Correspondence.

The Cause of the Density of Snow.

To the Editor of the Scientific American:

This last winter I had occasion to observe the cover of snow in the State of Moscow. Although last winter we had no thaw, the snow in some places presented a very dense mass. The snow presented the greatest density in the places exposed to the greatest squeezing of the wind, whose force depended upon the force of the wind and upon the angle of the meeting of the wind with the surface of the snow. But in protected places, in hollow ways, in forests, etc., the snow always was extremely light and tender. Though the squeezing of the wind is sometimes not very strong, in a great space of time it can strongly press the snow. N. SMIRNOFF.

St. Petersburg, Russia, Physical Laboratory of the University, April, 1893.

How to Cement Wood to Glass and How to Bore Holes in Glass.

To the Editor of the Scientific American:

Having had occasion to cement wood to glass, so that the joint would stand changes of temperature, I thought perhaps your readers would like to know how it was done. In making a Wimshurst influence machine, the hubs were of wood, and every winter the cold made the cement all strip clean from the glass.

I took some gummed labels, such as druggists use on prescription bottles, and gummed them to the glass where I wanted my wood to be fastened, and allowed each label to dry on the glass, and nothing but a scraper or soaking in water will loosen it.

Then I cemented the hub of wood to the paper instead of the glass, and it holds strongly and permanently. Cement for this purpose may be made of virgin rubber 2 parts, resin 1 part, and gum shellac 2 parts, all melted together and applied hot.

I notice in the SCIENTIFIC AMERICAN more or less inquiry how to drill glass plates. I'll tell you my way:

Take a small common three-cornered saw file and break off an inch of the end of it. Then take to a grindstone and grind a blunt, triangular point on it, being careful not to hurt the temper. Leave the file in the handle and bore just like you would with an awl. The point of the file should not be longer than the file is thick. Use turpentine as a lubricant, and keep the cutting edges on point of file sharp with an oil stone. I have bored holes 2 inches deep in a short time by hand in glass by this method. In boring a plate, I have found it best to bore from both sides, using very light pressure toward the last, always laying the plate solid on a paper-bound book. M.

Palmer, Neb., April 10, 1893.

Electric Smelting and Casting.

Mr. George Ambrose Pogson, the British vice-consul at Hamburg, reeently explained to a number of gentlemen who visited him at the Wharncliffe Hotel, Sheffield, the "Taussig" system of smelting and casting metals in exhausted chambers. The system is claimed to produce, by a single process, every 15 minutes, with an expenditure of 360 cwt. of coal per 1,000 cwt. of finished cast metal, bronze, iron, steel, copper, brass, zinc, platinum, gold, or silver, free of pores or bubbles. The process is effected by electricity by means of flat metal electrodes in an exhausted furnace, large moulds being set up outside the furnace, and exhausted by one process simultaneously with the exhaustion of furnace. Castings up to 30 pounds of iron have been made in the presence of her Majesty's representatives at Hamburg within 15 minutes, the air pump in use showing 92 per cent exhaustion of air; ampere gauge, 2,500; voltage, 2½ volts.

The electric current does not effect its work from outside through surface of crucible or furnace, but by conduction through the metal itself which is about to be smelted. Siemens-Martin steel is fused without any other parts of the electric current undergoing any material increase of temperature. By use of metallic electrodes all contamination of metal by carbon is absolutely avoided, as coal slack is not present in any large quantity, refuse is reduced to a minimum, and oxidization and creation of air bubbles are, it is contended, by this new method of smelting in a vacuum, by means of removal of carbonic acid gas, etc., also avoided. The metal becomes more liquefied, and, on account of the casting forms being denuded of air, permits of extremely close and fine casting, even of objects of excessively small diameters. Among other pertinent justifications for these assumptions is the fact that the samples which have up to the present been tested in the proof-rooms of the Royal Technical School at Charlottenburg, near Berlin, have, notwithstanding the prejudicial circumstances under which they have been produced, according to a copy of the government report in regard to such tests, shown very satisfactory results. From the nature of the system adopted it ensues that the electric force which is carried out with currents of great strength, but low voltage, is attended with absolute freedom from danger. Small iron propellers and similar objects are constantly melted and cast at Bahrenfeld in the presence of witnesses within a period of 12 to 15 minutes. Currents of 20,000 to 30,000 amperes are no exaggeration, and exhaustion of air from the largest chambers now presents no difficulty.

