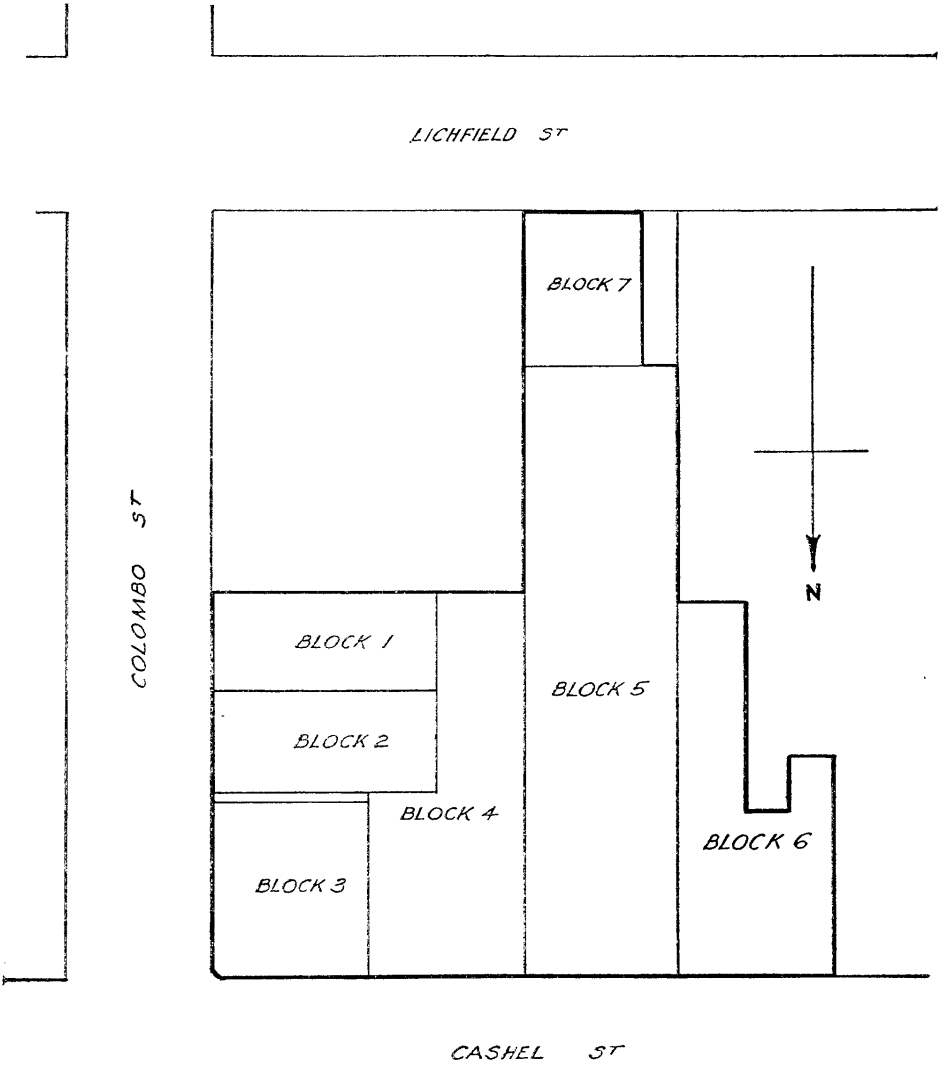
Witness.	Called by
Jenkin, Lily Elizabeth	Crown.
Johnston, Esther	Crown.
Just, Alan Victor	Fire Underwriters.
Kearton, John Bainbridge	Crown.
Kelly, Frank Walter	Crown.
Kennedy, Lois Marie	Crown.
Kneale, Margaret Elizabeth	Crown.
Kruse, James George	Crown.
Lanauze, Kathleen	Unions.
Landery, Frederick	City Council.
Lee, Henry Edward	Thompson and Doreen.
Line, Beatrice Mary	Crown.
Loach, Zelmac Mary	Crown.
Lockwood, Edward	Crown.
Loughlin, Mervyn Hylton	Crown.
Lucas, Gordon Tate	Crown.
	Ballantynes.
	Ballantynes.
Luke, Andrew	Crown.
Luney, Charles Seymour	Ballantynes.
McDonald, Graham Booth	Unions.
McDonald, Leslie John	Crown.
Machin, William	Unions.
Mangin, Myra Elizabeth	Crown.
Marshall, Seton Fulton	Fire Board.
	Fire Board.
Martin, Robert	Ballantynes.
May, Shirley Lee	Crown.
May, Tom	Crown.
Molineaux, Paul Loxton	Crown.
Morris, Leslie Nathaniel	Crown.
Morrison, Alexander	Fire Board.
	Fire Board.
Mott, Lorna Ethel	Unions.
Mulcahy, Patrick Michael	Unions.
Muschamp, Mabel Gertrude	Crown.
Nash, Nancy Gladys	Crown.
Neale, Raymond James	Crown.
	Crown.
Nicholls, Margaretta	Crown.
Nicol, Stuart Maxton	Crown.
Novell, Stanley Charles	Crown.
Oakman, Thomas George	Crown.
Ohlson, Barrie Frederick Thomas	Crown.
Parker, Campbell Ferguson	Unions.
Penney, Colin Alfred	Crown.
Philpott, John Cyril Frederick	Crown.
Prescott, James Wilson	City Council.
Read, George Blakeway	Crown.
Richards, Gwyn	Crown.
Roper, Robert Thomas	City Council.

APPENDIX A—*continued*

Witness.	Called by
Salvesen, Edgar Theodore	Ballantynes.
Sanders, Ernest Percy	Crown.
Sayer, Herbert Austin	Crown.
Scarlett, Harold James	Ballantynes.
Scott, James Alexander	City Council.
Scott, Richard Lepitit	Ballantynes.
Shah, Arthur Solomon	Crown.
Shaw, Raymond Patrick	Crown.
Shaw, Trevor William	Crown.
Shield, Thomas Leslie	Crown.
Simpson, Eric William Fergus	Crown.
Smith, Elsie	Unions.
Smith, Eunice Norma	Crown.
Smith, Keith Owen	Crown.
Somers, Ewart	City Council.
Stevens, Charles	Crown.
Stevenson, Charles Ernest Warner	Crown.
Stockwell, Walter Henry	Crown.
Stokes, George Lawrie	Crown.
Streetly, Ernest	Crown.
Stringer, Percy Gilbert	Crown.
Stroud, Edward Bryant	Crown.
Sutherland, Austin Frank	Crown.
Sutton, Howard Richard	Crown.
Symons, Joan Patricia	Unions.
Tait, John Edward	City Council.
Taylor, Dawn	Unions.
Taylor, Rosina June	Crown.
Templin, John Richard	Ballantynes.
Thomas, Trevor Ernest	Crown.
Thompson, George Joseph	Crown.
Thompson, Joseph Middlemiss	Crown.
Thomson, Edward Arthur Erskine	Crown.
Todd, Mary Margaret	Unions.
Troup, Gordon Sloane	Unions.
Troup, Robin Malcolm	Unions.
Vallance, Joseph Gladstone Ashley	Crown.
Wallace, Alfred George	Crown.
Wallace, Harry Gordon	Unions.
Walmsley, Edward Benjamin MacG.	Crown.
Walsh, James Joseph	Crown.
Ward, Jessie	Unions.
Webb, May Gertrude	Unions.
White, Rhona Geraldine	Crown.
Wilhelm, Thomas Henry	Thompson and Dorreen.
Wilkins, Thomas Davy	City Council.
Wilkinson, Leslie	Crown.
Williams, Percy Reginald	Crown.
Williamson, Alfred Brian	Crown.
Williamson, Lorna May	Crown.
Wills, Wilfred John	Crown.

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

DESCRIPTION OF BUILDINGS

This description is intended to be read in conjunction with the accompanying drawings showing plans of the buildings, the object being to give as clearly as possible a picture of what actually existed without obscuring the essential information with unnecessarily minute details of every space and block.

In preparing this description and the accompanying plans it has been necessary to obtain information from various sources, including the following: —

(1) Photographs taken after the fire.
(2) Plans supplied by the firm's architect.
(3) Measurements taken and sketches prepared by members of this Department's staff.
(4) Personal inspections of what remained after the fire.
(5) Information obtained from members of Ballantyne's staff.

The resulting drawings and description are believed to be correct.

Special mention is made of openings cut in brick party walls through which it would be possible for fire to spread. Where both dimensions of openings are given, the first dimension is the height.

Where the term "protected" is used with reference to openings it means that such openings were protected by doors or shutters intended to be fire-resisting.

The premises consisted of a group of buildings situated at the corner formed by the western side of Colombo Street and the southern side of Cashel Street, with frontages of 165 ft. to Colombo Street and 265 ft. to Cashel Street. At a distance of 133 ft. from Colombo Street the premises extended from Cashel Street to Lichfield Street, with a frontage to Lichfield Street of 69 ft., which included a right-of-way.

The group of buildings comprised the following blocks, which appear to have been erected as separate buildings, though in almost every case the dividing walls were party walls common to structures on either side.

BLOCK 1

A three-story block with a basement, situated at the south end of the group in Colombo Street, known as Congreves Buildings.

Construction

Walls.—Brick with stone facade to Colombo Street interior strapped and lined with matchlining, covered on the first floor with Pinex.

Columns.— Cast iron.

Floors.—Wood on timber joists carried on rolled-steel beams.

Roof.— Timber-framed, covered with corrugated iron, with skylights. Portion of roof over appro room asphalt.

Ceilings.—

Basement: No ceiling.
Ground Floor: Matchlining. Appro room, Pinex.
First Floor: Matchlining and Pinex.
Second Floor: No ceiling.

Partitions:—

Basement: Wire mesh on wooden framing.
Ground Floor: Brick and timber covered with Pinex with glass above.
First Floor: Pinex and matchlining.
Second Floor: Matchlining.

Stairs :—

Basement to Ground Floor : Timber, not enclosed.
Ground to First Floor : Timber, not enclosed.
First to Second Floor : Timber, enclosed with timber partition with doors at head and foot of stairs.

Fire-escapes.—Nil.

Lifts.—Nil.

BLOCK 2

A four-story block with basement, known as Goodman's building, situated in Colombo Street immediately to the north of Block 1, from which it was separated by a brick party wall.

Openings

This block was accessible from Block 1 by means of openings cut in the brick party wall as follows :—

Basement.—One opening 6 ft. 6 in. by 4 ft. 6 in. closed by light wire-mesh grille gate.

Ground Floor.—One opening 12 ft. by 10 ft. 6 in. ; One opening 8 ft. by 8 ft. 3 in.

First Floor :—

One opening 10 ft. 6 in. by 17 ft. 6 in., reported to have been closed temporarily with a Pinex partition, but otherwise unprotected.

One opening 7 ft. by 3 ft. with wooden door.

One opening 7 ft. by 3 ft. with wooden door.

Second Floor : One opening 7 ft. by 3 ft. 3 in., no door.

Construction

Walls.—Brick with stone facade to Colombo Street. Interior strapped and lined with matchlining, covered with Beaver board on ground floor, matchlining covered with Pinex on first floor, and matchlining on the third floor.

Columns.—Timber posts in basement under ground floor only.

Floors.—Wood on timber joists carried on timber posts and beams under the ground floor. Upper floors timber joists carried on rolled-steel beams spanning full width of building.

Roof.—Timber-framed, covered with corrugated iron, with skylights.

Ceilings :—

Basement : No ceiling.
Ground Floor : Matchlining.
First Floor : Matchlining covered with Pinex.
Second Floor : Matchlining.
Third Floor : No ceiling except over telephone-exchange.

Partitions :—

Basement : Wire mesh on wooden framing.
Ground Floor : Nil.
First Floor : Nil.
Second Floor : Matchlining, Pinex, and glass.
Third Floor : Matchlining and Pinex.

In the basement a dustproof partition of Pinex on wooden framing and fitted with a plywood-covered door had been erected to prevent dust reaching stock from a place where workmen were engaged in cutting an opening in the basement wall.

Fire-escape.—Steel and cast-iron stair with steep flights and landings accessible through sliding metal-clad doors from second and third floors. Also gave access through sliding metal-clad door to second floor of Block 3, and through wooden door to lavatory above strong-room of second floor of Block 3.

Stairs :—

Basement to Ground Floor : Timber closed at top with wooden door with spring closer.

Ground to First Floor : Timber stair not enclosed.

First to Second Floor : Timber stair not enclosed.

Second to Third Floor : Timber stair not enclosed.

Lifts :—

——	Shaft.	Doors.
Basement to ground ..	Timber frame enclosed with wire mesh ..	Timber covered with wire mesh.
Ground to first ..	Timber frame enclosed with Pinex to height of 7 ft.	Wood with wire-mesh panel.
First to second ..	Timber frame enclosed with Pinex to 7 ft. high	Wood with wire-mesh panel.
Second to third ..	Timber frame enclosed with Pinex to 7 ft. high	Wood with wire-mesh panel.
Third floor	Pinex hardboard	..

Hoisting-gear in roof; counterweights against south wall; cage, wood panelled, with telescopic gate.

Block 3

A three-story block with basement, situated at the corner of Colombo Street and Cashel Street, separated from Block 2 by two solid brick walls with a space of 3 ft., forming an alleyway in between and occupied by the steel and cast-iron fire-escape stair mentioned under Block 2.

Openings

This block was accessible from Block 2 through the following openings :—

Basement.—No access, though an opening was being cut and had been pierced between Block 2 and the alleyway enclosing the fire-escape.

Ground Floor.—Indirectly through the alleyway, one window and one door giving access to an otherwise enclosed space under the stair.

First Floor.—A large opening 9 ft. by 17 ft. cut through walls on both sides of alleyway and boxed around with reinforced-concrete slabs to provide access between buildings. Opening unprotected by fire or smoke doors. One window opening into alleyway.

Second Floor.—Indirectly through alleyway occupied by fire-escape by means of doors on opposite sides of fire-escape landing. Door, metal-clad, fire-resisting type.

Third Floor.—Indirectly through alleyway occupied by fire-escape. A doorway with a wooden door gave access from the fire-escape to the women's lavatory erected in timber on top of the strong-room.

Further details of window openings into the fire-escape alleyway will be given under "Fire Escapes."

Construction

Walls.—In basement, concrete; above that level, brick with stone facades to street frontages. Interior strapped and lined with matchlining covered with Beaver board on the ground floor, matchlining covered with Pinex on the first floor, and matchlining covered with Celotex on the second floor.

Columns.—Cast iron.

Floors.—Wood on timber joists carried on timber beams.

Roof.—Timber-framed, covered with corrugated iron and incorporating a large lantern light approximately 45 ft. long and a penthouse over the lift-well.

Partitions :—

Ground Floor: Brick and timber framed, covered with wood panelling and Beaver board.

First Floor: A few partitions brick, but mainly timber-framed and covered with plaster board, matchlining, and plywood.

Second Floor: The accounts and credit rooms separated from remainder of the block by a substantial brick wall. Remainder of partitions timber-framed and covered with Celotex. Brick partitions were strapped and lined with matchlining covered with Celotex.

Ceilings :—

Basement: No ceiling.

Ground Floor: Matchlining.

First Floor: Matchlining covered with Pinex.

Second Floor: Celotex only.

Stairs :—

Basement to Ground Floor: Timber, not enclosed.

Ground to First Floor: Timber, not enclosed.

First to Second Floor: Timber, enclosed on second floor with partitions timber-framed and covered with Celotex.

Second to Third Floor (lavatory): Timber, enclosed by timber partition covered with Celotex at head of stair.

Fire-escapes.—Access from second floor and third floor (a lavatory only) on to steel and cast-iron fire-escape previously mentioned, no access to fire escape from first floor.

Lifts.—Ground to 2nd Floor, situated in angle of two brick walls. Other walls timber-framed and covered with Beaver board, Pinex, and Celotex on the different floors :—

——	Shaft.	Doors.
Basement	..	Timber covered with wire mesh.
Ground to first floor ..	Enclosed with timber; framing covered with Beaver board	Wood with wire-mesh panels.
First to second floor ..	Pinex and Beaver board	Wood with wire-mesh panels.
Second floor ..	Celotex and Beaver board	Wood with wire-mesh panels.

Hoisting machinery in basement. Cage, panelled in oak ply, metal roof, and telescopic gate.

Block 4

A building with a frontage of 66 ft. to Cashel Street and extending as far south as the south side of Block 1. At approximately half this distance the width of this block was reduced to approximately 38 ft. For a distance of approximately 33 ft. back from Cashel Street the building was three stories in height, and beyond that distance, two stories in height. There was a basement at the rear of this block housing the main switchboard and pneumatic-tube equipment, and used for the storage of dress materials.

Openings

This block was accessible from Blocks 1, 2, and 3 through the following openings in the brick walls:—

Basement.—A doorway to the basement of Block 2 fitted with a steel door, which was apparently open at the time of the fire.

Ground floor.—

(*a*) An opening to the right-of-way at south of Block 1 (no door).

(*b*) An opening approximately 7 ft. wide to the rear of Block 2 fitted with a sliding door on one side of wall. This door is one of the doors that will be referred to as fireproof doors in evidence.

(*c*) An opening approximately 9 ft. wide at the rear of the art department in Block 4 to the rear of Block 2 (adjacent to the last opening mentioned). Fitted with a pair of sliding doors on one side only. This pair of doors is also referred to as fireproof doors in evidence.

(*d*) An opening approximately 12 ft. wide to Block 3; unprotected.

First Floor.—

(*a*) Two windows overlooking light area on the ground floor of which the appro office was built, one fitted with metal-clad fire-resisting shutter which was open at the time of the fire; therefore both openings unprotected.

(*b*) Two door openings at rear of Block 1, fire-door on one; other filled in with wood partition.

(*c*) One doorway 6 ft. 3 in. by 3 ft. to rear of Block 2; fitted with fire resisting door.

(*d*) One door opening 7 ft. by 3 ft. between display area in Block 4 and cloak room in Block 3; no door.

(*e*) One opening 10 ft. by 14 ft. wide between display area (over art department) and Block 2; unprotected.

(*f*) One doorway; unprotected.

Second Floor.—One door communicating with Block 3 and provided with a sliding fire-resisting door one side only, in addition to ordinary wooden door. Fire-resisting door was apparently not closed during fire.

Construction

(*a*) *Walls.*—Walls were concrete in basement, brickwork elsewhere. Facade to street, stone. The north and south walls of the three-story portion were carried on rolled-steel beams and cast-iron columns, leaving practically the full width of the block clear on the ground floor. Inside walls were strapped and lined with matchlining covered with Beaver, Pinex, or Gibraltar board. Both outer and inner lounges on the first floor were panelled in polished blackwood to a height of 7 ft. Walls of the second floor were lined with matchlining.

(*b*) *Columns.*—Cast iron.

(*c*) *Floors.*—Wood on timber joists carried on timber beams on upper floors.

(*d*) *Roof.*—Timber-framed, covered with corrugated iron. The first floor of the two-story portion was lighted by continuous skylights on either side of the ridges of the roof.

(*e*) *Partitions.*—Timber framed, covered with Beaver board or plaster board approximately 7 ft. high. Partition separating small rooms to the south of the main stair on the first floor were 7 ft. high covered with Beaver board.

(*f*) *Ceilings.*—Matchlining and Celotex on timber framing, but ceiling on first floor of two-story portion consisted largely of roof lights.

(*g*) *Stairs.*—The main stair was situated in this block and was of timber in an open well, unprotected.

(*h*) *Fire-escapes.*—A hanging ladder giving access to the roof over tailoring workroom.

(*i*) *Lifts.*—Nil.

BLOCK 5

A block facing on to Cashel Street to the west of Block 4 and extending back approximately 265 ft. towards Lichfield Street. Except for a distance of approximately 33 ft. from Cashel Street, which was three stories in height, this was a single-story building with a timber structure erected upon the roof adjoining the west wall of the first floor of Block 4, from which it was accessible. There was no basement to this block.

Openings

This block was accessible from Block 4 through the following openings :—

Ground Floor :—

(*a*) A door to the rear of Block 4.

(*b*) Three large openings ranging from approximately 11 ft. to 19 ft. in width, all unprotected.

First Floor :—

(*a*) Four doorways between Block 4 and the timber structure erected on roof of single-story portion of Block 5. All unprotected.

(*b*) One opening approximately 10 ft. wide, unprotected, between inner lounge and tea-room.

Second Floor.—One doorway between tailoring workroom and staff cafeteria.

