SCIENTIFIC AMERICAN

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A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

Vol. LXIV.—No. 21.] ESTABLISHED 1845. NEW YORK, MAY 23, 1891. [$3.00 A YEAR. WEEKLY.

THE PROPOSED HUDSON RIVER SUSPENSION BRIDGE.

Nearly a year has elapsed since we illustrated the proposed bridge across the Hudson River, to be constructed from designs by Mr. Gustav Lindenthal, of Pittsburg, Pa. At that period the bill authorizing the construction of the bridge had passed the House of Representatives, and was awaiting action by the Senate. The bill has now passed both Houses, has been signed by the President, and is law. Under it the question of the height is left to the discretion of the Secretary of War, provided a minimum height equal to that of the East River bridge be obtained. This question was delegated by the Secretary of War to the Board of Army Engineers, sitting in New York City, and plans have been just approved by the Secretary of War and the height fixed at 150 feet above high water.

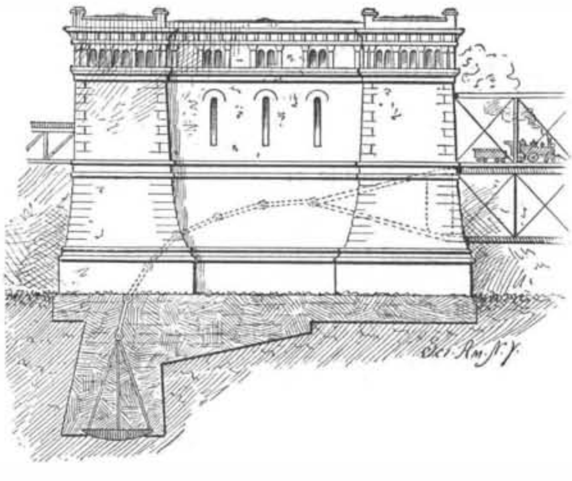
The plan of the bridge has been modified in several respects, and we give a perspective view of the proposed structure. It will comprise five divisions: a central span, two land spans, and two approaches. The bridge proper will start from the New Jersey anchorage, abutting on the northwest corner of Bloomfield and Twelfth Streets, Hoboken, and on the New York side will terminate at its anchorage on the northeast corner of Twenty-third Street and Tenth Avenue. The distance between these points, as far as ascertained, is 6,650 feet. The central span will be 3,100 feet from center to center of piers, and the shore spans will be 1,750 feet each, measured as above. The clear span of the central bay is to be 2,920 feet.

At the point selected for the bridge there is a space of 2,740 feet between the pier head lines as established by law. Both piers come inside of this line, so that the legal channel of the river is not to be interfered with.

The structure is to be of steel for the roadway and towers, while stone and concrete (beton) will be used in the anchorage and foundations. These foundations it is proposed to establish upon the solid rock.

Double steel towers 525 feet high, on foundations 180 by 350 feet, will carry the cables, which will pass over balancing saddles. The cables, four in number, are to be arranged in pairs, one nearly vertically over the other, and of 48 to 50 inches diameter each. The cables are 55 feet apart vertically. To prevent deformation and to cause the cables to act to a certain extent as truss chords, diagonal braces are inserted between the members of each pair of cables. The whole thus constitutes two arched trusses, which will resist deformation from strains to considerable extent.

The cables are to be made of steel wire, laid parallel, and bound together at intervals; but they are not to be bound with wire, as in the East River bridge, but are to be surrounded by a cylindrical sheet steel casing bolted on. This casing is to be water tight, and of such size as to provide two inches of space all around the cable for the circulation of air and for the equalizing of temperature. It has been found that in this gigantic structure uneven heating of the wire cable would produce undesirable strain, and the covering of the cables will to some extent counteract this. The planes of the cable are inclined about eight per cent from the vertical, in order to give stiffness to the structure.