By the employment of 30,000 amperes and 50 volts, a force equivalent to about 2,000 horse power, or somewhat less than that used by the aluminum works at Neuhausen, on the Rhine, the casting form would have a minimum length of 12 meters and a width of 1½ meters. This would give a body of metal of 180,000 cubic centimeters, or about 1½ tons. According to the experience gained in experiments at Bahrenfeld, such casting would be effected in one process, lasting in all not longer than a quarter of an hour. The expenditure of coal is, therefore, in round figures, but 50 per cent of that necessitated by the most perfect system at present in use. The use of water power naturally increases these advantages in an enormous extent. The iron furnace seen by Mr. Pogson at Prof. Taussig's works at Bahrenfeld consisted of a rectangular vessel, 6 feet by 3 feet by 3 feet. Two electrodes, apparently of wrought iron, were placed upright inside the furnace, so that their surfaces of 8 inches by 4 inches faced the arc-shaped piece of iron which was to be fused; a channel of clay served the purpose of conducting the fused metal from its clay melting bed into the empty clay mould of a model propeller, the mould in question being placed at a lower altitude in the other empty iron furnace.

The wires connecting the flat metal electrodes with the powerful generating machinery put up by Messrs. Schuckert & Co., the well known German electrical engineers, were already in position, as was also the exhaust pipe connecting the furnace with a steam air pump of about 20 horse power, which also drove the dynamos. Having personally placed the 30 pounds of pig iron in the clay bed, placed parallel with, but a few inches in front of, the flat electrodes, the cover of the oven was swung on; the necessary exclusion of external air being effected by India rubber pads fastened to the furnace cover. Punctually at noon the cover was fastened down, and the pump set working, the current being switched on at the same moment. The indicator of the exhaust pump soon showed an exhaustion of 92 per cent of air. The electric indicators showed respectively 2,500 to 3,000 amperes and 2 to 2½ volts. The gradual approach from red to white heat could be followed from the eyelets in the furnace. Fusion was obtained at about 12:8, the indicators showing great unsteadiness until the resistance had been reduced to nil by the current being allowed to pass freely through the fused metal. At 12:14 the furnace was opened, and a minute or two later the clay was being chipped off and a perfect cast of a propeller was exposed to view.

Identity of Light and Electricity.

From the experiments recently performed in electrical oscillations, the conclusion that light and electrical oscillations are identical is very strongly substantiated. The principal parts in which they practically agree are the velocity, rectilinear propagation, laws of reflection, interference, refraction, polarization and absorption by material substances. In fact, the sole certain difference appears to be the wave length. There is difficulty in producing continuous electrical oscillations of less than a foot in length, while light is about the hundred thousandth part of an inch. The only difference between them is that our eyes will appreciate the short ones, but are not affected by the long ones. The great question for electrical engineers is to produce these very short wave lengths directly. Hertz by the induction coil and condenser, and Tesla with a specially designed multipolar dynamo, have produced similar waves, which will set molecules in a rarefied atmosphere into such rapid vibration as to produce light. But the great question has advanced only one step. Probably neither of these methods will furnish more than a suggestion to the real solution. A simple computation will show that by the Hertz method, in order to produce directly vibrations capable of affecting the retina, the condenser would be of nearly molecular size; on the other hand, by the Tesla method, the dynamo necessary would be a mechanical impossibility. However, the outlook is encouraging, and any work done along these lines cannot be otherwise than of benefit to science and to practical engineering.

In the domain of wireless telegraphy this subject is of prime importance. Much has already been done in this direction, and much more will undoubtedly be done by the aid of electrical oscillations of high power and frequency. The Edison method of telegraphing from moving trains is probably the best known practical application of electrical oscillations in air to commercial practice. Betts' method of telegraphing between ships at sea is another well known application, and depends upon the transmissibility of electrical oscillations through water. Although these methods are far from perfect, the end seems not distant, and we can confidently expect that in the near future we will be able to telegraph on land and sea without wires with great ease by means of electrical oscillations of high power and frequency.—*E. S. Ferry in Electrical World.*

Liquid Oxygen.

