America's cup, for which the British cutter Galatea is now the avowed competitor. Whether the Atlantic will fulfill her mission, and win the honorable office of defending the cup, will be determined by the preliminary races between the four competitive American clippers, the Puritan, Priscilla, Mayflower, and Atlantic. Each boat has its champions, but they are all so admirable that the most experienced yachtsmen hesitate to express any opinion about the result of the forthcoming trials. The success of the Puritan has made the superiority of the centerboard over the cutter a foregone conclusion in the minds of nearly all American yacht owners. This confidence has made the interest in the national contest much more lively at present than in the real contest between the American champion and the British challenger. Apparently, everything possible has been done to make the successful clipper, whichever she may be, a worthy representative of the most advanced principles of American yacht building.

Iron Foundations for Heavy Guns.

In case of a war with foreign powers, we should be forced to the rapid construction of temporary fortifications behind earthen parapets. One of the great difficulties in the way of such construction is the time required for building properly the heavy, massive masonry foundations up to this day regarded as necessary under heavy guns. This difficulty may be now avoided (according to Captain W. H. Bixby, Corpsof Engineers, U. S. Army) by the use of wrought iron instead of masonry for these foundations.

Captain Bixby proposes to replace the present slowly built, difficultly moved, difficultly releveled masonry foundations for heavy guns behind earthen parapets by rapidly constructed, easily moved, easily releveled wrought iron foundations, to rest on cross girders or sleepers, embedded in the earth of the *terre-plein*, and provided with a front parapet anchorage sufficient to resist all direct recoil.

The holding power of anchorages embedded in mere earth is well known by the experiments of our Q. M. Department on suspension bridge anchorages during the war of 1861–65, and it is also well shown by the Shoeburyness experiments of 1881 (see p. 41, Part 2, of Captain Bixby's report on "Sea Coast Fortifications in Europe").

A 40-foot earthen parapet and suitable iron rod and cross girder anchorage may well be trusted to resist and absorb all the direct horizontal recoil of even a 100-ton gun, leaving to the foundation alone the lighter duty of supporting the carriage and gun and the comparatively small vertical component of the recoil.

An iron girder foundation, resting on sleepers and earthen bed, may be fairly well trusted to serve as an efficient support to the vertical weights and blows of our heavy guns, after the first few rounds have been fired. A little unequal settlement may naturally be expected, but such settlement is of minor account today, for two reasons: first, heavy guns of the present and future must be traversed by machinery, and such machinery will overpower the slight extra resistances due to unequal settlement of the gun's platform; second, whenever an unequal settlement becomes marked and objectionable (probably not oftener than once in a month during action), the iron girder foundation can be jacked up and earth tamped in underneath it (exactly as is currently done to remedy similar unequal settlements of railroad tracks).

It seems now quite probable that future fortification in the United States (when it does come) will demand economy of time rather than economy of money. In any case the advantages which may arise from rapidity of original construction, rapidity of construction in place, facility of repair, facility of change of position if necessary to allow of other angles of fire, facility of replacement if necessary to allow of guns of greater weight and size—all these advantages appear sufficient to authorize at least the trial of such a foundation under one of our heaviest guns.

Captain Bixby's suggestions are now being considered by the War Department, and will undoubtedly lead to some change in the present slow methods of gun foundation construction.

The Tongue in Disease.

One of our medical contemporaries states that different complaints are indicated by the condition of the tongue, as follows:

A white-coated tongue indicates febrile disturbance; a brown moist tongue indicates disordered digestion or overloaded primæ viæ; a brown dry tongue indicates depressed vitality, as in typhoid conditions and blood-poisoning; a red moist tongue indicates debility, as from exhausting discharges; a red dry tongue indicates pyrexia, or any inflammatory fever; a "strawberry" tongue with prominent papillæ indicates scarlet fever or rotheln; a red glazed tongue indicates debility, with want of assimilative power of digestion; a tremulous, flabby tongue indicates delirium tremens; hesitancy in protruding the tongue indicates concussion of the brain; protrusion at one side indicates paralysis of the muscles of that side.