Construction

(*a*) *Walls.*—Brick and rubble masonry. Facade to street, stone. Walls of upper floors carried on columns similar to Block 4. Wall linings: matchlining, Beaver board, and fibrous plaster.

(*b*) *Columns.*—Cast-iron and structural steel.

(*c*) *Floors.*—Wood on timber joists carried on timber beams on upper floors.

(*d*) *Roofs.*—Timber-framed covered with corrugated iron with sky-lights to single-story portion.

(*e*) *Partitions.*—A main partition (actually a bearing wall) of brick down the centre of the ground floor pierced by a number of openings of varying widths. Minor partitions timber framed covered with Beaver board.

(*f*) *Ceilings.*—Matchlining, but a large proportion of area taken up by ceiling lights.

(*g*) *Stairs.*—Timber, two in number, not enclosed. One external.

(*h*) *Lifts.*—Nil.

(*i*) *Fire-escapes.*—Nil, with exception of external stair.

The structure on the roof of the single-story portion measured 118 ft. long by 11 ft. 6 in wide, constructed of timber.

BLOCK 6

The westernmost block in Cashel Street, to which it has a frontage of 66 ft. In depth it varies from 95 ft. to 165 ft. and in height from three stories at the front to one story at the rear.

The spread of the fire was stopped at this block, which, in general, is of similar construction to those already described.

BLOCK 7

A two-story brick building situated in Lichfield Street at the rear of Block 5. This block was comparatively unaffected by the fire.

FIRE-ESCAPE TO COLOMBO STREET

The fire-escape that will be referred to in evidence was a steep steel and cast-iron stair situated in an alleyway 3 ft. wide opening on to Colombo Street and extending from the highest floor—the women's toilet over the credit-room strongroom at the rear of Block 3—to within 7 ft. of the ground at Colombo Street. There were landings at the top and the bottom of the stair with four intermediate landings between—three steel and one concrete. Steel handrails were provided on both sides. A vertical ladder led from the bottom landing to the ground.

The alleyway could be closed at Colombo Street by means of a steel grille gate which was open at the time of the fire. Apart from this, the alleyway was open to Colombo Street full height. At the western end it was open above the level of the second floor.

The walls on either side of the alleyway were of sound brickwork, about 2 ft. thick at the bottom and were pierced by the following openings, most of which were fitted with metal clad fire resisting shutters or doors :—

Basement :—

Block 2 : One opening 6 ft. by 1 ft. 10 in. where pavement light had been removed from bottom of alleyway.

Ground Floor :—

Block 2—

One opening 9 ft. 6 in. by 6 ft. 6 in. ; sliding shutters closed.
One opening 9 ft. by 4 ft. ; hinged shutter open.
One small opening approximately 9 ft. by 9 ft., evidently the commencement of an opening being cut.

Block 3—

One opening, window 2 ft. 6 in. by 3 ft. 3 in. ; unprotected.
One opening 7 ft. by 3 ft. unprotected.

Block 4 : One opening 7 ft. by 3 ft. 6 in. ; hinged shutter closed.

First Floor :—

Block 2 : No openings.
Block 3 : Window 3 ft. 3 in. wide ; unprotected.
Block 4 : 7 ft. by 3 ft. 6 in. ; hinged shutter closed.

Second Floor :—

Block 2—

Two doors 7 ft. by 3 ft. ; sliding doors closed (one the door to fire-escape).
One 9 ft. by 7 ft. ; sliding shutter open, therefore unprotected.

Block 3 : One door 7 ft. by 3 ft. ; sliding door closed (door from credit room to fire-escape).

Block 4 : End of alleyway open above roof.

Third Floor :—

Block 2—

One 9 ft. by 7 ft. ; sliding shutter open (therefore unprotected).
One 7 ft. by 3 ft. ; sliding door open (therefore unprotected).

Block 3 : One door to women's toilet, which was of timber construction and therefore combustible.

Block 4 : End of alleyway open.

Basement Opening

The removal of a pavement light from the floor of the alleyway by workmen engaged in cutting an opening between the basements of Blocks 2 and 3 left an opening 6 ft. by 1 ft. 10 in. between the basement of Block 2 and the right-of-way. This opening was unprotected.

Fire-resisting Doors and Shutters

These were of two types, sliding and hinged, and were constructed with a laminated core of timber sheated on both faces and all edges with small sheets of metal with seamed joints and attached to the wooden core.

Sliding shutters were hung on steel or wrought-iron hangers bolted to the doors and with sheaves running on steel rails bolted to brickwork.

Hinged shutters were hung on steel or wrought iron strap hinges with gudgeons bolted or set into the brickwork.

Interior Linings

Very little plaster work appeared to have been used in the building, brick walls in general being strapped and lined from floor to ceiling with 6 in. by $\frac{7}{8}$ in. tongued and grooved matchlining. Ceilings also were covered with matchlining. In some parts of the building the matchlining was left exposed, but mostly it had been covered with some form of wallboard. Beaver board, Celotex, Pinex, Donnaconna, and plywood all appear to have been used for covering walls, partitions, ceilings, and fittings.

Fixtures

A very large proportion of the surfaces of walls and partitions in the various shops and salerooms was taken up by wooden fixtures for holding stock.

Veranda

The veranda that extended along the full length of both the Colombo and Cashel Street fronts was of the suspended type, but of unusual design. The roof was the full width of the footpath with a ridge down the centre with slopes on either side pitched at an angle of 30° towards both the road and the building. It was covered with slates with a gutter at the lower edge of each slope for the removal of rain-water. The underside was covered with a sheet-metal ceiling, except to Block 6, where fibrous plaster was used.

The veranda was of wooden construction supported at intervals of approximately 10 ft. by triangular steel frames and suspension rods.

Building Services

Electrical

The premises were served by both A.C. and D.C. supplies of power.

A.C.—The A.C. supply was laid on from a pole in Colombo Street and entered the building through a conduit above the first-floor level at the north-east corner of Block 1. A fuse for each phase was located inside the building at the point of entry. From this point the incoming main was led in armoured cable to the main A.C. switchboard located against the south wall of the basement in Block 4. The cable was taken down a duct in the north-east corner of Block 1 to below the ground-floor level, then southward along the east wall for approximately 8 ft., after which it was taken between the joists of the ground floor and over the top of the beams supporting them to the west end of the basement along a line approximately 10 ft. from the north wall. Passing under the ground floor at the rear of Block 1, the cable was taken across the basement of Block 4 to the north wall of that basement then turned southward along a timber beam to the main switchboard.

Main Switchboard.—This carried the main circuit breaker and switches and fuses for the sub-circuits. Current-transformers were mounted behind the switchboard which was totally enclosed by a wire mesh screen.

Alternating current (A.C.) was used for lighting throughout the building, minor space heating, single-phase power for small motors, and three-phase power for larger motors, including those for two electric hoists.

D.C.—The D.C. supply entered the building from Colombo Street at the south-east corner of Block 1.

The incoming D.C. main was taken along the south wall of the right-of-way on the south side of Block 1 to the D.C. switchboard on the south wall of the ground floor of Block 4, the main fuses being mounted on the switchboard.

Direct current (D.C.) was used for driving both the passenger-lifts and also motors of sewing-machines in the dress-making department.

Fire-alarms.—There was no fire-alarm system, either automatic or manual, installed in the building.

Bells.—A system of time-bells was installed on the wall opposite the door of the cash-desk for the purpose of informing the staff of the times for commencement and cessation of work. These bells were operated automatically by a time mechanism located immediately alongside the bells.

There was a night bell situated on the ground floor of Block 2 over the opening leading to the main stairway. It was operated from a push button at the staff entrance in the right-of-way from Colombo Street and was used for the purpose of calling the night-watchman when required to admit staff returning back to work after normal working-hours.

There was a system of bells for calling the various dressmaking workrooms operated from three bell-pushes located alongside the lift-door on the second floor of Block 2 and from pushes in Miss Drake's room and Miss Hardy's room. A bell in the hairdressing workroom was operated by a push near the entrance to the hairdressing department, and a bell in the credit office was operated from a push in the credit manager's office.

Fire-fighting Equipment

Hoses.—There were four first-aid fire-hoses situated at accessible points on the roofs of Blocks 1, 3, 4, and 5, and also in the kitchen on the second floor of Block 6. A canvas fire-hose was provided in the tea-room on the first floor of Block 6.

Fire-extinguishers, fifty in number, were well distributed throughout the building. They were serviced by the Christchurch Fire Brigade at six-monthly intervals.

Lifts

Passenger lifts were Waygood-Otis lifts maintained by Messrs. Turnbull and Jones, Ltd., and were inspected at weekly intervals.

A goods-lift between the ground floor and the basement of Block 4 was hand-operated.

A service lift located in Block 6 ran from the ground floor to the second floor, serving both the tea-room and the staff cafeteria and was operated electrically (A.C.).

A dumb-waiter, or food-hoist, between the kitchen on the second floor and the servery on the first floor was also electrically operated (A.C.).

Gas Services

Gas services entered the building at five points, each provided with a meter: –

A 1¼ in. supply to a meter (A) in the basement of Block 1.
A 1½ in. supply to a meter (B) in the basement of Block 2.
A 2 in. supply to a meter (C) in the basement of Block 3.
A 1¼ in. supply to a meter (D) on the ground floor of Block 5.
A 2 in. supply to a meter (F) on the ground floor of Block 6.

Internal reticulation from the various meters was as follows:—

Meter A: Gas-fires in dressmaking-rooms.

Meter B—
Cake counter (pie-oven).
Miss Drake's Alteration Room heating gas fires.

Meter C: Credit office, accounting office, shirt-room, tailoring workroom, and cafeteria overhead heating, and gas-fires in Mr. K. Ballantyne's and the cutters' rooms. The supply for the hatters' oven in the tailoring workroom passed through a check-meter (E) in the tailoring workroom.

Meter D: Cafeteria food-warming equipment and gas-fires.

Meter F: Tea-room, kitchen, and cake kitchen.

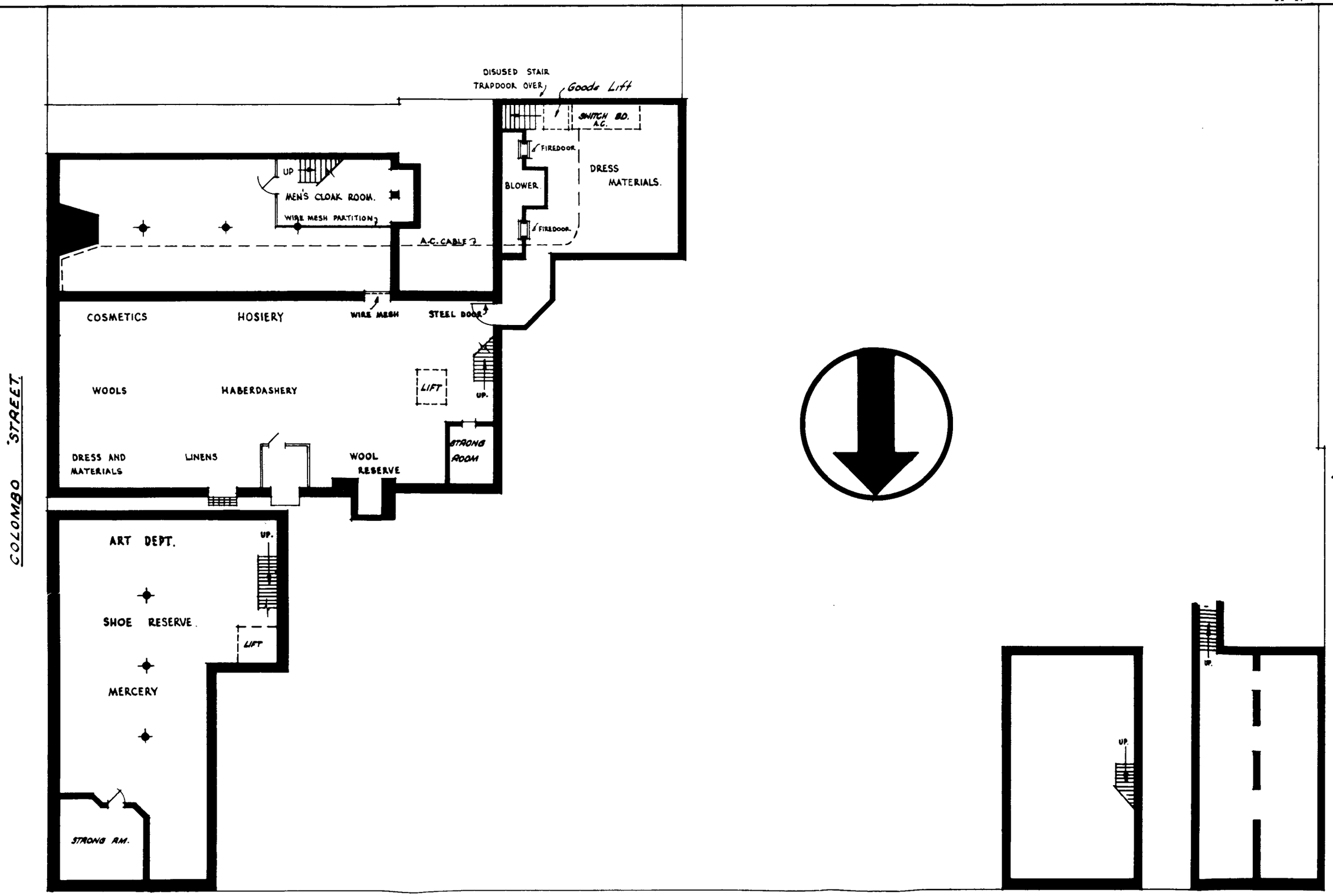
Central Heating System

All departments on the ground floor, as well as the hairdressing department on the first floor of Block 4, were heated by means of hot water circulated to radiators from a boiler installed in Block 7.

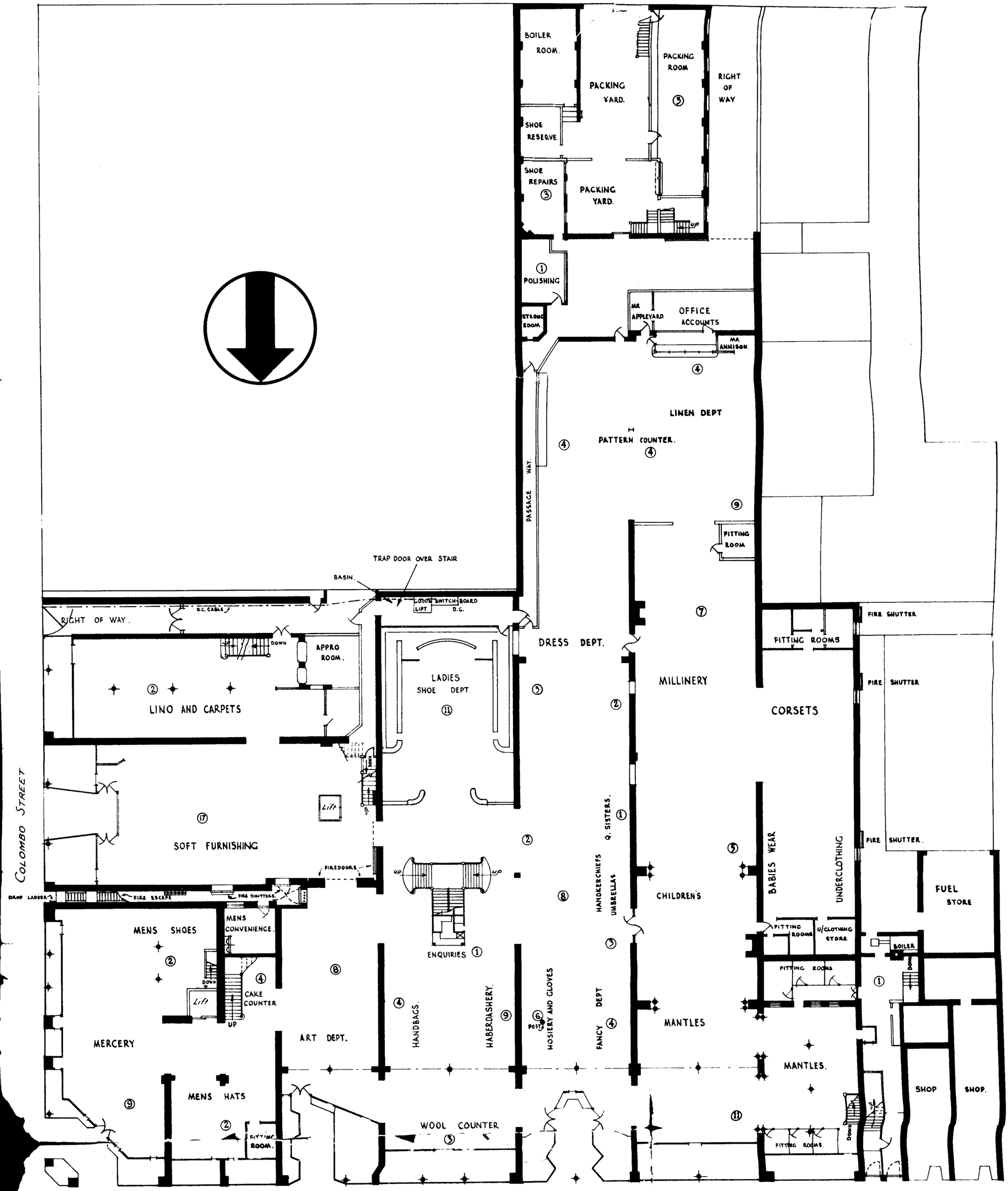
Christchurch, 22nd January, 1948.

