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BRITISH FIRE PREVENTION COMMITTEE.—No. 41.

Edited by Edwin O. Sachs.

The Safety
OF
Theatre Audiences and the Stage Personnel
AGAINST
Danger from Fire and Panic.

A Paper

BY

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ETC., ETC.

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No. 32.—OFFICIAL FIRE TESTS WITH GLASS (No. 12).
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OBJECTS OF THE COMMITTEE :

The main objects of the Committee are :—

To direct attention to the urgent need for increased protection of life and property from fire by the adoption of preventive measures.

To use its influence in every direction towards minimising the possibilities and dangers of fire.

To bring together those scientifically interested in the subject of Fire Prevention.

To arrange periodical meetings for the discussion of practical questions bearing on the same.

To establish a reading-room, library and collections for purposes of research, and for supplying recent and authentic information on the subject of Fire Prevention.

To publish from time to time papers specially prepared for the Committee, together with records, extracts and translations.

To undertake such independent investigations and tests of materials, methods and appliances as may be considered advisable.

The Committee does not hold itself in any way responsible for the opinions expressed, or methods advocated, by members and others who kindly contribute to these publications.

Comments on the opinions expressed in these papers, or further information on the subjects under consideration, are cordially invited by the Executive, at whose discretion they will be circulated among the members of the Committee.

The Committee's Reports on Tests with Materials, Methods of Construction, or Appliances are intended solely to state bare facts and occurrences, with tables, diagrams, or illustrations, and they are on no account intended to read as expressions of opinion, criticisms, or comparisons.

NOTE.

The Executive of the British Fire Prevention Committee has always attempted to bring out its publications at a moment when the subject dealt with would have a special bearing on some particular event of technical interest. To-day it is again the question of "theatre safety" that is brought forward, and the special occasion for the issue of the present paper is that curious series of theatre fires at St. Helen's, at Cardiff, and at Sheffield, of which we have been hearing during the last ten days. Fortunately, there has been no loss of life, the fires occurring when the premises were closed. But such a series of fires should be a reminder to us of the ever-present danger of the badly-planned playhouse. And it is at such an opportunity as this one that the Executive desire to show what safeguards can be adopted to limit the risk to life and limb, if those responsible are really anxious to improve matters.

The paper which the Executive presents in this publication must rank among the most important so far issued, for not only is the subject deserving of very serious consideration, but the very name of the author commands the full attention of all concerned in fire prevention throughout the world. Mr. Paul Gerhard is the leading authority of the United States in matters of theatre safety, and has been fighting an uphill battle of theatre protection for many a long year. His writings

are well known to all concerned, and have not only served as a guide to the legislators of his own country, but also in the "Old World."

That Mr. Gerhard should now—as an honorary corresponding member of the Committee—have contributed so courteously to our publications is a matter of congratulation, and I need scarcely express the appreciation of the Executive of the value of the assistance given, otherwise than to indicate that we also look upon Mr. Gerhard as an example to his fellow-corresponding members, in respect to the assistance given in our work.

As to the tenour of the paper here presented, I do not wish to add any remark other than to say how glad I am to see that Mr. Gerhard, when dealing with theatre safety, also follows what he so courteously describes as my lead, by giving primary importance to the theatre *planning* as distinct from construction. At the Amsterdam Fire Congress of 1896, I suggested the following as the order of importance, *i.e.*, (1) *planning*, (2) watching, (3) inspection, and (4) construction, and a resolution recommending this order to the notice of the Public Authorities was unanimously adopted.

I am glad to see that so eminent an expert as Mr. Gerhard has also adopted the same principle. It is *life* we are mainly interested in when talking of theatre safety, and not property. This is all too often confused.

EDWIN O. SACHS.

LONDON,

7th November, 1899.

The Safety
OF
Theatre Audiences and the Stage Personnel
AGAINST
Danger from Fire and Panic.

Motto :

“Man pfercht das Brennlichste zusammen,
Da steht's denn alsobald in Flammen.”

(WOLFGANG VON GOETHE, Xenien.)

Among the main objects of the British Fire Prevention Committee, as stated in its Rules, I find the following, viz. :—

“To direct attention to the urgent need for increased protection of life and property from fire by the adoption of *preventive* measures, and

“To use its influences in every direction towards minimizing the possibilities and dangers of fire.”

Having been invited by the Executive to prepare a paper for the publications of the Committee, I propose to discuss briefly the question of personal safety in theatres. I am well aware of the fact that the ground has been gone over so thoroughly by competent writers, as to leave hardly a possibility of making any new or promising suggestions, yet I hold that some good must come from agitating the question over and over again. It is a matter of common observation, that when a serious fire disaster has occurred—whether in a hotel, an asylum, a dwelling, or a theatre—the press for a while takes up the

subject and discusses means and remedies, while the thoroughly alarmed and frightened public stays away from those theatres or hotels, the reputation of which from a safety point of view is doubtful. It is, unfortunately, the rule, however, that as soon as the first excitement subsides, the general interest ceases, and after a very short interval things begin to go again the same way as before, and safety measures or precautions against the well-known dangers to life and limb in such structures are either neglected or forgotten.

In this question history truly repeats itself, and to quote but a few instances, let me recall the numerous suggestions for theatre reform, the flood of plans, pamphlets, newspaper articles, and the revisions of theatre ordinances, etc., which came forth immediately after the calamity of the Ring Theatre fire in Vienna, in December, 1881; or the sentiment in favour of better means of safety which was aroused by the theatre fire at Exeter, in September, 1887, in England; or the intense public excitement following the deplorable disaster of the Paris Charity Bazaar fire, in May, 1897; or, finally, the horrors of the recent catastrophe of the burning of the Windsor Hotel in New York, which occurred in the afternoon of St. Patrick's Day, March 17th, 1899, and caused the loss of many lives. In every instance mentioned—and these instances might be multiplied indefinitely—the public excitement which followed the casualty did not last more than a few weeks.

Now, I hold that the subject is too important to be dismissed so soon from our thoughts. The interest in this grave question should, on the contrary, be kept up and maintained, and measures of safety agitated, until all dangerous public buildings are either made perfectly safe or are closed up. Owners or managers of theatres, in particular, must be given to understand that their highest duty toward the public lies, not in giving them attractive performances, but in providing absolute safety to the public while assembled in their buildings.

To begin with, let me state that I shall confine my remarks to a consideration of safety measures for the theatre-goers and the performers and stage hands. I shall leave out of consideration the question of the safety of the building—in other words, the subject of protection of property from fire—except in so far as the safety of the building incidentally helps to increase the safety of the people assembled, during a performance, on both sides of the curtain. The safe construction of the building and measures tending to reduce the immense losses due to the destruction of such buildings by fire are, no doubt, desirable; but compared with the problem of how to avoid the terrible loss of life due to theatre-fire calamities, they are of secondary importance only. Besides, the matter of safe construction has been well and thoroughly discussed in numerous excellent treatises, of which I would only mention the recent standard work by Mr. Edwin O. Sachs, on “Modern Theatres and Opera Houses.” Another reason why stress will not be laid upon fire-resisting construction, and which will be brought out in what follows, is that incombustible or fire-proof construction, *per se*, cannot, and does not, absolutely prevent theatre-fire disasters. For instance, an ill-planned theatre, having its exits badly arranged or insufficient in number, may, in case of a real or false alarm of fire, prove a veritable death trap, though its construction may be thoroughly fire-proof; and *vice versa*, a theatre which is combustible, which has wooden staircases, and which lacks fire extinguishing appliances, may yet be so planned and arranged as to afford the public perfect means for quick escape from smoke and fire, and therefore be the safer of the two. This instance indicates clearly that there are other safety measures of much more importance than fire-resisting construction.

