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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

TAMMANY AND THE NEW BRIDGE.

May it not truly be said that the biggest problem affecting the welfare of the citizens of New York that confronts the new Tammany administration is the provision of improved transit facilities? May it not also be said with equal truth that the biggest element in this problem is the construction of the urgently needed Manhattan Bridge, which was designed with a view to the speedy relief of the shockingly congested conditions that prevail on the Brooklyn Bridge? The obvious duty of the new administration is to expedite in every way possible the construction of the new thoroughfare. The new Commissioner of Bridges will find on file in his department the complete specifications and drawings of the bridge, all in good shape for the acceptance of bids and immediate construction of the work. The design was drawn by one of the most distinguished living bridge engineers, and it was passed upon and unanimously approved by a board of experts including some of the best-known engineers in this country, one of whom was the great bridge engineer, George S. Morison, past president of the American Society of Civil Engineers. With a view solely to expediting the construction of the work and avoiding the intolerable delay which seems inseparable from the construction of steel wire cables, the bridge was designed with nickel-steel eye-bar cables. The type lends itself to rapid construction and erection, so much so, indeed, that if the appropriations are made at once, and the bids let, the bridge will be open for public use within three and a half years from the present date. It is a matter of history that the bridge would have been under construction at the present time, had it not been that the necessary appropriations were withheld by the Board of Aldermen on the ground of certain technical objections raised by the engineers who were responsible for the wire cable design, which the late Bridge Commissioner condemned at the time of his taking office.

The first act of the new Bridge Commissioner was to appoint as chief engineer one of the most active opponents of the new design, and the question which is now uppermost in the minds of the citizens of New York, particularly those who live on the Brooklyn side of the river, is whether the new administration has the true interests of the city sufficiently at heart to go right ahead with the present plan, and so avoid the three or four years' delay that would result if this plan were thrown down at the twelfth hour, and the tedious and necessarily lengthy task of getting up a new set of plans undertaken. We speak of three or four years' delay advisedly. To get out the strain sheets and the enormous number of detail working plans necessary for a structure of this magnitude; to draw up specifications; to solicit bids and to close the contracts, would consume the greater part of two years' time. Then the time consumed in the necessarily slow work of stringing the cables, wire by wire, would increase the time of construction of a wire-cable bridge by at least twelve months over the three and a half years required in building the accepted design. This estimate is based, very properly, upon the record of the construction of the Williamsburg Bridge, the delay upon which was notorious.

We have no wish, however, to go at present into the question of wire cables as against eye-bar cables. We do not believe that the average New York citizen cares a snap of the finger about the relative merits of the two systems, but we do know that he is tremendously interested in getting this new bridge and getting it at the earliest possible moment. We do not for one moment believe that the most strenuous opponent of the eye-bar type considers that the present design would fail to do the work demanded of it for a thousand years to come.

The new administration has here an admirable opportunity to rise superior to mere political considerations in its desire to meet a great public necessity; while its chief engineer, by subordinating his personal preferences to the same urgent need of the public, has an opportunity to show that he can live up to the best traditions of his profession.

THE NAVIES OF RUSSIA AND JAPAN COMPARED.

The strained diplomatic relations between Russia and Japan, and the fact that in the event of a conflict the issue would be determined more than anything else by the command of the sea, render a comparison of the effective naval strength of the two nations a matter of no little interest. In such a comparison the important fact must never be lost sight of, that in the event of war, only a part of the Russian navy can be available in the Far East, whereas the whole of the Japanese navy will be within the sphere of active operations. However, we will first summarize the strength of the two fleets *in toto*, regardless of whether the Russian ships are in European or Asiatic waters; and then we will consider the question of the relative strength of the whole Japanese navy and that part of the Russian navy that is, or may be, concentrated in the Pacific. The total effective fighting force of the Russian navy, excluding obsolete ships or ships of doubtful utility, is made up of fifty vessels (battleships, cruisers, and gunboats) of an aggregate displacement of 358,670 tons; that of Japan consists of thirty-three ships, with a total displacement of 208,240 tons. These two navies are composed of the following classes of ships: Of battleships of the first class, that is, vessels launched within the past decade, Russia has ten, of an average displacement of 12,160 tons; Japan has six, of an average displacement of 14,115 tons. Of second-class battleships, launched between 1886 and 1896, Russia has ten, of an average displacement of 9,545 tons; Japan has no second-class battleships. Of third-class battleships, suitable for coast defense, Russia has three, of 4,126 tons displacement, and Japan one, of 7,220 tons. Of first-class or armored cruisers, Russia has five, of an average displacement of 10,260 tons, and Japan eight, of 9,210 tons. Of second-class cruisers, that is, protected cruisers of larger size, Russia has nine, of 6,425 tons displacement, and Japan eight, of about 4,500 tons average displacement. Of third-class cruisers, Russia has four, of about 3,500 tons displacement, and Japan eight, of an average of 2 870 tons. Lastly, Russia has nine gunboats of 500 tons, and Japan two, of 875 tons. It will thus be seen that in point of numbers Russia has a large preponderance in vessels available for immediate hostilities. Indeed, she may fairly be considered to rank as the third naval power, coming next to France, with Germany a close rival.

On the other hand, a considerable proportion of her fleet consists of coast defense vessels and ships that are too slow or otherwise deficient to be available for duty in the Far East; and since the war must inevitably be fought out in the Pacific, a forecast of the probable fortunes of war should take account only of that portion of the navy that can be concentrated near the seat of war. Applying this test, the Russian fleet is cut down to thirty-one battleships and cruisers, of an aggregate displacement of a little over 200,000 tons, made up of eight battleships, of about 12,000 tons; four armored cruisers, of about 11,400 tons; six second-class protected cruisers, of 6,500 tons; five third-class cruisers, protected and unprotected, of from 1,200 to 3,000 tons, and seven gunboats, of about 1,200 tons average displacement. To these figures may be added about a score of torpedo-boat destroyers on both the Russian and Japanese side, the Japanese boats being of about 300 tons, and the Russian of about 340 tons displacement. It will now be seen that in point of total number of ships and total displacement, the balance is somewhat in favor of Japan. Mere aggregate figures, however, do not tell the true story of relative strength, and this must be determined, in the present case, by an examination of the character of the individual ships themselves.

