feet below the surface are laid pipes containing the conductors, the pipes and conductors terminating at intervals in boxes forming a sort of expansion joint. The pipes are cemented in the boxes with an elastic insulating cement, and the conductors are connected by copper loops which are capable of springing sufficiently to compensate for expansion and contraction. These loops are soldered to the conductors, a cylinder of compressed gas and a blowpipe being employed for this purpose.

Fig. 2 represents a service box in which the two copper loops are provided with arms extending to one side of the box and attached to service conductors leading to the building to be illuminated.

The conductors might be described as half round. They are of drawn copper of the size and shape shown in the transverse section, Fig. 3, and are supported throughout their entire length by insulating material in an iron pipe. The conductors thus mounted are made in different sizes for different localities, as there is a definite relation between the interest on the investment and the price of coal. When coal is cheap the conductors are made smaller, when it is dear they are made larger. Throughout a system the conductors are of the same size, and they are connected together at the corners of the blocks so as to practically increase capacity of the system.

Various forms of boxes are shown in Figs. 5, 6, and 7. Fig. 4 shows a street connection for the purpose of making electrical tests and for special purposes. There are thirteen varieties of street boxes and five for buildings.

The central lighting station is to be provided with twelve large Edison generators requiring 2,200 horse power. These machines are in process of construction.

The works in Goerick street are turning out from twenty to twenty-four of the smaller generators per week.

The New York Steam Company is placing pipes in Greenwich street, while at the same time an immense boiler house or heating station is being erected on the same street to supply steam to one of the ten districts into which the city is divided. The majority of the stations are located, and the work in the district in progress is being advanced with all possible speed.

The boilerhouse is something over 100 feet in height, and contains four floors of boilers, with sixteen boilers on a floor, making sixty-four boilers, having an aggregate of 15,000 horse power. The two chimneys of this immense boiler house will be a little taller than Bunker Hill Monument. The steam from these boilers is to be discharged into large vertical pipes or separators—to separate the water from the steam—whence it passes into the street mains, of which there are five, two of ten inch, two of twelve inch, and one of twenty-four inch diameter. These huge pipes are laid in sections, connected together by expansion joints of peculiar construction which permit the pipes to expand and contract without injury. The pipes are protected from the effects of external cold by a layer of mineral wool surrounded by a wooden jacket.

A return pipe runs parallel with the supply pipe to carry the water of condensation back to the boiler house. This pipe is much smaller than the supply pipe and is protected in the same manner. The steam pressure is generally relied on to force the water back, but in case of a great inclination in an adverse direction, a pump will be employed to force the water back. Steam will be taken from the supply pipes for heating, for cooking, and for power, and the water of condensation will be delivered to the return water pipe. We are unable in this connection to give the details of the steam meter or of that portion of the system that relates to the building.

This system is based upon the inventions of Mr. B. Holly, but the credit for the perfection of the system is due in a great measure to Mr. C. E. Emery, engineer of the company.

Accidents at the Paris Exhibition.

The correspondent of the London *Times* reports in that paper's issue of the 4th Oct., the following accidents at the Exhibition. He says:

"Yesterday a gentleman was leaning over a balustrade to examine an extremely interesting machine of M. Christofle, when his gold chain made a connection between two conducting wires which happened to be exposed. His chain became red hot and set fire to his waistcoat. To-day I had some conversation with a gentleman who was nearly killed the other day by a Brush dynamo electric machine. Part of the conducting wire was not insulated and was lying on the floor. He touched the stand of a lamp which formed part of the conducting system. His body then formed a connection through the ground to the naked wire, and contracted his muscles so as to cause his hand to clinch the lamp. Ten lamps were in circuit at the time, and so much current was passed through him that eight of them were extinguished. He was powerless to unclasp his hand. Every muscle in his body was paralyzed. His face was distorted; his lungs were so acted upon that he could scarcely breathe. He could only utter a faint and unnatural cry. The workmen in the place fled from the workshop, believing that some explosion was about to happen. A friend came up and tried to unlock his hand. It was impossible. He then lifted his legs from the ground. This broke the circuit and his hands were released, while burning sparks flew to his hands in the action of breaking the circuit. He was insensible, but has since then greatly recovered, and has devised an improvement to the lamp which will prevent a recurrence of such an accident."

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THE MADGE AND HER VICTORIES.

