bulkheads similarly armored inclosing a central battery.

At the fore and aft ends of the armor belt, and rising directly from the protective deck, are barbettes of steel-faced armor 17 inches thick, in which are mounted the main armament, comprising four 67-ton breech-loading guns, two in each barbette. The auxiliary armament includes ten 6-inch 5-ton quick-firing guns, six of which are carried on the upper deck and protected by shields, while four others are mounted in armored casemates on the main deck, sixteen 6-pounder and nine 3-pounder quick-firing guns, besides machine guns and seven torpedo tubes for launching Whitehead torpedoes. Four of the tubes are on the broadside, one at the stem, and two submerged. The magazines are situated on either side of the engine and boiler spaces, immediately beneath the barbettes, and, in view of the development of high explosives and quick-firing guns, precautionary measures have been taken for the protection of the ammunition supply during its passage from the magazines to the guns. The propelling machinery consists of two sets of triple expansion engines capable of developing, collectively, upward of 9,000 horse power with natural draught and 13,000 horse power with forced draught, producing speeds of 16 knots with open stokeholds and 17·5 knots with closed stokeholds. Each set of engines is contained in a separate compartment, the two being divided by a longitudinal middle line bulkhead extending the whole length of the magazine spaces. There are eight boilers, each supplying steam at a working pressure of 155 pounds per square inch. The auxiliary engines will number, altogether, sixty-nine, and will include steering engines, electric light engines, workshop engine, boat hoisting engine, and air compressing engines. Her bunkers will take 900 tons of coal, and with this quantity it is estimated that she will cover a distance of 5,000 nautical miles at a speed of ten knots. When fully equipped and ready for sea, the value of the Royal Oak and Revenge will be about £1,000,000 sterling or $5,000,000 each.

Treasures Found in Street Excavations.

In Rome the eighty-two miles of new streets made last year yielded the following "dugups:"

905 amphoræ.
2,360 terra cotta lamps.
1,824 inscriptions on marble.
77 columns rare marble.
313 pieces of columns.
157 marble capitals.
118 bases.
590 works of art in terra cotta.
540 works of art in bronze.
711 intaglios and cameos.
18 marble sarcophagi.
152 bass-reliefs.
192 marble statues.
21 marble figures of animals.
266 busts and heads.
54 pictures in polychrome mosaic.
47 objects of gold.
39 objects of silver.
36,679 coins.

Even this astonishing list does not cover everything, but embraces only those objects which were worthy of a place in the museums.

How a German Train is Started.

According to the *Railway Review*, an official of the Pittsburg and Lake Erie Railroad recently returned from Europe, referring to railway practice in Germany, says: "The roadbeds are about perfect, while the stations are simply magnificent, even in the most insignificant places being very fine. The roadbeds are quite rigid, but this is mainly due to the iron and steel cross ties that are used. The locomotives are fine pieces of mechanism, but their capacity is scarcely equal to those on this side of the Atlantic. Their entire passenger equipment is away behind that in use here. Their trains, however, run like clockwork, and the connections are perfect. The method of starting trains is altogether unique and peculiar, and will cause local agents and trainmen to smile. The agent is an imposing, dignified and solemn-looking official, attired in elaborate uniform, literally gilt-edged, and he acts as master of ceremonies on the imposing occasion. When the train arrives at a station he is standing bolt upright in an almost military position, and he is on dress parade. One minute before the train starts he reaches up and taps a gong three times. Then a strange scene takes place, and it would seem that he had pressed a button, for at the last tap the conductor, who has been at the rear car, comes galloping along the entire length of the platform, shouting in German the name of every station the train will stop at. When the engine is reached he wheels about, and on his return quickly closes and locks the car doors, darts back to the van to his perch on the rear car, whistles thrice on a tin or metal whistle, which is instantly repeated by the brakeman at the front end, and the train starts.

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NEW YORK, SATURDAY, DECEMBER 3, 1892.

Contents.

(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 883.

For the Week Ending December 3, 1892.

Price 10 cents. For sale by all newsdealers.

EXTENSION OF RAPID TRANSIT FACILITIES IN NEW YORK CITY.