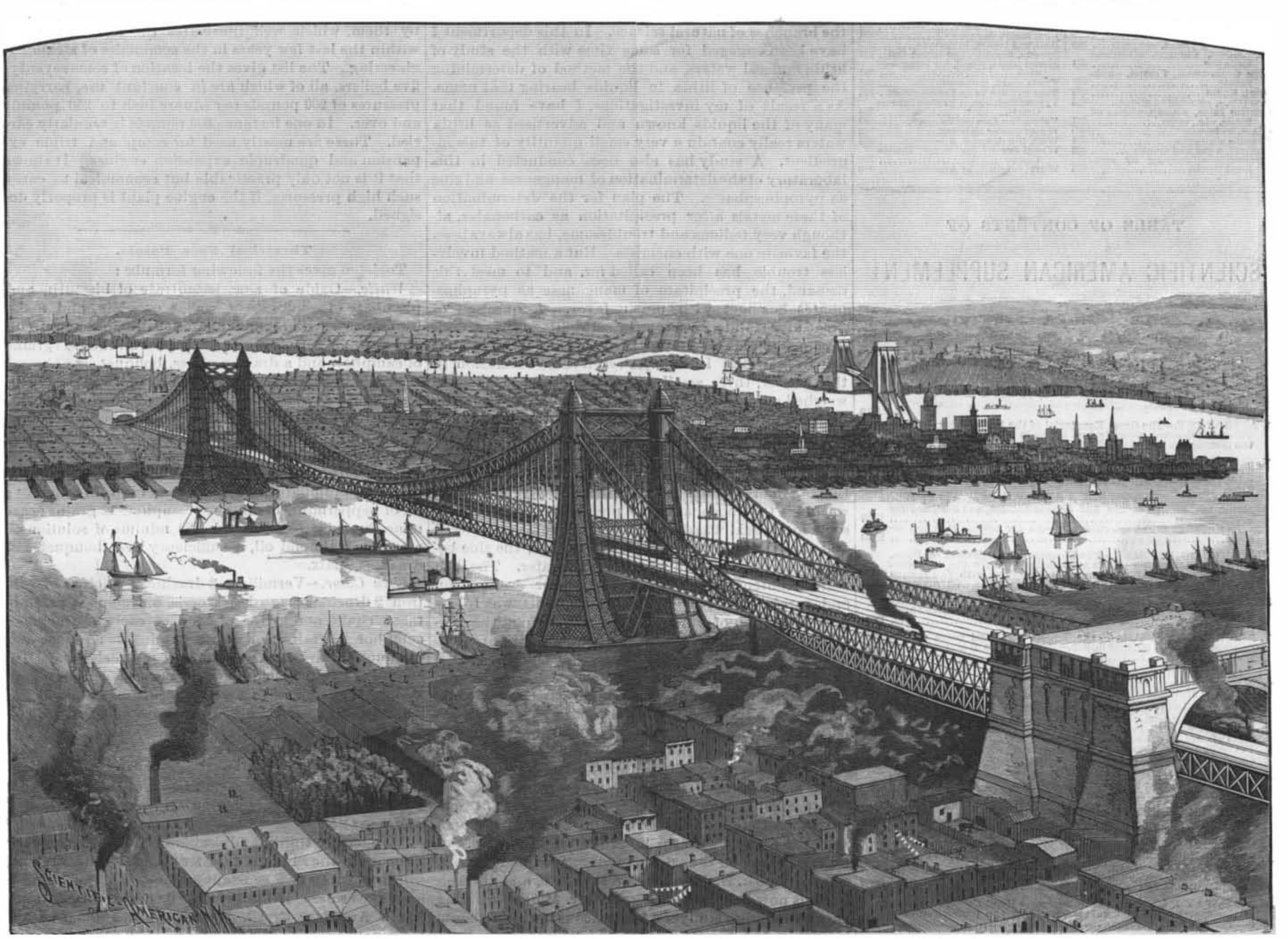
DOUBLE CABLE ANCHORAGE AND ANCHORAGE PLATES.

With extreme ranges of temperature, it is calculated that the center of the cables will rise and fall through a range of nine feet. Thus in cold weather the height of the bridge at its center may exceed by 4½ feet its normal height.

Two anchor columns are placed at intermediate points between the anchorage pedestals and the main towers. These are entirely below the roadway and carry no dead weight, but come into action in cases of unequal loading.

The maximum load to be allowed is only equal to one-quarter the ultimate strength. As live loads in the calculations, for each of the main tracks a 1,000 foot 1,200 ton train was assumed, and for the rapid transit tracks a 300 foot 200 ton train each, while for the promenade 13,000 men were assumed. All this weight was supposed to be placed upon a single span, with the result of indicating the large factor of safety expressed above. With 1,330 locomotives loading the bridge from end to end, only one-third its ultimate strength will be called upon. The dead weight of the structure will be nearly three and one-half times this amount. The suspended framework is to be made as rigid as possible.

(Continued on page 323.)



THE PROPOSED HUDSON RIVER SUSPENSION BRIDGE, CONNECTING NEW YORK AND HOBOKEN.

THE PROPOSED HUDSON RIVER SUSPENSION BRIDGE.

(*Continued from first page.*)

It comprises trusses, also of 55 feet height, to accommodate the decks.

A wind pressure of 50 pounds to the square foot has been assumed as a basis for the calculations, and to resist it two horizontal trusses, 115 feet deep, extending continuously from anchorage to anchorage, are provided. This represents the space afforded for the decks, which are of this total width, being a few feet less in the clear.