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AN UNDERGROUND RAILWAY FOR NEW YORK CITY.

In March, 1870, the SCIENTIFIC AMERICAN published illustrations of an underground railway which had then been built, for a distance of one block, under Broadway, New York. It was known as the Beach pneumatic tunnel road, the cars to be propelled by compressed air, but was never completed, except for a distance of about two hundred feet. From that day to this, the project of an underground Broadway railroad has come up at almost every session of the State Legislature, until a bill for this purpose has at last been passed, and received the Governor's signature. There are said to be grave doubts about the constitutionality of the act, which will have to be settled before the work of building is actually begun, but the names of the eminent capitalists and business men connected with the enterprise afford an assurance that this great undertaking will now be prosecuted in earnest.

By the plan adopted, the company is allowed forty-four feet under the surface, the least width between the sidewalks on Broadway being, for a short distance, thirty-nine feet, and the average width being about forty-nine feet. The sewers, water, gas, and steam pipes, with tubes for wires, etc., are to be carried in vaults and subways of brick or iron, to be built and kept in repair by the company; they are to be open for entrance at every quarter of a mile distance, and it is estimated will cost $400,000 a mile. This will, of itself, be a great saving to the city, and obviate the necessity of the frequent tearing up of the pavement, at present so great a source of public inconvenience. The kind of power to be used is not specified; it may be electricity or any motor not emitting smoke, gas, or cinders.

During construction, a temporary bridge is to be maintained over all places where the work is going on, so that travel will not be interfered with during the progress of the work. The road is to extend under Broadway from the Battery to Fifty-ninth Street, a distance of about four and a half miles, with a branch at Madison Square to Forty-second Street, but both of these lines to be further continued, if found desirable, in the future. The sections named are to be completed within five years, and the city is to receive for the privileges granted three per cent. of the gross revenue. The capital stock of the company is fixed at $25,000,000, and the cost of building is variously estimated at from $3,000,000 to $6,000,000 per mile.

The only work in the world at all similar to this proposed arcade subway under Broadway is the underground railway system of London, by which that city is belted by a nearly complete double circle of subterranean roadway, though with many open cuttings within high walls. These underground roads cost from two and a half to four million dollars per mile, and pay from three to four per cent. interest on the capital invested. Although the total population of London is more than four millions, while that of New York should not be placed higher than probably one-third of this, the rapid growth of the latter city, and its peculiar configuration, determining most of its travel in main north and south lines, seem to indicate that the new road is likely to have as large a business, in proportion to its mileage, as its London predecessor. Let us hope that it will, also, be as well and solidly built, for the London road is, both in its building and operating, a most creditable example of a high order of engineering skill.

PROGRESS OF INDUSTRIAL ELECTRICITY.

"How was that made?"

This question was asked of a prominent metal merchant as a vessel was handed him, made in the shape of a head-light reflector. It was composed of copper about one sixty-fourth inch thick, tough, pliable, and very smooth on the inner surface. Examining the edges of the flange, the merchant noticed that the thickness of the metal did not vary in the least around the entire rim.

"It was spun."

"No."

"Stamped."

"No."

"Pressed."

"No."

"Cast? Impossible."

"No, it was not cast."

"Then it must have grown."

It had grown, but it was with the rapidity that only electricity can give to growth.

The process by which the above casting or vessel was made is as follows:

A rigid male form is made of the approximate shape and less in size than the article wished to be reproduced. This form is then immersed in a kettle of refined wax, paraffine, or similar substance.