The phenomena presented by liquid oxygen promise to furnish science with additional data for the completion of chemical, electrical, and magnetic theory. Prof. Dewar, who has made special research into the properties of liquid gases, has already produced small quantities of liquefied oxygen obtained under great pressure at very low temperatures, and has remarked the sky-blue color and the considerable magnetic properties of this body. But its extremely low boiling point, 182° C. below zero, has hitherto prevented any appreciable quantity of oxygen remaining long in a liquid state, and the intense ebullition which occurs has rendered experiments on its magnetic and other properties difficult to accomplish. Recently, however, before a large and distinguished audience at the Royal Institution, Prof. Dewar kept, during the whole of his lecture, a globe the size of an egg filled with liquid oxygen in a tranquil state below its boiling point, evaporating slowly as water at ordinary temperatures. This result he accomplished by the discovery that by surrounding the vessel containing the liquid by an extremely high vacuum, the influx of heat-vibration from the outside air is reduced one-seventh, as is indicated by the amount of escape of gas; or by further precautions even to a still lower amount. The vacuum must be high in the extreme meaning of the term, for Prof. Dewar has produced vacua measurable not in millionths but in hundred-thousand-millionths of an atmosphere, and by means which exhaust a large vessel more quickly than the mercury pump exhausts the smallest. The difference in temperature between the globe of liquid oxygen and the air of the theater was not less than 210° C., yet the globe remained four-fifths full of liquid by reason of its vacuum jacket at the conclusion of the lecture.

The experiment leads to some interesting considerations as to the principle of radiation across interstellar space, as our own world has its "vacuum jacket." The crucial experiment would be an hermetically sealed bulb of liquid oxygen, self-poised in the center of a perfect vacuum—an experiment impossible under present conditions (unless the magnetic properties enabled the bulb to be so poised). There is always some connection between glass spheres and their support, as well as convection and conduction of heat at the evaporating surface.

The liquid oxygen so obtained becomes the means of further research in liquefaction of gases. Prof. Dewar showed that atmospheric air can be condensed into a liquid at ordinary pressure by the cold of liquid oxygen boiling under the air pump. But the liquid air itself can be produced by other means, and the cold of one superposed on the cold of the other may enable the final task of liquefying (and possibly solidifying) hydrogen to be eventually accomplished.

The essential difference between a liquid and a gas of identical composition was illustrated by the behavior of atmospheric air. Air liquefies as a whole with the usual proportions of oxygen and nitrogen. But when liquid air is allowed to boil the nitrogen distills off first, showing no appreciable admixture of oxygen until half the liquid has evaporated. Liquid air behaves in the magnetic field and in the spectroscope like dilute oxygen, and the color is simply a more watery blue.

The most interesting part of Prof. Dewar's researches from the electrical point of view, undertaken in conjunction with Prof. Fleming, could only be alluded to in the lecture. It is found that pure metals reduced to these abnormally low temperatures increase in conducting power, perfectly pure metals showing a conductivity increasing as the temperature falls in such a manner that all the temperature curves, if produced, would pass through the zero of absolute temperature. Electricity would pass through a wire of pure metal in interstellar space absolutely without loss. But the smallest impurity or alloy destroys this condition of perfect conductivity. On the other hand, non-metallic bodies so cooled show a conductivity decreasing with the fall in temperature. These investigations await interpretation. Meanwhile, science is furnished with another test of purity of element. Nickel prepared in the ordinary way does not conform to the law, but nickel deposited by Mr. Mond's process, from its combination with carbon monoxide, obeys this law perfectly. We do not yet know what an "element" is, but the experiments allow it to be stated that some at least of the chemical elements do behave in a manner totally distinct from compounds. At the low temperatures produced, chemical forces remain in abeyance, and oxygen becomes as inert as nitrogen. At a temperature that is conceivably possible to produce, all molecular motion ceases, and every gas becomes rigid. At —273° C., or absolute zero, hydrogen itself will become solid and all matter will become dead.—*The Electrical Engineer (London).*

THE NAVAL PARADE AND REVIEW.