In addition to the many first-class horse and cable street railways which gridiron the city in all directions, no less than four of the finest avenues of the city, running north and south, are occupied and darkened by hideous iron bridges, known as the elevated railways. On some of the avenues the tracks are supported on iron columns that stand on the sidewalks. In other examples two rows of columns are set in the middle of the streets, where they seriously obstruct the travel of ordinary vehicles, and are the cause of many accidents. The noise of the steam trains, the dirty droppings from the cars, the cinders, gas, and escaping steam, all conspire to render the presence of these elevated railways a serious nuisance. Still, as a convenience to the public, they are almost indispensable, and by many are regarded as a highly desirable sort of nuisance. This is proved by the hosts of people who travel upon them; also by the fact that large and valuable buildings have been erected on both sides of the lines of these railways. Many of these buildings are tenanted by families, who, strange as it may seem, appear to take pleasure in the din and dust raised by the steam trains close under their windows.

The New York elevated railways are probably the most largely patronized and most profitable of any railway works in the world, mileage considered. They have an aggregate length of about forty miles. Last year they carried over two hundred and fifteen millions of passengers. The gross earnings were almost eleven millions of dollars and the net earnings about five millions of dollars.

In the early days of these railways the man who appears to have most highly appreciated their value and foresaw their great future was Mr. Jay Gould, a Wall Street broker. He bought out the Tilden and Field interests and so gained control of the works. The roads are admirably managed, and their extension in various directions would greatly add to the public convenience. But so strong is the passion of envy in the municipal heart that no further privileges can be extended to Jay Gould; he is making too much money already, and for fear he should make more, he must not be allowed to improve or extend his roads, even if the people thereby suffer.

So great is the need of additional facilities for rapid transit that a new commission was appointed some two years ago, under legislative authority, to lay out new routes, designate the plans for construction, and inaugurate a new and independent system for faster rapid transit in the city.

The commission has lately completed its work, the plans have been drawn, and the franchise is soon to be sold at public auction.

As a whole the new system consists of railways to be built underground. The main line is to run under Broadway, which is one of the greatest thoroughfares of the city; from this as a stem branches are to extend in various directions. In the northerly parts of the metropolis the tunnels give place to elevated structures.

The purchaser of the franchise must pay 10 per cent cash to the city, and must also deposit $1,000,000 as a guarantee of full compliance with the terms of sale.

The company to build the road must be organized within two months. The capital stock of the company must be $50,000,000, divided into 500,000 shares at $100 a share. The company may mortgage its property for $50,000,000. The limit of fare permitted to be charged is 5 cents. The company must give a bond of $2,000,000 to protect the city and property owners from damages.

Work on the road must be begun within four months from the time the contract is awarded, and the road must be finished and in operation within five years of beginning it. The part between the City Hall and Fourteenth Street must be finished in two years, the part south of the City Hall and the parts between Fourteenth and Fifty-ninth Streets and between Fourteenth and Forty-third Streets on the east branch within three years, the part between Fifty-ninth Street and Harlem River within four years and the rest within five years.

In case the corporation fails to begin or finish the construction within the times limited, it forfeits its rights, and upon the forfeiture being adjudged by the court, the commissioners will have the power to advertise and resell the franchises of the road and so much of the road as shall have been constructed, and the proceeds of the resale will be applied to the payment of the expenses of the resale, then to the discharge of any liens which may have been created.

The articles of incorporation must be signed and acknowledged by not less than twenty-five persons. Books of subscription to the capital stock of the company must be opened at once. The capital stock must be held by not less than fifty persons, and the stockholders must choose thirteen directors. After the organization of the company and the sale of the stock the company must pay the State a tax of one-eighth of

one per cent on its stock, and it will be deemed fully organized.

When in operation the company must start and run its cars for the transportation of passengers and property at regular times to be fixed by public notice, and furnish sufficient accommodations for the transportation of all such passengers and property as shall, within a reasonable time previous thereto, be offered for transportation at the stations.

The best and most efficient system of block, switch, and train signaling must be adopted when the road begins running.