The shape of form will decide in what position the form is to be held; in the case of a reflector, the form is held with small end up. The wax must be pure, and free from dirt or water to get best results. The wax is heated so that it will run nicely. By immersing form in kettle and withdrawing vertically, the wax will run smoothly, and as it cools in a few seconds leaves a smooth, true surface. This surface is now rendered conductive with the well-known electrotyper's process, by the application of black lead, iron filings, and blue vitriol. The whole thing is then immersed in a copper solution, and connected electrically with a dynamo. Copper anodes are also put in solution, and connected electrically with opposite pole of dynamo. The dynamo is set in motion, and the "growth" of a vessel begins. The thickness of vessel is dependent upon the length of time deposit is allowed to continue; pieces of copper an inch thick have been made. The time required to make a vessel of a certain weight and size depends altogether upon the size of the dynamo. The perfection and strength attained by these "electric engines" through the perseverance of recent inventors and manufacturers is something marvelous. The Brush people of Cleveland are now building a dynamo which will have a current strength of 122,500 amperes. A current strength of 386·4 amperes will deposit 1 pound of copper per hour. This large dynamo, then, will deposit over 315 pounds copper per hour—3,150 pounds in a run of 10 hours. The weight of copper in reflectors will average 14 pounds; 225 reflectors can be made in 10 hours, or about 6,000 per month.

The output of the United States averages between 5,000 and 8,000 reflectors per annum. Given the required number of forms, a dynamo of above size and a few workmen will turn out in 30 days what now requires the use of many spinning lathes and other machinery and the entire time of many workmen. Electro deposit is crystalline in its nature, and therefore the conclusion is hastily jumped at by many men that vessels made in this way will necessarily be porous. The advances made in this point are as marked as those in the development of the dynamo, and the casts properly made by above process are as ductile and pliable as the finest rolled sheet copper. In examining the digest in the Patent Office on electro deposition, it was found that the idea of making reflectors and other copper wares by electro deposition was an old one, patents having been issued to foreigners as early as 1841 and 1842. At that time the dynamo was scarcely in existence, and the point of failure in the practical application of their specifications lay in the fact that they failed to see that unless moulds could be formed quickly and cheaply, the idea was useless. To bring out this point clearly, let us go back a little; when the vessel has acquired the necessary thickness, the form and vessel are removed from the bath, and a slight pressure is brought to bear upon the vessel or hot water is poured over it. This will loosen the wax, and allow the vessel to be removed.

The original or principal form is made of wood, clay, earthenware, glass, brass, copper, or of any substantial material. It will be at once seen that it is only necessary to immerse this original form in the wax again to prepare it for another cast. In the patents above referred to, granted in 1841 and 1842, the forms are composed of either wood, clay, brass, etc., but are composed entire of one material or substance, requiring for the removal of vessel the destruction or mutilation of mould, necessitating a new mould for each vessel made. This method was too expensive to be practical, and the process was abandoned.

The above new method of preparing moulds is fully covered in letters patent recently issued to a Western inventor. Electricity is surely taking the lead in valuable inventions, and this promises to do away with much time and labor. It will also introduce some new and important articles upon the market.

It is well known that it is an impossibility to cast copper in thin sheets, and rolling is expensive. As the forms in above process may be of any size or shape, a burial casket may be made in one piece, of copper, and at a much less cost than if cast from iron, as now made. Probably the greatest revolution which this process will bring to the commercial world will be in the plumbing goods line. Instead of having to roll sheets of copper, then cut them to exact dimensions, and then solder together to make a bath tub, an entire shell will be made in one single piece, set in a wooden frame, and a far better and probably cheaper bath tub will be the result. Linings for flush tanks will come under the same change.

A Belt Carries Fire through a Mill.

On the morning of the 21st ult. the Merchant mill of Pennsylvania Steel Works, at Steelton, Pa., was completely destroyed by fire. The mill was an immense wooden structure, with iron roof, 100 feet wide by 400 feet long. At 10:30 o'clock in the morning there were 312 men at work. A boy who wanted to fill his torch with oil went to the pump house for that purpose, and while thus engaged the torch exploded, and the lad tried to stamp out the flame. In doing so he scattered the blazing oil, and the fire was communicated to the barrel of oil, which stood under the belt that ran from the pump house to the main mill and furnished the motive power for the machinery. The flames shot up from the burning oil barrels, and set the oil-saturated belt on fire, and in an instant the moving belt dragged a trail of fire into and clear across the mill, communicating flame to whatever it touched, and making a display of fireworks gorgeous but costly.

American Clays, and Their Use for Constructive Purposes.

