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JOINT FIRE RESEARCH ORGANIZATION

REPORT OF VISIT OF MR. D. I. LAWSON TO THE UNITED STATES AND CANADA

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Fire Research Station,
Boreham Wood,
Herts.

REPORT OF VISIT OF MR. D. I. LAWSON TO THE UNITED STATES AND CANADA

Introduction

No visit had been made to Canada and the United States since that of the Director in 1947, after the formation of the Joint Fire Research Organization. Although liaison had been maintained by an interchange of reports, and by the receiving of visitors from time to time, it was felt that a second visit should be made to the laboratories in North America to see what progress had been made in the intervening six years.

Early in 1953, the National Bureau of Standards had been asked to co-operate with the Joint Fire Research Organization in the fire testing of prestressed concrete beams, and this they willingly agreed to do. In June, 1953, they suggested that a member of the Joint Fire Research Organization should spend a month in Washington assisting with the tests and discussing with the staff matters of mutual research interest. This was followed by an invitation from the Building Division of the National Research Council in Ottawa, for a representative to attend the opening of their new Building Research Station, and to have discussions with the staff of the Fire Protection Section on their research programme.

Quite apart from these considerations there were indications, from various publications, of differences of opinion between the Joint Fire Research Organization and some United States laboratories, and it was desirable to seize the first opportunity of first hand discussion.

During the visit the following Organizations were seen:-

United States of America:

- United States Department of Commerce National Bureau of Standards, Washington.
- Naval Research Laboratory, Washington.
- United States Navy Department Materials Laboratory. New York Naval Shipyard, Brooklyn.
- National Board of Fire Underwriters, New York Underwriters' Laboratories, Chicago.
- Factory Mutual Laboratories, Boston.
- United States Department of Agriculture, Forest Products Research Laboratory, Madison, Wisconsin.
- Illinois Institute of Technology, Chicago.
- National Fire Protection Association, Boston.
- Massachusetts Institute of Technology, Cambridge Massachusetts.

Canada:

- Building Division, National Research Council, Ottawa.
- Canadian Underwriters' Laboratories, Toronto.
- Office of the Ontario Fire Marshal, Toronto.

I - UNITED STATES

National Bureau of Standards

Nearly one month was spent at the Bureau of Standards; this coincided with the testing of the first three prestressed concrete beams which had been designed and sent out from England. The fire performance of these beams which were larger than any which had been tested at Elstree, fulfilled the predictions made from the smaller-scale models tested in England.

The Bureau of Standards is part of the Department of Commerce and has an allocation for research and testing of about three-and-a-half million dollars. Further allocations of two million dollars are made for routine protection research, and just over one million dollars for administration. The total staff numbers about four thousand, of which two thousand-five-hundred are engaged on applied research, the testing of materials for Government purchase, and the maintenance of primary and secondary standards. The balance of the staff is engaged on ordnance work, started during the war with the development of proximity fuses for bombs.

Working within the Bureau are research teams belonging to various trade associations; these are maintained by industry, and the Bureau provides accommodation and a certain amount of equipment. An example of such research has been the development of dental materials for the Dental Association, recently sponsored by the Gypsum Association. The Fire Protection Section is part of the Building Technology Division, which is headed by Mr. D. E. Parsons. This has a total staff of about eighty and is divided into the following Sections:-

(1) Structural engineering
(2) Heating
(3) Floor, roof and wall covering
(4) Fire protection
(5) Codes and specifications.

The Fire Protection Section under Dr. Robertson totals fifteen, nine of whom are professional staff. The Section is divided according to the functions each group generally performs, though this has to be fairly flexible with such a small team. The main divisions are:-

1. Fabric test - Dr. Sandholtzer
2. Heat transmission - Mr. Genesky
3. Spread of flame - Mr. Bender
4. Flame detection - Mr. Poesser
5. Fire extinction - Mr. Shoub.

Fabric test

Dr. Sandholtzer was concerned with the testing of fabrics to be purchased by the Government.