APPENDIX C.—PLANS SHOWING LAYOUT OF FLOORS

[*Two following folders*]



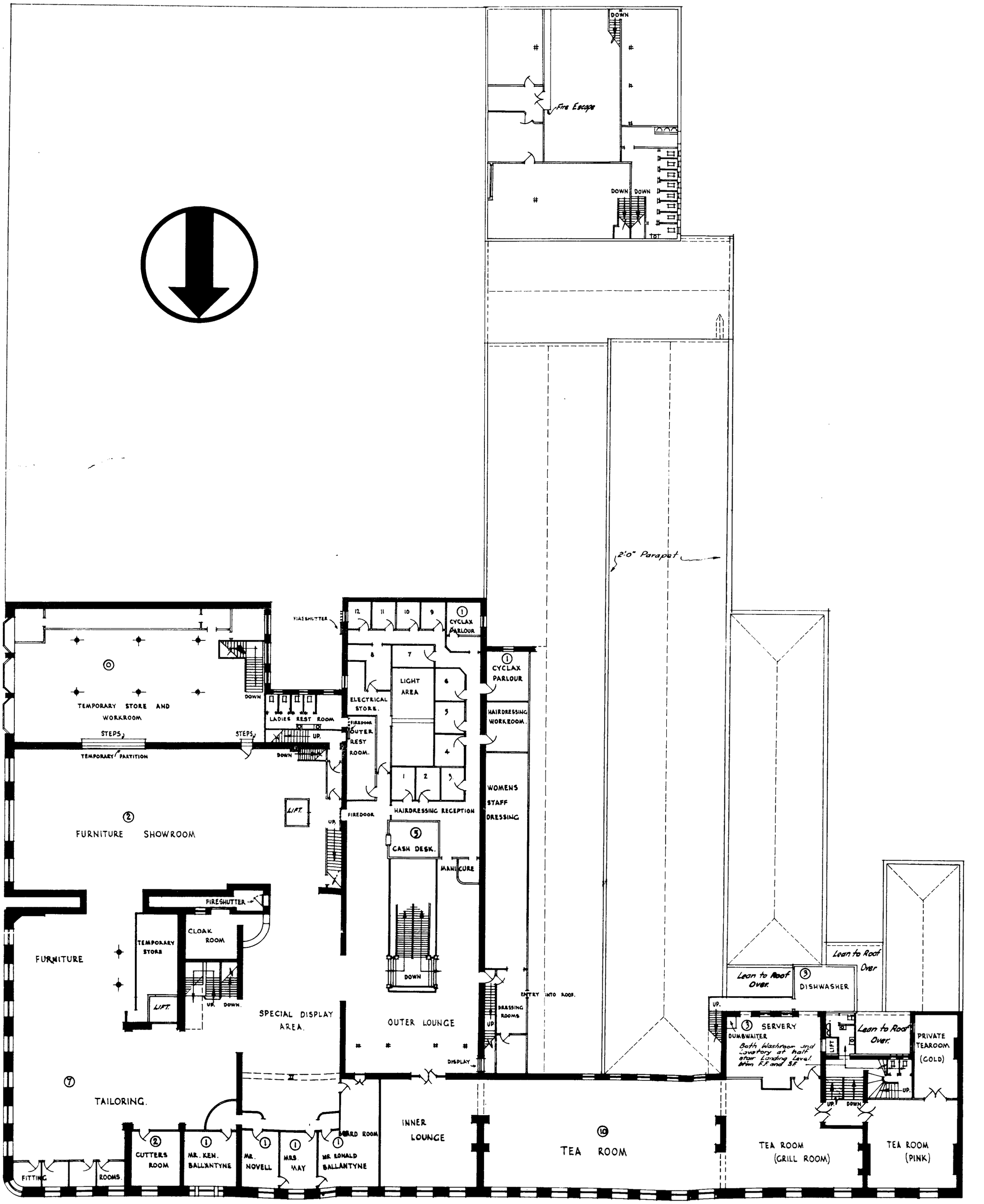
BASEMENT PLAN



GROUND FLOOR PLAN

LEGEND

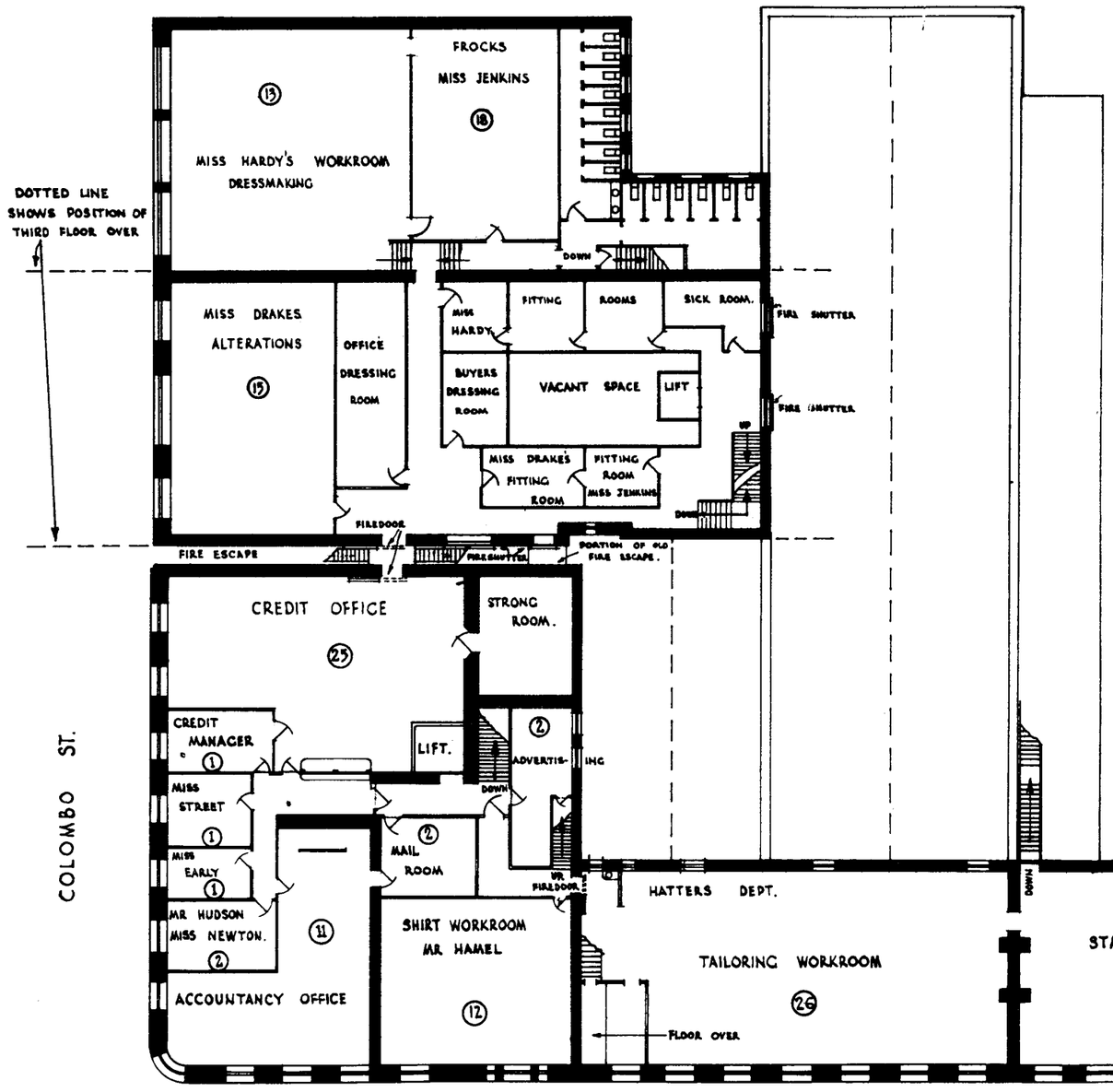
NUMBER IN CIRCLE INDICATES NUMBER OF OCCUPANTS.



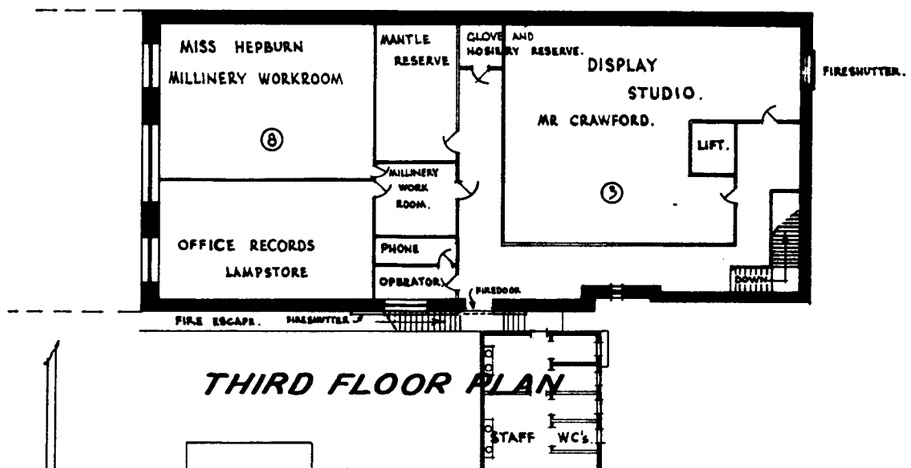
FIRST FLOOR PLAN

LEGEND

NUMBER IN CIRCLE INDICATES NUMBER OF OCCUPANTS



SECOND FLOOR PLAN



THIRD FLOOR PLAN

LEGEND

NUMBER IN CIRCLE INDICATES NUMBER OF OCCUPANTS

APPENDIX D.—REPORT UPON INVESTIGATION OF THE MAIN ELECTRICITY SUPPLY CIRCUIT FOR THE PREMISES OF MESSRS. J. BALLANTYNE AND CO., CHRISTCHURCH, FOLLOWING THE FIRE OF 18TH NOVEMBER, 1947.

INDEX

LIST OF PHOTOGRAPHS

Test-room, State Hydro-electric Department,
Addington, Christchurch, 14th January, 1948.

Memorandum for—

The Acting District Electrical Engineer,
State Hydro-electric,Department,
P.O. Box 1251,
Christchurch C. 1.

REPORT UPON INVESTIGATIONS OF THE MAIN ELECTRICITY SUPPLY CIRCUIT FOR THE PREMISES OF MESSRS. J. BALLANTYNE AND CO., CHRISTCHURCH, FOLLOWING THE FIRE OF 18TH NOVEMBER, 1947

GENERAL

An investigation of the main electricity supply circuit from its source in the Lichfield Street Substation of the Municipal Electricity Department, Christchurch, up to and including the main electrical switchboard on the premises of Messrs. J. Ballantyne and Co., at the corner of Colombo and Cashel Streets, Christchurch, was commenced on Friday, 21st November, immediately upon request by the Police Department, Christchurch.

The main electrical switchboard and about half the total length of electricity mains cable, being that portion terminating in the main electrical switchboard, was found on the site.

The service entrance mains, service fuses, and the balance of the total length of electricity main cable, being that portion originating at the service fuses, were found on the premises of Messrs. Wooff and Salvesen, Christchurch. It is understood that Messrs. Wooff and Salvesen caused these parts to be removed from the premises of Messrs. J. Ballantyne and Co. to their own premises, and it is further understood that that portion of the electricity mains cable so removed was first cut into five parts for the purpose of ease in removal.

There is no reason to believe that the parts found on the premises of Messrs. Wooff and Salvesen were not parts removed from the premises of Messrs. J. Ballantyne and Co., and there is no reason to believe that they were not all the parts so removed.

Observations, measurement, tests, and photographs were made on the site, observations were made on the premises of Messrs. Wooff and Salvesen, and ultimately the service entrance mains, service fuses, all the electricity mains cable, two cable-end boxes, and that portion of the main electrical switchboard known as the oil-filled circuit breaker were removed to the State Hydro-electric Department's premises at Addington, where further observations, measurements, tests, and photographs were made and recorded.

LIST OF PARTS UPON WHICH INFORMATION IS SUBMITTED

The parts upon which information is submitted are those several parts necessary for the supply of electricity in the order of from the source of electricity supply in the Lichfield Street substation to the main electrical switchboard on the premises of Messrs. J. Ballantyne and Co., and described as follows:

(*a*) Source of electricity supply in Lichfield Street substation.

(*b*) Overhead lines between Lichfield Street substation and the outside wall at the first-floor level of the most southerly Colombo Street frontage of Messrs. J. Ballantyne and Co.

(*c*) Service entrance mains passing directly through the Colombo Street wall on the first-floor between the overhead line termination outside and the service fuses inside.

(*d*) Service fuses at an elevation of approximately 7 ft. 6 in. above the floor-level of the first floor and on the inside of the Colombo Street wall.

(*e*) Electricity mains cable of approximately 185 ft. total length originating in a cable-box immediately below the service fuses on the first floor and passing directly to the basement being secured to the wall *en route*, thence, beneath

the floor-boards of the ground floor and within view from the basement throughout most of the route to the termination cable-end box, attached to the oil-filled circuit breaker at the main electrical switchboard in the basement.

(*f*) Main electrical switchboard.

SUMMARY OF INFORMATION SUBMITTED ON THE SEVERAL PARTS

(*a*) *Source of Electricity Supply in Lichfield Street Substation :—*

Transformer capacity.

Make, rating, and technical data of overhead line protective device and finding following the fire.

(*b*) *Overhead Lines :* Route and area served.

(*c*) *Service Entrance Mains.*—A description of sort, size, and number of conductors, size of enclosing pipe, and description of appearance after the fire.

(*d*) *Service Fuses :—*

Physical details of fuses and report of condition following the fire.

The fuse-link portion of one of the fuses for purpose of comparison with similar fuses blown at Addington under controlled conditions, also the fuse-link portion of all the fuses blown under controlled conditions.

A treatise upon a method of determining the magnitude of the current which flowed in a circuit immediately prior to the passage of fusing current by means of the appearance of the blown fuse and the application of the method to the blown service fuses from Messrs. J. Ballantyne and Co.

(*e*) *Electricity Mains Cable :—*

A drawing of the alleged route of the electricity mains cable.

A portion of the cable removed from the premises of Messrs. J. Ballantyne and Co., so prepared as to show constructional details.

Samples of steel-tape armouring showing, in some cases, burns believed to be due to electricity.

Physical details of cable, description of how it appeared to have been installed, and summary of damage to cable by fire.

Physical constants of metal parts of the cable.

(*f*) *Main Electrical Switchboard.*—A description of inspection of switchboard and oil-filled circuit breaker and details of tripping tests carried out on the oil-filled circuit breaker at Addington.

FINDINGS

There is no evidence to show that the supply of electricity, the protective device within the Lichfield Street substation on the circuit to the overhead line or the overhead line was improper so as to cause, due to electricity, fire on the premises of Messrs. J. Ballantyne and Co.

There is no evidence to show that, due to electricity, the fire on the premises of Messrs. J. Ballantyne and Co. originated in any of the following electrical parts :—

Service entrance mains.
Service fuses.
Electricity mains cable.
Main electrical switchboard.

In regard to the service entrance mains, the insulation was burned off the conductors where they projected beyond the indoor and outdoor ends of their enclosing pipe. There was no sign of electrical burning throughout their length, and, for this reason, it is not considered that these service entrance mains caused the fire.

All three service fuses were found to be blown. The fuse link which melts when the fuse is referred to as having blown is enclosed in an open-ended asbestos tube. Molten metal could drip out of the end of the fuse when it is being blown, but experience has

shown that the enclosing asbestos tube is protection from fire due to the blowing of a fuse. In the light of this experience it is not considered that the actual blowing of the three service fuses caused the fire.

The electricity mains cable shows signs of having been at a very high temperature and of electrical burning in a length confined to that portion in the basement which is considered to have been between the third I bearer in from the Colombo Street frontage and the first of two brick walls immediately beyond this I bearer and parallel to it. Also within this length the cable was found to be severed. The severed ends have the appearance of having been alive from the source of electricity when the severing took place because they have the appearance peculiar to burning by electric arc. In addition, the steel tape armour has several burns considered to be due to an electric arc. These burns have caused the two tapes forming the armouring to be welded together, and thus the amount of overlap existing at these points at the time of welding was preserved and has since been measured. There are four cases of welding and, instead of the overlap of the double steel tape armour being the normal amount of $\frac{1}{2}$ in., it is $\frac{3}{4}$ in., $\frac{3}{4}$ in., $\frac{3}{8}$ in., and $\frac{1}{8}$ in. respectively for the four welds. Because of these four cases of departure of the amount of overlap of armouring from the normal it is considered that, when the welding took place, the cable armour was not in its normal state and that in order to bring about this departure of the amount of overlap from the normal and welding of the armouring in this new position considerable external forces would be required to be applied to the cable while it was alive. Such forces could be applied by falling debris due to a fire, by an explosion or by other means.

It has been claimed by others that one of these four welds between tapes, the one with the $\frac{1}{8}$ in. overlap, was where the armour was found to be welded to the I bearer referred to above. This claim is supported by visual evidence of two marks of burning on the top of the I bearer. These marks of burning on the I bearer were not immediately below the place where the cable is believed to have been fixed on installation. The nearest point of burning on the I bearer was at a distance of $1\frac{5}{8}$ in. measured in a horizontal plane from what is believed to have been the vertical centre line of the cable. Because of this it is considered that the cable was moved bodily horizontally from its position, that it was moved by the application of external force, that this external force also moved the cable in a downward direction, and that the cable was still connected to the live source of electricity when it reached the position where it was found welded to the I bearer.

The welding of the cable armour to the I bearer is considered to have been brought about by the armouring having been made alive from in the vicinity of the severed cable ends and the I bearer having been, for some reason, at earth potential. At the points where the cable armour was welded to the I bearer the jute serving of 0·125 in. thickness on the outside of the cable armour either was not present or had become a very good conductor, possibly by charring, so that, instead of requiring an electrical pressure of 2,860 volts (by test) to break it down, virtually it permitted the armour to be in electrical contact with the I bearer.

It is to be noted here that there was no evidence of the lead sheath and the double steel tape armour of the cable having been in intentional electrical connection with each other and with earth as was expected. In the absence of this evidence it was considered desirable to know the electrical pressure necessary to cause break-down between the lead sheath and the double steel tape armour and external metal which might have been in contact with the jute serving on the outside of the armour. These values of electrical pressure were measured and, expressed in volts, they are as follows:—

Between the lead sheath and the double steel tape armour ..	6,300 volts
Between the double steel tape armour and a metal sleeve clamped to the outside of the jute serving and made completely to surround the cable for a length of 5 in.	2,860 volts.

In regard to the insulation of the conductors of the cable the electrical pressure in volts which they were required to withstand without breakdown in the maker's works is :—

Between conductors and between each conductor and the lead sheath : 2,500 volts for 15 minutes.

(The normal electrical pressure in service was 400 volts between conductors and 230 volts between conductors and the lead sheath.)

In a cable such as this electricity mains cable, experience has shown that failure of its insulation other than at a point where it has been prepared for connection to apparatus is extremely unlikely. There is no evidence of failure of this cable at the two points where it was prepared for connection to apparatus—namely, the service fuses at one of its extremities and the oil-filled circuit breaker at the other of its extremities.

In this cable the thickness of insulation in relation to the normal electrical stresses is approximately 44 per cent. greater between the conductors and the lead sheath than between the conductors themselves.

The possibility of an electrical breakdown of the cable prior to the fire and the heating of the steel tape armour by the passage of leakage current along it to earth so as to promote fire has been considered.

There is evidence from tests of fuses similar to the service fuses that leads to the opinion that any leakage current in the armour of the electricity mains cable prior to the blowing of the service fuses was so small as to be ineffective in promoting heating.

The evidence from these tests on fuses is that just prior to the blowing of the service fuses a current of not more than 100 amperes per phase was flowing. There is no record of the actual load current at the time of the fire, but from the Christchurch Municipal Electricity Department's records the current in amperes in the three phases at the time of maximum loading over the two months prior to the fire was 173, 171, and 173 amperes respectively. The load current at the time of the fire is not expected to have been as great as the above values because it was mid-afternoon, the day was sunny, visibility had been good, and it is understood that certain electrical loads were switched off as it became known to employees that something untoward was happening with the premises.

In view of this it is estimated that the value of load current just prior to the blowing of the fuses was 100 amperes per phase.

With a fuse pre-heating current of not more than 100 amperes as indicated by the appearance of the blown fuses and an estimated load current of 100 amperes it is considered that there was little room for fault current and that any fault current flowing in the armour of the electricity mains cable was so small as to be ineffective in promoting heating.

The oil-filled circuit breaker was the sort that automatically interrupts the circuit when fault current of sufficient magnitude flows through it for sufficient time. It is not known, on the occasion of the fire, whether or not it tripped automatically.

Afterwards, two of its three trip devices were found still to function, and on examination it was found that fire had caused some damage which prevented operation of the third trip device. The main contacts of this circuit breaker were in good condition and did not have the appearance of having interrupted heavy fault current.

In regard to the main electrical switchboard, all the evidence was consistent with the effects of fire on electrical equipment, and there was no evidence to lead to the belief that therein lay the cause of the fire.

INFORMATION ON THE SEVERAL PARTS

(*a*) Source of Electricity-supply in Lichfield Street Substation

The transformer capacity was 2,000 kVA. or 2,890 amps. per phase the voltage being 400 volts phase to phase and 230 volts phase to neutral and earth. The overhead line protective devices consisted of three Aeroflex cartridge-type fuses each

of 500 amps. rating. These fuses consisted of two bi-metal strips in intimate contact throughout most of their length between the end terminal posts, except for a short section of approximately 1 in. at the centre of the link where a pocket is formed by the inner surfaces having a concave shape. This pocket is covered with a special flux to prevent oxidation or deterioration when the link is raised to a temperature approaching melting-point. On either side of this pocket is a reduced section of a metal other than that of the metal comprising the greater part of the link. The whole of the link is enclosed in a tube filled with a damping powder.

The magnitude of the fusing current can be determined as follows :—

(i) Up to ten times fuse rating the link blows at the pocket.

(ii) From ten times up to twenty times fuse rating one of the reduced sections blows.

(iii) Over twenty times fuse rating both reduced sections blow.

The fuses on red and white phases were found to be blown after the fire, with the blow occurring at the pocket, thus indicating that the fusing current was not in excess of 5,000 amps.

For discrimination of these fuses compared with that of the heaviest link of the service fuses installed at Ballantynes (see graph, page 102).

(*b*) Overhead Lines

The overhead lines from which Ballantynes was supplied runs from the Lichfield Street Substation supplying Ballantynes' bulk store as its first consumer and then passes around the corner of Lichfield Street in a northerly direction into Colombo Street, where it supplies all those consumers on Colombo Street between Lichfield and Cashel Streets with the exception of Beath's Building.

(*c*) Service Entrance Mains

Each phase lead consisted of twin V.I.R. 19/·083 in. conductors, while the neutral lead consisted of twin V.I.R. 19/·072 in. conductors. All leads terminated in cable sockets attached to the overhead service lines outside the building and cable sockets attached to the service fuses inside the building. The conductors were enclosed in a 3 in. water-pipe which passed through the outside wall. Where protected from the fire by this pipe the conductors were in reasonably good condition, where exposed they were burnt, but at no portion of their length was there any evidence of electrical breakdown either between conductors or between conductors and their enclosing pipe.