(*Continued from first page.*)

tion with which had been most appropriately set for this time. The Swedish singing societies, Swedish Mechanics' Society, and Swedish Art Society, with other organizations, participated, the presentation address being made by Mr. Ashley Cole and the acceptance by Mr. Paul Dana, while Col. William C. Church made a commemorative address. The statue stands about twenty-five feet from the water's edge, facing north, and is about seventeen feet tall from the base to the crown of the head. The base is of granite and a little over eight feet high.

The sculptor is Jonathan Scott Harley, and he was present at the dedication of his work. Four low-relief bronze figured panels are set on the four sides of the base of the statue. The one above the name Ericsson on the front of the base represents the battle between the Monitor and the Merrimac. Another shows a steam fire engine in action, another the steam war sloop Princeton, the first war vessel to have a screw propeller, and still another panel represents a number of Ericsson's inventions.

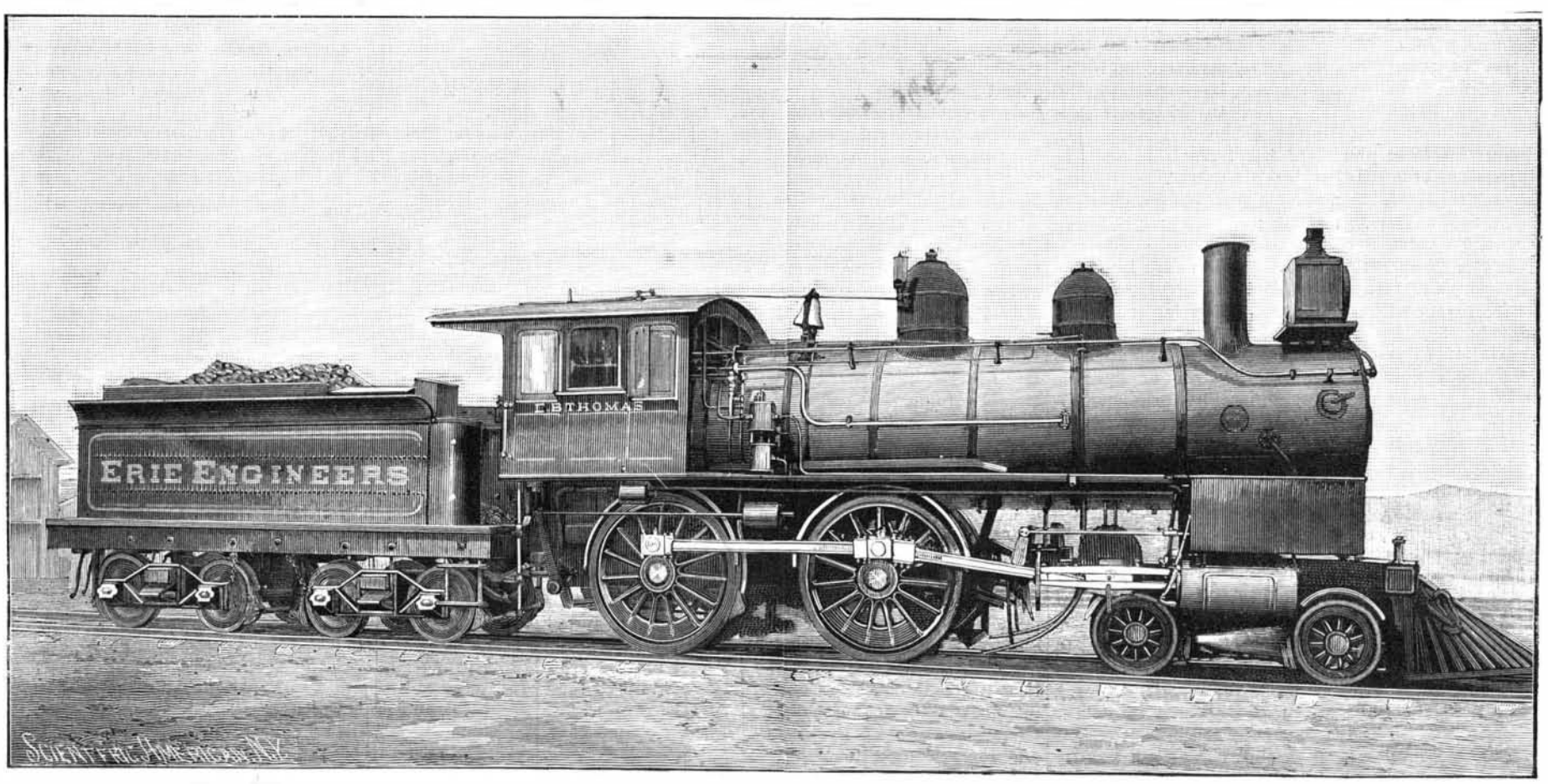
Perhaps one of the most noticeable and most warmly admired objects presenting itself to the eyes of the officers of the foreign war vessels, many of whom were on this occasion making their first entry to the harbor of New York, was the Bartholdi statue of Liberty, the illustration of which we herewith reproduce from a former issue of the SCIENTIFIC AMERICAN. This noble figure, greatly exceeding in size every other work of a similar nature ever projected, always appeals vividly to the imagination, and has commanded unstinted praise as a highly successful working out of a magnificent conception. The statue is made in *repoussé* of copper one-eighth of an inch thick, the envelope being kept in position by iron plates and braces. Its dimensions are: Base of pedestal, 62 square feet; from water level to top of pedestal, 149 feet; from bottom of plinth to top of torch, 151 feet; from heel to top of head, 111 feet; height of head, 13½ feet; width of eye, 28 inches; length of nose, 3 feet 9 inches; length of forefinger, 7 feet 11 inches. The torch, reached by a spiral staircase, will hold twelve persons, and the head will hold forty persons. It may be remarked that on one occasion a *bona fide* marriage service was performed in this portion of the statue.