Three fabric tests are current:-

1) A test for the flame-resistance of textiles in which a strip 12 in. x 2 in. is held vertically above a Mecker burner and the charring distance noted. This test is used mainly for flame-retardant treated textiles.

2) A test in which the fabric under test is held at 45° and the time for the flame to travel 9 in. is noted automatically. The flame burns through a cotton, allowing a weight to fall on the stopping mechanism of a stop-watch.

3) A horizontal strip test, in which the flame is timed as it travels over 10 in.

No test is associated with any particular application and the requirements vary with the authority for which the test is being carried out.

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Dr. Sandholtzer was interested in the proposed British Fabric Flammability Test and asked that a report be sent as soon as it was completed.

In the United States, the public are protected against fraud through the Federal Trade Commission, but often before such action is taken, the Post Office refuses to carry materials for companies suspected of fraud, on the grounds that it will not be a party to misrepresentation. This is often sufficient in itself to put the offending firm out of business.

Before this action is taken, the Post Office asks the Bureau if the work fulfills the claim made for it, and this provides a fair amount of testing work. The Post Office also sends articles for test which are suspected of being a possible hazard to the mails. Two examples of this have been:- Pressurized paint cans for spray painting, and "everlasting" petrol lighters, (miniature cans of petrol with a lighter mechanism on top).

Heat transmission in solids

Mr. Genesky was interested in the exploration of self-heating in materials. Experimental work had been previously carried out by Messrs. Robertson and Raskin and an attempt was then being made to interpret the results theoretically. This involved the solution of the differential equation for heat conduction along the radial direction of a sphere; that is, the rate of heat transmission per unit volume following the usual Arrenhius Law:-

$$\rho \frac{dT}{dt} = K\left(\frac{\partial^2 T}{\partial r^2} + \frac{\alpha}{r}\frac{\partial T}{\partial r}\right) + A e^{-\frac{E}{RT}} \qquad \ldots\ldots (1)$$

The following boundary conditions must be considered:-

$$K\left(\frac{dT}{dr}\right)_{r=R} = \psi(T_R - T_A)$$

$$T = T_0 \quad t = 0$$

$$dT/dr = 0 \quad r = 0$$

where ψ is the Newtonian cooling coefficient,

a is the radius of the sphere,

T_A is the ambient temperature,

T_o is the initial temperature of the sphere,

R is the gas constant per gram-molecule,

E is the activation energy of the material per gram molecule,

K is the thermal conductivity of the material,

ρ is the density of the material,

and C is the specific heat of the material.

Equation (1) had been solved when $\partial T/\partial t = 0$, that is under steady-state conditions, but unfortunately there were no experimental results to check the theoretical predictions. Chambre had derived a more general solution (1). The computed solutions of equation (1) so far indicated that the practical conditions for the self-heating of cellulose may involve a number of reactions proceeding simultaneously.

Fire extinguishers

There was no fire test for the water-type extinguishers. The tests involved the expulsion time, hydrostatic tests of the shell and hose, and mechanical inspection. The body of the extinguisher might be made of copper or brass, lead-tin coated inside. Stainless steel was also being used. Seam-welding appeared to be resistant to corrosion; the metal, however, corroded on butt-welds and these had to be passivated. No steel extinguishers were permitted except for the hand-pump type. The extinguishers were tested for corrosion by being kept for a year in the charged condition.

Dry powders

Dry powder was stated to act as a radiant shield and had been found to be a most effective medium for petrol spill fires; 4 lb was found to extinguish a fire area of 8 sq. ft, and $2\frac{1}{2}$ lb a fire area of 6 sq. ft. These fires could sometimes be extinguished with 15 lb of carbon dioxide, though not with certainty. The commercial powders so far produced had particle sizes down to 5 μ, and the Bureau intended to try the effect of particle size on extinguishing efficiency. In so far as the action may be attributed to the cooling of the fire, Portland cement may be quite effective as 30 per cent of the particle sizes are less than 5 μ.

The powders themselves were tested for water absorption by keeping them for several days in contact with a saturated atmosphere; the increase in weight was then noted. Some tests had been carried out trying to tamp the powder down, but in spite of this it had always remained fluid, even at low temperatures. Carbon dioxide is not suitable as an expellant at the low temperatures encountered on the American Continent, as the pressure falls rapidly with temperature; in that climate it would be necessary to use a more perfect gas such as nitrogen.

