malady and usually die within the space of five to twelve days. A number of experiments have already been made with the new method, especially in the sewers of Paris, which are full of rats, and very good results have been obtained. It was proved during the experiments that the young rats are the most sensitive to the action of the microbe. At present the new rat-exterminating culture is coming into practical use at Paris and especially at the Bourse de Commerce where it is used to protect the deposits of grain. Dr. Chantemesse, who is now at Marseilles, has sent to Paris for a large quantity of the culture and he intends to use it for destroying the rats on shipboard.

THE THEATRE FIRE AND ITS PREVENTION IN GERMANY.*

BY CARL LAUTENSCHLAEGER, TECHNICAL STAGE DIRECTOR OF THE METROPOLITAN OPERA HOUSE.

Despite the rapid advances made in almost all the arts since the introduction of the steam engine and its attendant improvements in the mechanical industries, stage-building has progressed more slowly than almost any other branch of architectural engineering. Even in Germany, a land of model theaters, there are still to be found stages not much better in arrangement than those of the seventeenth century. Even the introduction of illuminating gas did little to improve the conditions. In countries where no very strict laws for the prevention of fire have been enacted, countries such as France, England, Russia, and the United States, we still find much of the insecurity of previous centuries. Although almost every year can show its appalling record of theater fires, the various European governments were not spurred into activity until the great fire of the Ring Theater in Vienna. Strict laws were then passed, the purpose of which was to secure better fire protection in theatres of long standing, and the utmost possible safety in structures still in course of erection. It was largely as a result of these stern measures that the first iron theatre was built in Germany, in Schwerin in the eighties, according to the plans of Carl Lautenschlaeger. To-day, the laws of Prussia provide that stages must be built entirely of incombustible material, with the exception of the stage floor.

Stage illumination has been revolutionized in late years. Gas, which is the cause of many, if not most, catastrophes, was supplanted by the safer electric light.

In a properly-designed stage, almost everything with the exception of scenery and the stage floor can be made of iron or other incombustible material. The stage floor itself can be impregnated with suitable chemicals. The only combustible parts in reality are the properties and the scenes, which, since they must of necessity be painted upon canvas mounted on wooden frames, are naturally highly inflammable. It may be statistically shown that even if all the scenery and properties of a large production were to burn, still the ironwork could hardly be heated to a dangerous point. Painted canvas produces more smoke than flame. The heat generated rises to the upper part of the stage. Moreover, constant supplies of fresh, cool air are always received from below. Audiences have more to fear from smoke, consisting largely of poisonous carbon monoxide gas, than from flame; for the gas spreads outward with great rapidity from the stage to the audience. In order to confine the smoke to the stage, iron curtains are used in Germany, which also serve the purpose of shutting off the flames long enough to permit the entire burning of the scenery, which is, after all, the chief source of danger. If iron curtains are used, it is evident that the entire stage scenery may be completely burnt without in the least subjecting the public to peril.

Absolute safety from fire can be obtained only by using incombustible material throughout the theatre. So far as the actual building of the auditorium and stage is concerned, this ideal can be obtained. Girders, pillars, floors, staircases, roof trusses, can all be made of iron. In the auditorium itself, the only combustible material is to be found in the chairs, cloakrooms, and box offices.

Since combustible scenery and properties must of necessity be used, measures have been taken in Germany for the purpose of checking and extinguishing a fire from the minute of its discovery. Every German theatre has its staff of firemen, who are either drilled employés of the theatre or members of the city fire department. Much store is set in Germany upon the employment of many trained firemen. At least eight to ten men are to be found in every theatre. For very large productions, the number is usually twelve. Five firemen must sleep in the theatre each night. Stages which have wooden floors are watched night and day. Stages which are built entirely of iron, and therefore open to little danger, are watched only during the day and during a performance. It is evident, therefore, that as a matter of economy alone, the iron stage is to be strongly advocated. The firemen have at their command an admirable water-distributing system. On every German stage there are at least four hydrants, one in each corner of the stage, four on the lower galleries, and four on the gridiron. If there be a rear stage, or Hinterbuehne, as it is called in Germany, it is provided with one or two hydrants.