Other things being equal, the outcome of any naval war will be determined by the relative strength of what might be called the first line of battle, that is, vessels of the battleship and armored cruiser type that carry sufficient protection to enable them to lie in the first line of defense and attack, and endure the give and take of a great fleet action. Now it is just here that Japan is particularly strong. She has a homogeneous fleet of six battleships and eight armored cruisers that are built upon the same plans, have the same speed and maneuvering ability, and in the battleship division have the great advantage of large size of individual units. All of these vessels have been completed within the last five or six years, and they have an average displacement of over 14,000 tons. The latest of these, the "Mikasa," is typical of the whole fleet. She is 15,200 tons displacement, 18 knots speed; is armed with a 9-inch continuous belt, with 6-inch armor protecting the central battery, and she carries four 12-inch, fourteen 6-inch, twenty 3-inch, and a dozen smaller guns, all of the latest Armstrong pattern.

Six of the eight armored cruisers are practically identical vessels, of about 9,700 tons displacement, and from 20 to 22½ knots speed. The other two are the fine 7,700-ton vessels illustrated on another page in this issue. They have continuous 7-inch Krupp steel belts, 5 to 6 inches protection on the casemates and turrets, and are armed with four 8-inch, twelve or fourteen 6-inch, and a dozen smaller guns. They carry four submerged torpedo tubes, with one above-water tube. It should be mentioned that the battleships also carry each four submerged torpedo boats. Now, these fourteen fast, well-protected and powerfully armed ships, with an aggregate displacement of 158.000 tons, will be matched against twelve battleships and cruisers in the Russian fleet, of an aggregate displacement of 142,000 tons. The eight Russian battleships have an average displacement of 10,750 tons, and the four cruisers have an average displacement of 11,400 tons. The battleships although smaller than the Japanese vessels, are equally modern; their speed, however, is not as a rule so good. The best of them is the "Cesarevitch," of 13,000 tons displacement and 18 knots speed. She has a 10-inch belt, and the battery of four 12.4 inch and twelve 6-inch guns is carried entirely in turrets, the 12-inch in two turrets, one forward and one aft, and the 6-inch in six turrets, arranged three on each broadside. A most interesting feature in the event of a conflict is the fact that the Japanese and Russian battleships will represent two different schools of design, the Japanese the English, and the Russian the French. The chief difference is in the method of carrying the guns of the secondary battery, which in the Russian ships of the later type is carried in pairs in turrets, while the English guns fire from casemates or open central batteries. The Russian armored cruisers include the "Rossia," "Ruric," and "Gromoboi," big vessels of 11,000 to 12,000 tons displacement and 20 knots speed, and the "Bayan," a 7,800-ton vessel of 21 knots speed. Should the war take place, it is evident that the very latest types of battleship construction will receive an ample test. In the class of protected cruisers, Russia is particularly strong in the possession of six fine vessels of 6,500 tons displacement, and speeds which run up, in the case of one of them, the "Variag," built in this country, to 24 knots, the others having easily made the contract speed of 22 knots. She also has available two third-class vessels of 3,000 tons, which have made the remarkable speed of 25 knots an hour. Against these Japan has four second-class cruisers, of about 4,500 tons and 22 to 23 knots speed, and the three curious vessels of the "Hashidate" class, of 4,300 tons, which did good work in the Chinese war. They are of 17 knots speed, and carry, strange to relate, one great 12½-inch Canet gun, in addition to a numerous battery of 4.7-inch guns. In third-class cruisers Japan has a considerable superiority.

On the point of personnel, discipline, and general efficiency of the officers and crews, all that can be said is that the Japanese proved in the Chinese war that they possess all the requisites of bravery, dash, daring, and intelligence; of the Russian personnel, nothing more is known than can be gathered from the comments of qualified observers; but the discipline is said to be excellent, and the officers are known to be a highly-educated and intelligent class of men, who are believed to have a thorough mastery of their profession. Japan will, of course, have the great advantage of fighting in home waters and within comparatively easy reach of her dockyards.

DISCOVERY OF DR. DANYSZ, OF PASTEUR INSTITUTE, FOR EXTERMINATING RATS.

The great precautions which were taken not long ago at Marseilles in order to prevent cases of pest being introduced into that port has brought up the question of contagion by rats, seeing that the rats which are carried on the vessels from the eastern countries are the principal agents in the propagation of the pest. The French government is looking for a good method of exterminating the rats so as to decrease the danger of such epidemics. Dr. Danysz, of the Pasteur Institute, has lately been studying the question of the destruction of parasites and claims to have discovered a novel method for destroying rats which will be quite successful. Different methods have been tried before this, among others the Clayton apparatus invented in England, which destroys the rats by asphyxiating them with carbonic acid gas. But Dr. Danysz has found a means of getting rid of the rats without the risk of killing any other animals, and thus the method may be applied especially in the country, on farms and in different establishments where the other animals are to be free from harm. In the course of his researches, Dr. Danysz found that the rats can contract a special disease to which other animals are not exposed. He succeeded in obtaining the bacillus of the disease and at present it becomes quite easy to destroy these animals. It is necessary only to soak bread or grain in a bouillon of the microbe culture and allow the rats to eat it, when they contract the 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 handwheel 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.