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 solution of 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.

Para-amidophenol Citrate.

A solution of citric acid is, according to Liesegang, an excellent solvent of para-amidophenol — ninety-seven grammes of the latter being soluble in two hundred grammes of the citric acid solution of equal parts, the para-amidophenol being added little by little at a temperature of 18° to 20° C. The citrate of para-amidophenol so formed is employed as a developer in the following proportions:

Para-amidophenol citrate (concentrated solution)	1 c.c.
Sodium sulphite (concentrated)	4 "
Sodium carbonate	5 "
Caustic potash (ten per cent solution)	2 "
Water	50 "

This gives dense blue black images full of detail, the image, with normal exposure, appearing in about ten seconds. Brown tones are obtained if the para-amidophenol citrate is rendered alkaline with caustic potash. The citrate and sulphite are also applicable in aqueous solution as a developer for partly printed images on gelatino-chloride.—*British Journal.*

An American Grain Train.

The Pennsylvania Railroad Company recently ran a special grain train through from Chicago to Jersey City without uncoupling a car or changing locomotives. A distance of 824 miles was traversed, during which time the locomotive was not uncoupled from the train. The total length of the train was 1,602 feet, and it carried 2,640,000 pounds of grain, an average of 66,000 pounds to each car. The locomotive and cars were equipped throughout with Westinghouse brakes. The locomotive and tender weighed 88,500 pounds. The forty thirty-four foot box cars, with loads, weighed 3,824,000 pounds, and the caboose 18,000 pounds. The total weight of the train was 4,030,000 pounds or about 2,000 tons.

SWORD TRICK—A STAB THROUGH THE ABDOMEN.

A trick in which a sword is apparently passed through a person's abdomen and drawn out on the opposite side of the body is explained by a contributor to *La Nature.*

The sword employed is a simple, thin, flexible blade of steel, not at all sharp, and the plan of which is seen at A in the accompanying figure. The point is sufficiently blunt to prevent it from doing any harm.

As for the prestidigitator, whose body the sword will simply pass around but not pierce, he carries concealed beneath his vest a sort of sheath that consists of a tube of rectangular section, and semicircular in shape, and the two extremities of which are bent in contrary directions in such a way that they are situated in the same straight line, the two orifices opening in front and behind at right angles with the abdomen. This apparatus, B, is held in place by cords attached to two small rings at the two extremities of the tube.

It is the prestidigitator himself who, appearing instinctively to grasp the point of the sword as if to protect himself, directs it into the metallic tube. It makes its exit between the tails of the coat. It might be made to come out at the center of the back, but in this case it would be necessary to have an aperture formed in the seam of the coat.

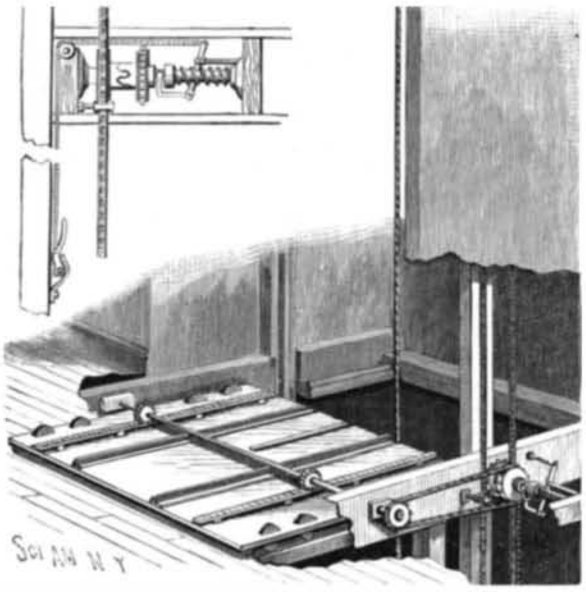
The illusion produced is complete, seeing that the flexible blade straightens out on making its exit from the tube, on account of the form of the latter's extremity. It is necessary to operate rapidly, so that the spectators shall not have time to see that the length of the sword has diminished at this moment, the curved line that it follows not being the shortest passage from one point to another.

A SWORD TRICK.

The figure represents a variant of the trick, in which the sword is provided with an eye through which a long red ribbon is passed, and which follows the blade when the latter is pulled out at the opposite side of the body.

AN IMPROVED SLIDING HATCH DOOR.

An efficient and durable non-combustible door, adapted to close tightly an elevator opening, and with mechanism for closing the several doors in a building simultaneously, or either one of them separately, are



KIBELE'S HATCH DOOR.

shown in the accompanying illustration, and form the subject of a patent issued to Mr. Cuno Kibele, of Bluffton, Ind. The door is preferably made of sheet metal stiffened by angle irons riveted to its top, and slides on grooved rollers running on tracks on supports between the floors, the side edges of the door projecting beyond the tracks, so that the door will close the well and the slots adjacent to the side posts on which the elevator car runs. The inner edge of the door is slotted, for the passage of the hoisting cable, the slot being normally closed by freely swinging leaves so arranged that the door may be readily pushed over the cable, which is held in the inner end of the slot and inside the leaves when the door is closed. On the top of the door, near its edges, are parallel rack bars meshing with pinions on a suitably journaled transverse shaft, the latter carrying also a sprocket wheel driven by a chain connecting with a loosely turning sprocket wheel on a shaft at one side of the elevator well. The latter sprocket wheel forms part of an interlocking clutch mechanism arranged at each floor, and shown in detail in the small view, whereby the gears connected with each door may be thrown into or out of connection with the endless chain extending vertically through the building, by means of which the various sprocket wheels are operated. With the clutch mechanism in normal position, it is only necessary to pull downward on one side of the chain to close all the doors, or to pull downward on the other side to open them all. By means of a lever connected by a cord or cable with the clutch mechanism, any of the doors may be thrown out of connection with the endless chain.