For two or three years the interest in English yacht racing has centered mainly in the ten tons class. The results of 1879 proved beyond a doubt that the Madge was the best British ten-tonner afloat. The next year she met her match in the Neptune and later in the Maharanee. The champions of the past season were the Neptune and the Buttercup, the former winning substantially everything in the north, the latter everything in the south. The record of the Madge, however, is a proud one, she having won in three years fifty-six prizes out of sixty-eight starts. Foreseeing possibly a better chance for continued victories in other waters, the owner of the Madge had her brought by steamer to this port to try conclusions with American craft.

The Madge was built by G. L. Watson, of Glasgow, in 1879. Her dimensions are: Length over all, 45 feet 8½ inches; on the water line, 38 feet 9 inches; beam, 7 feet 9 inches; depth 6 feet 6 inches; draught, 7 feet 10 inches. Her keel is of oak, 10x12 inches, to which is bolted nearly eleven tons of lead; her inside ballast is only 500 pounds. The stem and stern posts are of oak. Every third frame is oak, 2x3 inches. The intermediate frames are of elm, 2x1½ inches, spaced twelve inches from center to center. In the wake of the chain plates the frames are double. The deck beams are of elm, 3x2¾ inches, placed twenty-four inches apart. On these is laid a light deck of pine. Below the water her planking is of oak and elm, 1½ inches thick; above she is planked with cedar. She is coppered to above the bends. Her deck is flush, and she has no bulwarks. Her mast is 36 feet in extreme length, and 8 inches in diameter at the partners. Her boom is 36 feet long; gaff, 26 feet; bowsprit, outboard, 20 feet; topmast, 26 feet; spinnaker boom, 40 feet. She carries an enormous spread of canvas, the fitting of which is superb. Her extreme narrowness and great depth are in striking contrast with the breadth and shallowness of American small craft.

With these differences in style of construction came disputes as to the proper vessels to match with the Madge. The representative of the Madge refused to sail except upon the water line area rule of measurement—a rule which few American clubs recognize, and which shut out from competition vessels of an actual capacity corresponding with that of the Madge.

The first victories of the Madge were won over the Seawanhaka course in races with the Schemer, whose dimensions are: Extreme length, 38·95 feet; at water line, 37·17 feet; beam, 14.5 feet; depth, 4·6 feet; draught without center board, 3 feet.

In two races with the Shadow, at Newport, the Shadow won the first and the Madge the second. The dimensions of the Shadow are: Length over all, 36 feet 8 inches; water line, 33 feet 5 inches; beam, 14 feet 4 inches; depth, 5 feet; draught, 5 feet 4 inches.

The Madge was also sailed against the Wave at New York and at Newport, winning both races.

A race was refused with the Gracie of the New York Yacht Club, whose length over all is 48 feet 9 inches, and on water line 44 feet, a difference in favor of the Gracie considerably less than that of the Madge over the Shadow.

The controversy seems to hinge on the question whether length, breadth, and depth shall be taken as factors of capacity, or length and breadth only, a question which yachtsmen will have to settle for themselves.

Seeing that stability and speed can be secured either by great depth with narrowness, or by great breadth of beam with light draught, it would seem as though there ought to be some satisfactory means of determining fairly the comparative rating of the two types of vessels.

That the two methods of measurement and estimating time allowances are important elements of the problem may be seen from the fact that, applying the rules of the Atlantic Yacht Club, the Madge was beaten in all of her races save one, the New York race with the Wave.

THE ST. GOTHARD TUNNEL.

The first complete railway train, carrying one hundred passengers, passed through the St. Gothard Tunnel, Tuesday, November 1, time fifty minutes.

The St. Gothard Tunnel, nine and a third miles long, pierces the Helvetic Alps, and forms a link in the St. Gothard Railway, connecting the Swiss railways with those of Upper Italy. It exceeds the Mont Cenis Tunnel in length by 8,856 feet. The northern end of the tunnel, Goeschenen, is 82 feet from the southern end of the station platform, situated 3637·5 feet above the sea level, and 2,204 feet above Lake Lucerne. From this point the line rises with a gradient of 1 in 171 for 24,600 feet, then with a gradient of 1 in 1,000 for 4,428 feet, where it reaches the highest point of the tunnel 3,785 feet above the sea. Then after a length of 1,279 feet it descends with a gradient of 1 in 200 for 3,870, when the gradient is reduced to 1 in 500 for 13,792 feet, which brings it to within 984 feet of the platform of the station at Airolo, situated 3,755 feet above the sea, and 3,109 feet above Lake Majeur. The normal width of the tunnel is 24 feet $11\frac{3}{16}$ inches at the level of the rails, and 26 feet 3 inches at the height of 6 feet 6 inches above the rails. The height of the tunnel is 20 feet; the roof is semicircular. The floor of the tunnel is formed with a fall of 2½ per cent from each side toward the center, and at the lowest part is a drain 21⅞ inches deep. Up to the level of the top of the railway sleepers the floor is filled with ballast. The nature of the revetment varies with the rock traversed. In addition to the main tunnel there are fifty-two subsidiary tunnels on the line, having a total length of 16 miles, and 64 bridges and viaducts. Of the entire length of the St. Gothard line 17 per cent is tunneled and 1 per cent bridges and viaducts. The main tunnel carries two lines of railway, 4 feet 8½ inches gauge.