A study of the principal causes of theatre fires and panics, and of the dangers which arise in such cases, should form the basis of the subject of prevention. It also offers the best clues for the essential requirements to

be insisted on for the protection of theatre-goers and performers.

According to the carefully-compiled statistics of Mr. Foelsch and Mr. Sachs, 207 fires out of a total of 491, of which the cause could definitely be ascertained, or somewhat over 50%, had their origin, either on the stage, or near the stage in the stage part of the building. The causes of these fires were, defects in the gas installation, unprotected gas lights, careless or defective arrangement for the lighting up of the gas, defects in the heating apparatus, fire works, lamps, explosions, firing of guns, and defects in the electric light installation. Therefore, the stage in a theatre is the point where the majority of fires break out, and the stage construction, the scenic apparatus and its lighting require above all to be improved and made safe, if theatre fires are to be reduced in frequency.

When Mr. Foelsch's first paper on "Theatre Fires" was published, in 1870, he had collected statistics of 130 fires; when his book came out, in 1878, it contained a record of 523 fires; the appendix to his book, issued in 1882, increased this number to 631, and in his last essay on theatre fires, published in 1889, he enumerated 936 fires. Mr. Edwin O. Sachs, who continued and elaborated the work of Mr. Foelsch, published, in 1897, a list of 1,115 theatre fires (up to May, 1897).

In his last book "Reminiscences from the life of a civil engineer," Mr. Foelsch gave the following statistics, in intervals of 6 years:

From 1841-1846	occurred	32	theatre	fires
„ 1847-1852	„	41	„	„
„ 1853-1858	„	40	„	„
„ 1859-1864	„	41	„	„
„ 1865-1870	„	82	„	„
„ 1871-1876	„	96	„	„
„ 1877-1882	„	161	„	„
„ 1883-1888	„	215	„	„

The point brought out by these statistics is that the

average number of theatre fires per year is on the increase. This agrees with the deductions from statistics as given by Mr. Sachs. While the average annual number of fires in the last 30 years is 27, the average of the last 20 years is 33, and that of the last 10 years is 36. This may be partly due to the increasing number of theatres erected, and partly, possibly, to the fact that the statistics of the last decade are more accurately kept. Still, one would hardly expect such a startling result, in view of the numerous really valuable suggestions made from time to time regarding improvements for the safety of theatres.

Occasionally one finds the subject divided into measures of safety to be applied to *old* buildings, and those that should be carried out in *new* buildings. From my point of view this division is unimportant, except in so far as the older buildings are naturally more dangerous and likewise more difficult to improve than theatres of more recent construction, which, as a rule, are better planned, better constructed and better equipped and maintained. On the whole, the principal measures of safety apply to both classes of buildings, and they can be carried out with only few exceptions whether the building is old or new. Of course, those who wish to avoid risks always go safer by shunning the older buildings and patronizing only the recently-built theatres, at least in the larger cities, where special theatre ordinances are enacted. For instance, a very little reflection ought to teach theatre-goers that theatres in which the electric light is installed, particularly on the stage, are less dangerous than those still provided with gas illumination, or that theatres necessarily located in a block are much safer if there are large courts on each of its sides, giving numerous means of egress to the open air in case of an alarm or panic.

In my paper I shall have in view constantly the dangers from fires or panics breaking out *during* a performance. Statistics show that during the last 100 years

(1797-1897), at least 9,355 persons lost their lives in theatre fires. This loss of life seems so appallingly large, as to certainly make it worth while to make continued attempts to minimize the dangers to which people crowded together in a theatre during a performance are exposed. Mr. Sachs, in his work on "Fires and Public Entertainments," which contains the elaborated continuation of the statistical figures gathered by the late engineer, Aug. Foelsch, informs us that out of 769 theatre fires, 103, or about 13.5 % broke out *during* the presence of the audience. These figures certainly point out the graveness of the the dangers to theatre audiences and stage personnel. Dr. Brouardel, in an interesting article on "*La mort dans les théâtres,*" explains wherein these dangers chiefly consist. He tells us that the loss of life in theatre fires or panics is caused by burning, due to the fire and the flames; by suffocation, due to the heat, the smoke or fire gases; by shock or fright; and by the crush or jam of the panic in which people are trampled to death, or have their chests crushed in and die from hemorrhages, etc.

It follows that in the case of a fire or panic the chief and essential conditions for the safety of the human beings are, first, *fresh air*, to prevent suffocation by smoke and gases, and exhaustion by the heat of the flames; second, *light*, for darkness leads to confusion, frantic struggles and crushes; and third, *plenty of unobstructed exits* leading to out-doors, for the lack of proper exits and obstructions in passage-ways or on stairs leads to jams and causes many violent deaths.

In considering the principal measures of safety for spectators, players and stage hands, I shall not, in this paper, follow the usual course of describing and discussing the various parts of a theatre building, their planning, construction, arrangement and equipment, but I shall consider the safety measures as nearly as possible in what appears to me to be their relative order of importance. Fire protection in theatres includes the following safety measures, viz.:

1. Means to permit the audience and the stage personnel to make their escape safely in case of either fire or panic.
2. Measures tending to prevent an outbreak of fire, and for quickly detecting and signalling a fire outbreak.
3. Measures for protecting the play-goers against fire and smoke.
4. Means for the protection of the stage personnel.
5. Measures for confining a fire to the stage and preventing its spreading.
6. Means for saving life.
7. Means for fighting fires in their incipiency.
8. Measures to guard against a panic.

I.—MEANS TO PERMIT THE AUDIENCE AND THE STAGE PERSONNEL TO ESCAPE IN CASE OF FIRE OR PANIC.

Under this heading will be considered the question of theatre exits, which safety measure I place at the head of the list, because it is by far the most important measure. In this all leading authorities are agreed. The safety of the persons assembled in a theatre building depends more upon properly arranged means of egress, than upon fire resisting construction, or upon the provision of suitable fire appliances.

Experience teaches that a theatre fire may become fatal to life within five minutes after the discovery of the fire. What must be done, therefore, in every such building, whether old or new, is to provide such means of egress as will insure the emptying of the entire house within three or four minutes. Rightly carried out, this safety measure is entirely sufficient to save the lives of all people, spectators as well as performers, even when all other precautions, be they ever so good, are neglected.

But there is still another reason why the question of theatre exits is *all important*. Frequently false alarms of fire occur in a theatre, or a small stage fire is put out in

its incipency, yet sudden terror may seize the audience, and though their lives are threatened by neither flames nor smoke, they become panic-stricken and a wild stampede towards the exits occurs. In such a case, the safety of the audience from the danger of being trampled to death or crushed in the jam depends entirely upon a provision of proper and sufficient exits to afford a possibility of quickly reaching the open air.