Dry chemical had been found to break down protein but not chemical foam; this apparently was connected with the fatty acid coating, as the breakdown was not observed when this coating was omitted.

Vaporizing liquids

It was stated that nearly all carbon tetrachloride extinguishers gave trouble with leakage due to corrosion. A magnesium ring had been placed in the extinguishers to avoid this leakage, but no beneficial

effect had been observed. No work had been done at the Bureau on the relative efficiencies of chlorobromomethane and the fluorinated compounds. The Bureau would be very pleased to have a copy of our
ACTION report on this work. Reference was also made to a report on "Vaporizing fire extinguishing agents" (2).

Water sprays

Experiments had been made using applicators of the impinging-jet type to extinguish petrol fires. It was stated that the operating pressure should be about 100 Lb/in^2 and that the spray should be applied as rapidly as possible in order to snuff out the fire.

Data of interest on fog nozzles and particle size distribution of the spray produced, had been published by a firm, "Fog Nozzle International" of Wooster, Ohio.

Flame detection

This Section was concerned with the study of the properties and characteristics of flame in order to ascertain which system should be used for the detection of fires in aircraft engine nacelles and compartments. The work arose because of the dissatisfaction of the Air Force with the current commercial fire detection systems for aircraft engine nacelles, one of the principle reasons being the frequent false alarms which they caused. As a result of many failures, the Air Force had decided to study the fundamentals in order that a decision might be made as to the direction of further development in instrumentation.

The Section were considering the use of a fire alarm operated on the flicker frequency of flames, and this had been built commercially. It had been found that flames generally flicker with a frequency of between 5 and 20 cycles per second. The light from the flames was picked up by a lead sulphide cell and the output from this was passed into a tuned amplifier. This system had the disadvantage that it was likely to give false alarms when rain spattered on the hot exhaust of the aircraft.

Smoke detectors had been discarded because it was found that a leaky engine exhaust would give false alarms. Flame detectors working on an ionisation principle, had also given trouble due to leakage at high altitudes, and detectors designed to pick up the ultra-violet radiation from the flames had suffered from interference from cosmic rays and also from ultra-violet rays at the height of travel, say 50,000 ft.

So far, no completely satisfactory flame detector had been found, but work was proceeding on the flicker detector as this seemed to be the most promising.

Fire tests on building materials

The spread of flame test in most common use is that described in S.S.A. 118A/7(3). This was developed for acoustical units and the test is applied to a representative sample of ceiling. The specimen 2 ft. 6 in. square, is held above the burner so that the temperature 1 in. below the centre of the specimen, follows the standard time/temperature curve. The grading depends partly on the time for which the heat is applied, and partly on the area of flaming of the specimen.

Some work had also been carried out on another spread of flame test using a 1-ft square radiant panel such as is used in this country, but in this case the specimen is held vertically facing the panel, with its upper edge 3 in. nearer to the panel than the lower edge. It was stated that this facilitated the measurement of the position of the

flame front as the specimen burned downwards. This work had not proceeded far enough to permit correlation with the British test.

The Section planned to carry out theoretical and experimental studies of heat and vapour transfer through simple solids when exposed to fires. They were also hoping to study the relationship between the method of curing of plaster and concrete materials and their resulting fire-resisting properties.

Construction, codes and practices

This work was under the leadership of Mr. G. N. Thompson, the Deputy Head of the Building Technology Division. The Section had as its general objectives the development of recommendations for construction of buildings, the determination of factors affecting the safety of building occupants, technical research in building design and construction, with particular reference to safety and the satisfactory service, preparation of recommendations for safe construction of federal buildings, and the co-operation with officials and standing bodies in the preparation of building and planning codes and manuals of construction.

The immediate work in hand was concerned with a proposed code dealing with flame spread over interior finishes to which heavy loss of life in fires had been attributed, and on wind pressures on buildings which had not then been satisfactorily determined. Work was also to proceed on recommendations for safe construction of federal buildings from the standpoint of fire hazards and existing facilities.