The contract for the work was taken by Mr. L. Favre, August 9, 1872. The construction was begun at Airolo, September 24, and at Groeschenen October 24, 1872.

IS INSANITY INCREASING?

It is a common saying that an increase in the number of insane persons is one of the necessary results of the intensity of modern life. There is certainly a steady increase in the number of inmates in asylums for the insane, an increase greater than the growth of population would seem to warrant. For this there may be several causes:

1. An actual increase in the proportion of persons of unsound mind in comparison with the entire population.

2. A more general and systematic commitment of insane persons to asylums for protection and medical treatment.

3. A steady accumulation of insane persons owing to the better care of the insane and the consequent lowering of the death rate of such persons.

That the second and third causes are real and potent is amply sustained by the statistics of our public institutions. The proportion of insane persons at large naturally diminishes with the improvement and multiplication of asylums and the growing popular conviction that neither individual nor public well-being is furthered by allowing the insane to go free, uncared for, and without medical assistance; and as a natural result the number of the insane in asylums increases proportionally.

Accordingly we may have an increase in the number of annual commitments to asylums, as well as in the number of permanent occupants, without any increase in the total percentage of insanity in the country.

Increased efficiency in the medical treatment of the insane may also seem to increase the number of cases as well as the actual number under care at any time. With unskillful treatment many cases of acute mania may result in speedy death, or, what is worse, chronic insanity. In such cases the patient counts but once. With better treatment the patient is ultimately, often speedily, discharged, apparently or really well. The disease is liable to recur, however, and in the course of years the same patient may have to be under treatment several times, each time adding one to the statistics of insanity.

Another fact which tells against the theory that "high pressure" living tends to unhinge the mind may be found in the source of the larger portion of the inmates of insane asylums. The records of asylums show that most of the insane come, not from the busy professional, mercantile, and manufacturing classes, but from those whose lives are a monotonous round of petty drudgery, or, what is equally killing, petty inaction, unfruitful idleness, and dissipation. Frivolity probably leads more men and women to the insane asylum than the hardest and intensest pursuit of mental or material wealth.

RAILROAD INVENTIONS WANTED.

Notwithstanding the fact that the past twenty years have witnessed wonderful improvements in railway fixtures and appliances there yet remains a wide field for mechanics and inventors to labor in in this direction. The fact that there are more than 2,000 existing patents on car couplers is no evidence that the demand is supplied. On the contrary, a *good automatic coupler* is among the needs of American railways, and the inventor who will produce a satisfactory coupler will not only be regarded as a public benefactor, but at least a dozen fortunes are at his command. A complicated rattletrap of an affair will not do. One that is plain, simple, durable, and reliable at all times is what the railway public are looking for and will, undoubtedly, pay handsomely for when found. There are a few of the couplers that have been brought out lately that are not entirely without merit, but they are lacking in many of the essential points of a perfect coupler.

The foregoing has reference solely to freight cars. The couplings now in use on passenger trains are, in the main, satisfactory, but for freight service *the* coupling is yet to be found. Here are some of the requisites of a perfect coupler: Any number of cars coming in contact should be coupled automatically. But it should be so arranged that no coupling will be effected unless so desired. It is obvious that if cars coupled at all times when they came in contact it would cause trouble in switching and yard work. The coupling must be so arranged that it can be operated from the tops of cars or on the ground without going between them. By "operated" is meant that a brakeman can uncouple from the top of a car or he can "set" the coupler so that it *will not couple* if so desired, and an operator on the ground can do the same thing without going between the cars. Next comes durability, which may be regarded as the "mountain in the path."

Chief among the causes of railway disasters are misplaced switches. It is true that we have safety switches that are reliable, but as their use (like many other good things) has not become general, there is a demand for a *reliable* switch signal. It is also true that we have some very good switch and drawbridge signals, but they do not always prevent accident, which may be accepted as proof that they are defective in some vital points. We have reports of from seven to twelve accidents from misplaced switches monthly, and accidents of this class are usually of a serious nature, being destructive of life and property. In August last eleven accidents are reported from this cause, and it is certain that many accidents from misplaced switches are not reported, and we have from three to five drawbridge accidents yearly. About a year since a $40,000 accident occurred at a drawbridge in New Jersey, and the draw was provided with an electric signal, but it appears to have become deranged. Some of the interlocking signals now coming into use are so arranged that if they get out of order in any manner the signal always stands at danger. This would seem to render switches and draws absolutely safe, but accidents are yet far too frequent, and although we have greatly improved these appliances they have not yet reached perfection.