Under "exits" should be understood much more than merely the exits proper. We must include under this term the arrangement and dimensions of the seats, the width of the passages between the seats, the number of seats between aisles, the width and number of aisles, the size of the gangways in the rear of the seats in the auditorium; the arrangement of vestibules, foyers and lobbies; the dimensions, planning and construction of staircases; the fire escapes and balconies; the arrangement and width of exit doors; the door bolts, and the lighting of the exits. In other words the term "exit" includes the entire road which a spectator, seated in the audience, has to travel in order to reach the open air.

In Publication No. 4 of the British Fire Prevention Committee the subject of "Theatre Exits" has been admirably treated by Mr. Alfred Darbyshire, and Mr. Thos. Blashill has referred to the same subject in his paper on "Lessons from Fire and Panic." Mr. Sachs has, perhaps, struck the keynote in the following most important advice, which theatre owners and managers would do well to take to heart: "Everything to insure good exits should be done, even if some of the other requirements of modern theatre construction have to be given a second place. As far as the audience is concerned, suitable exits and straightforward planning should be giving precedence." Equally true is the statement of Mr. Darbyshire: "Construction may minimize the risk of a fire outbreak, equipment may prevent the spread of fire, but clear exits and good planning will principally contribute to the safety of an audience."

The problem of how to secure the quick and safe departure of a theatre audience is largely a question of its proper and sufficient sub-division. While this is, to some extent, secured, *a priori*, by the division into different tiers, this in itself would not be sufficient, particularly if exits from different tiers are made to lead into a common lobby. Each section should be again divided and made to leave by several independent outlets. In other words, the audience in the parquet, balcony, and gallery should each be decentralised as much as possible. The exit passages from different sections should, under no circumstances whatever, cross each other, meet, or be combined; each sub-division should have, *at least*, two entirely separate and independent exits leading to the open air; in large buildings a greater number even may be required. The spectators occupying gallery seats have the farthest to travel, and should therefore have the best facilities for exits, whereas actually the reverse is often the case.

It is not at all necessary that all the exits provided in a theatre should be used as entrances before the performance begins; but it is essential that all exits should be used nightly, *after* the performance, so as to familiarize the public with the different routes of travel. Nothing, to my mind, is worse in a theatre than the provision of so-called "*emergency*" exits, which are supposed to be used only in case of threatening danger.

The number of exits will depend upon the number of tiers and the size of the theatre; the number of tiers should be limited, and the gallery should not be located too high above the street level, nor should the main auditorium ever be located a story above the street floor. In general, smaller theatres may be considered safer than large houses. The arrangement of a sunk pit, so common in English theatres, is unknown both in the U.S. and in Continental theatres. The pit arrangement is good, in so far as it reduces the height of the upper gallery above the street level, and thereby shortens the

exit from the most dangerous part of a theatre. In the U.S., building regulations call for the principal floor of the theatre to be not more than a few steps above the sidewalk.

The arrangement and placing of the exits will depend upon the plan of the theatre, and this, in turn, is determined by the available site. Clear planning is most desirable, so that in the event of danger the audience may clearly see their way out; as a rule a symmetrical arrangement of both sides of each tier will conduce to the quicker emptying of the theatre.

It would be well to institute actual tests of the time required to empty a theatre building. According to Foelsch, a theatre in Milan, Italy, having 13 exits opened, was emptied in June, 1887, in less than four minutes (the size or capacity of the house is not stated). I am informed by a person who has frequently visited the Wagner performances, that the Bayreuth theatre, having a capacity of 1,500 persons, can be emptied in just two minutes. The Fifth Avenue theatre in New York (holding 1,400 persons) can be emptied in two and a-half minutes, the larger Gaiety theatre in Boston (3,000 persons) in four minutes; the recent Abbey theatre in New York (1,450 persons) in one and a-half minutes. The large Madison Square Garden in New York, which holds 17,000 people, requires four and a-half minutes for emptying. All these are examples of more recent buildings.

The minimum width of an exit and exit door for 500 persons or less should be five feet, and for every additional 100 persons 20 inches should be added to the width.

Regarding the arrangement of the exit doors, it is of the greatest importance that these should swing outward, for many a disastrous panic and loss of life were abused by doors which opened the wrong way, and which could not be opened during a jam because the maddened crowd was pressing against them in their

frantic efforts to reach the exits. It is not sufficient that doors should open outwards, but they should swing entirely out of the way in order not to form, when opened, an obstruction in a passage-way or staircase.

All exit doors should be plainly designated as such in large legible letters; all other doors may be either marked "No exit" or should have the name of the room into which they open marked, such as "Cloak-room," "Toilet-room."

Doors of exits leading to staircases should never open directly upon the stairs, but there should always be a wide landing between the doors and the stairs. Under no circumstances should doors with lock and key be tolerated in a theatre; exit doors may be provided with bolts placed on the inside and at shoulder height, and of such construction as to be easily drawn or pushed back. Several so-called panic bolts are now obtainable which fulfil the requirements of safety. In the Abbey Theatre of New York City the exit doors are controlled by electric openers, which are operated by pressing a button, either from the stage or from the manager's office. The device is, perhaps, not new, for it was proposed in 1882 by a clergyman, Don Ravaglia, and tried with success at the Allighieri Theatre, in Ravenna, Italy.

Regarding the staircases in a theatre, these should be wide and easy; they should never have any winding steps, nor should there be single steps. Very long stairs should be broken by wide landings. All risers and treads should be uniform to prevent stumbling. Stairs should be at least 4 ft. 6 ins. wide, and if possible, they should be made wider than the width of the corridors leading to them. A strong and well-fastened hand-rail should be provided at both sides of the staircase, and very wide stairs should be divided in the centre by a centre rail. No obstructions of any kind should be permitted in staircases of theatres. Concerning construction, it is desirable, though by no means absolutely necessary, that the stairs should be fireproof or incombustible.

Ill-planned fire-proof stairs may not prove to be as safe as well-arranged wooden stairs. Iron stairs with slate treads are better than stone stairs. Stairs enclosed on both sides with brick walls are better and safer than open well stairs. It is essential that stairs leading to the exits should be smoke proof.

All corridors, halls and passages, should be planned of ample width to accommodate the number of people passing through them. They should be not less than $3\frac{1}{2}$ ft. wide for 200 persons, and for every additional 100 persons, 6 ins. in width should be added.

The aisles in the auditorium should be of proper width, and sufficient in number, as this will assist greatly in the quick emptying of the house. The minimum width of aisles should be 3 ft., and it is desirable that the width of the aisles should increase towards the exits. Aisles should never have steps, but must be planned with gradients or inclines. All passages and aisles should be kept free and unencumbered; no extra chairs, camp stools, or other temporary obstruction should ever be permitted. There should be a sufficient number of aisles between the seats, so that persons in leaving may quickly reach the aisle. Most theatre regulations prescribe that there should be not more than twelve seats between aisles. The dimensions of the seats should be generous, not only for comfort's, but principally for safety's, sake. The seats should be from 18 to 21 inches wide, and the distances between the rows of seats should be from 29 to 31 inches (generous dimensions are 20 inches wide and 33 inches deep). All seats should be well fastened, for loose chairs might become, in times of panic, a dangerous obstruction by accidental overturning. The seats should be so-called flap-seats, hinged so that they may be turned up out of the way, thus affording more room between the rows for people passing between them.