Attention was being given to co-operative efforts to reduce the differences in technical requirements then found in city building codes recommended by various organizations as suitable for general adoption. There are at present four main building codes in existence:- The National Building Code issued by the National Board of Fire Underwriters' (the oldest of the codes), the Southern Standard Building Code, used mainly in the South, the Uniform Building Code of the Pacific Building Codes' Conference, and the Basic Building Code of the Building Officials' Conference in America.

The function of the Bureau is to provide technical information for the Standard Committees when the codes are revised; this is done every three years.

General

In common with most laboratories, the Bureau of Standards has accumulated much work since its beginning which needs publishing, and this is now being done by Messrs. Mitchell and Ingberg.

The following reports were then about to be issued:-

(1) The fire tests of brick walls.

(2) The duration and severity of fires. These were carried out in rooms 15 ft x 29 ft x 10½ ft.

(3) The stability of brick walls under fire conditions.

(4) Tests on wood-joisted floors with ceilings of 'gypsum plasterboard. Here it was shown that the performance is very much improved by the inclusion of chicken mesh between the two gypsum boards forming the ceiling. In this way it is possible to get fire-resistances of greater than 1 hour.

Whilst at the Bureau, the author gave a talk on "Fire Research in the United Kingdom" and addressed a Building Technology Staff meeting on "Some Fire Research Programmes in the United Kingdom".

Naval Research Laboratory, Washington

The Fire Engineering Section of this Laboratory, under the leadership of Mr. R. L. Tuve, is concerned mainly with the production of foam for aircraft crash fire-fighting. This Section had carried out a number of fire tests on trays, 20 ft square, filled with petrol, and as a result had concluded that the optimum expansion ratio was about 12. For protein foams, the application rate in terms of the water used was 0.1 gal ft^{-2} min^{-1}, and at this rate the fire was controlled after about 70 seconds. It was stated that foams having an expansion ratio above 12 were not so effective because of their extreme lightness and stiffness.

The Section had developed a jeep first-aid equipment with a capacity of 240 gal of water and 20 gal of foam compound. This could be expelled at a rate of 100 gal/min producing foam with an expansion ratio of 11. The foam branch was movable and mounted on the front of the jeep, and could be arranged to throw the foam either in a straight stream or as a spray which would protect the jeep and its occupants. The straight stream left a pattern between 60 and 100 ft in front of the vehicle, while with the spray, the coverage was from 5 to about 25 ft, the pattern spreading out about 15 ft on either flank of the vehicle. The total loaded weight of the jeep was about $2\frac{1}{2}$ tons and it could cover the first 500 ft from rest in about 18 seconds.

A larger foam crash rescue truck had also been developed. This vehicle had a capacity of 1,250 gal of water and 80 gal of foam compound and would discharge foam at the rate of 6,000 gal/min. The expansion factor in this case was 11·5. The two foam branches were again mounted on the front of the vehicle, but in this case were controlled by servomechanisms from inside the cabin.

Some experiments had also been carried out on the effects of dry chemical extinguishing agents with a bicarbonate base on mechanical foam blankets; these had shown that the presence of the dry chemical was definitely detrimental to the establishment and preservation of a foam blanket.

Some tests without fire had shown that the presence of 0.08 lb of chemical/sq. ft. of surface was sufficient to cause a pronounced attack on the foam.

United States Navy Department Materials Laboratory

The tests on foam were carried out by a group under the supervision of Mr. Lacks, but no work had been done on the extinction of fires by the base injection of foam. This method was not used in the Armed Services and very little interest had been shown by the Navy Department.

Some air-stirring experiments had been carried out, but in these there was not a long enough pre-burn and large amounts of air were used; in fact, the experiments were really demonstrations.

This group had succeeded in extinguishing fires by using the pumping of petrol in tanks to cause turbulence, but no final apparatus had been developed. The nozzle acceptance tests are described in the Joint Army/Navy Specification JAN/C/266 (4). The foam is examined for specific gravity, viscosity, pH-value, fluidity at low temperature, sedimentation, precipitation, ageing, iron salts, and its ability to put out a standard fire.