(*d*) Service Fuses

Physical Details of Service Fuses

These service fuses were mounted on a switchboard between the terminations of the service mains and cable and were loaded with the following sizes of wire :—

No. 1 5/·029 in., 5/·029 in., 7/·029 in., 5/·029 in...	Total 22/·029 in.
No. 2 3/·029 in., 7/·029 in., 7/·029 in.	Total 17/·029 in.
No. 3 4/·029 in., 7/·029 in., 7/·029 in.	Total 18/·029 in.

The above strands of fuse wire were twisted together in three continuous conductors, which were enclosed, in each case, by an asbestos tube.

Report of Condition

The porcelain wedges of the above were cracked as by heat, the contacts, though blackened, appeared to be in sound condition, and the asbestos damper tubes were undamaged with the exception of one which showed a clean break and was presumably broken after the fire.

The fuse wires were blown, the strands being welded together and terminating in blobs of copper. There were gaps of $\frac{5}{8}$ in., $1\frac{3}{4}$ in., and $1\frac{1}{8}$ in. where the fuse wires had blown.

When found the service fuses and their panel were lying amongst the charred debris on the floor of the first floor due to the collapse of the wooden wall on which they were mounted.

In order to determine the manner in which the service fuses were blown tests were carried out under controlled conditions with the object of reproducing similar physical effects as those shown by the service fuses.

Physical Effects on Fuse Links Blown in Various Ways

Tests were carried out on a set of ten fuse links similar to the heaviest of those used in the service fuses at Ballantynes at the time of the fire. Each link consisted of twenty-two strands of 0·029 in. tinned copper twisted tightly together and having an overall length of 8 in. The ends of these links were divided into groups of 5, 5, 5, and 7 strands, which were secured to heavy brass blocks by means of four clamping screws. The link itself was enclosed in an asbestos tube of $\frac{1}{2}$ in. internal and $\frac{3}{4}$ in. external diameter.

The recovery voltage throughout all these tests was approximately 12 volts, which permitted a true indication of the physical conditions of the fuse links at instant of blowing as no destructive arc was formed by a high recovery voltage in the order of 230 or possibly 400 volts as would be found in normal service.

At 300 amps the central portion of the fuse link maintained a temperature approaching melting-point (cherry red), but did not blow after fifteen minutes. The lowest fusing current was found to be 325 amps with a fusing-time of six minutes twenty seconds, and the interstrand welding extended over a length of approximately $\frac{1}{2}$ in. With an increase in fusing current the time decreased and the interstrand welding increased, until at 1,200 amps the time was only five seconds and the length of weld was approximately 5 in. (see Fig. III, page 102, for time-current curve).

With reference to length of interstrand welding this measurement is that between extremities of interstrand welding with the original ends of the fuse links 8 in. apart.

From test samples of blown fuse links submitted herewith it is seen that at low fusing currents the length of the link raised to melting-point is very short, while at high fusing currents (1,200 amps or over) the length that has been raised to melting-point is practically the full length of the link.

From the above results curves (*a*) and (*b*) Fig. I, are typical temperature gradients for low and high fusing currents respectively, while curve (*c*) is considered to be the temperature gradient for a current below minimum fusing value.

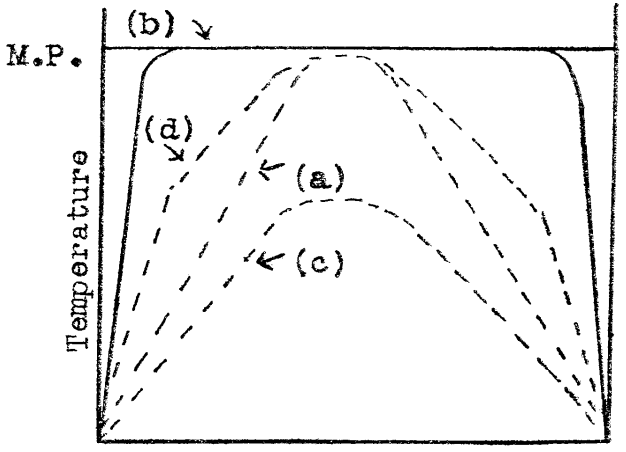


FIG I.—LENGTH OF FUSE LINK.

As the temperature gradient before the fuse link is preheated—that is, before a given minimum current is passed through the link—is a straight line, and the final temperature gradient is also a straight line for the greater part of the fuse link, it can be assumed that the portion of the curve below the extremities of the final straight line remains a straight line throughout its rise from zero to melting-point. That is, for a given time the temperature rise along that part of the curve is uniform.

If a fuse is preheated—that is, if a current less than minimum fusing current is passed through the fuse—a temperature gradient having the characteristics of curve (*c*), Fig. I, will be obtained. Now if the current is suddenly increased to a high fusing value the temperature rise along the greater part of the fuse link will be uniform, thus giving a resultant temperature gradient having the characteristics of curve (*d*), Fig. I.

That is, if the fuse is carrying sufficient current to preheat the link only a short central portion of the link will be raised to melting-point and a type of blow similar to that at minimum fusing current will be obtained irrespective of the magnitude of fusing current.

Further tests were carried out by using various preheating currents and then blowing the fuse by suddenly increasing the current to a definite value (1,800 amps.). From curve Fig. II, page 101, it will be seen that a preheating current in excess of 30 per cent. of minimum fusing current has a marked effect on the length of interstrand welding. For fuses blown with a preheating current less than 30 per cent. of minimum fusing current some of the metal had run down to the lower end of the link.

Now if the fuses are blown with a high recovery voltage the physical conditions at instant of blowing will be identical to that of fuses blown with a low recovery voltage, but the larger arc formed will raise a section of the metal above its melting-point. This molten metal will flow down the link till such time that it comes in contact with a cooler part of the link.

In the case of a peaked temperature gradient this molten metal will " freeze " to the fuse link almost as soon as it leaves the vicinity of the arc, but with a practically straight line temperature gradient over the whole length of the link the molten metal will flow down to the lower end of the link before " freezing." This is of importance, as the point of " freezing " gives a more definite indication than interstrand welding, of the distance from the original and of the link at which the temperature reaches melting-point. From both the theoretical point of view and from practical tests the temperature gradient along both sections of the fuse on either side of mid-point will be symmetrical, and if one point can be determined definitely then the overall length reaching melting-point on interstrand welding can be fixed.

Although the central portion of the link might be destroyed by the arc those portions attached to the end blocks are not affected and a fairly definite indication with regards to preheating current can be obtained from the physical condition of the ends of the fuse link.

One fuse (17/·029) was blown at 300 amps. with a recovery voltage of 400 volts and the physical conditions were as expected from the above deductions.

Referring to Fig. I, curve (*a*) is a typical temperature gradient for a fuse link having an initial straight line temperature gradient. Now, if the whole fuse assembly is subjected to external heating the initial temperature gradient would remain practically a straight line as the fuse link is enclosed in an asbestos tube and the radiation would be negligible compared with the conduction of heat from the brass end blocks. That is, the physical effects would remain constant irrespective of the ambient temperature unless that temperature approached melting point.

As the tinning of the group of end strands going to the terminal posts was not affected it can be assumed that the fuse links were not raised to an excessively high temperature.

With reference to the original link (22/·029 in.) as removed from the service fuse at Ballantynes after the fire, the interstrand welding extended over practically the whole length of the fuse link and the molten metal had run down to the very lower end of the link before " freezing " and forming a globule of metal.

This indicated that the fusing current had been in excess of 2,000 amps with a time-delay less than five seconds and that the preheating current did not exceed 30 per cent. of minimum fusing current of 325 amps—that is, 100 amps.

From information received from Municipal Electricity Department the maximum load current for two-monthly period prior to the fire was 173, 171, and 173 amps per phase.

As the fire occurred at approximately 3.30 p.m. on a hot, sunny afternoon in the middle of November it can safely be assumed that the lighting and heating load would be low and that the load per phase would be in the vicinity of 100 amps. This means that if there was any fault current it would be of a very low value.

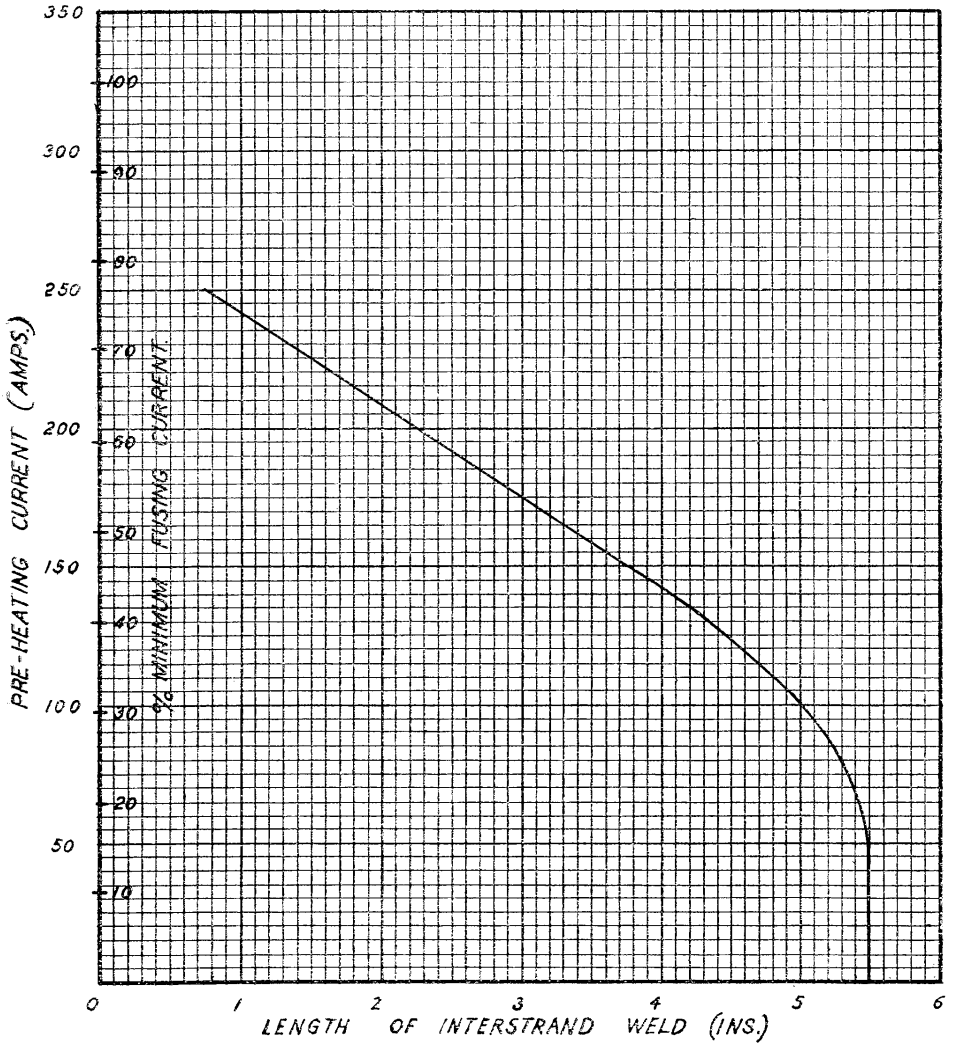


FIG. 11.—LENGTH OF INTERSTRAND WELD AGAINST PRE-HEATING CURRENT FOR 22/·029 FUSE LINK WITH BLOWING CURRENT OF 1,800 AMPS.

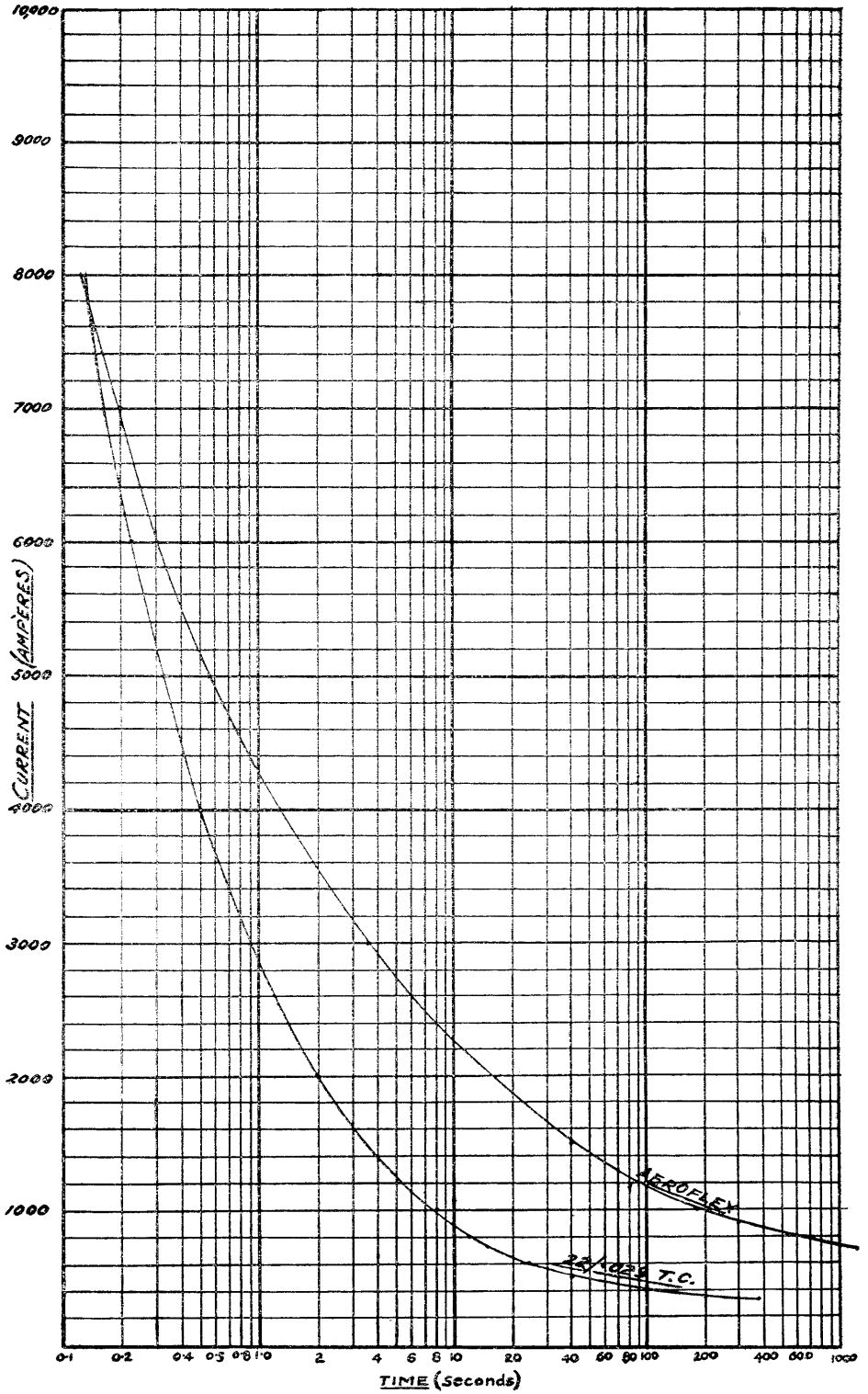


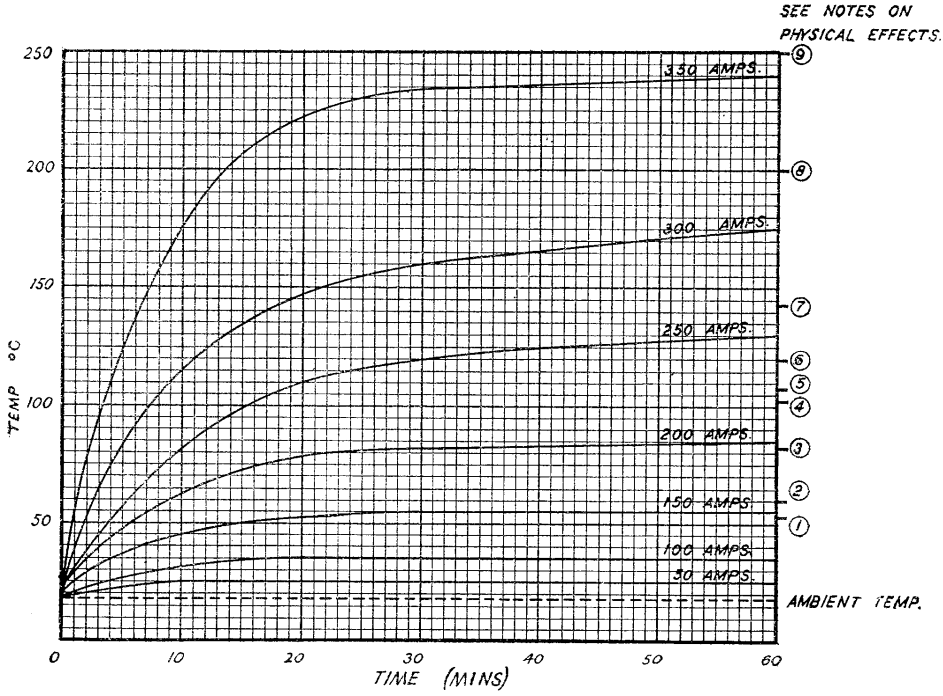
FIG. III.—TIME-CURRENT CURVES FOR AEROFLEX FUSES (500 AMP RATING) LOCATED IN M.E.D. SUBSTATION, LICHFIELD STREET, AND HEAVIEST FUSE (22/·029 T.C.) USED IN SERVICES FUSES AT MESSRS. J. BALLANTYNE AND CO. AT TIME OF FIRE

Temperature Rise of Cable

Tests were carried out on a 7 ft. length of cable similar to the electricity mains cable in Ballantynes to determine the time against temperature rise, and maximum final temperatures of the cable for a given current being passed through the steel armouring. These tests were carried out under still atmospheric conditions in the High Tension Laboratory, State Hydro-electric Department, Addington.

For each given current three (3) temperature readings were taken at equal intervals of time during the heating of the cable at that current, and from these results the time against temperature rise (Fig. IV, page 103) and final maximum temperature (Fig. V, page 104) were calculated.

A further heat run at 500 amps. was carried out in order to observe the physical conditions of the cable at given temperatures. For results of tests see notes attached to temperature-time curve. (Fig. IV, page 103).



Note No.	Temp. °C.	Physical Effects.
1	53	Serving softening.
2	61	Smell noticeable.
3	83	Vapour noticeable.
5	108	Compound bubbling slightly.
6	120	Compound dripping out of serving.
7	143	Vapour noticeable, gassing volubly.
8	200	Vapour less dense.
9	250	Impregnation running out of paper insulation around conductors.
10	320	Vapour increased and became more pungent. Jute serving charred but did not ignite immediately when match was applied to it.