Of these decks there are to be three, although it is designed to construct only one of them at present. The lower one is to carry for the present six and ultimately eight tracks for regular railroad service. On the second deck there are to be four rapid transit tracks and there is room for two additional heavy service tracks. The third deck is to afford a promenade twenty feet wide. It seems a pity not to arrange a roadway for carriages, as it would afford a most impressive drive, but the approaches for such roadway from the low ground on either shore are considered impracticable, and the ferries are relied upon as more convenient for wagon traffic.

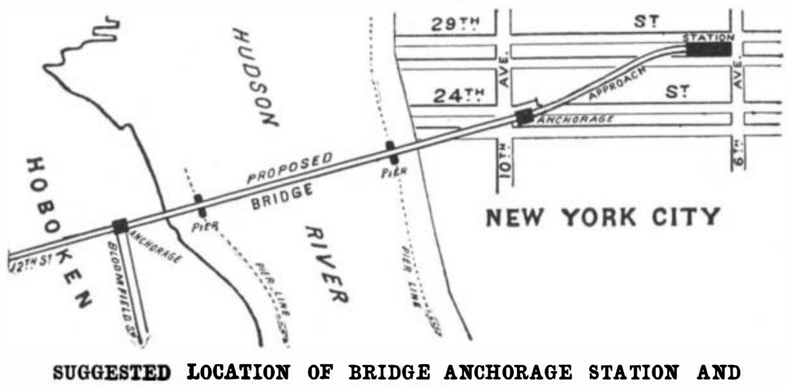
As regards the question of height, this is limited by the necessity of preserving a proper grade. At the height of 135 feet, as originally proposed, at 60° F. the grade upon the New York side is 1·9 per cent, or 95 feet to the mile, and on the New Jersey side 1·4 per cent. The heavier grade is more than is desirable. The middle span, in order to keep the grade low, is restricted to a rise or camber of not more than 19 feet. Shipping will be to some extent inconvenienced by the lower height, but it is stated that last year only seventeen ships lowered their upper masts to pass under the Brooklyn Bridge.

The New York station is to be in the neighborhood of Sixth Avenue, above Twenty-third Street. It is to be 1,300 feet long, and is to include a 400 foot loop for drilling trains. The approaches to the anchorage will be largely of stone and brick. On the New Jersey side the approach will extend across Bergen Hill through an open cutting. At the two anchorages passenger elevators will be provided, giving access to the foot promenade.

The future work of the bridge is based upon the present traffic from the New Jersey shore. Daily, over 150 express and 680 local trains arrive at and depart from this locality. The Hudson River ferries carry now fifty-two million passengers annually, and it is believed that thirty millions of these would use the bridge during the first year of its existence. It must be remembered that it may take ten years to complete it, and that the traffic will be increasing meanwhile.

Again, as regards its capacity, it is found that the New York elevated railroads carry one hundred and eighty millions of passengers annually on eight tracks, and the Brooklyn Bridge carries thirty millions on two tracks. There is to be no restriction on speed on the Hudson River Bridge, so that its capacity *pro rata* will be still greater.

The government and direction of the company is vested, by the act of Congress authorizing the building of this bridge, in a board of seven directors. The president of the company is Mr. Jordan L. Mott, of New York, and the other directors are Edward F. C. Young, of Jersey City; Thos. F. Ryan, Charles J. Canda, and Wm. Brookfield, of New York; James Andrews, of Allegheny, Pa.; and J. K. McLanahan, of Hollidaysburg, Pa.



SUGGESTED LOCATION OF BRIDGE ANCHORAGE STATION AND APPROACHES.

The Deepest American Well.

An 8 inch well which is being sunk near Wheeling by the Wheeling Improvement Company, in a search for oil or gas, has reached, after several months of boring, a depth of 4,100 feet. Both oil and gas have been struck throughout in paying quantities. It has gone through several thick veins of coal, and has traversed layers of gold quartz, iron and numerous other minerals.

Professor J. C. White, State Geologist, who has watched the drilling closely, has succeeded in getting the government interested in it. The result is that after the well has been sunk to the depth of one mile the government will take up the work, and, under the direction of expert officers of the Geological Survey, drill into the earth as far as human skill can penetrate.

The temperature and magnetic conditions will be observed as far as possible, and, by means of an instrument constructed for the purpose, a complete record of the drilling and all discoveries made will be kept. This record will be placed in the Geological Survey's exhibit at the World's Fair and afterward preserved at Washington. Professor White and the government officers state that this will be one of the most novel and important exhibits at the Fair and will attract the attention of the scientists of the world.