The gangways or passages at the rear of the auditorium seats, and all foyers, vestibules, lobbies, colonnades

or terraces reached by the play-goers from the aisles, should be generous in size, and of capacity to hold the entire number of persons of each tier. They must be well ventilated and be free from any smoke. Each tier must, in addition to the regular exit ways, be provided with external iron safety balconies and iron fire escapes, leading to the open courts in those theatres which have only one front on the street. These fire escapes should be constructed so that they can be well and conveniently used by women, children, and infirm old persons generally. It is very necessary that the fire balconies and stairs be covered or roofed over, so that they may not become slippery and dangerous in freezing weather. It is also important that these fire balconies and stairs be kept at all times entirely free and unobstructed.

Given plenty of exits through which a crowd may safely escape in case of fire or panic, it is necessary that all exits, passages and corridors and stairs, including, as I believe, the rear portion of the auditorium, be lighted by some lighting system which is entirely independent from the lighting system of the stage or the main auditorium. Where gas or electric light is used in the theatre, it is usually required that the exits be lit by vegetable oil lamps or candles, but either of these should be well protected from draughts. If gas lights are used, they should be supplied from an entirely separate gas service, and the gas lights should be controlled by gas keys with detachable keys, in order to prevent mischievous persons from tampering with the lights, which are so absolutely essential to the safe retreat of an audience.

The safety measures named will secure the safe escape of the play-goers from a theatre in case of a false or real alarm of fire. Equally necessary are the means for the safe escape of the theatre personnel, comprising the performers, musicians, dancers, stage hands, etc. In some performances there are sometimes as many as three or four hundred people behind the curtain, and their safety is of as much importance as that of the theatre audience.

The stage house therefore requires several properly-arranged and located exits, leading directly to outdoors and preferably located on the two opposite sides of the stage. There should be wide passages around the three sides of the stage, divided from it by fire-walls. There must also be well-arranged, strongly-built stairs from the dressing rooms of the actors, leading to the exits, and these stairs should in every respect be as safe as those for the audience; they must be smoke proof and kept well lighted until the emptying of the stage house. The dressing-rooms should not be located too high above the stage, nor up near the rigging loft, from where escape is more difficult.

For the stage hands there must be at least two fire-proof stairs leading from the flies and the rigging loft down to the stage.

II.—MEASURES TENDING TO PREVENT AN OUTBREAK, AND FOR QUICKLY DETECTING AND SIGNALLING A FIRE.

We have seen in the foregoing remarks, how very necessary it is, in case of a fire breaking out in a theatre building during a performance, to get the people out of the building as quickly as possible, and in such a manner as to prevent any panic, jam or stampede.

We must now consider briefly some of the general measures which will tend to prevent an outbreak of fire. These measures comprise chiefly four points of consideration, namely, the site and plan of the building, the construction and equipment, the managing and watching, and finally the theatre inspections.

Regarding the site for a theatre, a free site is, of course, the ideal one. In some continental cities this is insisted upon, but in both England and the United States of America a free and isolated site is very exceptional. Most American theatres have only one street front, and until quite recently many such buildings were badly

hemmed in on the sides, so that it was almost a matter of impossibility to provide a suitable number of safety exits. In recent theatre buildings, located in the middle of a city block, a compromise has been effected by making provision for wide courts on both sides of the front. Some stage exits and the outside fire stairs lead into these courts, which must have a certain minimum width, depending upon the number of persons which the theatre holds.

In choosing the site for a theatre, due regard should always be had to the neighbourhood and the surroundings. A theatre should never be located near dangerous trade establishments, large factories, etc. Danger of fire from without should be guarded as much as fire from within. The location of a theatre in rear courts, with entrances passing through front buildings devoted to other purposes, is one that is universally considered out of the question.

The general arrangement of the plan should be as clear and symmetrical as possible, as this increases the safety. The number of tiers should be as small as possible, and never more than three tiers above the parquet. The sub-divisions comprise the parts devoted to the public, such as the entrances, stairs, vestibules, foyers and the auditorium; and, on the other hand, the parts devoted to the players, viz., the stage, the dressing-rooms, the manager's offices, the property-room, the scene-dock, the engine and boiler-room, etc. It is well to eliminate from a theatre building in the front part of the house all stores, living apartments, restaurants provided with kitchens, etc., and from the stage part of the building the scene-dock, the painters' and carpenters' shop, the steam boilers, the gas meter, vaults, the property and costume-rooms, in short, all rooms for storage of a considerable amount of inflammable materials, etc.

It is not my purpose in this paper to discuss theatre construction, except to indicate in a general way that as the safety of a building has a direct bearing upon the

safety of the people in the theatre, all walls should be well-built solid fire-walls, and that there should be as many sub-divisions as practicable, each made as fire-resisting as possible, and divided from the adjoining division by properly-constructed fire-walls. Besides, the theatre should have a fireproof roof, to guard against danger of a conflagration from the outside, and all chimney and smoke flues should be built in the very best manner possible.

As explained heretofore, the stage of a theatre is the chief danger-point, hence particular care is necessary to make it as fire-resisting as possible. The stage is the place where a vast quantity of very inflammable material—such as wood-work, canvas, paper, ropes—is concentrated. The scenic decorations are naturally subjected to a constant drying-up process by the great heat to which they are nightly exposed. They are always to be considered as being in danger of fire from their exposure and closeness to open lights, wherever gas-light is still used, and they are apt to catch fire very quickly. It is self-evident, therefore, that the stage should be made much safer than it is found to be in the majority of theatres, by eliminating from it combustible material as far as practicable. The central part of the stage must necessarily remain a wooden construction, owing to the requirements of the numerous stage traps, but the two sides of the stage, the so-called wings, the fly galleries, and, finally, the grid-iron and the stage roof can, and should, be constructed of fire-resisting material. Moreover, all scenic decorations can be rendered safer against catching fire by being impregnated with chemicals. All woodwork, the scenery and, finally, the costumes, particularly the light gauze costumes worn by the ballet girls, should be rendered non-inflammable by impregnation, which in the case of dresses must be repeated after each wash. The canvas scenes may be covered with fireproof paints, and, indeed, one may go a step further, and substitute for the wooden and canvas

decorations those of sheet iron held in light iron frames, or else asbestos cloth, as urged by modern stage reformers. Instead of hemp cords, wire ropes should be used, and for the wooden drums and hoisting apparatus, the more modern hydraulic, or the electric stage appliances should be installed. No scenery accumulation should be permitted on or near the stage, and special fire-proof scene-docks should be provided for the purpose beyond the limits of the stage house.