An admirable arrangement for the extinguishment of a fire immediately after its discovery, an arrangement now used throughout Germany, is the sprinkling apparatus invented by Hofrath Stehle, and first used in the Royal Court Theater of Munich in 1874. By means of the apparatus it is possible to extinguish a fire not only at any particular part of the stage, but also completely to drench those parts which have not yet been ignited, thereby preventing a spreading of the flames. A typical example of a Stehle installation is to be found in the Prinz Regent Theater of Munich. At the level of the gridiron, pipes are extended across the stage, each pipe perforated with many holes. Water-tanks on the roof communicate with these pipes, through four mains controlled by valves. To the hand-wheel of each valve a wire rope is fastened, which is carried to the side walls of the stage, and thence descends to a point within convenient reach. These ropes are so connected with a single operating lever that either one valve, two valves, three valves, or all four valves can be opened, so that either a portion of the stage or the entire stage can be drenched with water. Only firemen are permitted to operate these valves. Had a similar device been in use in the Iroquois Theatre, the terrible disaster which occurred would have been avoided. How serviceable this apparatus of Stehle actually is has more than once been proven. On one occasion, during a performance of "Das Rheingold," in which guncotton is used to produce lightning flashes, some of the gauze clouds were ignited. A vigilant fireman pulled the rope lever. The sprinkling apparatus was immediately set in operation, and the scenery and stage so thoroughly soaked with water that the flames were almost at once extinguished. The audience never for a moment suspected the danger in which it had been, and mistook the downpour of water for a bit of modern stage realism. Only after the accident had been reported in the newspapers a few days later, did any one know of the danger that had been avoided.

This sprinkling apparatus is annually inspected at each theatre with a rigorousness that leaves nothing to be desired. At such times, a large trough is placed on the stripped stage. At a signal from the fire inspector, usually a whistle, the water is turned on. A few days later the results of the official test are published in the newspapers, with the result that the public is assured of the safety of its theaters.

The main reliance for safety in Germany, as elsewhere, has always been the curtain. The enormous pressure of the gases developed renders any curtain having as a basis a textile fabric of questionable utility. The stoutest asbestos curtain cannot long withstand this pressure. It would be torn into shreds. In Prussia the law requires that iron curtains be used. They are so arranged that they can be lowered from the director's box or from any other convenient point; but even an iron curtain cannot long withstand the pressure of a stage fire. At best it would last but a quarter of an hour. Still, in that time the most leisurely audience would find time to escape.

In Prussia the iron curtain must withstand a pressure of 90 kilogrammes per square meter. This apparently unnecessary requirement is of importance if the curtain be used on an old stage built entirely of wood. The difference in weight between the cold, heavy air of the auditorium and the hot air of the flaming stage is so great that the pressure upon the iron curtain is considerable. In Buda-Pesth it has happened that, despite constant sprinkling, an iron curtain bulged out and finally collapsed. The elevating apparatus of the iron curtain should always be of such a nature that if it be thrown out of gear, it is always possible for the curtain to descend by its own weight. The curtain-raising apparatus should be installed upon the stage floor. It should also be possible to drop the curtain from the adjacent corridor, since the flame and smoke of the stage may render it impossible to operate the curtain from the stage.

Owing to its peculiar construction, a stage cannot be made absolutely fireproof. It is essential that when a fire does occur, the gases be allowed to float upward in a strong draft. At the Prinz Regent Theater, previously referred to, this end is attained by huge ventilators, located at the very top of the stage, over the gridiron. They are controlled by manila ropes operated by the firemen from the stage floor. Even if they should not be lowered by the firemen, they would drop of their own accord upon the burning of the ropes.

Although there may be no actual danger of fire in a properly-constructed theatre, still an audience may become panic-stricken at the mere smell of smoke and the sight of flames. In such cases there is always a mad rush for the exits. It is therefore of prime importance that the auditorium be emptied with the utmost dispatch. The chief source of danger to life is found in the staircases. Winding stairs should be always avoided. Long staircases present the possibility of causing an injury to those at the lower steps by the pressure of the people above them. Very broad staircases are also objectionable, for the absence of railings in the center robs many of means of support. The most favorable type of staircase is that in which the steps are about 9½ feet wide, with 12 to 16 steps to the flight.