The cars must be propelled by electricity or by some form of power not requiring combustion within the tunnel. This motor must be sufficiently powerful to readily start a train of eight cars, each weighing, in addition to its load of passengers, not less than 30,000 pounds, on a gradient with a rise of one and one-half feet per 100 feet of distance, and the motor must also be able to maintain the same train at a speed of not less than 40 miles per hour on a level gradient.

Should each car be provided with its own motor, such motor must be capable of exerting sufficient power to comply for each car with the above requirements.

Each car must be provided with suitable arrangements for heating and lighting, and must have ample and comfortable seating capacity for the number of passengers to be carried by the car. Each station must be provided with suitable waiting and toilet rooms, with all proper convenience for the use and comfort of passengers, including proper platforms and suitable arrangements for heating and lighting. The platforms and stations and the stairways, hallways, galleries, approaches, and passages must be of ample size.

At present the general impression is that the cost of building the gigantic works proposed by the commission will be so great as to leave little profit to the builders, and hence capitalists will refuse to take up the enterprise. If this should prove to be the case, then all the labors of the commission will have gone for naught, and another commission will have to be appointed to hatch out a better and more practical plan.

NOTES FROM THE GREAT FAIR.

THE WATER SUPPLY, DRAINAGE AND SANITARY ARRANGEMENTS OF THE WORLD'S COLUMBIAN EXPOSITION.

[SPECIAL CORRESPONDENCE OF THE SCIENTIFIC AMERICAN.]

CHICAGO, December 1, 1892.

The Water Supply.—The requisite supply of drinking water is accomplished by installing two pumping engines, each having a capacity of 12,000,000 gallons per day, in the 68th Street (Hyde Park) water works. The water is drawn from Lake Michigan at the two mile crib, and from the water works passes through a 36 inch main to Machinery Hall, from which point it is carried throughout the grounds in pipes of lessened capacity, ranging down to 8 inches, and distributed by laterals into every building and to each exhibit wherever desired.

This lake water will be supplied free of charge from 300 ornamental fountains, located at various points about the grounds, and from thousands of single faucets within the buildings. Each fountain will have four or more ⅜ inch faucets and twelve metal cups, thus accommodating at least 1,200 thirsty vistors at one time at the fountains alone. This lake water is contracted and paid for by the Exposition officials, and may be used for all purposes within the grounds.

Hygeia Water.—For drinking purposes, water is also supplied that is piped direct from the Hygeia Springs, at Waukesha, Wis., a distance of 102 miles, where the overflow capacity of the springs exceeds 650,000 gallons a day. Steam pumps will force the water into a reservoir that is being built on a high ridge 200 feet above and eight miles distant from Waukesha, and ninety-four miles from and 416 feet above the level of the exposition grounds, and from this reservoir it is expected that the water will flow by gravitation through a 6 inch Maltby coated steel pipe, at the rate of 50,000 gallons a day, to the cooling reservoir located between the Transportation Building and the grand passenger depot. This great cooling tank has a capacity of 100,000 gallons, and will be covered by an ornamental structure 80×40 feet in size, containing a full refrigerating plant that will furnish 100 tons of ice daily. From this reservoir the water will be forced by a small pumping plant through the refrigerating coils to the twenty-five miles of 3 inch distributing mains and the small connecting laterals extending into each exhibit, from the faucets of which it will probably be drawn, at a temperature of about 38° F.; a water meter registering the amount drawn. In addition to the private faucets, there will be 250 fountains erected, within ornamental booths built to harmonize with the different forms of architecture of the buildings to which they are attached, where a half pint glass of Hygeia may be secured from one of the many female attendants at the cost of a penny a glass.

The water supplied to these fountains will be kept in circulation, so that an evenly cold temperature will practically be maintained. While the capacity of the main supply is 50,000 gallons daily, it can be largely increased by pressure, though it is believed that the demand on the Exposition grounds will not exceed 30,000 gallons, or 500,000 drinks of half a pint each, daily. At one cent each this alone will give the Hygeia Company an income of $5,000 daily, to say nothing of the advertising effect of this great enterprise. This plant is a concession controlled by the Hygeia Company, who pay a portion of the gross receipts to the Exposition.