A special point, namely the lighting of the stage and of the decorations, requires some mention. We know well that most fires originating on the stage are due to defective stage lighting or to open flames, hence the stage lighting should be modified. Such a modification—nay, revolution—came about with the introduction of the incandescent electric light. It is scarcely necessary for me to praise its many points of superiority over gas-light for the theatre stage, for its advantages are now well recognised. Of course, its installation does require careful attention to the details, but with wiring well insulated, and with motors and dynamos located in a special annex, nearly all danger is eliminated. The electric light is not only brilliant, but readily brought under control. It does not vitiate the air, and, above all, it does not create the fierce heat which is due to the numerous gas flames serving to illuminate a scene. Finally, it does away with the dangerous lighting-up processes of rows of gas-lights, and thus eliminates one of the dangers inherent to the gas-lighting system. Hence the use of electric light instead of gas is rightly considered one of the best measures to prevent fire in a theatre. It is, perhaps, unnecessary for me to mention specially that the above recommendation of the electric light is confined to the incandescent light only, for the arc light must be regarded as rather dangerous for use on the stage of a theatre. Where, however, electric light is not available, and gas must be used, special pains should be taken to reduce the accompanying danger as

much as possible, particularly where open flames must be used, which should always be well protected. Care should also be taken in using the best available means for the lighting of rows of gas lights, particularly those which illuminate the battens, and likewise should care be bestowed to movable gas hose connections for shifting pieces of the scenery. The lighting of the stage and of the main part of the auditorium, excluding the gangways at the rear of the seats, should be controlled from a gas table on the stage, and the lighting of stairs, corridors, lobbies, foyers should be entirely separate and controlled from the foyer only.

To render a theatre safe, there should be but one central heating apparatus. Heating by steam is preferable to furnace heating, which latter has a tendency to render the inside trim very dry.

Every theatre building should have sufficient protection against lightning. The protection which a proper system of lightning-rods affords should not be underrated. Lightning rods may prevent the outbreak of fire, and they may likewise serve to avert a serious panic, which may follow where a theatre building is struck by lightning. In August, 1894, the Royal County Theatre at Reading, England, was struck by lightning, and the resulting fire completely destroyed the building, which fortunately was empty at the time. In several instances, where theatres were struck by lightning during a performance, the panic which followed resulted in the deaths of several people. Quite recently, on the night of June 7, 1899, a theatre at Chautauque Lake, in the State of New York, was struck by lightning while a play was in progress. "With the crash all the lights went out, but the audience was prevented from stampeding by the coolness of an actor."

A further safety measure to prevent an outbreak of fire, consists in the efficient watching of the theatre building, particularly before and during a performance. The inspection should be directed particularly to the heating and lighting apparatus of the theatre. Many fires break

out within two hours after the close of a performance, hence it is an excellent precaution to have the entire building carefully gone over and watched nightly. To ensure safety of the spectators, however, with which we are principally concerned, it is necessary to maintain in a theatre, during the entire performance, an efficient fire watch, composed of well-drilled and experienced members of the city fire department, and to institute and maintain daily inspections before the performances.

Then again, safety is attained by having regular periodical inspections of the building by fire experts, architects, engineers, and firemen, and also special inspections and actual tests of the gas-piping, of the electric appliances, of the water and fire-extinguishing appliances also tests of the efficient working of the stage roof ventilators, to which I will refer hereafter, of the fire alarm apparatus, of the heating apparatus, and of the lightning-rod protection. Besides these, there should be occasional inspections by the authorities, which should, preferably, be unannounced.

Every theatre should be provided with the most improved and modern means for quickly detecting, reporting and signalling an outbreak of fire. This includes an automatic fire telegraph system and telegraphic or telephonic communication with the nearest fire-engine house, with fire department headquarters, with the city water reservoir or water department headquarters, and with the station house of the life-saving patrol.

Finally, many measures tending to prevent an outbreak of fire are matters belonging to theatre management. Every theatre manager should issue rules of order and should see to it that they are strenuously enforced. He should insist upon and maintain strict discipline and order in all parts of the building; he should maintain regular fire-drills carried out by the stage employees and the theatre staff. Instruction should be given in the use of the fire-extinguishing and life-saving appliances, and

special instructions issued to the watchmen in the theatre.

Gas leaks should be reported immediately ; lamps on the stage, if required, should be handled with care, and all exposure to draughts avoided ; the use of alcohol lamps in the dressing-rooms should be forbidden ; safety lanterns or electric candles should be provided for use in entering large costume or property rooms ; extreme caution should be exercised in the lighting of foot and batten lights of gas, and in the use of matches, candles, oil lamps, fire-arms, fire-works, representation of conflagration in spectacular plays, benzine or turpentine in workshops or costume rooms. Smoking should be rigidly prohibited in all parts of the house, including the actors' dressing-rooms, and be permitted only in a special fireproof smoking room. All accumulation of rubbish, straw, oily rags, etc., and combustible material, liable to spontaneous combustion, must be avoided ; no obstruction should be permitted of the fire appliances. The manager should not only enforce the greatest carefulness of persons on or near the stage, but also insist upon the constant and nightly use of the fire-proof curtain ; he should see personally that all exits are constantly used, and that they are kept efficiently lighted until all persons have left the building.

III.—MEASURES TO PROTECT THE AUDIENCE FROM FIRE AND SMOKE.

We have now discussed two principal safety measures, namely first, the exits and their proper arrangement to enable an audience to make their safe escape under all circumstances ; and secondly, measures tending to prevent an outbreak of fire. We must now point out two important further measures, which have for their object the protection of the audience, in case of an actual outbreak of fire, from both the fire or the flames, and from the smoke and fire gases incidental to every theatre fire. Dr. Brouardel has given a very good description of what

happens when a fire breaks out on the stage of a theatre. In the majority of cases the fire originates from stage decorations catching fire, and owing to the inflammable nature of the material usually adopted for them, large volumes of a thick smoke are at once generated, which contain both carbonic acid and carbonic oxide. The flames, the fire gases and the smoke at once jump from the stage into the auditorium, particularly into the upper galleries, and within a very few minutes, incredible as it may seem, their deadly work is accomplished, and hundreds of people may be killed, partly by the heat and the flames of the conflagration, partly by the deadly gases which render respiration impossible after only three or four minutes. In many of the theatre fire calamities recorded the deaths were due principally to suffocation by carbonic oxide, or by the inhalation of hot air. As proof of this assertion Dr. Brouardel cites the fact that the dresses of many of the victims were found unscorched, dead bodies were found with the eyebrows and whiskers unsinged, and the bodies bore no marks of scalding, nor were they covered with blisters. Further proof that death was caused by carbonic oxide poisoning was given by the analysis of the blood which was found to contain carbonic oxide.

To guard against the dangers thus described, two important safety measures have been devised, which can readily be introduced into every theatre building, whether old or new. One of the measures consists in the use of a fire-proof and smoke-proof curtain in the proscenium opening, to divide the auditorium from the stage; the other consists in providing large smoke flues, outlets or ventilators in the roof of the stage.

The fire-wall dividing the stage house from the auditorium would not constitute a protection in case of fire, owing to the large stage opening. This should, therefore, be closed by a fire-proof curtain.