FIG. IV.—TEMPERATURE: TIME CURVES FOR HEATING OF CABLE BY PASSING GIVEN CURRENT THROUGH STEEL ARMOURING

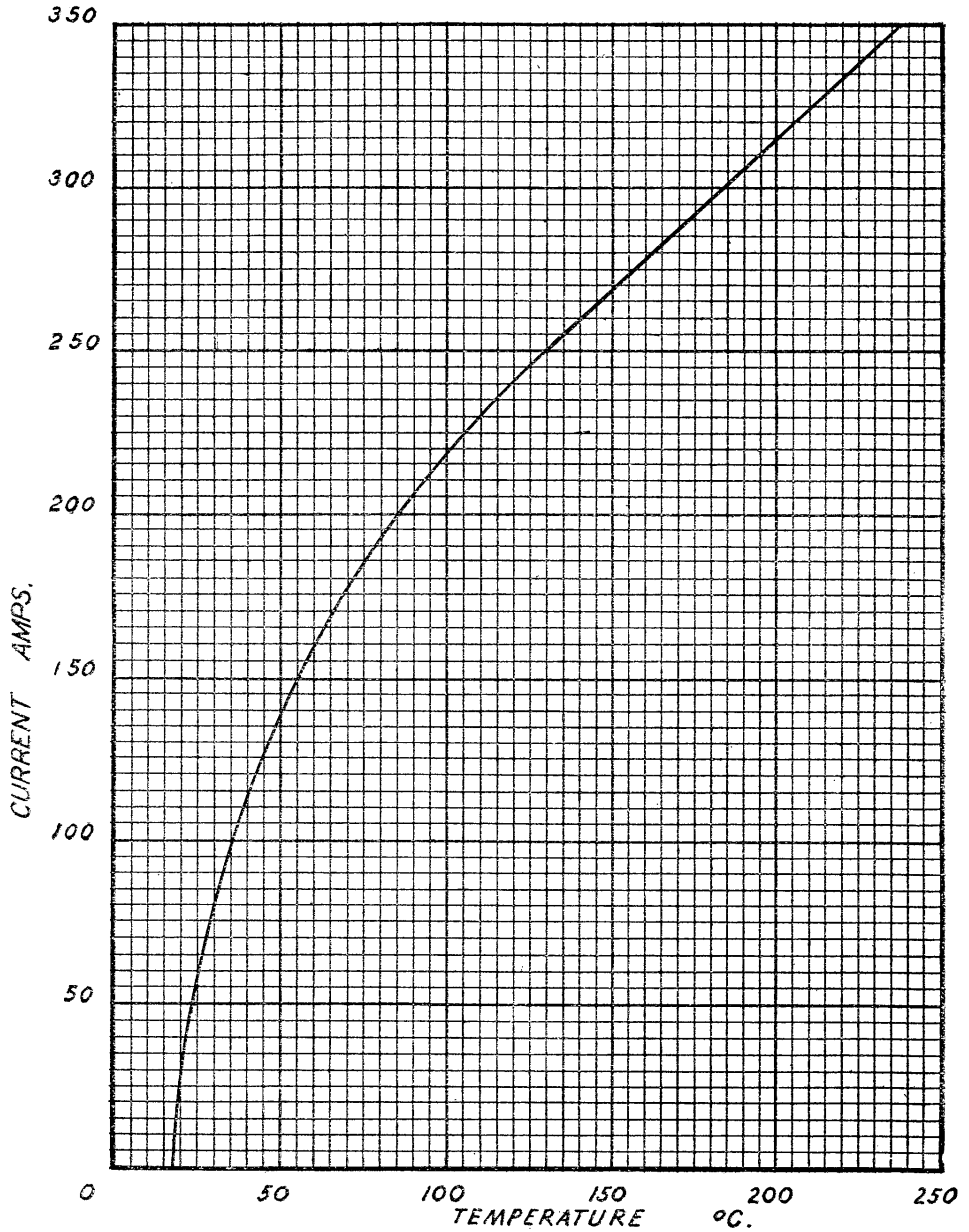


Fig. V.—Current: Maximum Temperature Curve for Heating of Cable by Passing Given Current Through Steel Armouring

(*e*) Electricity Mains Cable

A drawing of the alleged route of the electricity mains cable is numbered (F.Ch. No. 907) and attached hereto.

A portion of the cable removed from the premises of Messrs. J. Ballantyne and Co. prepared to show constructional details is available and is labelled Exhibit 3. Samples of steel tape armouring showing, in some cases, burns believed to be due to electricity are available labelled Exhibit 4.

Physical Details of Cable

The cable was a four-core-shaped conductor, belted paper-insulated, lead-sheathed, one having double steel-tape armouring, a coat of bitumen paper insulation and jute bedding over the lead sheath and a coat of bitumen and jute serving over the armouring, this latter covering being thoroughly impregnated with bitumen.

The makers' name stamped on the paper insulation was "Pirelli General."

Number and sizes of conductors strands—

Outer layer, 23 each, ·082 in. diameter.

Inner layers, 45 each, ·072 in. diameter.

Area of each conductor, ·305 square inches.

Dimensions of first paper insulation—

Between conductors 0·1 in.

Between each conductor and lead sheath, ·083 in.

Lead sheath, ·139 in.

Second paper insulation, 0·1 in. (comprising two layers of ·005 in.).

Jute bedding, ·125 in.

Armouring twin tapes, each 1·75 in. wide, of ·0395 thickness; lap of tapes, $\frac{1}{2}$ in.

Jute serving, ·125 in.

Approximate total overall diameter, 2·50 in.

Note.—This cable conforms to British Standard Specification No. 480 of 1933.

Physical Constants of Cable

The following tests were carried out on a piece of cable (approximately 7 ft.) similar to the cable as described above:—

Resistance and Impedence of Lead Sheathing and Steel Armouring—

Lead Sheathing: Resistance per foot, ·0001304 ohms.

Steel Armouring: The inner and outer steel tapes were bonded together at the ends and the resistance per running foot of cable determined. Resistance per foot, ·001321 ohms.

Impedence of Steel Armouring: A.C. was passed along the steel armouring and the potential difference between ends measured. Impedence per running foot, ·00214 ohms.

Temperature Coefficient and Specific Resistance of Steel Armouring.—Ten feet of the steel tape was immersed in an oil-bath and the whole heated to approximately 85° c. by passing current through the tape. A Kelvin Double Bridge was used to measure the resistance as the temperature decreased. For results see Fig. VI (page 107).

Temperature Coefficient .. $R_1 = \cdot 009025$ when $t_1 = 0°$ c.
$R_2 = \cdot 011175$ when $t_2 = 50°$ c.

$$\text{Therefore temperature coefficient} = \frac{R_2 - R_1}{R_1 t_2 - R_2 t_1}$$

$$= \frac{\cdot 011175 - 009025}{\cdot 009025 \times 50 - 0}$$

$$= \frac{\cdot 00215}{\cdot 45125} = 4{\cdot}77 \times 10^{-3}$$

Specific Resistance—

Length, 304·8 cm.
Width, 4·45 cm.
Thickness, 0·1005 cm.
Area, 0·447 sq. cm.
Ro (Fig. VI), ·009025 ohms.

$$\text{Sp. Res.} = \frac{\cdot 009025 \times \cdot 447}{1 \times 304{\cdot}8} = 1{\cdot}35 \times 10^{-5} \text{ ohms/cm}^3$$

Resistance between the two steel tapes forming the armour, over a length of cable of 7 ft., was less than 0·01 ohms. This did not alter appreciably when the cable was bent. From the above the resistance per running foot of cable is approximately 0·0014 ohms.

Pressure Tests on Cable :—

From Lead Sheath to Steel Armouring—

Megger tests—

Before : 6 megs.
After : 50,000 ohms.

Insulation broke down at 6,300 volts.

From Steel Armouring to Metal Sleeve 5 in. Long and Clamper Outside of Cable—

Megger tests—

Before : Infinity.
After : Zero.

Insulation broke down at 2,860 volts.

NOTE.—500 volt Megger used for above tests.

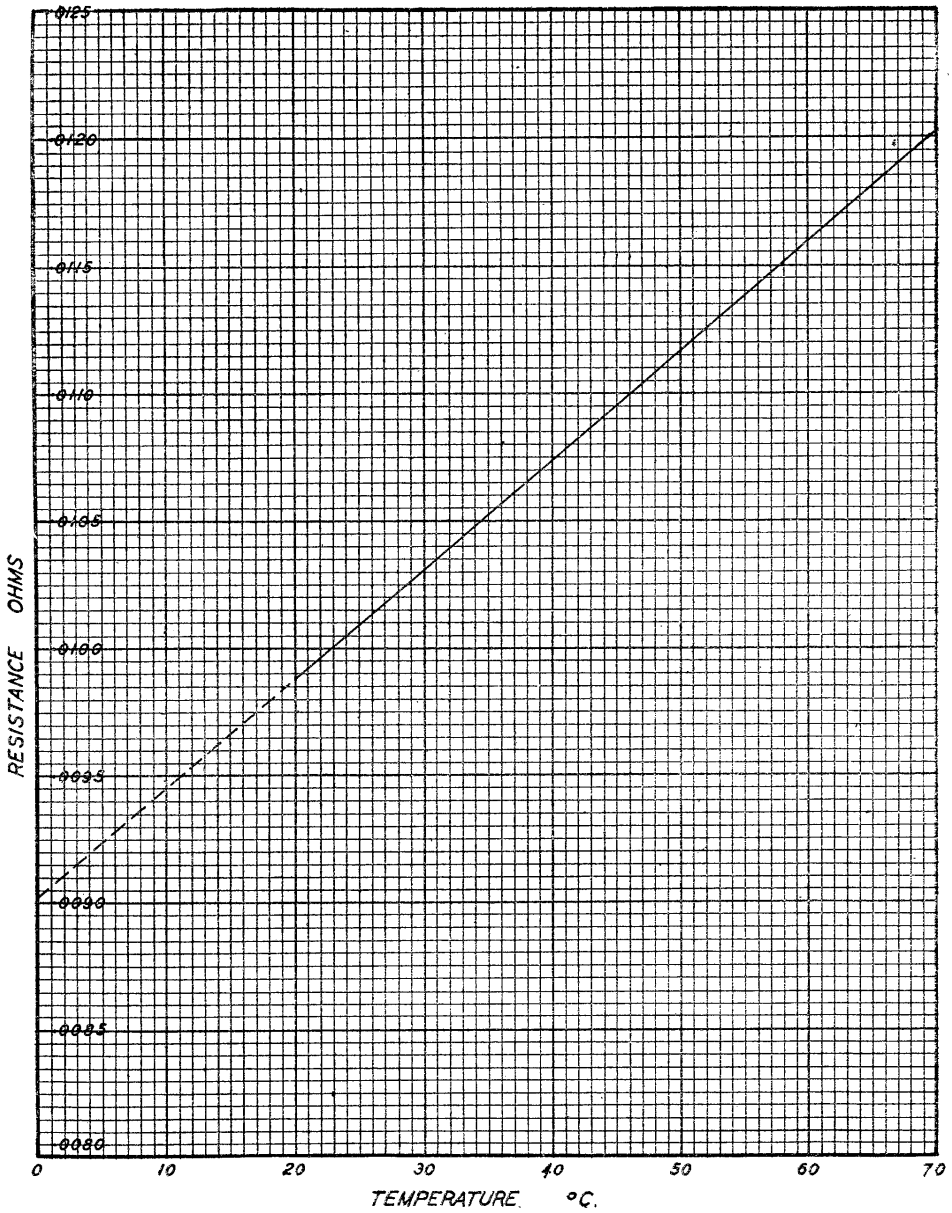


Fig. VI.—Resistance Against Temperature for Steel Armour

Overall Length of Cable and Method of Termination

Length.—From measurements taken in the building and various markings and remains of cable clips the approximate position of the cable run was plotted and, with due allowance being made for bends the estimated length from thimble to thimble, was thought to be approximately 185 ft. This, together with an unused 7 ft. 6 in. length at Addington, 1 ft. 4 in. held by Mr. Salvesen, and an estimated installation wastage of 1 ft. 2 in. brought the total length of the cable up to the length ordered for the job—viz., 195 ft.

Terminations.—The terminations consisted of an unfilled cable-end box being part of the O.C.B. at the switchboard end and a bitumen-filled cable end-box at the supply end of the cable. Here the conductors terminated in three service fuses which were installed on the inside of the outer wall of the first-floor compartment and which were connected to the ends of the short service mains passing through the outer wall to the termination of the service line.

Supports.—From the position of that portion of the cable which had been removed from the building before we were given the opportunity of inspection, and from various marks showing where the cable had been lain, it would appear that the cable passed down from the service fuse panel on the wooden lining, thence across the outside of the ground floor joists and along the side of one of these for the full length of the cellar. Where these floor-joists were supported by the steel I bearers there was 5 in. clearance from the tops of these girders to the flooring-boards above. Leaving the main cellar, the cable passed over a concrete foundation under a 4½ in. asphalt path, and thence through a brick wall into the cellar containing the main switchboard, where it was again supported on the floor joists and the wooden bearer.

Summary of Damage to Cable with Relation to Approximate Position In Building

From service fuse panel to cellar the conductors were intact, the paper insulation blackened where exposed, the lead sheathing melted and missing where the cable entered the cellar. The armouring still retained its original colour and springiness.

From the point of entry in the cellar to the second I bearer the conductors were intact, the paper insulation and lead sheathing missing, and the armouring was of a rusty colour and only slightly springy.

From the second I bearer to the first brick wall the conductors were broken at a point between the third bearer and the first brick wall. Near the bearer end of the break two conductors had two mechanical fractures in some strands (refer Photos 6 and 7). These fractures were approximately 5 in. apart, which was also the width of the bearer. At the broken end all conductors had tapered ends (refer Photos 2 and 4) and showed signs of intense heating, in some cases the strands running together whilst in a semi-molten state. Strands at the ends of conductors were melted together. The short conductor had a pointed termination with a deep scour on the outer side. Another conductor also had a deep scour on its outer side which may have been located beside that on the short conductor. There was also a slight melting of strands on this long conductor about one foot from the end (refer Photo 3).

The armouring marked by various indentations, which could have been caused by falling debris, became very soft towards the break, where it appeared to have been subjected to the most heat. At a distance of 5 ft. 11 in. from the broken end of the cable there were two irregular holes of $\frac{3}{16}$ in. and $\frac{1}{4}$ in. diameter burnt in the armouring, and 4 in. nearer the break there was a small burn on the edge of the outer steel armouring tape. The tapes were welded together at these holes with an $\frac{1}{8}$ in. lap (refer Photo 8).

Loose Piece of Armour

A piece of armouring which proved to be the continuation of the last preceding piece was discovered in the fire wreckage, the condition of the ends indicating that it had been cut away from the main cable. This piece was, unlike the others, stretched out so much that it was possible to measure the actual length between points of damage, which consisted of the complete severing of the outer tape with a lap of $\frac{3}{8}$ in. welded together (refer Photo 9), the partial severing of the inner tape with a lap of $\frac{3}{4}$ in. welded together (refer also Photo 9), and, 6 ft. away, two holes $\frac{3}{4}$ in. and $\frac{1}{4}$ in. in diameter with a welded lap of $\frac{3}{4}$ in. (refer Photo 10).

At the brick wall end of the break two short conductors had burnt terminations and the others showed mechanical breaks. The armouring was very soft and pliable, and where the cable passed over the brick wall the armouring had been flattened presumably by falling debris.

Between the first and second brick walls where the cable passed along a trench dug at ground-level there was a protective covering of timber and asphalt, and here the cable was virtually undamaged.

Between the second brick wall and the switchboard the cable seemed to have been subjected to a lesser degree of heat, and where running along a wooden bearer towards the O.C.B. the lead sheath was again intact, and at the O.C.B. the outer serving, though charred, was still intact.

Lapping of Armouring

The layers of steel tape armouring each $1\frac{3}{4}$ in. wide were originally laid on the cable with a space of $\frac{3}{4}$ in. between adjacent edges, which would mean that the outer layer overlapped the inner by $\frac{1}{2}$ in., whilst the pieces of damaged armouring under inspection showed the following laps: $\frac{1}{8}$ in., $\frac{3}{8}$ in., $\frac{3}{4}$ in., and $\frac{3}{4}$ in. This would indicate that the layers of armouring were not in their normal position when welded together at these points.

Possibility of Electrical Damage

Conductors.—The pointed termination of the short conductor and the marks on the adjacent conductor, on account of their clear definition, were possibly of electrical origin brought about as a result of the action of the fire on the cable. Were they caused by the actual heat of the fire it would be reasonable to expect a more gradual degree of melting without any clear definition of the marks. The same type of marks were apparent at the brick wall end of the break where two short conductors had burnt ends.

Armouring.—The damage of the armouring was also, for the same reason, possibly of electrical origin, the holes being clearly defined and possessing blunt edges. As previously noted, the indications are that the layers of armouring were in other than their normal positions when fused together.

Bonding or Earthing of Cable

Street End.—At this end-box there was no sign of the lead sheath having been wiped to the gland, but there was an earthwire from the lead sheath to a stud in the end-box. There were the remains of two 7/·029 earth wires attached to the cable end-box, and the presence of an earthing clip on the mains entry pipe and a slight mark on the armour clamp could indicate that these wires were attached to those two points. When found, this armour clamp did not fit tightly to the armouring. This end-box had contained bitumen.

O.C.B. End.—At this end-box there was no sign of the lead sheath having been in electrical connection with it by " wiping " to the cable gland or in any other way. There was no sign of the earthing of the armouring at this point, and it was made of jute serving about 1 ft. below the gland.

General Earthing

The remains of the main 7/·064 earth wire was still connected to the main water-pipe where it entered the building. While this pipe was being inspected it pulled away from its source, and the break showed no signs of electrical burning, but rather a deterioration of metal, presumably by rust. From the position of the cable socket, located on the framework of the O.C.B. and half-full of solder, it is assumed that this contained a bonding earthwire.

Inspection of Structural Metalwork

Possible Contact between Cable and I Bearers.—The three I bearers supporting the ground floor had a vertical clearance of 5 in. from the underside of the floor-boards, and the cable was run through this space, being secured to the sides of the floor-joists. It is not known whether or not the cable was resting of the upper surface of these I bearers, nor is there a known relationship between the metal parts of the cable and the I bearers had they been touching.

It has been claimed that after the fire the armouring of the cable was found welded to the third bearer and had to be prised off.

Earthing of I Bearer.—These bearers were grouted into the brick walls of the building and were supported midway by circular metal pillars which rested on the floor of the basement. There was a similar set on each floor and they were connected to the set immediately above or below by similar metal pillars making three separate frames of structural metalwork extending from the cellar to the roof. It is very probable that these frames were in mechanical contact with earthed metal in the form of conduits, waterpipes, &c., and in the cellar the main water-supply pipe ran parallel with the cable and over the tops of the three ground-floor bearers. It is possible that this water-pipe was in contact with some of the bearers.

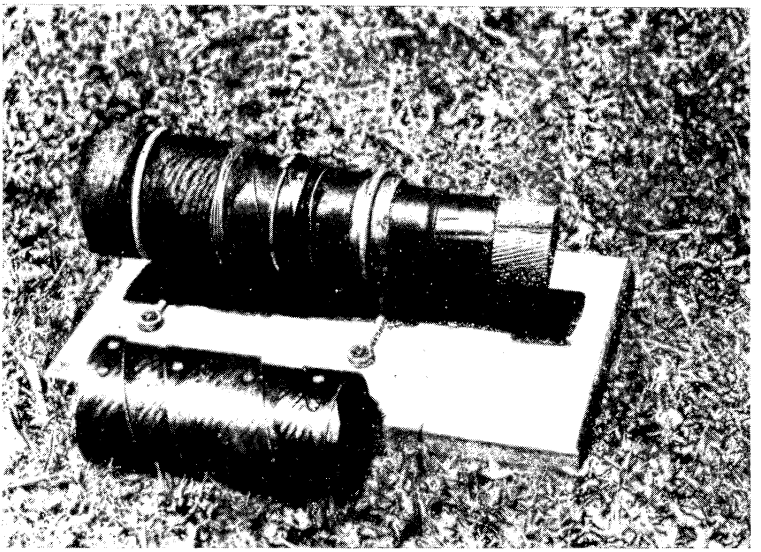
Marks of Third Bearer from Street.—On this bearer $1\frac{1}{4}$ in. from the edge nearest the cable break there were two crusts of burnt metal approximately $\frac{1}{4}$ in. diameter and $2\frac{1}{2}$ in. apart. These crusts were removed and placed in envelopes. This is the position where, according to others, the armouring was welded to the bearer. No other marks were noticed on the bearers or on the only remaining piece of water-pipe left intact by the fall of debris.

(*f*) Main Electrical Switchboard

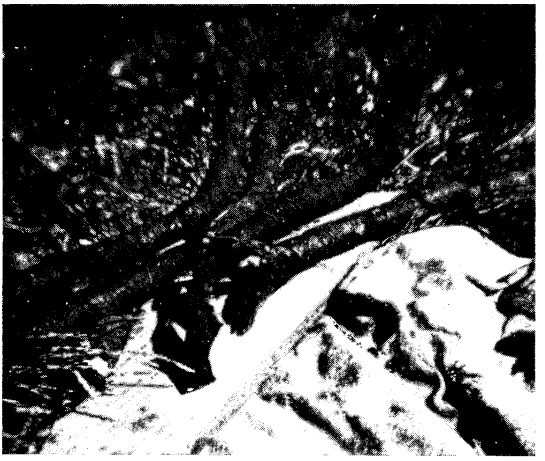
The marble main switchboard, naturally enough, had been damaged by fire and falls of debris, and it was difficult to make an inspection. However, no signs were noticed which would point to a heavy short circuit occurring on any of the apparatus or sub-circuits. On two sets of three-phase top-entry fuses pieces had been burnt out of the conductors feeding same about 1 in. above their terminations, and the only mark visible on the panel indicated that an accummulation of debris had been built up over these fuses. There were similar accumulation of debris over other fuses with no apparent excessive burning of the conductors. The main neutral earthing leads and meter shunts were still in the main thimble attached to the neutral bus-bar. The main O.C.B., which was full of water due to the flooding of the cellar, was removed for inspection and test. Although this switch had been subjected to sufficient heat to melt the solder out of all the cable sockets and burn most of the insulation off the current transformer trip coils and terminal blocks (C.T. circuit), it was found to be in comparatively good mechanical order. The main contacts were in good order, with no signs of burning due to opening on fault current. The three current transformers were found to be still in working order, but the condition of the trip coils was as follows :—

Tripping value setting, 375 amps.
The Left-hand Coil: Tripped twice at 500 amps but short between turns developed and prevented any further tripping.
The Middle Coil: Did not operate.
The Right-hand Coil: Continued to operate at approximately 465 amps.