The review of the fleet by the President on the 27th, which was designed to be the crowning feature of the Columbian festivities at New York, had been arranged to commence at 10 o'clock in the forenoon, but the rain was coming down so heavily all the morning that the hour was changed to 1 P. M. At this time the rain had ceased, and the President and his suite stepped aboard the Dolphin, one of the earliest built and smallest of our white cruisers, to pass in review and receive the salutations of the combined fleet. Our first page illustration gives a good idea of the scene. The little caravels were anchored at the north end of the line, between the two columns of which the Dolphin slowly moved from south to north, ship after ship shooting out red tongues of flame and belching forth clouds of smoke across her path, the vessel always seeming to be just emerging from the smoke of the opposing broadsides. The Miantonomoh, at the south end of the line, led this thunderous salutation, vessel after vessel joining in, each with a salute of twenty-one guns, as the Dolphin passed by, the President standing on the poop deck and lifting his hat as his vessel came abreast of each of the others. Arrived near the anchorage of the caravels, and between the big English ship Blake and our cruiser Philadelphia, the Dolphin dropped her anchor, and here the President held a reception. Nine admirals and thirty-five captains from the different ships, conveyed to the President's vessel by their gigs and boats, here came to do honor to the President and his party, which included the young mistress of the White House, and for the exchange of those civilities and friendly greetings which the people and the government of the United States can so independently and yet so cordially reciprocate with all the other peoples of the globe.

While this was taking place, the Philadelphia slipped her moorings and moved a little farther up to a point opposite General Grant's tomb, where a salute was fired in honor of the dead hero whom the nation so much delights to honor.

The review over, many of the officers came to the city to take part in a grand ball given in their honor, but the vessels remained at their anchorages, and vast crowds lined the shores to look upon a display of signal lights, flash lights, search lamps, and fireworks, which had been promised. In this exhibition all par-

THE COLUMBIAN NAVAL FESTIVITIES NEW YORK—THE STATUE OF LIBERTY.



THE WORLD'S COLUMBIAN EXPOSITION—THE ENGINEERS' LOCOMOTIVE—DESIGNED BY ENGINEERS OF THE ERIE RAILROAD.—[See p. 281.]

ticipated, but the British ships led all the rest. Just before 8 o'clock the river around the four British ships the Blake, Australia, Magicienne, and Tartar, suddenly assumed the appearance of golden lakes. Somebody had pressed several buttons and the electricity had done the rest. The hulls of the ships, from water line to the rail, were outlined in globules of fire.