Numerous discussions have been held about the best material for such a curtain. In Continental cities and

also in England preference has been given to iron curtains, either of wire, or of flat or finely-corrugated iron. Flat iron curtains have not, in practice, proven sufficiently strong to resist the air pressure from the stage in case of fire, and they have sometimes buckled out in the centre and thus proven inoperative. Wire curtains prevent the passing of flames from the stage to the auditorium, but permit the passage of the deadly smoke, and moreover they give the audience, already panic-stricken, a full view of the fire, and thereby increase the rush to the exits and the wild excitement. Corrugated iron curtains are by far the best of all iron curtains, as they are strong and fire-resisting, and at the same time, if properly fastened and guided at the sides, they are smoke proof. They are, of course, heavy to handle, and must be well counter-balanced. The best iron fire-curtains are doubtless those operated by hydraulic machinery. The mechanism for the raising and lowering of the curtain must be perfect from a mechanical point of view; this mechanism should be operated from the level of the stage, and preferably also from another accessible point. Several cases are on record where iron fire-curtains became stuck in the grooves when it was intended to lower them. Accidents have also happened by the curtain falling down on the stage. Flat iron curtains have been bent and thrown by the strong air pressure, due to the expansion of the air by the heat of the fire into the auditorium. A much more practical fire-curtain consists of thick and strong woven asbestos cloth, well guided in iron guides at both sides of the proscenium-opening. Such curtains are used exclusively in modern American theatres, and it is believed by experts that they are sufficiently fire-resisting to keep flames and smoke from the audience, until all have escaped by the numerous exits which are provided in modern play-houses. The fire curtain is kept lowered in the theatres, until the beginning of the performance or the rehearsals.

With proper fire-walls between stage and auditorium

and no openings in these above the level of the stage, and with a good fire-curtain, a fire breaking out on the stage will successfully be confined to this point, until the house has been emptied and all the persons saved.

The other, equally essential, requirement consists of large outlet openings for the smoke provided in the roof over the stage. These openings may be formed of regular vent flues, or they may be special forms like sliding skylights, which are quickly opened in time of need, or which operate automatically. It is important that the ventilators should be of sufficient area to remove the volumes of smoke generated by the burning of much inflammable scenery. Some regulations require their combined area to be one-tenth of the area of the stage. When they consist of flues, their lower end may be closed by light muslin or other substance easily destroyed when the flames first reach the stage roof, or they may consist of automatic sliding ventilators like those of the new theatres of New York City. Finally, the flues may be closed by registers operated from the stage by ropes or other appliances.

The chief object for which they are intended is that there should be created a strong draught from the level of the stage floor up to the roof, and away from the auditorium. This will afford a very good protection to the theatre audience, certainly until they have had time to make their escape in safety.

Should there be in the ceiling of the auditorium a ventilator, possibly even assisted by the upward draught created by the obsolete central chandelier, it is necessary that arrangements should be provided for closing the ceiling ventilator, to prevent a draught from the stage towards the ceiling-vent in the auditorium. In Europe several theatres have arrangements by means of which it is possible to close by one movement this ventilator and simultaneously open the stage ventilators. The stage roof being invariably higher than that of the auditorium, it is natural that the draught towards the

stage should be the stronger, and that thereby the audience will be protected against smoke.

The diffusion of smoke from the burning scenery into the staircases, both of the part of the house before the curtain and in the stage house, should be efficiently guarded against, hence the requirements that corridors, lobbies and staircases, for the public as well as for the stage people, should be smoke-proof. Doors should be provided between the auditorium and the foyers and corridors, likewise doors between the sides of the stage and the dressing-rooms.

Inside staircases are bad, as the air in them may become full of smoke, whereas outside stairs can generally have windows which will secure fresh air. Light in the stairs is also of importance, and therefore we have mentioned elsewhere that it is essential to have a separate system of lighting of the exits and corridors and stairs; this will prevent confusion in the darkness due to smoke and often avert dangers to the people using the exits. The maintenance of the auxiliary lights in the exits is a very important safety measure, which in itself will prevent direful confusion and a crush. These lights will also prove of great utility to the firemen when entering a burning building, and in some cases, they may assist them in finding and rescuing persons who may have fainted or become overcome from the smoke.

The abolishment of the central gas chandelier in theatres is a great improvement, but the ceiling ventilation in the auditorium cannot so easily be dispensed with, as during the times when the curtain is lowered there would otherwise be no ventilation for the auditorium. It is either necessary to arrange the ventilation on the so-called downward system, or else there must be provided a perfectly working appliance which will permit the ceiling ventilator in the auditorium to be closed whenever the curtain is raised, or, at least, when fire breaks out on the stage.

Regarding the auxiliary lighting of exits, I would mention that where these consist of candles or oil lamps they require to have lanterns encasing the lights, which must be provided with fresh air ducts to keep the lights burning in case of smoke.

IV.—MEANS FOR THE PROTECTION OF THE STAGE PERSONNEL.

It is not sufficient that we should protect the audience from fire and smoke; the people behind the curtain are deserving of the same considerations for their safety. Owing to the fact that fires in the majority of cases break out on the stage of the theatre, the performers and stage hands would be immediately and directly exposed to the flames, the fire gases and the smoke, unless proper means for their protection are provided.

Hence, the dressing-rooms should be completely isolated from the stage house, as well as from the auditorium; the part of the building in which they are located should be isolated by fire-walls, and by a wide fire-proof corridor. There should be wide, well-lighted fire and smoke-proof staircases for the performers, one for each side of the stage. These should lead directly to the courts on each side of the theatre, or to outdoors where the building stands isolated. The dressing-rooms should have windows to the outer air, and these should never be guarded with iron bars or grilles, which would render escape through the windows impossible; additional iron fire-escapes at these windows are desirable. It is advisable not to put the dressing-rooms of the actors too high up above the stage level, as this would necessitate a long route in case of an alarm. Regarding the size and dimensions of the stage exits and exit doors, the same rules as for the audience should apply, and they should be proportioned to the largest number of persons which may be on the stage and behind the curtain generally.

For those workmen who are employed during the performance in the fly galleries or the rigging loft, there must be provided an iron staircase, or preferably one on each side of the stage.

The greatest safety for the stage personnel is attained, of course, by adopting a better construction of the stage, and doing away with as much woodwork and inflammable scenery as possible, or at least, where the cost of an iron construction cannot be borne, the scenery and the woodwork should be rendered inflammable by an improved fire-proof treatment by chemicals.

Greater safety is also attained by rendering the dresses and costumes non-inflammable by impregnation. Space forbids my going into the details of the various now available processes.

The stage ventilators and the automatic sprinkler system will also be efficient means of protection, the former by removing the smoke, the latter by the chance which it offers to put out a fire among the scenic decorations in its incipiency.

Greatest care should be exercised in the planning of the stage and its accessories, and the success of a well-organized stage management will depend chiefly upon it.

In the actors' dressing-rooms attention should be paid to numerous small details tending to give greater security. Here all woodwork should be rigidly excluded, all open gas flames must be well protected, and the smoking in dressing-rooms should be absolutely prohibited. The rules of the theatre management should emphasize the need of greatest care on the stage with lights, matches, lamps, torches, fire-works and the use of fire-arms.

A proper installed electric lighting system on the stage will form another efficient protection of the stage personnel, as already explained elsewhere in this paper.

Finally, it will enhance the safety of the stage personnel if the carpenters', painters', and tailors' workshops are completely isolated from the stage building.

Panic may break out on the stage as well as in the auditorium, hence, besides provisions against smoke and fire, means to avert a Panic should be contrived, or at least, every possibility should be afforded to the performers and stage hands to make their escape in safety, and to avoid a crush or jam with its often fatal consequences.

V.—MEANS FOR LOCALIZING AND RESTRICTING A FIRE ON THE STAGE.