In addition to the localities already known, further geological researches have disclosed the occurrence of large deposits of brick clay in different portions of Maine, and particularly along the Kennebec and Penobscot rivers. Deposits have also been found in Augusta Co., Va., producing both fire and potter's clays; at Birmingham, Ala., and in several new localities in Ohio and New Jersey. No new finds are reported in the Rocky Mountain division, but in California clay deposits of some importance have recently been discovered in several portions of the State. An excellent quality of kaolin, or porcelain clay, occurs at Calico, in San Bernardino Co. Clays suitable for making the coarser kinds of pottery have been found in a number of localities, stretching from the Oregon line to Lower California.

With the greater diversity shown by American industries, the uses for clay have largely increased, until now a long list of articles is made exclusively of this material. The processes of manufacture differ both with the quality of the crude article and the uses to which it is to be put. They have just now, however, a greater interest than usual, since the high price of lumber and the desire to make our structures more fireproof than formerly have operated to invest all mineral constructive materials with an increasing importance. In the manufacture of common brick a great variety of clay is employed, but that containing much lime is avoided, since it would be made caustic by burning, and its subsequent hydration on exposure to the atmosphere would cause the bricks to crumble.

Particles of stone or iron pyrites are also removed to prevent trouble in the after working. When partially dry, the clay is ground in roller mills, and then mixed for use. The mixing is necessary to produce a homogeneous and, consequently, a durable product. When this process is completed, the clay is moulded into bricks, either by hand or machinery.

It is said that an experienced moulder with proper assistance can make 2,000 bricks in a day, when working by hand. The moulded bricks are permitted to partially dry in the sun, and are then stacked in kilns for burning. The fuel varies, but when available, anthracite screenings are usually employed. With coal, the burning requires from four to six days, and the cooling of the kiln about the same time. Building brick for city fronts, and the better class of work, are made in the same manner, except that better clay is used, and the operations are more carefully performed. Pressed brick, such as is made at Baltimore with success, are moulded larger than required, and then compressed to the proper size in a brick press. The color and smoothness depend upon the moulding sand employed. All of the operations are conducted under cover, and the bricks are laid on their faces in drying, instead of on end, as with the commoner kinds. Special precautions are also required in firing. The arches and four or five lower courses are made of common brick and the pressed brick on top of these. The burning requires from ten to twelve days. The bricks are allowed to cool slowly, and when taken from the kiln are sorted, the defective ones being rejected. The ornamental and intaglio bricks now so popular are made in a similar manner, save that even greater care is required.

Glazed brick are now largely used for both interior and exterior decoration. They are manufactured in Ohio and elsewhere in the United States. For this purpose an ordinary red or light colored brick is used, and a suitable enamel produced on the surfaces to be exposed. Some colors are very easily obtained. A simple lead glaze on a cheap buff fire brick makes a good yellow. A manganese and iron glaze is used for black. White and blue are the most difficult to produce, since the red color of the ordinary brick must first be hidden by an opaque layer of white before the finishing glaze is applied. Green must be made in the same way.

Roofing tiles are made by ordinary brick clay. This is first moulded into strips, about six inches wide and three-eighths of an inch thick, and is then cut into desired lengths. Oil is used to keep the clay smooth and prevent the plates from sticking. A specially devised machine then trims off the edge of the plate to a symmetrical shape, and presses it to the desired pattern. It takes about two weeks in a steam heated chamber to dry the tiles, as the oil hinders the escape of moisture. They are piled loosely in a kiln, to a depth of six feet, and subjected to a slight firing. Several designs of tile are made. The shingle tile is simply a slab of burnt clay, 12 x 6 x ⅜ in., having suitable holes for the nails to pass through, which hold them to the roof. The diamond tiles hook into each other and are more ornamental, but less durable. The chief objection to roofs of this character is in their excessive weight. A ten foot square of plain shingle tile weighs about 1,100 pounds; of the diamond tile, from 650 to 850 pounds.