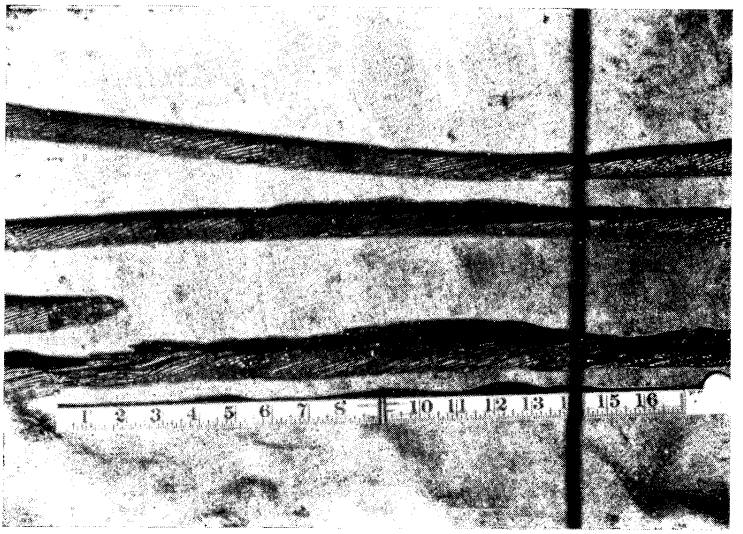
(Sgd.) S. M. Nicol,
Testing Engineer.



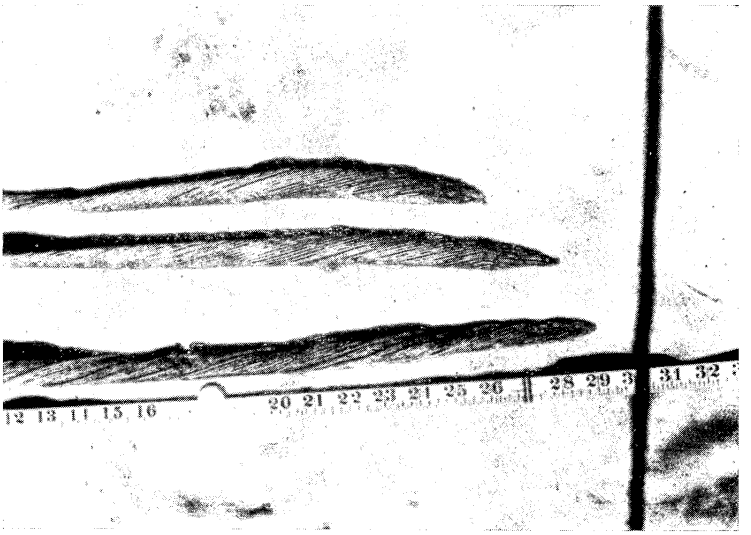
No. 1.- Portion of Undamaged Part of Electricity Mains Cables Prepared to Show Method of Construction.



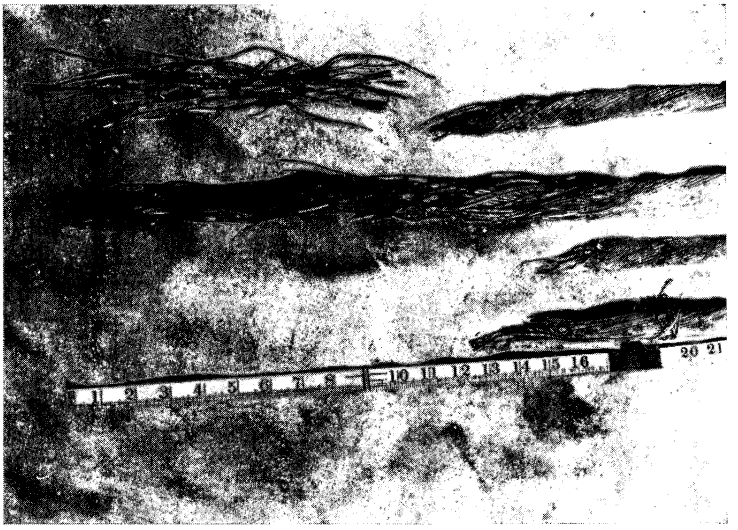
No. 2.—Severed Ends of Conductors I Bearer End of Cable Break Showing Double Steel Tape Armouring Subsequently Removed in the Course of Examination.



No. 3.—Severed End of One Conductor and Damage to Adjacent Conductor I Bearer End of Cable Break.

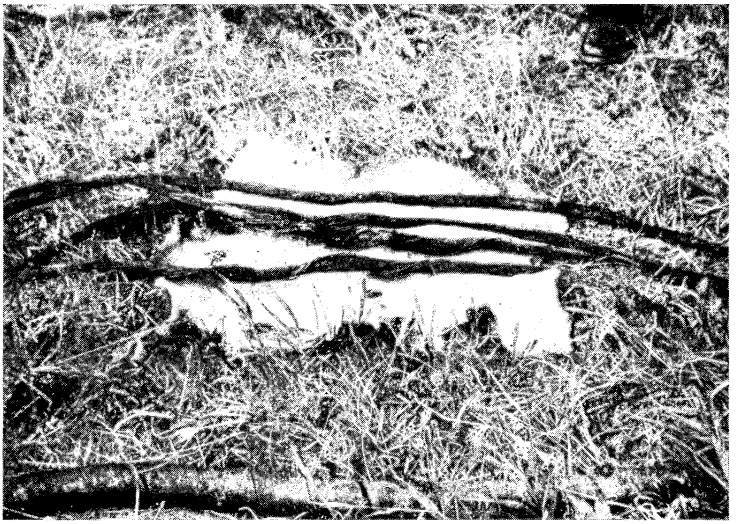


No. 4.—Severed Ends of Three Conductors: I Bearer End of Cable Break.



No. 5.—Severed Ends: Brick Wall End of Cable Break.

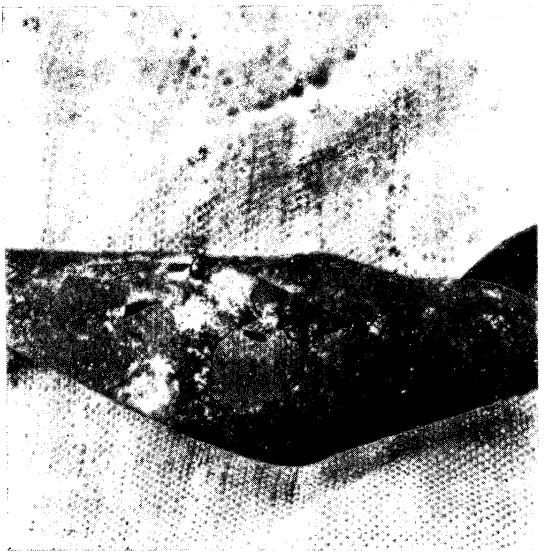
No. 6.—Fractured Cable 5 ft. 8 in. from I Bearer End of Cable Break Showing Double Steel Tape Armouring Subsequently Removed in Course of Examination.



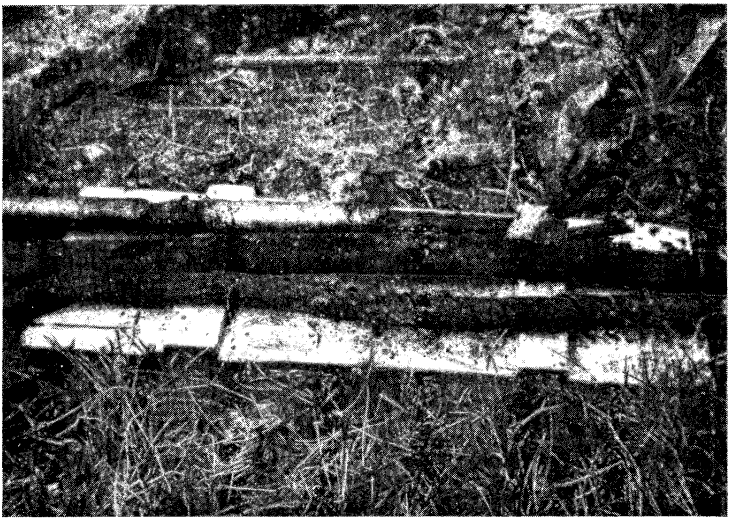
No. 7.—Fractures of Conductors 5 ft. 8 in. from I Bearer End of Cable Break.

No. 8—Armour Welded With $\frac{1}{8}$ in. Overlap and Claimed to Have Been Welded to I Bearer.

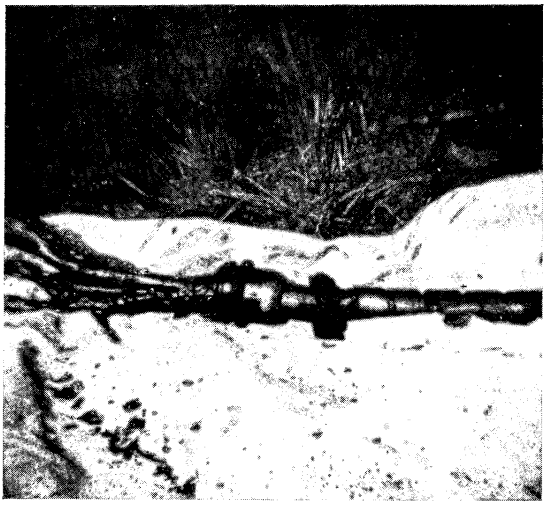
No. 9.—Armour Welded in Two Places; One with $\frac{3}{8}$ in. Lap (Section 9B). This is Part of the Piece of Armour Found Loose.



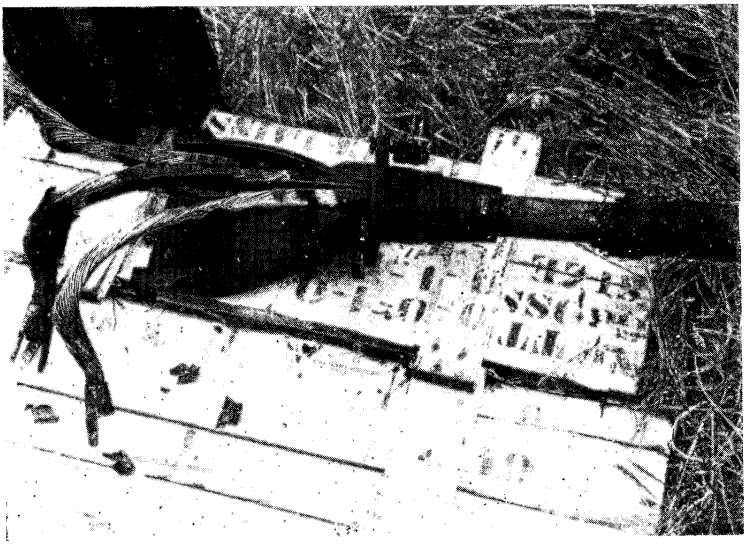
No. 10.—Armour Welded with $\frac{3}{4}$ in. Lap. This is a Further Part of the Piece of Armour Found Loose.



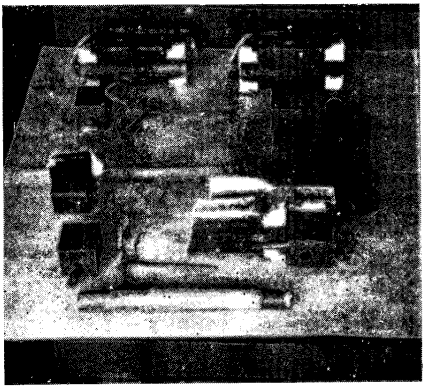
No. 11.—Cable Sections Involved in Fire Showing Degrees of Damage.



No. 12.—Part of Cable-end Box and Cable End at Service Fuse End.



No. 13.—Part of Cable-end Box and Cable End from Oil-filled Circuit Breaker End.



No. 14.—Parts of Service Fuses.

Amendment.	Date.	By	App'd
Amendment.			

Drawn	N.S. Kenward	2-12-47	
Traced	J.O. TREVOR	30-12-47	
Comput'ns			
Checked		9-1-48	
Recommended			
Approved		9-1-48	

STATE HYDRO-ELECTRIC DEPARTMENT - N.Z.
F. T. M. KISSEL, B.SC., A.M.I.C.E., M.I.E.E.
GENERAL MANAGER

MESSRS J. BALLANTYNE & Co.
CHRISTCHURCH.

ELECTRICITY MAINS CABLE.

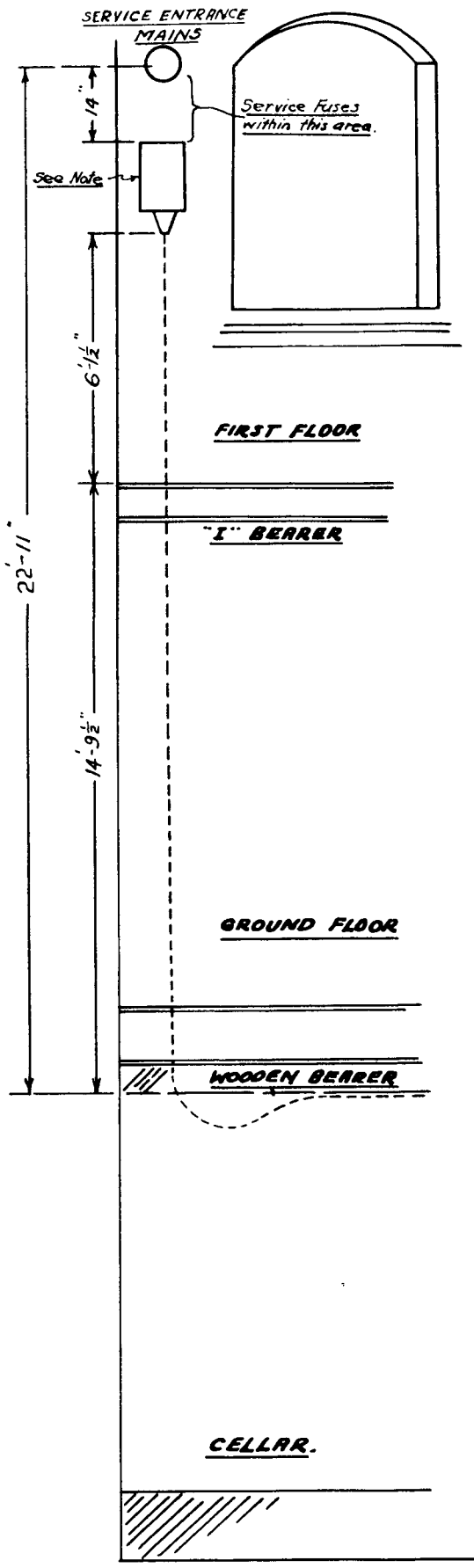
SCALE N.T.S.

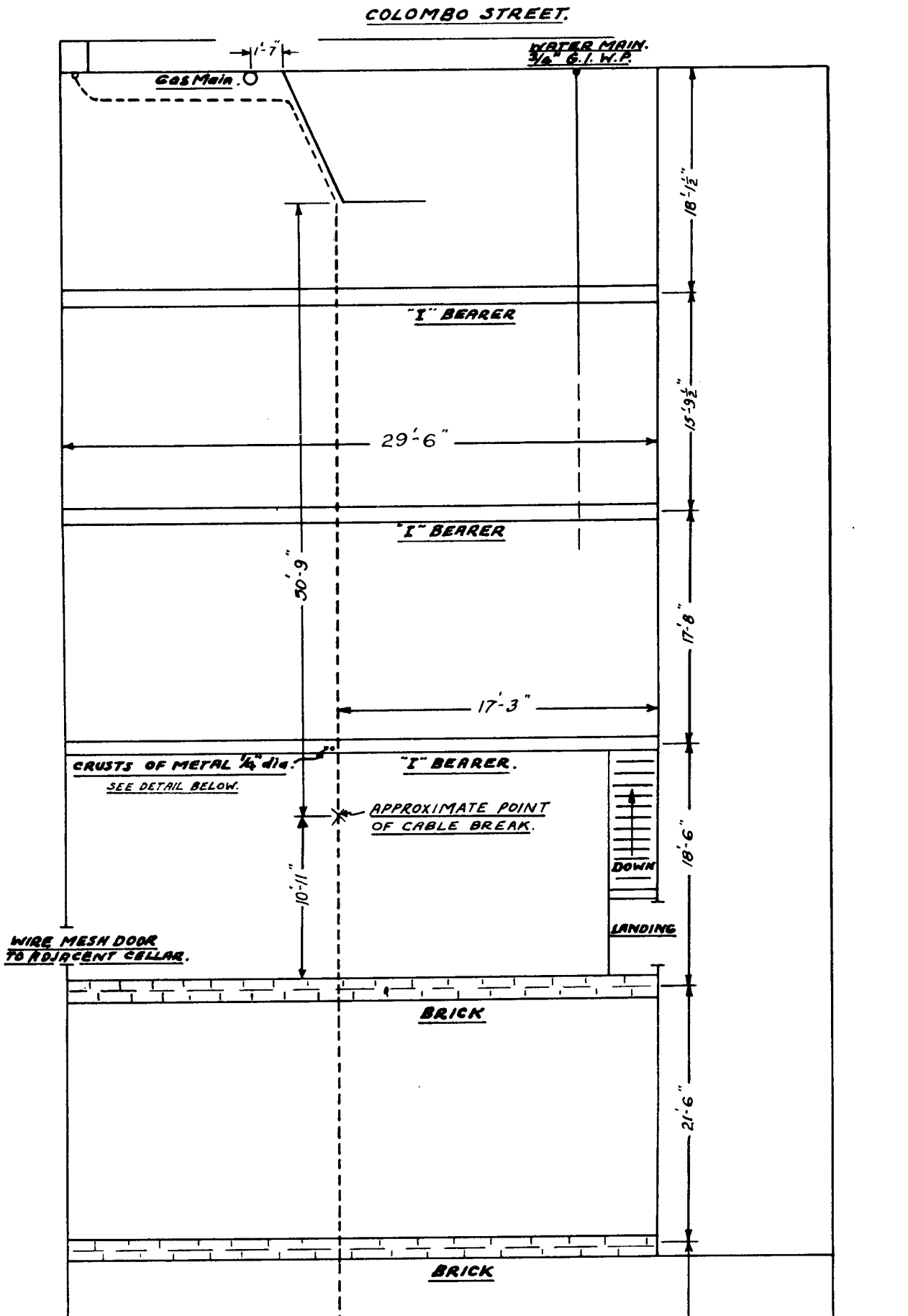
FILE

FOLDER

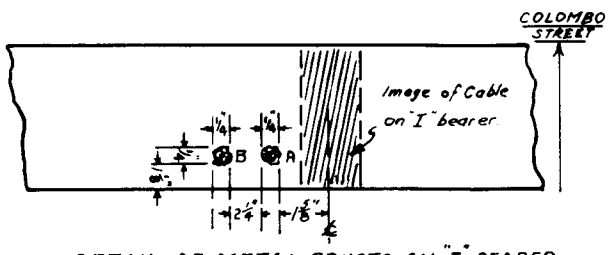
ISSUE

FCH 907

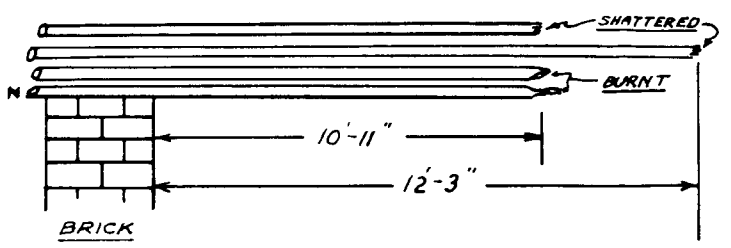


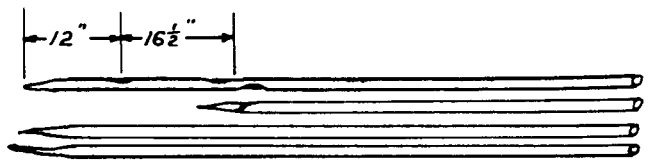


NOTE: When the cable was removed by Wooff & Salvesen Ltd., the cable end-box was resting on the floor of the first floor, the cable having slipped down through its channel.