In a tank 10 ft square x 2 ft deep with a steel backboard 10 ft long and 4 ft high, 150 gal of petrol are floated on 200 gal of water and the fire permitted to burn freely for 1 minute before foam application. The foam stream, which is developed in a standard nozzle, is directed across the fire to strike the approximate centre of the backboard and is applied for a 5-minute period.

It was stated that the use of a square tank measured the ability of the foam to flow into the corners. There was also a sealability test in which an opening 6 in. square was made at the centre of the tank and the petrol ignited; this fire was required to be extinguished within 5 minutes. This was stated to be a very difficult test to pass.

Some experiments had also been carried out on spraying foam on to a tank, but this was not found to be as satisfactory as application by flowing. The compatibility of foam was measured by mixing equal quantities of the foam of one manufacture with the other and testing both together.

Mr. Lacks said he would be very pleased to receive the following reports from us:-

ACTION

(1) The drainage times of foams over petrol at different temperatures.
(2) The production of sprays by impinging jets.
(3) The extinction of oil fires by sprays.

National Board of Fire Underwriters, New York

The National Board of Fire Underwriters has a membership of almost two hundred stock companies. Its objects are to secure stability and solidity in fire insurance and to protect it against unwise and unjust legislation, to encourage the introduction of improved and safe methods of building construction, and to establish and maintain stations for testing materials and constructions. The main laboratories for this work are located in Chicago.

The National Board of Fire Underwriters gathers and records statistics of fire losses which are available to all the participating insurance companies. It also publishes and distributes papers and monographs dealing with the work of the Board.

The members of the National Board meet annually, the day to day work being carried out by fifteen members of an Executive Committee who meet monthly. Besides this, the Board has a number of Standing Committees dealing with such matters as finance, membership, statistics, origin of fires, engineering standards and building construction.

Dr. Finnigan, in charge of the Statistical Section, expressed interest in our methods of coding, and said that he would like to see our report on this subject. He also said that he was preparing a report dealing with the development of large fires, and was told that we also were making a similar study.

ACTION

Underwriters' Laboratories, Chicago

The Underwriters' Laboratories have a staff of over six hundred, of which about three-hundred-and-fifty are employed in Chicago. There is an Electrical Laboratory in New York and another Laboratory in San Francisco.

Although originally the Laboratories undertook work more or less exclusively for the insurance companies, of late years they have carried out tests for a number of industrial concerns. These tests range over

a variety of subjects in the field of fire protection. Fire tests are carried out on fire doors, and structures, and extinguishers, sprinkler valves, sprinklers and hose are also tested.

In America much of the domestic heating is done by oil-burning equipment, and this, together with the petroleum pumping equipment, is tested by the Underwriters' Laboratories. The following list will give some idea of the variety of tests carried out in these Laboratories:- Petrol pumps, refrigerators, air conditioners, deep freeze storage, drink dispensers, pressure cookers, floor waxers, ladders, scaffolding, mufflers for auto-trucks and tests on toxicity of refrigerants.

In the field of burglary protection, tests are carried out on safes, alarms, and bullet-resistant glass, and in the Chemical Section on dry cleaning fluids, rubber compounds, hazards associated with electrical equipment, and dusts.

The Laboratory operates a labelling service, so that any product which has been tested by the Underwriters' Laboratories is entitled to carry a label to this effect. A premium is charged for each label used, and the Laboratories maintain a staff of five inspectors to ensure that the quality of the product is maintained.

Enquiry was made about the testing of dry powder extinguishers, and it was stated that the 140-lb size was tested against a petrol fire 2 in. deep, in a 100-sq. ft tray. The fire had a 6 in. ullage space and was allowed 1 minute pre-burn. The larger size of dry powder extinguisher, the 350-lb size, was tested against a 200-sq. ft fire; the test conditions were the same as for the smaller size. Besides the usual pressure tests on the body of the extinguisher and on the hose, the charge was tested for caking by exposure to an atmosphere having a relative humidity of 80 per cent for three weeks.

