of the current through the body, the conducting wires should in all cases convenient be placed out of reach, either by choice of location or the use of heavy and guarded insulation.

8th. That where lamps of the arc type are used, they be covered with a globe of glass, and that the lower end of such globes be furnished with a cup or pan for retaining any heated fragments.

The committee believe that if these precautions be taken electric lighting can be thoroughly safe and reliable, and that all dangers attending its use can be entirely obviated.

R. E. ROGERS, M.D., *Chairman.*

CHARLES M. CRESSON, M.D.

DAVID BROOKS.

E. ALEX. SCOTT.

EDWIN J. HOUSTON.

ISAAC NORRIS, M.D., *Secretary.*

REPORT OF COMMITTEE OF THE FRANKLIN INSTITUTE ON FIRE-ESCAPES AND ELEVATORS.

Your committee appointed "to examine and report upon the principles which should govern the erection of fire-escapes and lifts or elevators in new buildings and on those now erected," respectfully report that they have held four meetings, have examined a large number of models, designs and plans submitted to them by inventors, have individually examined means of escape now provided in many mills, hotels, etc., and after a full discussion of the subject have reached the conclusion, that while it is impossible to specify any particular form of escape applicable to all buildings, they can nevertheless lay down some general principles that should govern the erection of stairways and other fire-escapes.

As a general rule, applicable to all buildings, the main reliance should be placed upon stairways in daily use, for the obvious reason that the occupants of a building instinctively seek such an escape in case of fire, that they are familiar with it, and that, being in daily use, it is reasonably certain to be unobstructed and to have the approaches to it clear. For these reasons, and because a stairway is usually broader and easier to descend than any special contrivance such as a

ladder, probably ten times as many persons can escape by a stairway, in a given time, than can descend by any form of ladder or stairway used exclusively as a fire-escape.

Stairways, however, as ordinarily constructed, are liable to be cut off by smoke, or by fire itself. The best plan to make them safe in this particular is to have two or more stairways accessible from every room, separated therefrom by a broad air space but connected by bridges at each story. These stairways and bridges should be incombustible and the stairways enclosed in brick walls. This plan may easily be adopted in a group of mills and even where the stairways in existing mills do not answer all the desired conditions, the building of bridges connecting isolated buildings will add to the safety of the operatives. Where there is a single building with sufficient yard space to permit the construction of stairways in isolated brick towers, approached by bridges from each floor of the mill, the same *system* of fire-escapes can be applied.

In single buildings in the closely built parts of the city, where the bridge system cannot be applied, the first and most reliable means of escape is an internal stairway or, preferably, two stairways, one at each end of the building. They should be entirely enclosed in brick walls (fire walls) and be built of incombustible materials. Their safety will be increased if they start from the ground floor and are entirely shut off by stone or brickwork from the cellar. The danger of smoke entering them in such volume as to make them useless will be lessened if the necessary doorways by which communication is had with the rooms on each floor be made low and closed by iron-encased wooden doors, closing automatically, but always free to be opened by pressure from within. Circular stairways should be avoided, and straight stairways, with turns at each floor, should also have half landings to make rapid descent less dangerous.

In a building occupying the whole of the available lot, but which is large enough to admit of the construction of two stairways, one at each end, almost absolute safety with internal stairways can be secured by the following plan: Build both stairways of incombustible materials, substantially as heretofore described, but have no openings whatever to one of them from the interior of the structure. The stairway leading into the rooms would be used for the ordinary purposes of business, both for ingress and egress. The other stairway should have openings to *external* balconies on each floor, extending

over one, two or more windows of the main building. In the event of fire, both stairways could be used, if smoke did not obstruct the one opening into the mill; but if that were cut off from any cause, all the occupants, by passing out on the balconies, could enter the other brick-enclosed stairway which, having no direct connection with the building, would not be liable to be cut off by either flames or smoke.

For the class of buildings which, by reason of their small size, can have only one internal stairway, some form of external escape is needed, for it should be laid down as a rule that one stairway or one means of escape, however good in itself, cannot, in the nature of things, insure safety. It must always be liable to be cut off by fire or smoke. Every additional means of escape gives an increase of safety; but two, if widely separated, and of themselves good, may reasonably be deemed sufficient in buildings not large enough to permit the erection of more.