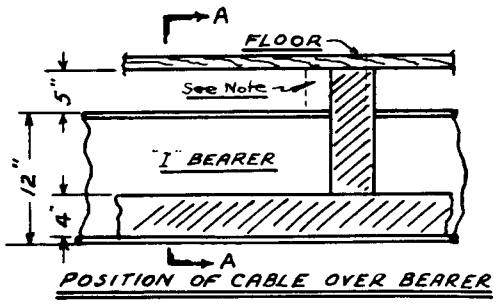


DETAIL OF METAL CRUSTS ON "I" BEARER



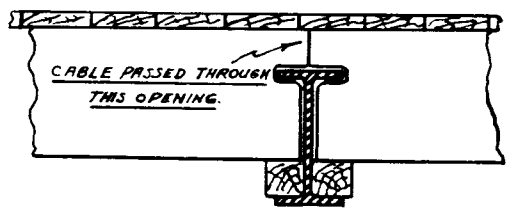


CABLE-CORE DETAILS



POSITION OF CABLE OVER BEARER.

NOTE: Cable was located within this area.



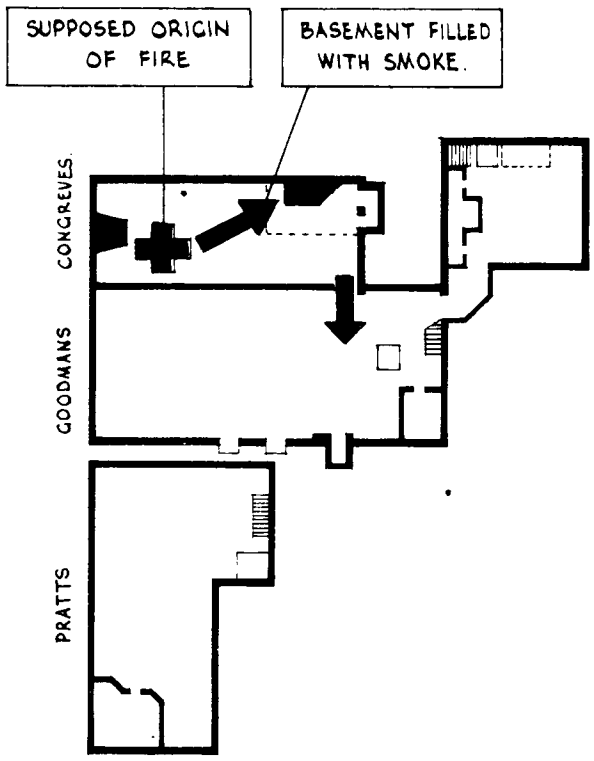
SECTION A-A.

See Report of 14-1-48. A.T.L. File 102/2

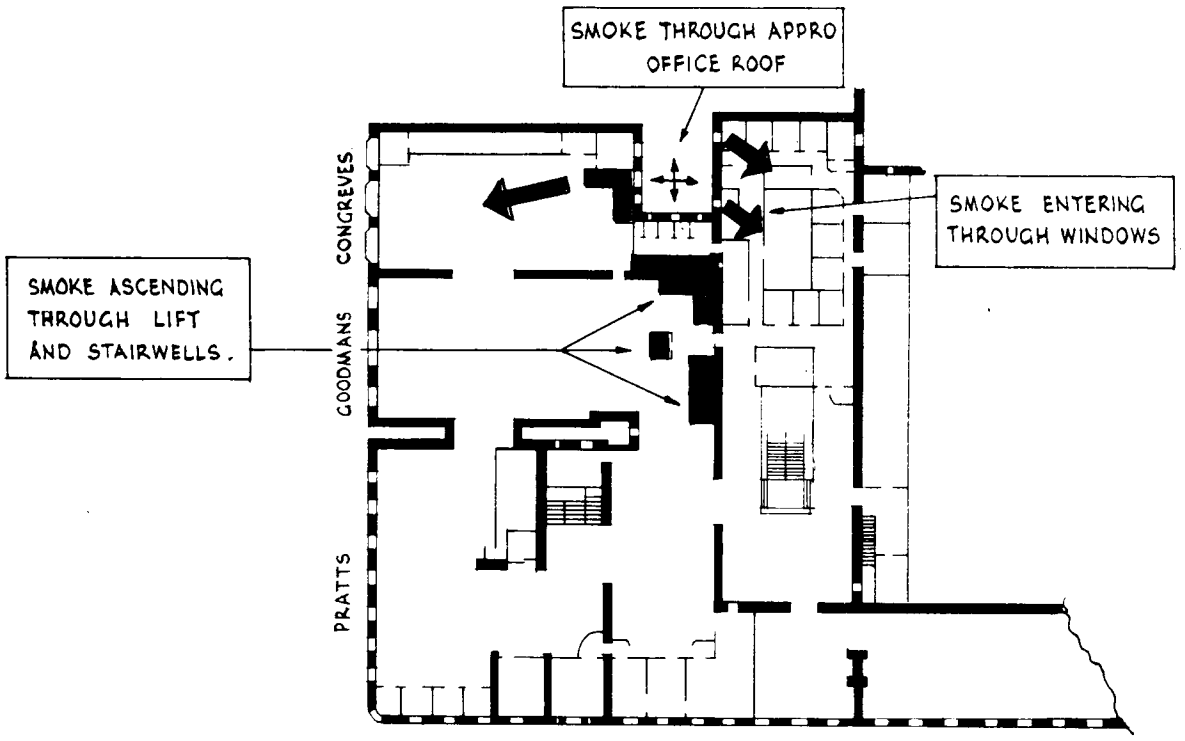
APPENDIX E.—PLANS PREPARED BY MR. V. J. HEAN, SHOWING ASSUMED SPREAD OF SMOKE AND FIRE IN THREE STAGES

APPENDIX. 1a.

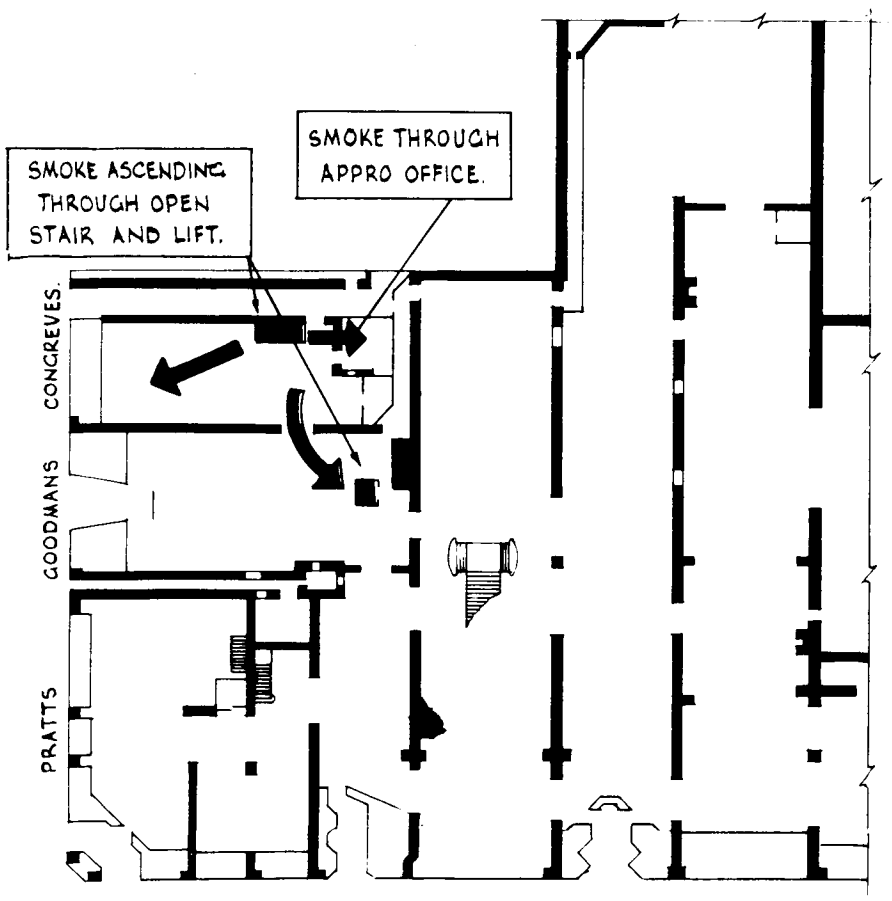
PLANS SHEWING ASSUMED SPREAD OF SMOKE AND FIRE STAGE 1



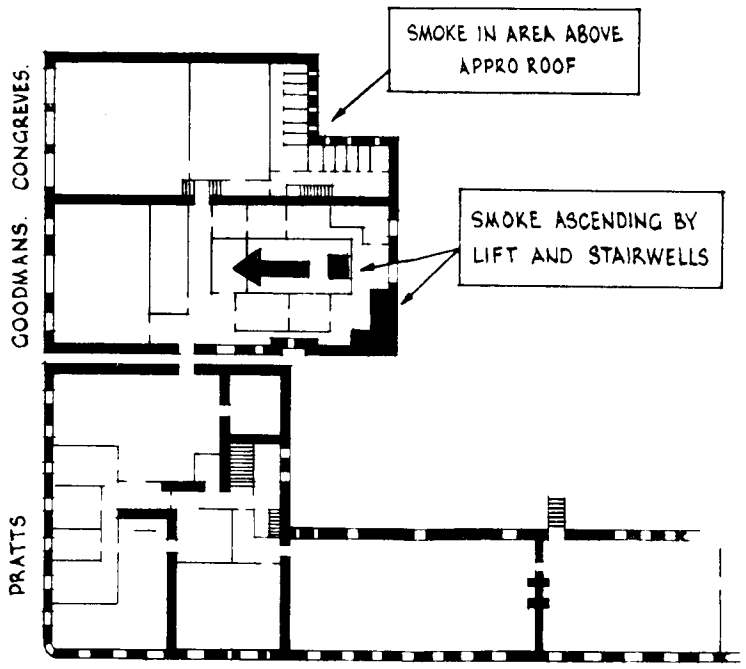
BASEMENT PLAN.



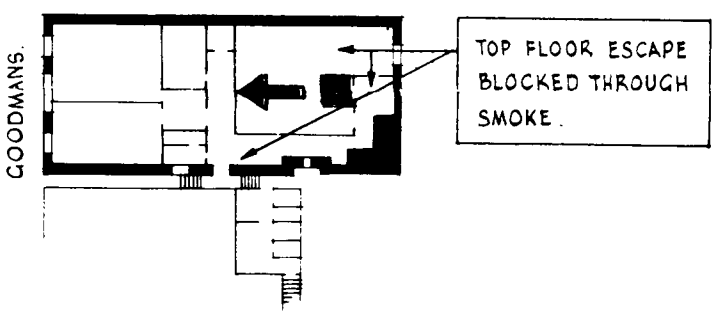
FIRST FLOOR PLAN.



GROUND FLOOR PLAN.



SECOND FLOOR PLAN



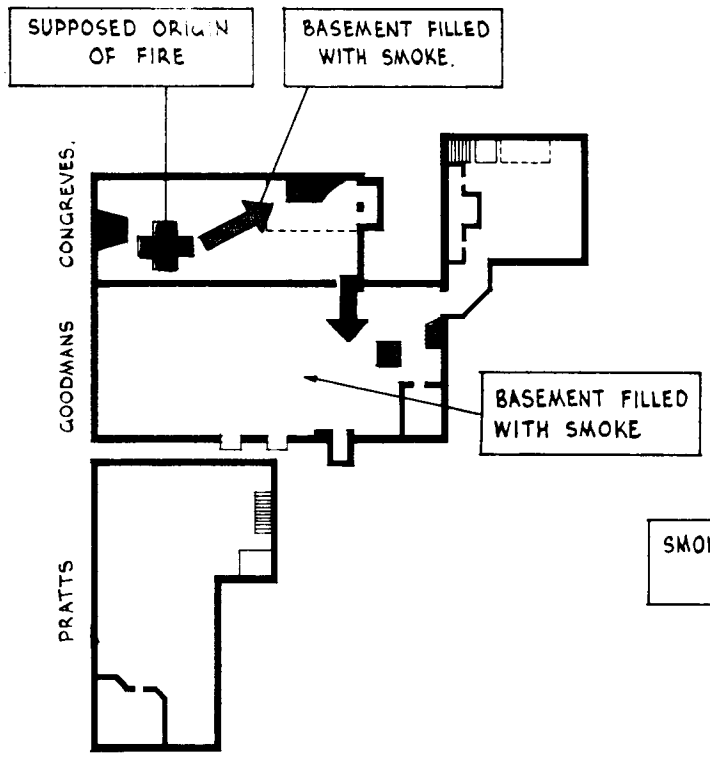
THIRD FLOOR PLAN.

TO ACCOMPANY REPORT V.R.J.HEAN

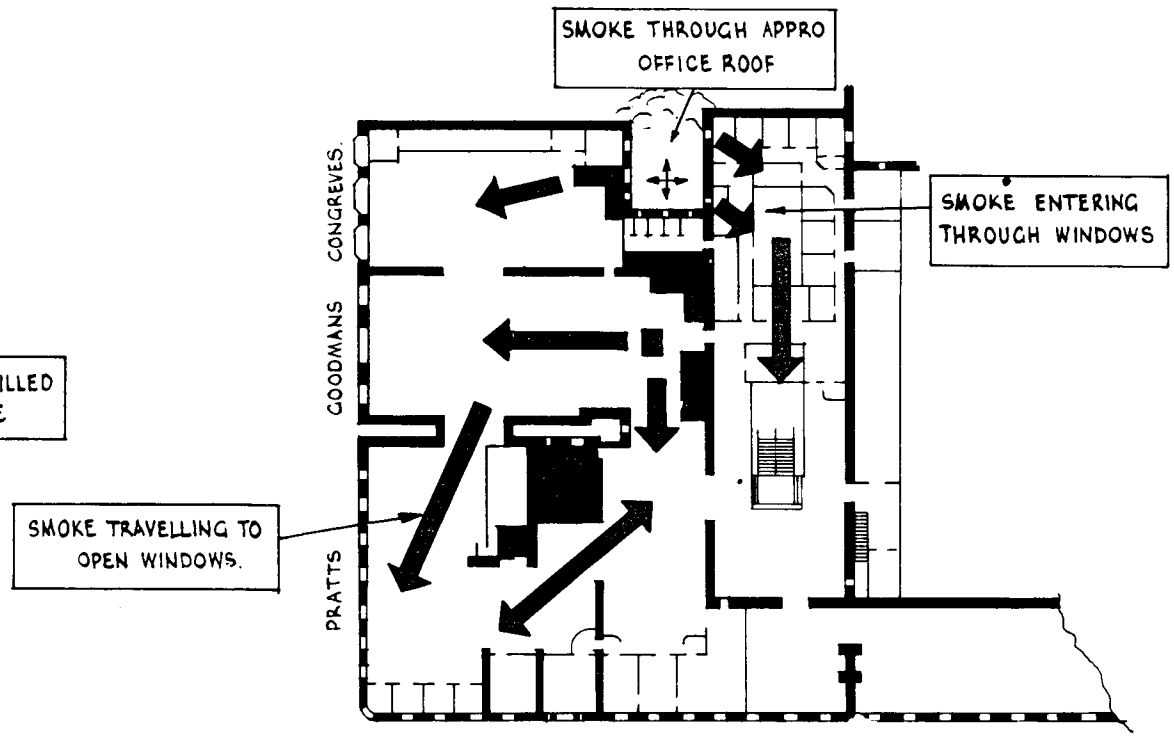
H-47

C.T.O.

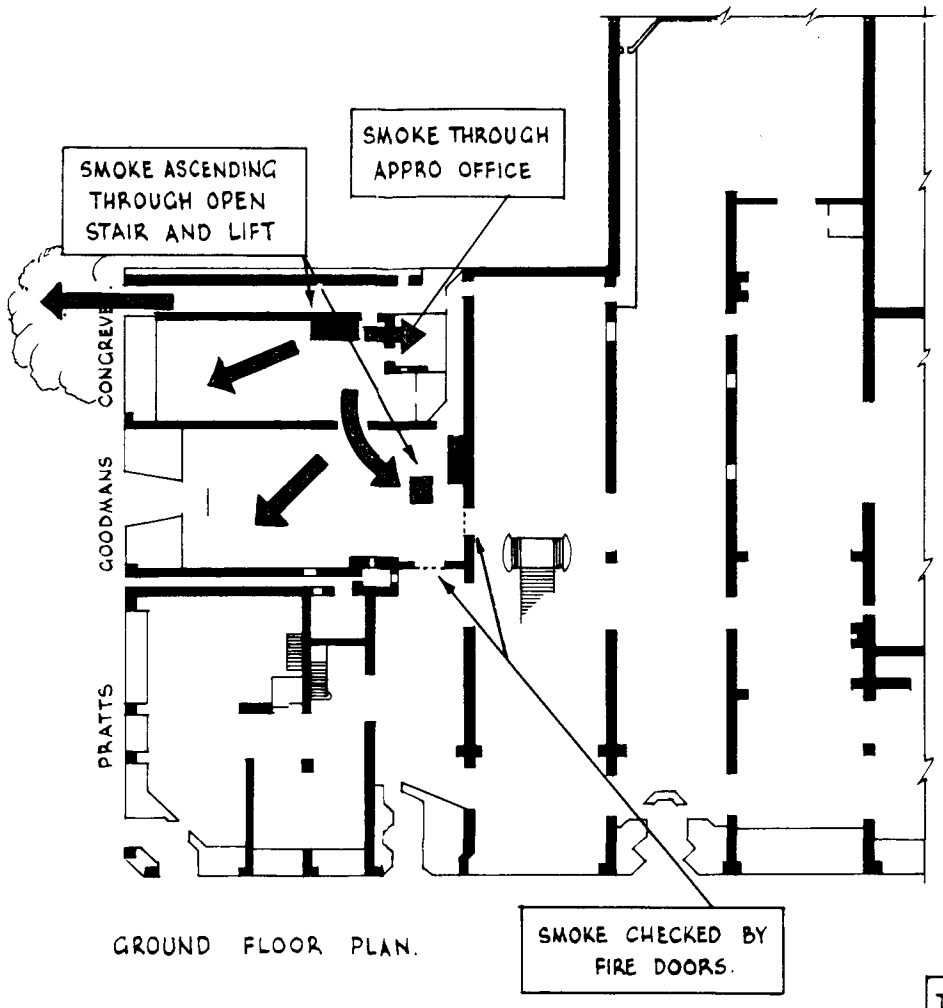
PLANS SHEWING ASSUMED SPREAD OF SMOKE AND FIRE STAGE 2



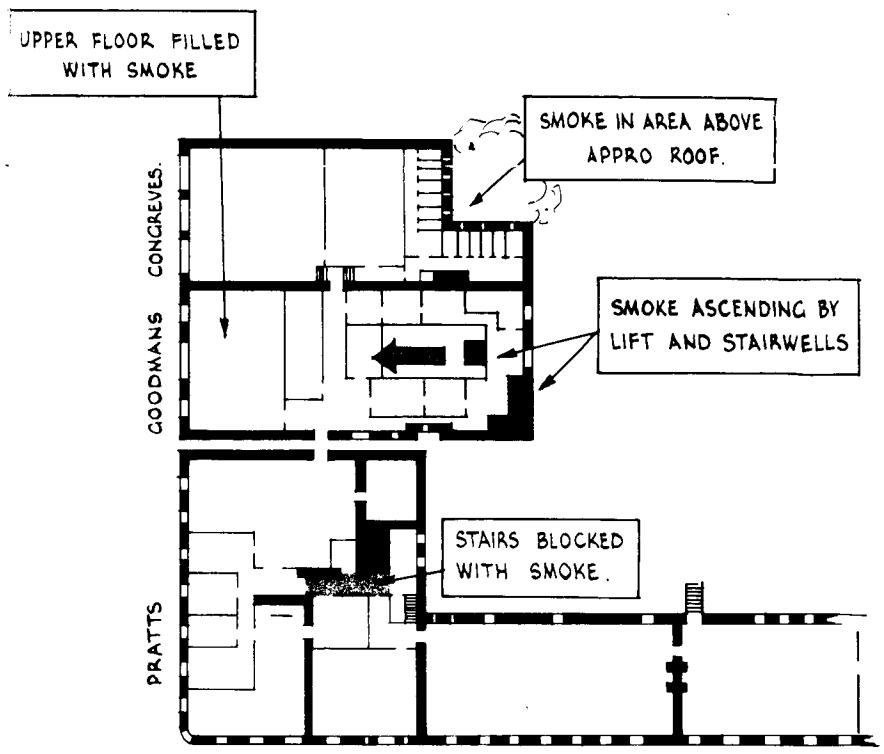
BASEMENT PLAN.