Simultaneously the electrician of the Jean Bart wove around her huge circular tops necklaces of golden beads. The Kaiserin Augusta revealed herself in bright dotted lines, and the Russian flagship arrayed herself in stars. Then came the exhibition of search lights. Electricians on every ship in the fleet stood to their work and sent their harmless charges through the mists. There was a stratum of fog extending a thousand feet or more above the river. Above that the air was clear, but above the cloudless stratum there was more fog. This condition of atmosphere caused many picturesque effects. The little caravels got a big share of attention. Every light on the leading ships was turned on the antique squadron, and they stood out like cameos.

Down the stream and up the stream the silver indices pointed; they gleamed across the historic river and lit up bits of the Palisades and startled folks in cottages along the Jersey shore. The *finale* of the search light exhibition was the concentration of all the glittering shafts on the American ships in one point in the sky. The signal for this display was made from the flagship Philadelphia by the Ardois lights, which flashed red and white in perpendicular strings from the masts. The meeting of the lights suggested a gigantic white-ribboned May pole before it is entwined by the ribbons. At the end of all the Blake showed a fiery figure of Washington, the man who led these colonies in war upon his kingdom. It lacked but an hour of midnight when this magnificent and most interesting display closed.

Although the President and many other officials of high and low rank were anxious to leave soon after the review, to be in Chicago at the inauguration of the Exposition on May 1, there was still a most important feature of New York's Columbian festivities to come off on Friday, the 28th. This was nothing less than a great land parade, such as has probably never before been seen in this or any other country, for it was a parade principally of men from all the different ships. Our own vessels furnished about fifteen hundred men, and about an equal number was landed from the foreign ships. There were bands without number, and some ten regiments of the New York State National Guard furnished the escort, but it was a sight well worth seeing and long to be remembered to view the contingents of English, Russian, French, German, Italian, Brazilian, Argentine and Dutch men-of-war's men swinging along Broadway, together with our own jack tars and marines, all like friends and compatriots, and all the foreigners doubtless forgetting any possible differences of their own in their generous admiration of and regard for the people of the country which Columbus discovered. And thus did New York execute its part of the inaugural work of the world's great Columbian Exposition for which Chicago has been so long preparing.

COST OF THE FAIR.—Auditor Ackerman has made a report showing that the building of the World's Fair has already cost $16,708,826, twice the sum paid for the Paris Exposition, and more must yet be paid out. There is at present a cash balance of $626,396, and $2,361,263 is due on contracts.

A MODEL LOCOMOTIVE.

Some time since it was determined by the locomotive engineers of the Erie Railroad system to join in the construction of a locomotive which should fully represent their ideas as developed in everyday practice in locomotive running. In this system there are between 950 and 1,000 locomotive engineers, who each subscribed for one or more shares of the stock in the engine, at five dollars per share. The result of this undertaking is illustrated by our engraving, which represents a first class passenger engine constructed according to modern ideas. It was built with the idea of exhibiting it at the World's Fair.

Our engraving is made from a photograph taken of the engine while it was being tested; consequently, the valve chest is shown covered with the box used to protect the indicators. This slightly mars the illustration, which in other respects is complete. Several of the great manufacturers of materials used in the construction of locomotives showed great liberality in furnishing some of the parts or the materials from which they are made. The Otis Steel Company presented the steel sheets from which the boiler is made. They are rolled to the thickness of five-eighths of an inch. The Midvale Steel Company gave the drive wheels, axles, journal boxes and side bars. The Snow Car Truck Company presented the pilot truck, and the Westinghouse Brake Company provided complete brake mechanism of the most modern type. The engine does not possess a great many points of novelty, but the variation from the ordinary construction is considered of great importance by these men, who are constantly using engines and know the various good and bad points of existing locomotives.

The total weight of the engine is something over 67 tons. This weight is distributed as follows: On the rear drivers 44,300 pounds; on the front drivers 44,450, and on the truck 45,850 pounds. The drive wheel axles are 8½ inches in diameter, the journals are 12 inches long, and the boxes are heavier than common. To permit of using journal boxes of this length, the wheels are dished, so that the spokes are outwardly convex. The crank pins are 6½ inches in diameter in the larger part and 5 inches in the smaller part, the cylinders are 19 inches in diameter and the stroke is 26 inches. The steam pressure will be 180 pounds. The wheel base is 48 feet and 9 inches, the boiler is of the straight cylindrical type, this form being deemed on many accounts preferable to the wagon top style. The expansion of the inner and outer parts being more uniform, unequal strains are avoided, and the principal cause of leakage is removed.