Another fruitful source of frequent and serious disasters is imperfect signals at railway grade crossings. Crossing collisions are frequent and disastrous, and a signal that will effectually prevent this class of accident is in demand. Signals for the purposes named above should be of such a nature that they cannot be either misunderstood or run past unnoticed.

For daylight or clear weather targets or semaphores may be arranged so as to be effective, but on foggy days or at night the gong, bell, or torpedo should be brought into use. Interlocking signals are in use to a considerable extent, but they are mostly of a complicated and delicate nature and liable to become deranged. Moreover, there are such a diversity of signals that those who operate them and those who are to be governed by them are liable to become confused and the results are disastrous. Accidents have frequently occurred by the engineers passing a distant signal which stood at safety when it was passed, but was changed with the switch or draw before reaching the home signal or switch or draw, and the home signal not being visible by reason of fogs, or obscured by curves in deep cuts, buildings, piles of lumber, etc. No switch, draw, or crossing is safe without both a home and distant signal, both interlocking. And there should be intermediate signals at short intervals between the distant and home signals, and all connected with the switch or draw and operated with the single movement that operates the distant signal. As signals trusting to the vision for safety are not reliable at all times, the bell or gong must be brought into use. The torpedo may also be made to give warning of danger by a simple mechanism connected with switches and draws, by which a number of the explosives may be automatically placed on the rail at proper intervals.

The American Humane Society some time since offered a prize of $5,000 for the best stock car, but at their recent annual meeting, at Boston, they decided that none of the many hundred designs so far submitted came near enough to the requirements to entitle any one to the prize. The offer is now open, and it is hoped that some one will soon win the prize.

The above hints may be worth something to inventors working in the directions indicated.

WM. S. HUNTINGTON.

[In respect to the prize offered by the Humane Society, one of the conditions was that the successful plan should be protected by a patent which should be assigned to the society. In these days of industrial progress it is idle to suppose that any patentee of a perfected cattle car would sell his patent for the small sum of $5,000. Such a patent would be worth more nearly five hundred thousand dollars than five thousand. We have good authority for the statement that the offer of the Humane Association had the effect to call out a number of highly valuable cattle car inventions, the patents for which were at once bought up by the Palace Cattle Car Company at figures a little above those offered by the association. This left in the hands of the association only the inferior plans, none of which were found to be within the association's offer; hence no award could be declared. The Palace Cattle Car Company ought to feel greatly obliged to the association for its arduous and gratuitous services in assisting it to acquire its valuable patent rights at a tithe of their real worth. Ten millions of dollars, we believe, is the amount at which the car company now values these patents; at any rate that is the par value of the company's stock, which we believe is based chiefly on these acquisitions.]

NEW COMPRESSED AIR LOCOMOTIVE ON THE ELEVATED RAILWAY, NEW YORK.

A trial was made on the Second Avenue Elevated Railroad of a new air locomotive on the 23d, and again on the 28th of October, with entire satisfaction to the Pneumatic Tramway Engine Company, who own the machine. In this locomotive air at a high tension is stored in tanks and distributed to the motive cylinders through a reducing valve and then through hot water, according to an old and well known plan, for the purpose of heating it, to counteract the refrigerating effect of the expansion of the air, and also to provide moisture as a lubricant for the pistons.

This locomotive was built by the Baldwin Locomotive Works, of Philadelphia, and is the invention of Mr. Robert Hardie, of Edinburgh, Scotland. It is on the same principle and an improvement on a street motor that was tested and reported on by General Haupt, whose report was published in the SCIENTIFIC AMERICAN SUPPLEMENT of June 28, 1879, No. 182. The obvious advantages of a noiseless exhaust, and the absence of fire, with its disagreeable odors, dust, and smoke in a street motor, are claimed for this locomotive, and so far as the experiments are concerned which have taken place in the last few days on the Second Avenue Elevated road, the claim is well established.