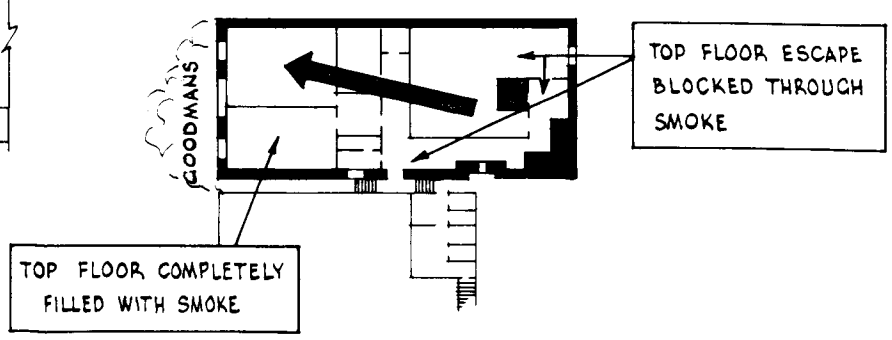
FIRST FLOOR PLAN



GROUND FLOOR PLAN.



SECOND FLOOR PLAN

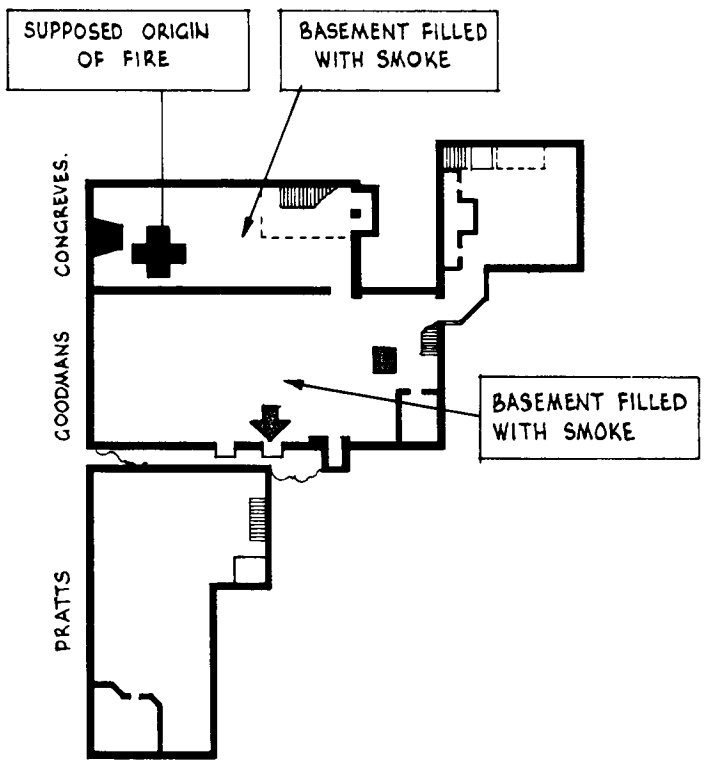


THIRD FLOOR PLAN

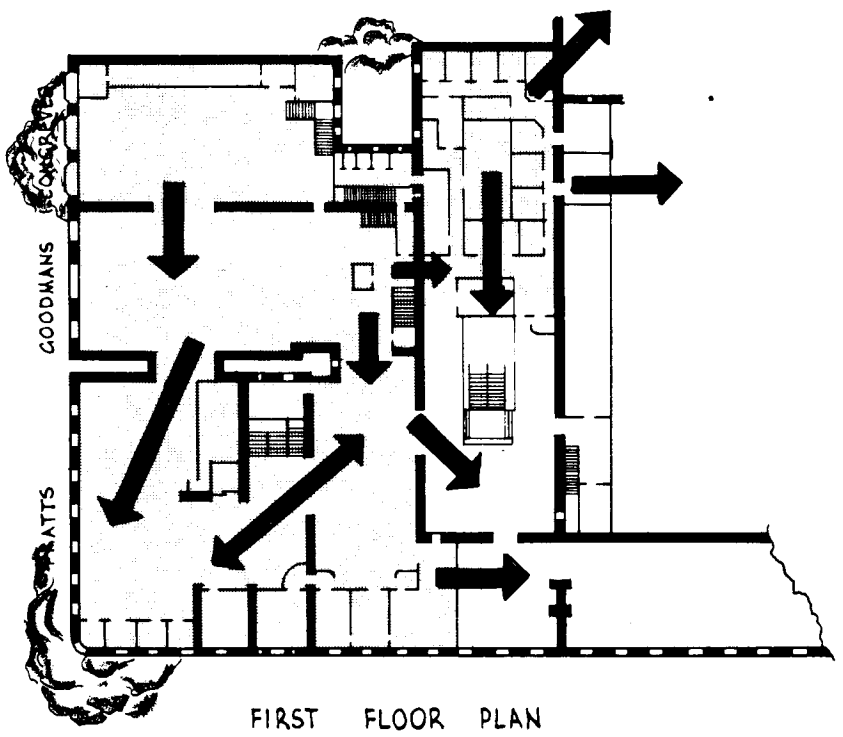
TO ACCOMPANY REPORT V.R.J.HEAN

C.T.O.

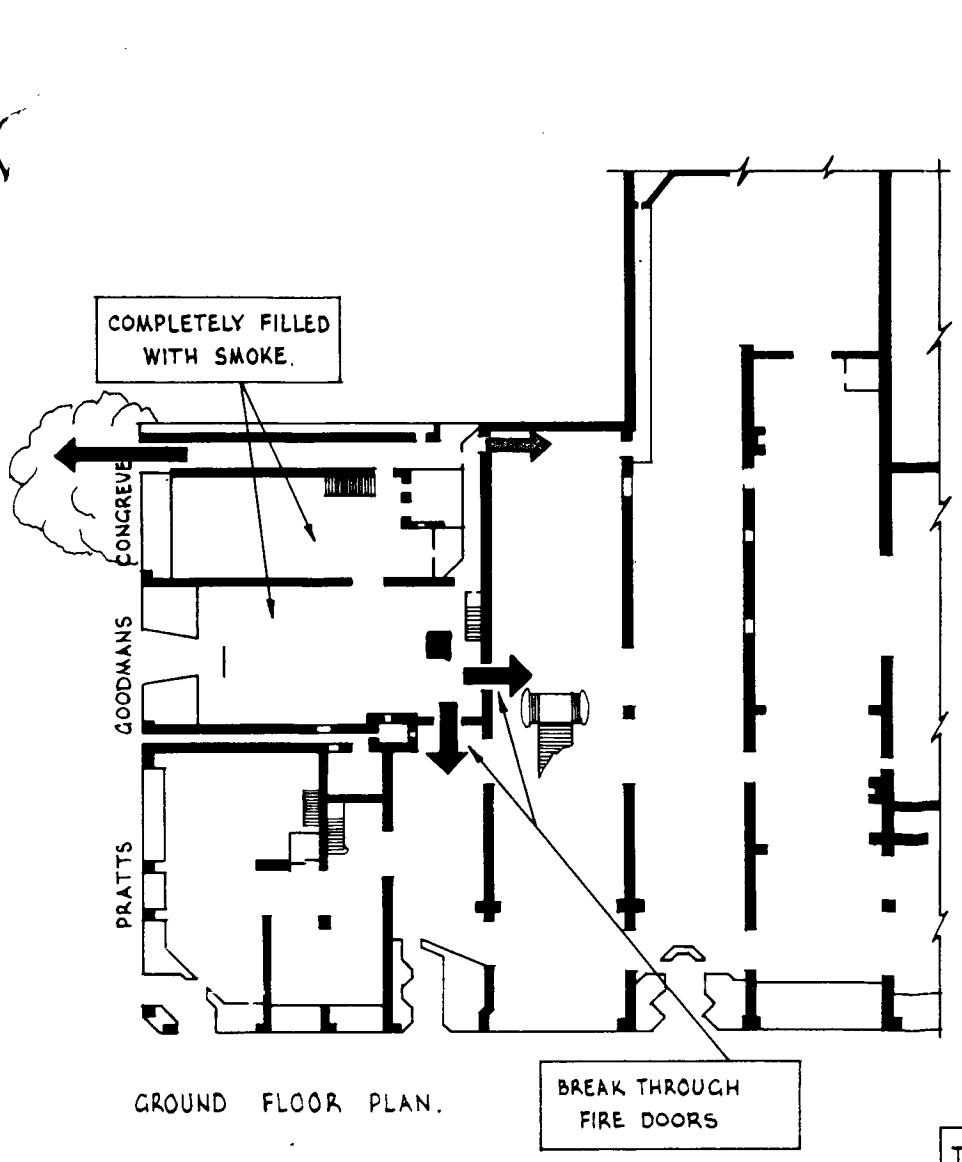
PLANS SHEWING ASSUMED SPREAD OF SMOKE AND FIRE STAGE 3.



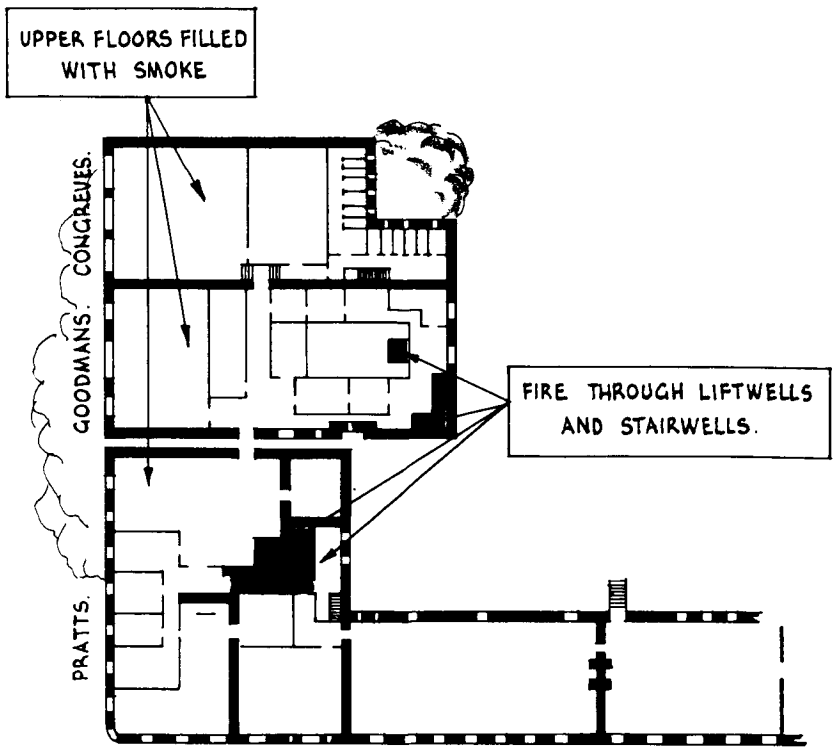
BASEMENT PLAN.



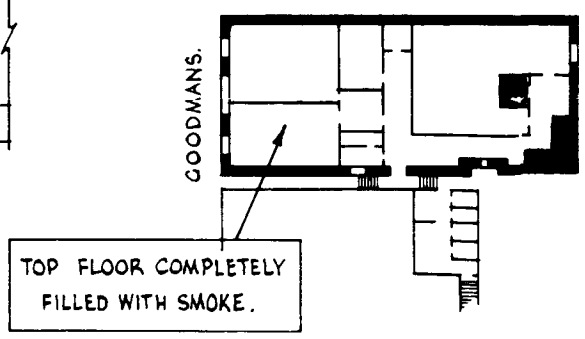
FIRST FLOOR PLAN



GROUND FLOOR PLAN.



SECOND FLOOR PLAN.



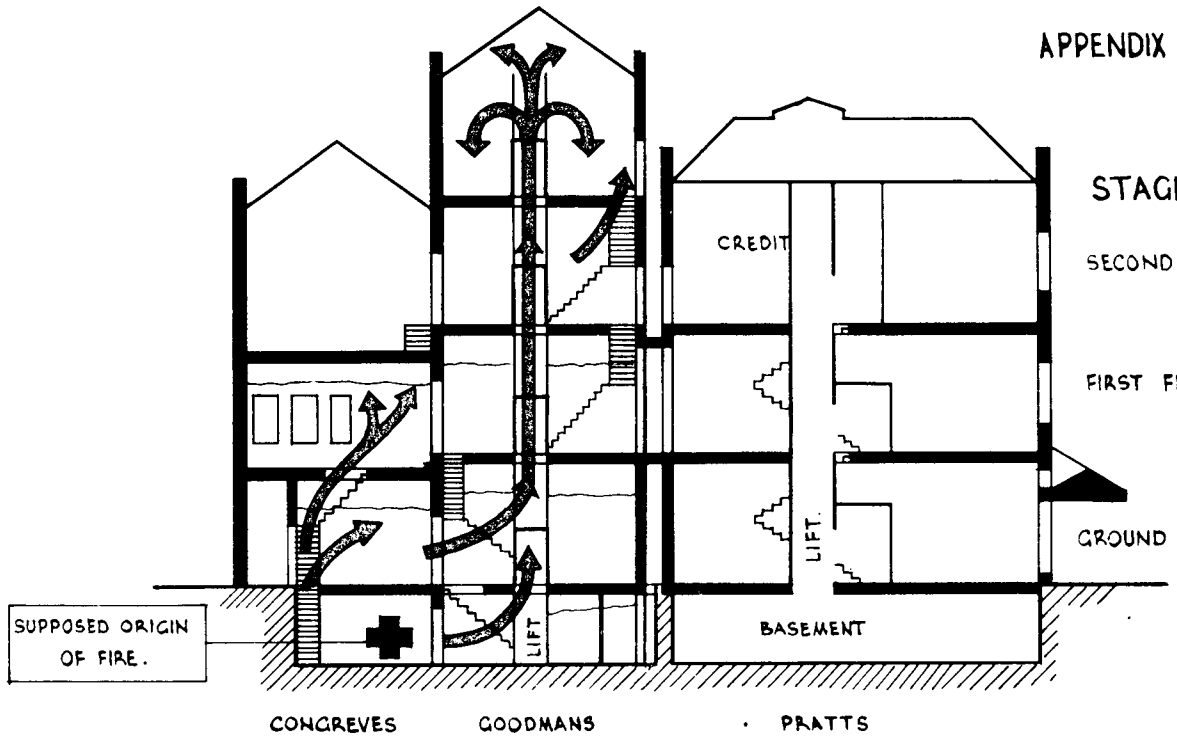
THIRD FLOOR PLAN.

TO ACCOMPANY REPORT V.R.J.HEAN

C.T.O.

ASSUMED SPREAD OF SMOKE AND FIRE.

APPENDIX 1d.

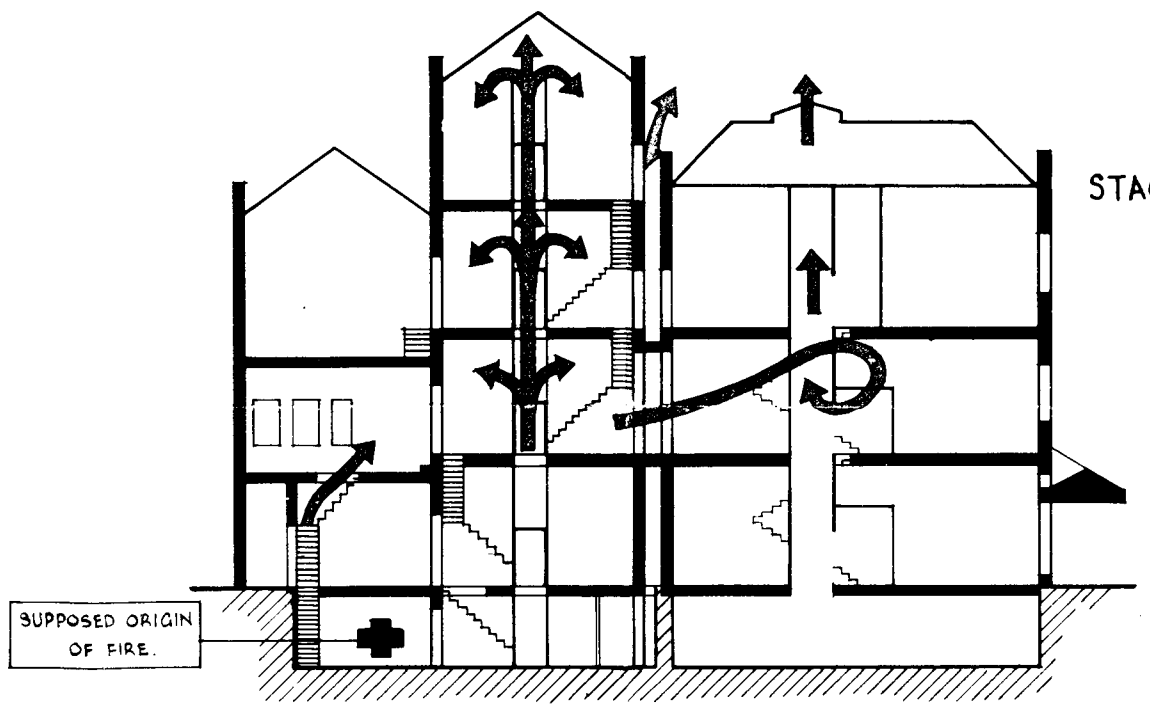


STAGE 1.

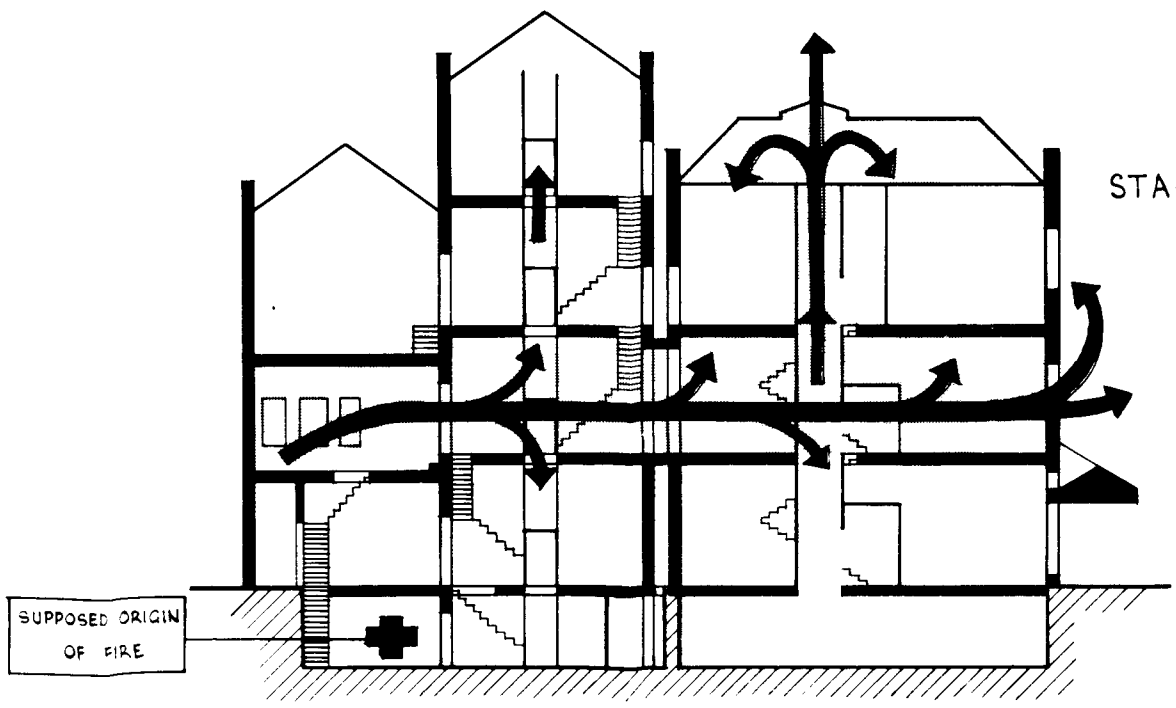
SECOND FLOOR.

FIRST FLOOR.

GROUND FLOOR



STAGE 2.



STAGE 3.

SECTIONS - SOUTH TO NORTH - LOOKING FROM COLOMBO STREET.

TO ACCOMPANY REPORT V.R.J. HEAN

CTO.

E. V. PAUL, GOVERNMENT PRINTER, WELLINGTON

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