In order to test the extinguisher's ability to withstand extreme temperature conditions, it was baked at 130°F for twenty days. The powder was tested for water repellancy by being placed in a beaker with water and decanted to see if any of the dry powder remained. During the operation of dry powder extinguishers, it was required that 85 per cent of the charge should be discharged and that the duration of the discharge should be less than 68 seconds. The extinguisher was also subjected to driving rain for 96 hours. In order to test for the liability of the powder to pack in the hose, the extinguisher was discharged with a blocked nozzle, the gas was then bled off and the extinguisher recharged and discharged again to ensure that the powder was not packed so as to interfere with the discharge.

It was very difficult to carry out fire tests at the present location of the Underwriters' Laboratory, but negotiations were on foot for acquiring a site of 1,500 acres, 25 miles North-west of Chicago. Here it was hoped to carry out 100-sq. ft fires on liquids and to test the extinguishing ability of foam. At that time, the foam tests were carried out at the manufacturers' premises with the manufacturers' equipments.

The Underwriters' Laboratories have an interesting Educational Section whereby apprentices attend the Illinois Institute of Technology for periods of three months. These periods alternate with three months' stay at the Underwriters' Laboratories, so that the student spends part of his time earning enough money to pay for his fees and then goes to the University for a spell. It was stated, that when the student ultimately qualifies, the Laboratories are able to pay him a higher salary than would otherwise be possible as he has already been trained in their techniques.

Illinois Institute of Technology

While in Chicago a visit was paid to the Illinois Institute of Technology, which is unique in having a Fire Protection Course. This is run by a staff of three and there are at present one hundred students. The Fire Protection Course occupies four years; the first two years are mainly an Engineering Course, but in the latter two years more and more emphasis is given to fire protection. The students do a certain amount of practical fire-resistance work on the furnaces of the Underwriters' Laboratories. It was stated that most of the students were absorbed by the insurance companies as fire surveyors.

Some research projects are carried out at the Illinois Institute of Technology. At that time, for example, one such project was to measure the rate of burning of materials at various angles to the vertical. All such work is sponsored by industry and is liable to be discontinued should the grants for any reason be withheld.

Factory Mutual Laboratories, Boston

Just as the Underwriters' Laboratories in Chicago give the technical background to the National Board of Underwriters, which is an association of Stock Insurance Companies, so the Mutual Laboratories provide the technical information for the Mutual Insurance Companies; that is insurance companies in which the premiums of the insured vary with the fortunes of the Company.

There is a good deal of co-operation between the Underwriters' Laboratories and the Factory Mutual Laboratories. Since the Underwriters are not able to carry out fire tests at their present location, these tests are often done by the Factory Mutual Laboratories, located at some distance from Boston. The Factory Mutual Laboratories, in many instances, use the same standard tests for fire extinction as the Underwriters' Laboratories.

At the time of the visit they had just carried out a test with spray sprinklers on refrigerator cartons piled to a height of $27\frac{1}{2}$ ft. The base of the pile was six cartons square and they were spaced between 1 and $1\frac{1}{2}$ in. apart. A fire starting at the bottom of the cartons was extinguished after 1 hour with a water pressure of 50 Lb/in^2 on sprinklers 32 ft above the floor. The smoke was detected 2 minutes after ignition and three sprinklers opened about 8 minutes after the start of the fire. The ceiling temperature was reduced to 100°F in about 1 minute. Normally constructions were tested over a crib fire 4 ft square. The fire was composed of six tiers of wood of section, 2 in. x 4 in. Underneath the crib was a tray into which petrol flowed at 2 gal/min. The sprinkler heads were 6 ft above the crib and observations were made of the time taken to open the sprinkler heads and of the time to extinguish the fire.

Tests were also being carried out on the use of spray installations to protect transformers. A mock-up of a transformer had been constructed and oil representing that from a split case was allowed to flow over the outside. This was ignited in the first instance by mixing petrol with the oil and after a fixed pre-burn, the water sprays were turned on. Particular attention was being given to the orientation of the sprays rather than to the type of spray.