The Sewerage.—What becomes of the waste water is almost as interesting to many as where the supply of water comes from. Thus, it is worthy of note that one system of piping carries all the storm water from the roofs of the various buildings into the lagoons, while a second system of piping carries all the surface water from the many catch basins, so it will not foul the lagoons, into two wells, from whence it is pumped into the lake by centrifugal pumping plants, consisting of Gould's pumps belted to line shafting driven by electric motors.

The construction department found the problem of how to quickly, economically, and effectually dispose of the discharges that will flow from toilet basins, closets, sinks, etc., not an easy one to solve. It was essential that a system should be adopted that would not only prove efficient as an odorless sewerage system, but also include a method by which the entire outflow could be chemically treated and both fluids and solids rendered inert.

The Shone hydro-pneumatic sewerage system was adopted by Mr. W. S. McHarg, chief of the department of water and sewerage, and forms the main sewerage system of the World's Fair grounds.

As installed at Jackson Park, the system consists of 26 ejector stations containing 52 Shone ejectors, there being a pair in each station, thus affording ample reserve capacity. The ejectors in service have a capacity of from 60 to 600 gallons each, and a total receiving and ejecting capacity of 17,000,000 gallons per diem. These ejectors are placed in cemented pits sunk to a depth of about 14 feet below the surface of the ground, and are placed either under the main buildings or at various points about the grounds. Thus under the Electricity building there is one pair of ejectors of 180 gallons capacity each, while under the Manufactures building there are two pairs, each of the four machines having a capacity of 600 gallons.

Each ejector has an inlet and outlet pipe for the sewage and an automatic valve for the compressed air by means of which the machine is operated. Through the inlet pours the waste water and other matter from basins, closets and sinks, till the machine is full, when a float automatically opens the compressed air inlet, and the pressure of the inrushing air (50 lb. to the square inch) instantly closes the inlet flap valve and ejects the contents into a branch pipe directly connected with the main discharge pipe. As the last of the fluid passes out the compressed air valve is automatically closed, and the ejector expanded down to atmospheric pressure through a muffler box, then the back pressure in the branch pipes closes the flap valve on the outlet, and, the pressure being released, the inlet flap valve opens, allowing the liquid washes to again flow in. This system was installed under contract by Mr. Urban H. Broughton, engineer and manager of the Shone Hydro-Pneumatic Sewerage and Water Supply Company, of Chicago. When the Exposition is well attended it is expected that each of these ejectors will fill and be emptied at the rate of about once a minute, and as the contents are ejected into the branch pipe the displacement of a similar quantity from the main discharge pipe flows into tanks, where it is treated with sulphate of aluminum, or other chemicals, which throw down the solids and leave the water comparatively innoxious.

The water, separated from the solids by filtration, flows from the tanks through pipes into the lake, while the solid matter, having passed through a Bushnell filter press, operated by compressed air, and been formed into small cakes, is burned under furnaces. This press consists of a series of round iron plates hung on rolls on the press rods, with filter cloths placed between the plates, thus forming chambers into which the material to be filtered is pumped through a center channel in the machine, when the application of pressure (about 700 lb. to the square inch) forces the liquid through the cloths to the surface of the plates, and thence through grooves or pipes into a receiver. The pressed cakes are then removed, thrown into furnaces and burned.

Toilets and Lavatories.—Each principal building on the grounds will have from one to four apartments devoted to toilet purposes, and placed in the most easily accessible portions of the structure.

The total number of closets on the grounds will exceed 3,000, of which 1,000 are free, and 2,000 are subject to the charge of five cents.

There will be nearly a thousand public lavatories, any one of which may be used on payment of five cents, this sum covering charge for a sufficient quantity of powdered soap, an individual towel, comb, and mirror.

The lavatories now being fitted up for women are as perfect as can be desired, and include a private room finished in English white enamel and containing chair, rug, towels, powdered soap, brush, comb and long plate glass mirror; all arranged to afford the utmost privacy and convenience, for which a charge of but five cents is made, including the services of a matron, and no room is to be used a second time till thoroughly cleansed by the attendant. This concession is controlled by J. B. Clow & Son, of Chicago, who will pay a portion of their receipts to the exposition. The same firm also controls the only advertising on the grounds, namely, the interior wall space in the rooms devoted to lavatories and closets. This was one of the first concessions granted and the World's Fair officials have since endeavored to repurchase it, in order to prevent advertising of any nature whatever on the grounds. Some idea of the value of this advertising space may be inferred from the statement that one house pays $25,000 for space in each room and another firm $12,500.