Since there is always an arch over the proscenium, the free space between the lower edge of the arch and the framework of the proscenium opening should be closed with a fireproof wall.

* Mr. Lautenschlaeger's suggestions deserve more than passing attention. He is a recognized authority the world over on stage design, an expert stage engineer, and ex-mechanical director of the Prinz Regent and Residenz theaters of Munich.

SCIENCE NOTES.

The fundamental features of the contact process for the manufacture of sulphuric acid were first described in an English patent granted in 1831 to Peregrine Phillips, Jr., of Bristol. The patent covered the application of platinum in a finely divided state for the oxidation of sulphur dioxide, and expressly stated how the catalytic action was to be obtained. Soon after the publication of Phillips's invention, experiments were undertaken by German chemists, but it was not until recently that the process was worked out in all its details and became a technical success.

Commendatore Boni has made further discoveries in the Forum at Rome, among them the site of the ancient temple of Janus, a small structure compared with later temples. In a gallery about twenty feet under ground he thinks he has discovered the substructure of the theatre built by Julius Cæsar. Short galleries ending in a square chamber run at right angles from the long gallery, four on the left and three on the right. All these chambers are connected by a narrow terra-cotta tube. His explanation is this: The gladiators entered these chambers and at a signal given by way of the terra cotta tube they rose up through trap doors, as if out of the earth, and appeared in the arena before the public. The tubes have been cleared and are found to work perfectly, while objects discovered in the galleries give further indications of their use.

How marked has been the advance in medicine during the last ten years, is shown by the report of the Vital Statistics Department of the Census Bureau, and how beneficial the effect of the introduction of antitoxine is shown in a most telling way, by the decrease in the death rate of fifty per cent. In croup the death rate has been reduced from 27.06 to 9.8 per 100,000. The reductions in other diseases are as follows: Typhoid fever, from 46 to 33; brain diseases, from 30 to 18; bronchitis, from 74 to 48; cholera infantum, from 79 to 47; malarial fever, from 19 to 8; whooping cough, from 15 to 12; convulsions, from 56 to 33; and scarlet fever, from 13 to 11. On the other hand, the death rate in some ailments has increased. The death rate of cancer in 1890 was 47. In 1900 it was 60. The rate for apoplexy has increased from 49 to 66; while the increase for diabetes and kidney diseases is respectively from 5 to 9 and from 59 to 83. No doubt these augmented rates are due to the conditions of life, which are not within the power of medical science to control. From the figures quoted it certainly follows that the general health of the people of our country is improving, and nothing shows this more clearly than the fact that the deaths from old age in 1890 were but 44 per 100,000, while in 1900 they were 54.

Sodium bisulphate, the residue of the manufacture of nitric acid, is a cumbrous product; it is drawn from the boilers from which the nitric acid produced by the reaction of sulphuric acid or sodium nitrate is extracted, and poured into the receivers, where it must be left to crystallize. The purpose in the manufacture of superphosphate is to put in advance into the receivers in which the sodium bisulphate is to be collected, lime phosphates in powder and in determined quantity, according to the quantity of the bisulphate to be collected. As the liquid bisulphate comes in, the mass is stirred with rakes, and the lime phosphate is immediately converted into superphosphate, the solubility of which is almost as great in water as in ammonium citrate. The superphosphate thus produced may be poured into chambers, as in the manufacture of ordinary superphosphate. In all cases, it may be drawn from the receivers without danger, the bisulphate being then converted into an inoffensive pasty mass. A few days afterward the superphosphate obtained may be pulverized by ordinary methods, and is then ready for agriculture. The sodium sulphate which is found in this superphosphate in consequence of the employment of sodium bisulphate, is not injurious in its results; on the contrary, it has been proved that certain plants absorb and assimilate the sodium in the absence of potash.