Of the many devices for external means of escape none that have been submitted to your committee can be recommended for all purposes, though several have merit and may be absolutely necessary in some buildings. Your committee believe that an external means of escape should be of the nature of a stairway, not of a chute, nor an elevator of any kind, nor a car to be lowered and hoisted to high windows, nor any other kind of apparatus dependent upon moving parts which are liable to be out of order when wanted; especially when used only on rare occasions. The objection to the chute form of apparatus is that it is an unusual means of egress in which terrified people could place no confidence.

The stairway forms of escape include ladders of all kinds, but the straight ladder exposed to the weather is the most objectionable form, because women and children can make little use of it, and in winter time it might be dangerous and practically useless even to experienced climbers.

A modified form of the straight ladder, which is set away from the wall so that the latter gives support to those who are descending and which also has side guards to prevent one from falling, is an improvement on the ordinary straight ladder set against the wall. The stairway-ladder, running obliquely down a building and furnished with a hand-rail, is also superior to the straight ladder, but, to make it at all safe, some light will have to be sacrificed in most mill buildings, for it should not cross open windows and thus be liable

to be cut off by flames or smoke from a lower story. It seems desirable that, in any form of ladder or stairway exposed to the weather and built of iron, the treads should be flat, covered with a light strip of wood and perforated.

One other form of external ladder escape submitted to us had the ladder itself, together with its balconies, suspended from a rail under the cornice, so as to permit it to traverse the building and be fixed opposite any set of windows which might happen to offer the best chance of escape. While this device is open to the general objection of being movable, and therefore liable to be out of order when wanted, this objection is not of much weight since, in its normal position without being moved, it is ready for service and may be regarded as a fixture. It is as good as a fixed ladder of similar form if not moved, and it *might* be better than a fixed ladder if its position could be shifted.

Your committee does not feel called upon to decide as to the relative merits of these ladders to be used as external means of escape, further than to point out what are regarded as their general merits and defects, for the reason that they regard the manner of constructing internal stairways in daily use as of paramount importance, and look upon all extraordinary means of escape as of comparatively little value. They, nevertheless, recognize the fact that external means of escape may be absolutely necessary for some buildings, and therefore set down as principles to govern their erection that they should be of stairway form (including in this category ladders), that they should be carried up to the roof of the building to permit escape in that direction, that they should be erected on the piers of buildings and in no case cross open windows, or windows not permanently closed by shutters, and that the treads of the ladders should be flat and covered with some material, such as wood, not as likely as iron to be covered with ice or made slippery by snow in winter time.

It has been suggested that adjoining buildings in the closely built parts of the city might be provided with external means of escape by the erection of balconies connecting the windows of different buildings on each floor. If a fire occurred in one building, its occupants could go by the balconies into the other and escape by its stairway, shut off from the fire by the dividing wall. It would be necessary, of course, for the owners and occupants of such adjoining structures to consent to having this connection made, which circumstance would limit its applicability. The chief objection to it, the

danger of robbery being committed by way of the balconies, is not so serious as might at first appear, because the two buildings are generally occupied during the same hours, the balconies are exposed to view, and at night, when one or both buildings have been vacated, the windows leading to the balconies could be secured against the entrance of thieves except by noisy violence.

Your committee is aware of the existence in the city of a large number of manufacturing establishments, on the upper floors of what were formerly dwelling houses, which are exceedingly dangerous to human life. They are filled with inflammable material, are not carefully looked after, and the stairways leading to the upper floors are either unenclosed, each stairway terminating at and opening directly into the room to which it leads, or the stairways and entries are, to save space, divided from the rooms by an inch board partition. In such buildings there is special danger of fire, and if it occurs on the lower floors the stairway may in a few minutes be cut off by flames or smoke. A reasonable degree of safety can only be secured in such buildings by requiring the erection of a brick enclosed stairway, and most of them should also be provided with external means of escape.