DE L.

Leather Dyeing.

The following particulars in regard to leather dyeing are from the *Leather Trades Circular*.

The tendency of leather to fix the aniline colors without the aid of mordants renders these dyes particularly applicable in leather dyeing. Fine grain leather cannot stand treatment with alcoholic solutions, so that the aqueous dyes are preferable, and if alcoholic solutions have to be used, they should be diluted to the verge of precipitation. Acid colors are more important than the basic. Tanned leather must generally be bleached by drawing it several times through a strong, warm, sumac decoction, or leaving it immersed therein for a few hours. Dyes which do not take uniformly on the leather must be mordanted; in nearly all cases they are best applied by painting them on. The most important of the saline mordants in this branch are the different soaps. A good, hard, white, soda soap is generally the best, Castile being recommended.

When the skin has been painted it is rinsed with cold water while upon the table, and well stretched with a brass slicker; another coat of the dye is applied, and again washed off with cold water; the skin is then rubbed until the water runs off clean. Colors that require to be darkened are brushed over with a solution of Salzburg vitriol (ferroso-cupric sulphate), a mixture of ferrous and cupric sulphates, 25·3 grms. of which are dissolved in 3 liters of water. The skin is finally washed with clean water, and dried.

Dark Brown.—Eight parts of fustic, 1 part of logwood, 2 parts of Brazil wood, 1 part of sanders, and ½ part of quercitron are boiled with soft water for one hour, and strained through linen. The vitriol treatment treatment serves to darken the shade; for light brown this is omitted and the skin primed with dilute potash.

Olive Brown.—Two parts of Hungarian fustic, 1 part of quercitron, and ¼ part of logwood are boiled, and the solution applied upon a strong potash priming; vitriol treatment follows.

Cutch Brown.—A docoction of ½ kilo. cutch, 60 grms. of copper sulphate, and 40 liters of water is applied upon a feeble priming.

Chestnut Brown.—The moistened leather is primed with a solution of 1 kilo. of copper acetate in 50 liters of water, slicked out, and then painted with a solution of yellow prussiate of potash in feebly acid water.

Chocolate Brown.—Brazil wood (1½ part) is boiled with water (45 parts) for two hours, and a little iron acetate added, according to shade.

Red.—Cochineal in a linen bag is boiled with water containing about 2 per cent. of aqua ammonia.

Alizarine Red.—A feeble flesh color is produced by brushing the leather with a solutionof alizarin in dilute soda, and then rinsing with soap water.

Scarlet.—Zaffer extract, diluted with 60 parts of water containing 1 part of tartar, is painted on a feeble annatto bottom.

Ordinary Red.—A decoction of sanderswood is used upon a feeble priming of alum free from iron.

Dark Green.—Quercitron (4 parts) and logwood (1 part) upon a strong priming of vitriol.

Light Olive Green.—A decoction of fustic (1 kilo.), archil (¼ kilo.), and water (20 liters) is painted on a light bottom of Prussian blue. For *picric green* an aqueous solution of picric acid is substituted for the fustic and archil.

Lemon Yellow.—Turmeric (1 part) is digested in alcohol (4 parts) for twenty-four hours, diluted with water, and applied upon a feeble potash bottom.

Barberry Yellow.—One kilo. of barberry root, 30 kilos. of water, and 200 grm. of iron-free alum.

Orange.—A red priming is given by Brazil wood, and fustic applied to impart the yellow. Seventy-five of the former to twenty-five of the latter produce a red orange, equal parts an ordinary orange, and twenty-five to seventy-five a yellow orange.

Chrome Yellow.—The dye is first applied with a solution of 30 grm. red chromate of potash in ½ liter of water, and is next fixed by 30 grm. acetate of lead in ½ liter of water.