The locomotive, as shown in our engraving, consists of four steel cylindrical air tanks of very perfect construction, having dished heads and triple riveted spiral seams in lieu of the usual longitudinal form, and double riveted circumferential seams, all of which are made tight by means of Connery's calking, and tested at a pressure of 850 pounds to the square inch. These tanks, having an aggregate capacity of 460 cubic feet, are supplemented by two smaller distributing tanks, a small steam generator, and a pair of motive cylinders, similar to steam engine cylinders, 12½ x 18 inches, with Stephenson link reversing gear and adjustable cut-off on the back of the slide, connected in the usual manner to four coupled 42-inch driving wheels. The cab is located at the forward or cylinder end of the machine. The method of hanging by means of equalizing levers between the drivers and an improved two-wheeled swinging center bearing pony truck effects the distribution of eighty per centum of the weight upon the drivers, and practically carries upon three points of the frame, thereby avoiding undue strains and securing steady motion over the inequalities of the track. The initial air pressure is 600 pounds to the square inch at starting, but is distributed to the motive cylinders through the distributing tanks, reducing valves, and steam boiler, at a uniform working pressure, about the same as that of ordinary locomotives. A small fire is kept burning in the furnace of the steam generator, which is a small upright tubular boiler. For the purpose of obtaining a high grade of expansion and a noiseless exhaust, the cut-off is arranged on the back of the slide, as above stated, which is instantly adjustable to any desired grade by means of an ingenious hand device within the cab.

A new and peculiar feature of this engine is the use of the main cylinders for working the vacuum brakes, which is done by simply putting the reversing lever in mid-gear, when the main cylinders become vacuum pumps, thereby greatly simplifying the handling of the train.

On the 26th of October we had the pleasure of a ride on this admirable engine, and we testify to the perfect manner in which it fulfills its mission as a noiseless, odorless, smokeless, and perfectly controllable motor. It will cover the full length of Second Avenue, from 127th Street to the Battery, with four loaded cars, at a higher rate of speed than the schedule calls for, with a single charge of air, and then the recharging is done in as short a time as is needed to change horses on a surface road.

The engine is now in charge of John A. Wallace, one of the "L" road engineers, who is more than pleased with it, and especially is he delighted with the absence of anxiety about boiler water, which is the steam locomotive driver's bugbear.

Curious Experiment in Crystallization.

The following experiment is given by Peligot in *La Nature:* Dissolve 150 parts by weight of hyposulphate of soda in 15 parts of boiling water, and gently pour it into a test tube so as to half fill it, keeping the solution warm by placing the glass in hot water. Dissolve 100 parts by weight of acetate of soda in 15 parts of hot water, and carefully pour it into the same glass; the latter will form a layer on the surface of the former and will not mix with it. When cool there will be two supersaturated solutions. If a crystal of hyposulphate of soda be attached to a thread and carefully passed into the glass, it will traverse the acetate solution without disturbing it, but on reaching the hyposulphate solution will cause the latter to crystallize at once in large rhomboidal prisms with oblique terminal faces. When the lower solution is completely crystallized, a crystal of acetate of soda similarly lowered into the upper solution will cause it to crystallize in oblique rhomboidal prisms. The appearance of two different kinds of crystals will not fail to surprise those not acquainted with such experiments.

Early Steamers in England and Canada.

At present (1814) there are five steamboats on the Thames. 1. The Thames (originally the Argyle), 14 horse power, plying between London and Margate; reckoned the best boat. The paddles alternate with each other, and are set at an angle of 45 degrees. 2. The Regent, 10 horse power, paddles set square, with rims like an overshot wheel; is expected to ply between Chatham and Sheerness. She was first built for the wheel to work in the middle; but this, not having been found to answer, has been altered. 3. The Defiance, 12 horse power, to Margate, with double horizontal cylinder engine. 4. A boat which plied between London and Gravesend was laid aside on account of a lawsuit, as she was not worked by a privileged person. Such a person has now taken her, and she will soon start again with a new 12 or 14 horse power Scotch engine, being originally fitted with a high pressure engine. The wheels of this have rims, and the paddles swing like top butt hinges. 5. A boat with double keel, 6 horse power, is now building above Westminster Bridge; paddles upright; said to be for London and Richmond. 6. Mr. Maudslay built a small boat last year for Ipswich and Harwich, 16 miles done in two and a quarter hours, but against a strong wind in three hours. This has six frying pan paddles set square, without rims. I have been informed, by letter of August last, from Gainsborough, of a steamboat from thence to Hull, which performs the voyage, 50 miles, in eight hours. And this week, from Canada, at present there are two steam vessels on the river St. Lawrence, one 48 the other 36 horse power, which go at 7 miles an hour, measure about 170 feet long and 30 feet wide! Another 48 horse power vessel will be launched next year on that river. So that one may go by steam from Quebec to New York in eight days, with a short land carriage.