If, notwithstanding all possible precautions, a fire actually breaks out on the stage, all efforts should be concentrated toward restricting and confining the fire. Good planning and sound construction will do more towards accomplishing this desired result than any human efforts at fire-fighting. Let the stage building be planned and built so as to be completely isolated, forming a fire risk in itself, and half the battle may be said to be won. This is accomplished by the use of fire-walls surrounding the stage on all sides; again, the fire-proof curtain, discussed in a former paragraph, will render efficient service in localizing the fire.

The proscenium wall should have as few openings communicating with the auditorium as possible, and these should be provided with fire-proof doors of oak, lined on both sides with tin, and possibly arranged to close automatically. Again, it should be mentioned that the construction of the fire-curtain must be such that it will close at the sides and not permit the smoke or flames to pass through.

Proper roof ventilators will assist in removing the smoke from the stage, but in case of fire, all doors leading to the stage should be instantly closed to avoid a draught.

Fire-extinguishing appliances and a well-organized fire-brigade composed of the stage hands and stage machinists will prove useful during the first outbreak of

a fire. An automatic fire alarm system, regularly tried and maintained in good order, will indirectly help in localizing the fire, by at once giving notice of the outbreak. Lastly, a good water service and efficient fire pressure at the fire hydrants will be the means to confine and restrict a fire. All fire-extinguishing appliances are to be considered as chiefly useful during the few first moments after the outbreak, for, as soon as the flames have begun to spread, these devices will prove powerless, and the building should be turned over to the quickly summoned fire department, while all efforts should be concentrated to save human life.

VI.—MEANS FOR SAVING LIFE.

In cases where the fire has spread and gained much headway, it may, notwithstanding all precautions, happen that the safe retreat of persons in the theatre is cut off by flames or smoke. Therefore, it is essential that every theatre should be provided with at least some means for saving life.

The outside fire-escapes belong, first of all, to these measures for safety. There should be provided, besides these, outside iron ladders, built into the walls, connecting the various roofs, and which may serve not only as means of escape for persons in the burning building, but which will prove extremely useful to the firemen in their work. In this connection, mention should again be made of the necessity of omitting any bars or iron gratings at the windows.

All large American cities, and many of the smaller ones, now have in their fire department a regularly trained corps of life-savers. They make use of light, but strongly-built, scaling ladders to reach persons at the windows, whose retreat by the regular stairs and exits may have been cut off. In connection with these scaling ladders it is worth while mentioning that, in the erection of the building, provision should at once be made for window

cornices or sills so moulded and of such dimensions as to be adapted to the scaling ladders.

The life-saving corps also make use of life-lines, of canvas belts with clutch hooks, or portable rope escapes, and of guns for firing the life-lines into windows. They likewise use asbestos cloth chutes or life-saving sacks of flexible canvas, which they carry up the ladders, fastened securely to windows, and by means of which persons in danger are readily rescued. Some fire departments use the jumping net or cloth, and while by no means without danger to the limbs, a jump from a window into the jumping net may save the life of many persons.

The theatre management should consider the advisability of providing some of these means of saving life for the building. Extension ladders, scaling ladders, possibly a chute, and some smoke protectors should be kept ready for use in emergency cases in every theatre.

VII.—MEANS FOR FIGHTING OUTBREAKS OF FIRE.

Notwithstanding the assertion made in the first part of this paper, that the safety of the persons in a theatre is much more important than the safety of the building, it is necessary that every theatre should be provided with some means for fire extinction, and particularly such as are useful in extinguishing fires in their incipiency. As such fire-fighting appliances, I would mention first the automatic sprinkler system on the stage. This includes rows of pipes with sprinkler heads, placed so as to command and protect every square foot of the understage, the stage proper, the fly galleries, the rigging loft, the engine and boiler room, the dressing-rooms of the performers, etc. They should be supplied from one or several roof tanks of generous capacity, or from pressure tanks in the basement, and these tanks should not be used for any other purpose, and must be kept constantly filled so as to be in readiness when wanted. The tanks are usually supplied from a

large fire-pump in the engine room. In addition, outside fire department connections for the sprinkler system must be provided. The same fire-pump should be connected with the fire stand-pipes, of which there should be in every theatre at least four lines, viz., one on each side of the stage and of the auditorium. Larger theatres and opera houses require a greater number of stand-pipes. There should be fire-valves on the stand-pipes at each of the floors, and each valve should have fire-hose of suitable quality, and of sufficient length connected with it, and kept ready for immediate use.

Besides this, there should be a large number of fire pails, for these are even more useful than the fire-hydrants to put fires out when just started; small hand extinguishers, chemical extinguishers, and large casks of water to refill the fire-pails.

There should be, on the stage, in the fly galleries and in the rigging loft, a full complement of fire axes, picks, pole hooks, brackets, saws, hatchets, crowbars, safety lanterns, torches or electric candles, and an assortment of portable ladders, also some wet blankets.

There should be, in the stage house, a general fire alarm, operating automatically; and the theatre should be in telegraphic and telephonic communication with the nearest engine house, with the police station, with the fire headquarters, each of these to have a separate and direct wire connection with the theatre.

It has already been said that every theatre should have a fire brigade composed of its stage hands and men of the manager's staff; furthermore, during the performances there should be a special fire watch, composed of experienced and trained firemen of the regular fire department.

The management should order frequent inspections of all fire-extinguishing appliances; it should issue special rules regarding the non-use and the frequent filling of the fire-pails; it should provide an electric float indicator from the roof tanks, indicating in the engine room and

also in the manager's room how much water the tanks contain, and when they are empty.

VIII.—MEANS TO GUARD AGAINST PANIC.

All the measures discussed so far had in view the contingency of an occurrence of fire and the prevention of fire outbreaks. It was, however, explained that one of the gravest dangers to be feared was the occurrence of a panic among the audience, caused by an alarm of fire. The alarm of fire may be real, or else, as frequently happens, it may be only a false alarm; in either case a dangerous stampede, jam and crush may result. Moreover, it must not be overlooked that there are many causes or disturbances other than fire which may precipitate a panic. This something causing a panic may happen in the best planned, best equipped and most safely constructed theatre, just as well as in the most wretched and inflammable structure. It is of the greatest importance that everything which may tend to cause a panic should be avoided, as the result would usually prove as dangerous or fatal to the theatre public and the artists as an actual outbreak of fire. The best system of fire-resisting construction, the best system of watching by trained firemen, the most careful inspection by experts and specialists cannot prevent the outbreak of a panic, when there is only apparent, but no actual danger.

It is well to study the possible causes of a panic not less than the causes of fires, for some of them at least may be avoided. Panics in theatres may originate either from imagined or suspected dangers caused by malicious alarms, by misunderstandings, by fright, or by some cause trivial in itself, or else they arise from actually present and often visible dangers, fire, stroke of lightning, etc. The danger is aggravated by the fact, now well known to many theatre visitors, that it requires but very few minutes in a burning building for the smoke and fire gases to suffocate people. This explains the terror, the

wild fright, the haste and confusion, the loss of both courage and presence of mind, the dangerous stampedes, the mad struggles at the exit doors, the trampling to death, and the jam following a panic. In such dire moments the instinct of self-preservation often drives people even to kill one another. Many of the older theatres have insufficient stairs, exits and passages, and the result is that feeble or frightened persons may, in case of a sudden rush, stumble, or fall when pushed, and cause those who follow them to fall over them.