The Orchilla Lichen.

Interesting reports from United States consuls, in Lower California, Cape Verd, and Ecuador, dealing with the orchilla lichen, have recently been published by the State Department. It grows on rocks on the coast of the Canary and Cape Verd Islands, Sardinia, Minorca, and elsewhere, and in some places is described as a miniature shrub rather than a lichen. It yields the archil of commerce, which gives a rich and extremely beautiful purple tincture. It was extensively used by dyers when, in 1853, the discovery of the orchilla in America and on the Galapagos Islands is said to have created a commercial sensation in Europe, because of its superiority over any lichen in use prior to that time. In 1872 a ship's captain discovered it in Lower California, and after a few years a certain Mr. Hale succeeded in obtaining a concession from the Mexican government of the entire orchilla lands on the Pacific coast of that State—a belt six miles broad and comprising nearly eight degrees of latitude. About 3,000 men were employed in the industry; but since the Congo Free State has become the main source of supply the Californian industry has languished. In the Cape Verd Islands it is plentiful, but difficult to obtain, for it grows on the sides of precipices. The export amounts to about 120 tons, and goes mainly to Lisbon. In Ecuador it is gathered by hand, put in the sun to dry and cure, and is then pressed into bales. The demand at present is small.

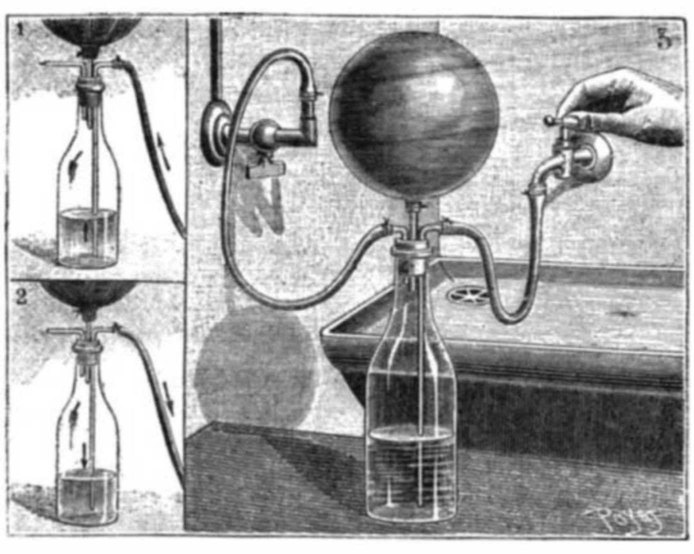
It is used in Europe, especially the Galapagos variety, because of the delicate color, luster, and tone that it gives to silk.

INFLATION OF RUBBER BALLS.

Rubber balls, large or small, protected by an envelope of leather, gradually contract and thus lose all their elasticity, and from this moment are out of use unless one possesses the means of reinflating them. It is then necessary to carefully loosen the rubber that compresses their tubulure, to introduce air under pressure into them, and to reclose them. The pressure that can be exerted with the lungs is far from sufficing, and, for want of a force pump, it is necessary to seek for an arrangement capable of replacing that apparatus. We shall describe here the small installation that serves us for this purpose. It is, we think, within the reach of every one, and will be able to render service to some of our young readers.

A bottle of good quality is provided with a wired cork containing three apertures, designed to receive as many glass tubes. One of the latter extends to the bottom of the bottle, the second is provisionally corked, and the third is drawn out to a point and smoothed with a lamp so as to present no sharp angle. The first is put in communication with the water conduit and to the third is firmly attached the ball to be reinflated. After this, the water from the conduit is allowed to flow into the bottle, and this forces air under pressure into the ball. Then, when the ball is judged to be sufficiently inflated, the cock is closed; but, if the entire contents of the bottle are insufficient, the cock is closed a little before the latter is full of water. A provisional ligature is applied to the ball, then the rubber is detached from the conduit and the contents of the bottle are allowed to flow out after opening the tube No. 2.

The first operation is begun again, care being taken not to reopen the ball until a little water has been



METHOD OF INFLATING A RUBBER BALLOON.

allowed to enter the bottle. If there is a cock at one's disposal, it should be placed between the tube, 3, and the ball, and the latter need not then be reattached before the end of the operation.

In order to introduce illuminating gas into rubber balloons, it will suffice to lead it to tube, 2. The bottle being first full of water, and the balloon empty of air, one will siphon in allowing the gas to enter, then the cock of the latter will be closed, and the gas will be forced in by allowing the water to re-enter. This operation seems to be complicated, but in reality it takes less time to perform it than to describe it. Fig. 1 shows the arrangement of the apparatus for the compression of the air. In Fig. 2 the bottle is being emptied in order to give what may be called a second piston stroke. Fig. 3 gives a view of the installation as a whole for inflating a balloon with illuminating gas.—*La Nature.*

Fertilizers.

The usefulness of nitrogen and phosphoric acid in slowly available forms, as they exist in bone, has been amply proved in practice, especially for slow-growing crops, in orchards, meadows and in such other cases where a gradual increase in general fertility is regarded as important. A mixture of fine ground bone and muriate of potash, in the proportion of three parts of bone to one of potash, is used quite largely and has proved a very effective and profitable manure for general use in grain farming. It furnishes all the essential ingredients, it costs less per ton than the average complete fertilizers, and it contains quite as much nitrogen and very much more phosphoric acid and potash.

Under the present condition of the fertilizer trade and for the purposes indicated, the substitution of ground bone, in part at least, for the more expensive though more available complete fertilizers, is in the line of wise economy.—*N. J. Ag. Ex. Station Bul.*