United States Forest Products Research Laboratory, Madison

The Forest Products Laboratory at Madison is one of the two laboratories operated by the United States Department of Agriculture, the other being in California. The staff of the Fire Protection Section was under Mr. Truax, and was at that time limited to three members. The main activity was the measurement of ignition by radiation,

but some work was also being carried on in an attempt to scale-down the tunnel test used by the Underwriters' Laboratories. Particular attention was being given to the manner of the impingement of the flame on the board under test.

It was stated that the United States Forestry Service was no longer using wetting agents for the suppression of fires as it had been found that very little advantage was to be gained by their use.

Some experiments had been carried out with foam; the results so far were not very conclusive, but foam was not much favoured since the fires were not completely extinguished and a considerable amount of smouldering took place.

Massachusetts Institute of Technology

Some work was being carried out in the Engineering Laboratories on the ignition of materials by radiation, and a solar furnace having an aperture of about 5 ft square had been constructed. Using this it was possible to apply intensities of about 5 cal cm^{-2} sec^{-1} over an area of about 3 in. square. The work was in abeyance at that time owing to the Officer-in-charge having left the Institute.

National Fire Protection Association, Boston, Massachusetts

As its title implies, this Association is concerned with the dissemination of knowledge on fire protection. It has a staff of forty and a membership of about fifteen thousand. Although in former years it was drawn largely from insurance companies, now its membership is largely from industrial organizations. It has a large number of Code Committees on which members sit who are specialists in their particular fields. Once a year the Association takes over part of an hotel at some central point in the United States, and for a week the various Code Committees meet every day in order to outline their particular Codes. After this the Codes are edited and issued from Boston.

The National Fire Protection Association have managed to secure some advertising space on both radio and television. In America, odd moments in the programmes are used to advertise such things as the Blood Transfusion Service, and National Defense Bonds, and the National Fire Protection Association has managed to get fire protection propaganda included in this service.

II - CANADA

Building Division of the National Research Council, Ottawa, Canada

The work on fire research is undertaken by the Fire Protection Section of the Building Division. This was at that time in its infancy, the Section having only three members. The work so far had been concerned with an investigation into fires in model structures in the hope of devising a test which would measure the hazards of wall linings. It was thought that the ideal test would take some account of the toxicity of the gases resulting from the burning of different wall lining materials, and Mr. Shorter, the head of the Section, was intending to find out, from the results of autopsies, the proportion of people who died from asphyxiation in fires as compared with those who died from burns.

The Fire Protection Section was very cramped for space and it was hoped that it would be possible to build a Fire Protection Laboratory in 1955.

Canadian Underwriters' Laboratories

The Canadian Underwriters' Laboratories carry out fire tests similar to those carried out at the Underwriters' Laboratories in Chicago. They operate a similar labelling system and many of the standards used are the same.

Up to the time of the visit, the work of the Laboratories had been limited by their lack of furnaces in which to carry out fire-resistance tests, but at that time new laboratories were being built at Scarborough, just outside Toronto; the first buildings to be put up were to be those housing furnaces.

Office of the Ontario Fire Marshal

Each province in Canada has a Fire Marshal who is responsible for the maintenance of an efficient Fire Service, and for an adequate standard of fire protection in buildings used by the public. The Fire Marshal has certain mandatary powers and can order necessary alterations to be made in buildings to bring them to an adequate standard of fire safety before their public use is permitted.

The Fire Marshal of Ontario occupies a specially important position, as Ontario is one of the more populous of the Canadian Provinces by virtue of its industries. From time to time, the Fire Marshal of Ontario holds Chief Officers' Conferences lasting about a week, at which lecturers from outside are invited to come and address the gathering on their aspects of fire protection and civil defence. Quite apart from these Conferences, the Chief Officers meet occasionally for more formal civil defence training and are kept abreast with the latest developments in atomic warfare by pamphlets issued from the Fire Marshal's Office. The author had the opportunity of addressing one of the Chief Officers' Conferences on the subject of Fire Research in the United Kingdom, and was most impressed with the manner in which these conferences were run.

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