The brakes are applied at the front of the drivers, to avoid the strain caused by applying the pressure in the usual way.

This noble machine does credit to the engineers who conceived the idea of constructing a perfect locomotive, and to the army of practical men who contributed toward its construction. We understand that the engine is to be sold after its exhibition at the World's Fair at Chicago.

This creditable piece of workmanship was produced by the Cooke Locomotive and Machine Company, of Paterson, New Jersey, and we have no doubt it will be duplicated.

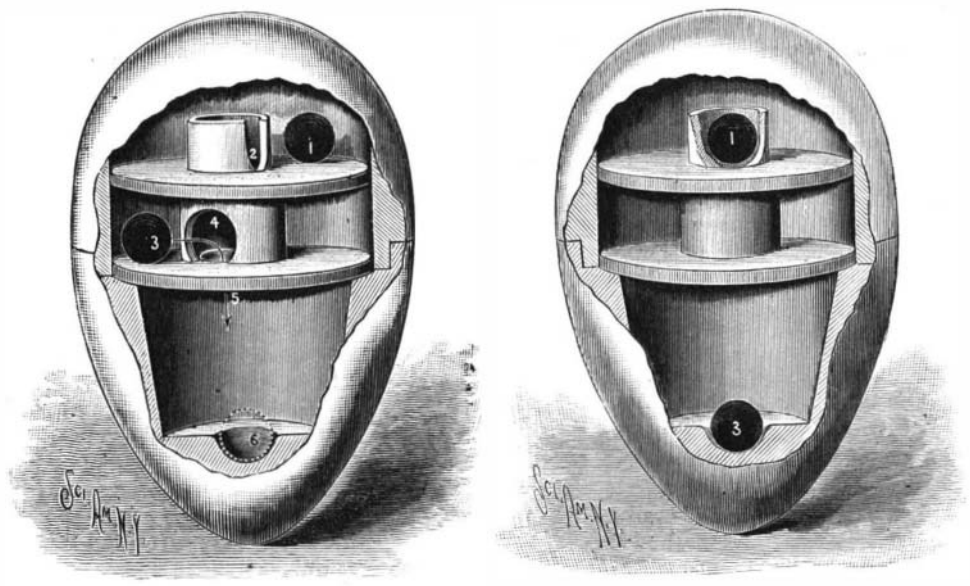
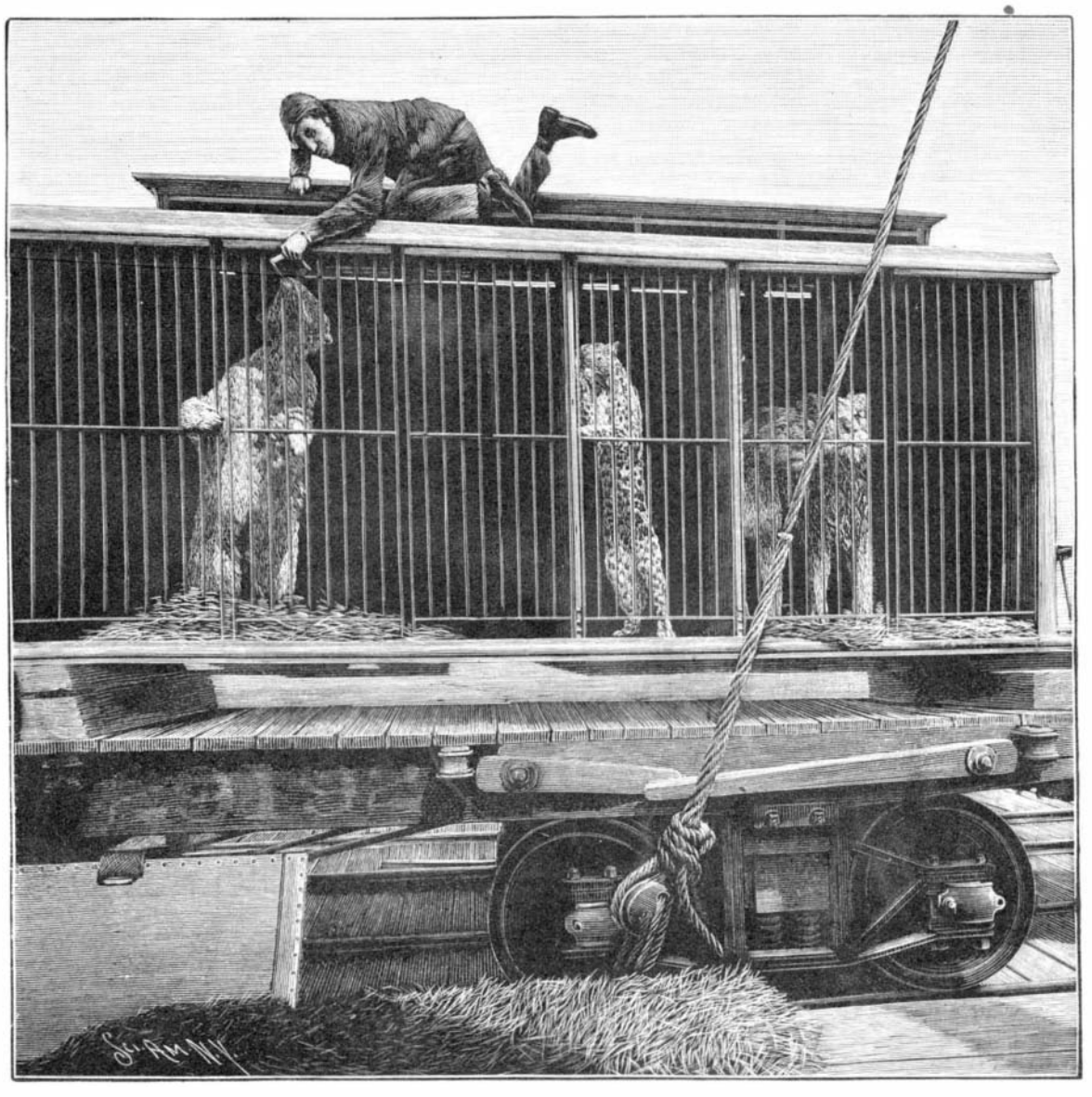