To say that there are no measures which will effectively prevent a panic is not correct. In my judgment, much can be done to prevent dangerous panics by giving the audience a feeling of security, and this they are bound to get, at least in some measure, when they know that the theatre is well planned, and that there are at all times available plenty of wide, free, and unobstructed exits and fire stairs, enabling the entire emptying of the theatre in less than four minutes; when they know and see that overcrowding and obstruction in the aisles are not tolerated, that the management does not sell a larger number of tickets of admittance than the theatre license permits, that no standing room or camp chairs in the aisles are permitted; when they are kept informed of the systematic and periodic inspections, and are told that there are nightly fire watches, particularly when dangerous spectacular plays are given, and that the attendants are instructed in their duties in case of fire, and that there are frequent fire-drills. This feeling of comparative security is also fostered by the knowledge that there is a fire-proof proscenium-curtain in actual use, that the stage roof is provided with ventilating skylights or smoke-flues, that there are well-built fire-walls separating the auditorium from the stage, and that the electric incandescent light is used to light up the scenic decorations.

The best preventative of a panic is doubtless the knowledge that there are more than ample facilities for

direct and quick egress from all parts of the house. Therefore, for panic not less than for fire, the theatre exits, and the clear planning are the two all important requirements which must be fulfilled irrespective of all other safety measures.

Other measures which the management may institute, and which will surely be helpful, are the printing of the exits on the theatre programmes, the hanging up of clearly-printed plans, showing the plan of the building and the nearest exits, in the foyers and vestibules, the lettering of all exit doors in large, easily-read letters, the nightly use of all exits, the maintenance of plenty of light in the exit passages, stairs and courts, and instructions to theatre ushers about directing the audience to the nearest exits. Inasmuch as a sudden and unannounced darkening of the auditorium may scare nervous people and thus precipitate a panic, it should not be practiced, except it is prominently announced either in the theatre programme or from the stage.

A safety measure, which has been mentioned under a former heading, and which is also important to prevent panic, is to provide every theatre with lightning rod protection.

CONCLUSION.

Summing up what has been said in the preceding pages, the following are the principal measures in the interest of safety of the persons in a theatre building, which should be carried out, irrespective of whether the theatre is a new or an old building :

1. Free or isolated site.
2. Open courts on the sides of building.
3. Clear planning.
4. Plenty of wide, unobstructed exits, doors opening out, separate lighting of stairs, passages and exits.

5. Fire-wall between auditorium and stage, and between stage and dressing-rooms.
6. Fire-proof curtain.
7. Stage smoke flues or ventilators.
8. Electric incandescent light in place of gas-light.
9. Impregnation of all woodwork, scenery, decoration and gauze dresses.
10. Fire watch and inspections.
11. Lightning rod protection.
12. Automatic sprinkler system.
13. Maintenance of fire-extinguishing apparatus in readiness.
14. Means for instantly signalling outbreaks of fire.
15. Rules of management ; control of theatres by municipality or building department.
16. Fire-resisting construction.

A careful review of the numerous propositions made to secure the safety of theatre audiences and the stage personnel, shows a tendency to lay altogether too much stress upon fire-proof construction. To Mr. Sachs, I believe, belongs the credit of having pointed out very clearly and conclusively that the order of importance should be somewhat changed, viz., good planning should come first, next efficient and constant watching, then careful and frequent inspections, and lastly fire-resisting construction. After all that I have said, it is not necessary for me to explain why fire-resisting construction is the least important of the four items when we have in view the safety of the persons in the theatre.

Wherever theatre regulations are enacted, the compliance with them should not be left to the voluntary choice of theatre owners or managers, but should be made compulsory. The Municipal Building Department of every city should have the fullest possible power to examine the plans for all contemplated theatres, and also the plans of alterations intended to be made

in existing theatres. These should either be altered to meet the requirements such as are outlined in my paper, or else they should be closed by the authorities.

It has been well said that "the problem of building a safe theatre is one where a combination of architectural and engineering talent is required. Each specialist, to solve his special problems, must take the technical resources of our age into account, and bring them to bear on the question."

No other class of buildings bears so much evidence of the modern tendency to specialization. For the successful planning and designing of a modern theatre building the architect should have associated with him a number of specialists or experts. The architect himself prepares the plan of the building and the design; he should have the general superintendence of the entire work, and should consult with, and direct, the other experts so that a harmonious working together, so necessary to avoid clashes or mistakes, will result. The architect should also have charge of the interior arrangements and equipment, and he should plan, in particular, the decorative schemes of the auditorium, the ceiling, the proscenium boxes, the foyers and vestibules, the entrances and facades; the seating arrangements, the lighting, the sight lines, the acoustics, etc.

The services of the constructing engineer are required in difficult foundations, in the iron construction, the roof construction, and for the design and details of the iron fire-curtain (where this is used). A heating and ventilating engineer should design and superintend the heating system, the steam boiler and the power plant, and the engines for running the exhaust fans or blowers for the ventilation of the theatre. A hydraulic engineer will have charge of the water supply system for house use as well as for fire protection; he will lay out the automatic sprinkler system, provide the fire-pump, the fire-hydrants and fire-valves, and possibly the hydraulic presses for the stage machinery. A sanitary expert will

design and carry out the entire drainage system of the building and the plumbing arrangements ; he should lay out the arrangement of the public and other toilet rooms, and, in general, look after the ventilation and sanitation in the theatre. A gas expert will specify and plan the gas service, lighting system, the details of the stage gas table, and provide the gas-light fixtures. An electrical expert will have under him the entire electric plant, the dynamos, switches, wiring and lighting system, the fixtures, and possibly the electric stage machinery. A chemist, finally, will provide and advise on the fire-proof treatment of the woodwork on the stage, on the chemical impregnation of the canvas decorations and scenery, the draperies, stage furniture, and of the costumes.

The higher conception of the function of the stage is that it should be educational in character, that it should form a moral and intellectual recreation for the people. A theatre ought to be a place where one goes to find motives for ideal thinking, and where one's thoughts are elevated above the realm of the commonplace everyday happenings. A great deal of real enjoyment may be derived from a good performance, for many matters combine to make a play at once attractive and educating, such as the sound and modulation of the human voice heard in declamation or in song ; the idealized stage figures clad in picturesque or historically correct costumes ; the ever varying stage settings, which attract and please the eye ; the rich colour combinations, the brilliant illumination of the stage sceneries ; all forming a rare combination of attractions in the field of the fine arts : painting, sculpture, architecture, poetry, music and rhythmic motion.

But in order to derive real enjoyment and pleasure from a stage performance, certain requirements for the audience must necessarily be fulfilled. The audience must be able to see and hear well, they must be seated comfortably, they require pure air, freedom from draughts,

a moderate heat in winter, and the cooling of the auditorium in summer time; there must be no bad odours of any kind, no dust, no disease germs lurking about. Finally, most important of all, the audience must feel safe and secure, beyond all doubt, from the dangers of fire, smoke and a panic, and the players must be made equally safe. This last-named consideration, beside which all others dwindle into comparative insignificance, is of paramount importance, and I hope my paper has emphasized this fact in a sufficiently clear manner.



GENERAL VIEW OF NEW TESTING STATION, NEAR WESTBOURNE PARK.