The manufacture of door knobs, as carried on at East Liverpool, O., is of considerable interest, since it requires a careful mixing of the different clays to obtain a well marbled product. Each color of clay is worked separately and is first put through a process called boiling. A vertical cylinder, about six feet in diameter, and carrying in the center a revolving rod provided with stirring and cutting arms arranged spirally, is filled with the requisite amounts of water and clay. It is then set in motion by horse power, and the clay beaten to a thin mud or slip. This is run through a fine bolting cloth into a large tank, from which it is dipped into an evaporating pan, heated by suitable furnaces. When removed from the pan, the clay is soft and plastic, and is piled up and covered with wet blankets to keep it tempered. The clay, when ready for use, is "wedged." A block of both colors is cut by a wire into six or eight layers each, which are piled alternately into a new block of double the size. This is thrown down with violence to consolidate the layers. It is then cut and wedged and so on until the colors are marbled in fine alternating streaks. Thus prepared, the clay is moulded into proper shape by stamping in a die. The knobs are dried, and when somewhat hard are turned to a smooth, regular face. They are then thoroughly dried and burned twice—once as biscuit, and then dipped in glaze and burned again.

A terra cotta lumber has recently been added to the list of mineral building materials. A kaolinite of good quality is mixed with sawdust, worked by machinery into slabs, and is then burned, sawed, and dressed. It is, in this condition, ready for market, and is said to be indestructible by fire, water, or gases. It is a poor conductor, and suffers but slight expansion or contraction with changes of temperature. Its weight is put down at one-half that of brick. It can be worked with edge tools, bored, and sawed, and holds nails as readily as timber. It is also made into hollow tile and fireproof casing. Mr. Wilbur's report to the Government, from which our information is taken, also gives the statistics of production of the United States, together with the imports and exports.

A Child Woman.

The recent death of Miss Caroline Terboss has attracted renewed interest in her remarkable case. She was a member of an otherwise normally developed family, and up to her twelfth year she was apparently like other girls. But at that age she suddenly stopped growing, and though she lived to the advanced age of seventy-seven, development, once interrupted, was never resumed. At the time of her death, she was in form, stature, and organization a child. For many years she was a familiar figure on Fifth Avenue in the neighborhood of the reservoir. Her age was a mystery, for her hair remained unchanged in color, and her face, though noticeably mature for so young a figure, was but slightly wrinkled. Beyond an extreme sensitiveness of the skin, she enjoyed apparently good health until within a short time of her death. Her height is given at but four feet and four inches. She is stated to have been remarkably quick intellectually. As no physician had been in attendance within twenty-four hours of death, it was necessary to summon the coroner. The autopsy revealed the perfectly formed body of an apparent girl of eleven. Beyond certain organic peculiarities, the anatomy was normal. The spine was straight, and there was no outward deformity. No examination was made of the brain.

The case attracts much interest among physicians, because, though similar instances have been recorded, they are very rare, and never has the subject lived to so advanced an age. Death has usually occurred before twenty-one. Twenty-five years of age is believed to have been the extreme limit.

The Telephone Nut Shell.

A large number of German publications printed from 1860 to 1865 contain accounts of the transmission of words and articulate speech by Philipp Reis with electricity, and the instruments as made by Reis do now transmit and receive articulate speech clearly and distinctly, and I maintain that if only five words were so transmitted the discovery of its being done with electricity by Philipp Reis is conclusive, and that no honest or intelligent person can concede to Bell what was done and given to the world unconditionally 15 years before by Philipp Reis. All subsequent efforts are merely mechanical improvements, and no honest man acquainted with the subject can dispute the discovery by Philipp Reis. W. VAN BENTHUYSEN.

THE President in a message to the House has suggested that the 3d of September be set apart as an appropriate day for the inauguration of the Bartholdi statue of Liberty. This day is selected as being the anniversary of the signing of the treaty of peace at Paris, by which the independence of the United States was recognized and secured. He asks that a sufficient amount be appropriated by Congress for the suitable recognition of this event. It is very encouraging to believe that the completion of this great work, begun so many years ago, is really at hand. The pedestal is quite finished, and presents a splendid appearance, looming up, as it does, above the old fort on Bedloe's Island in its solitary grandeur.