Fig. 1. BENITEZ'S COLUMBIAN EGG PUZZLE. Fig. 2.

A COLUMBIAN EGG PUZZLE.

The illustration represents a puzzle formed of a casing simulating an egg, with which may be accomplished the feat attributed to Columbus, that of causing an egg to stand on end, the shell of the casing being broken away and two views being given of its interior. A double-floored partition divides the larger from the smaller end of the egg, the floors of the partition being united by a hollow central cylindrical portion, in which is an aperture establishing communication with the annular chamber in the smaller end of the egg. Centrally on the upper partition, in the larger end of the egg, is a collar, open at one side, forming a chamber adapted to receive a ball. A ball is placed in the upper chamber and one between the floors of the partition, as shown in Fig. 1, and the egg can then be made to stand upon its small end by turning it around in the hand until ball 1 is moved into compartment 2 in the large end, ball 3 being at the same time guided through aperture 4 into the lower chamber 5, and to the cavity 6. The balls then will be in the line of the axis of the egg, and, its smaller end having a very slight cavity to give it a narrow base on which to stand, there will be no difficulty in making it stand on this end, as shown in Fig. 2. This puzzle has been patented by Mr. Manuel Benitez, and further information relative to it may be obtained of the Columbian Commercial Company, No. 126 Maiden Lane, New York City.



THE WORLD'S COLUMBIAN EXPOSITION—RARE ANIMALS FROM EUROPE EN ROUTE FOR CHICAGO.

IN his annual report for 1892, in respect of the Newton Abbot rural sanitary district, Mr. Harvey, in discussing the diminished tendency to spread of scarlet fever, puts it down, in a measure, to the free use of boracic acid, an ounce or two of which was given to each mother, with instructions for making an ointment by means of lard.