Where such a building has no back outlet, and is so narrow that the stairway cannot be erected in the front without destroying the value of the property, a brick enclosed stairway erected in the centre of the length of the building, against the side wall and leading from the upper floors to a passage way in the cellar, but completely separated therefrom by a brick wall, would offer a means of escape to the street without sacrificing the more valuable parts of the building. Whatever the expense and inconvenience may be, however, these manufactories constructed from dwelling houses should be made safe. They are at present more dangerous than large mills and public halls erected for the purposes for which they are used, although these are occupied by a larger number of persons.

One objection to the use of external, or extraordinary means of escape of any kind, that they are liable to become obstructed, and that occupants of the building may not be aware of their existence or the manner of reaching them, can be obviated by closing up the ordinary stairway one afternoon of each week and requiring the operatives to leave the building by means of the escape. This could be done systematically on a certain day of the week without special inconvenience to the

occupants of the building, even in stormy weather, *if the escape were of practical value*, and if it were not, the sooner that fact became known the better.

The resolution under which we were appointed refers to us the question of lifts or elevators as well as fire escapes. They undoubtedly add to the risk of a spread of flames and smoke through a building, but they are absolutely necessary in large hotels and manufactories. To make them as little dangerous as possible they should be enclosed in incombustible walls, should be free from wood work about the openings in the floors, and, preferably, should be automatically closed by iron encased wooden doors when not in use.

In preparing the general report as above submitted no special attention was given to the law of the State and its requirements, the purpose being to indicate the principles which should govern the erection of fire escapes, supposing the owners of property to be untrammelled by law. It must not be forgotten, however, that the law of the State requires the erection on certain buildings (generally speaking, all buildings three or more stories in height, except private dwellings) of "a *permanent, safe, external* means of escape therefrom in case of fire."

Your committee regards these qualifying words as unwisely specific. The means of escape should be such as to satisfy an official or Board of officials charged with the duty of seeing that such escapes are erected. The chief objection is to the word *external*, for in the majority of cases internal stairways, properly constructed, afford the best means of escape, and, by some forms of construction, make external means entirely unnecessary. The word "permanent" (in the sense of fixed) may rule out otherwise useful means of escape. The word "safe" may have any meaning, according to the judgment of the individual passing upon the merits of a fire escape.

Your committee would recommend, therefore, that at the earliest possible moment the law should be amended in this particular. In the meantime property owners, however well provided they may be with escapes, will have to run the risk of the penalties imposed by the act if they fail to comply with its terms.

Several ordinances having been offered in Councils to provide for an enforcement of the law, your committee deem it their duty to suggest that provision should be made for vesting authority to pass upon fire escapes in a single department of the city government, and that it should be required to approve the plans for fire

escapes *before* they are erected, and to prescribe a form where the property owner fails to submit one. This Board should also be given large discretionary power as to the kind of escape required on different buildings, and should be required in all cases to consider the character of the building, the nature of the business carried on therein, and the number of persons liable to be exposed to the dangers of fire. A plan of escape having been approved by the proper authorities, and the escapes erected in accordance with the plans, the owner of the building should be given a certificate, to be accepted as a sufficient defence in suits for damages, provided the building and fire escapes had been maintained as designed at the time the certificate was granted. Owners of properties making alterations should be required to take out new certificates. The officers charged with the duty of examining fire escapes and granting certificates should be paid by salaries; and the fees collected from property owners, if any, should be no more than sufficient to pay the reasonable expenses, and should be paid into the City Treasury.

It is also desirable that the work of examination should either be given exclusively into the hands of the Inspectors already charged with the duty of approving plans for new buildings and alterations, or be given to those Inspectors, subject to approval, in the matter of fire escapes, by the Fire Marshal. In either case, the way to get plans examined and certificates granted should be made as simple and free from delay as possible.

In submitting this report your committee desire to add that our aim has been only to lay down such *general* principles as seemed to us wise and proper, both in regard to fire escapes and to the character of the legislation which should govern their erection. The details of the escapes can only be properly considered by reference to particular buildings, and the details of the law should be left to the consideration of our law makers.

JOHN BAIRD, *Chairman.*

R. K. BETTS.

FREDERICK GRAFF.

C. H. BANES.

STRICKLAND KNEASS.

WILLIAM D. MARKS.

HENRY G. MORRIS.

J. B. LIPPINCOTT.

ISAAC NORRIS, M.D., *Secretary.*