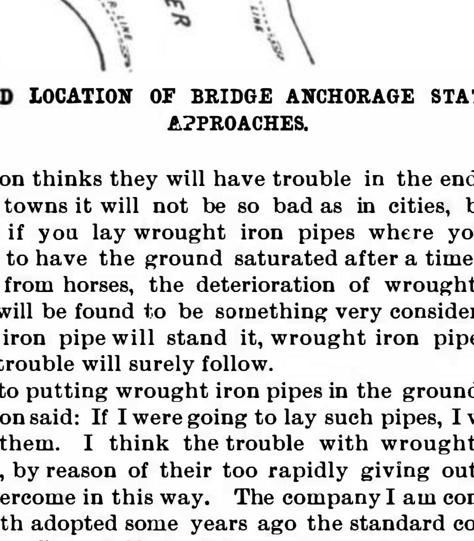
IRON corrodes with great rapidity at or about the temperature of boiling water.

Something about Gas Pipes.

The following is from a recent discussion by the N. E. gas engineers:

"What is the smallest size cast iron pipe that it is policy to lay?" The answer was: Nothing smaller than 4 inches in the streets. As to material, Mr. Nettleton said: Much wrought iron pipe is being used for mains through the West, up to 6 inch pipe, particularly in the smaller towns and cities. While they admit that the cost of the pipe is somewhat more, yet they think there is an economy in using it (although it has not been employed long enough to determine the fact), in two ways: First, by the leakage, because the pipe can be made absolutely tight; second, in the cost of laying, for the lengths can be screwed together very much faster, and at a very much less cost, than cast iron pipes can be put together in the ordinary way. Mr. Lamson thinks they will have trouble in the end. In small towns it will not be so bad as in cities, but in cities if you lay wrought iron pipes where you are liable to have the ground saturated after a time with urine from horses, the deterioration of wrought iron pipe will be found to be something very considerable. Cast iron pipe will stand it, wrought iron pipe will not; trouble will surely follow.

As to putting wrought iron pipes in the ground, Mr. Shelton said: If I were going to lay such pipes, I would coat them. I think the trouble with wrought iron pipes, by reason of their too rapidly giving out, can be overcome in this way. The company I am connected with adopted some years ago the standard coating used by General Hickenlooper, of Cincinnati. I think some 10 or 12 years ago he looked into that question and formulated a recipe for coating service pipes, which he adopted as a standard, and has used ever since. He claims that the services last indefinitely. Hence the coating is very satisfactory. It was satisfactory enough to cause us to adopt it as our standard, and our rule is that no service pipes shall be laid under any circumstance without being coated. It is a solution of rubber, tar, lime and turpentine. It is easily made at the works, and the men can dip enough pipe in a single afternoon to last them for a year. When they lay the pipe they have only to carry the pitch along with a brush, so that whenever the tongs make any nicks in the coating, just before filling in the



MAP OF NEW YORK CITY, SHOWING LOCATION OF HUDSON RIVER BRIDGE.

earth, they can coat it by hand. I do not see why that should not apply to wrought iron pipes of large size. It certainly pays to prepare them in small sizes in that way. I am myself a believer in wrought iron pipe. I think we are coming to it. We would be surprised at the amount of wrought iron pipe used in the West, as Mr. Nettleton says; but they have to be coated in some way. You can save leakage and can make them absolutely tight. You can lay them quicker, and I think that, by using a coating, eventually, wrought iron pipes will be the thing.

Leaded Pipes.—A firm in Philadelphia says: "Wrought iron service pipes may be lead-coated and rendered proof against rust or decay from dampness, or from passing through soil having an affinity for iron, which in many cases eats out a service pipe in a few months, swelling the leakage account considerably before the fault is discovered. Sheet iron for roofs and sides of buildings may be lead-coated and protected against the action of the smoke and gases in the generator and purifying houses, and being equally proof against rust from the action of the weather outside, affords a valuable addition to the buildings of a gas plant. We have coated materials for service pipes for gas companies, roofs, smoke stacks and car roofs for railroad companies, and for roofs for buildings for iron furnaces, and in these most trying positions our lead coating has been entirely satisfactory."

Galvanized Pipes.—Mr. Allyn said: "Any one who has had experience in using galvanized pipe must know there is a serious objection to it, while at the same time it certainly has its advantages. We have used nothing for our services for the last twelve years but galvanized pipe, but we often find a lot of pipe in which the fiber of the iron is entirely destroyed by the action of the zinc in galvanizing the pipe. A year or two ago we had a lot of pipe, mostly 1½ inch, which was rendered so brittle that as soon as the cutter wheel commenced cutting it the pipe flew apart like a piece of glass. We often find pipe in which the galvanizing has been improperly done, or put on at too low a temperature, and we occasionally find pipe which is filled nearly one-half with the zinc oxide of the pipe."

Liquid Fuel.

At a recent meeting of the Shipmasters' Society, London, a paper was read on "Liquid Fuel in Ocean Steamers," by Captain W. V. Carmichael. Premising that the question of liquid fuel in steamers was not a new one, the lecturer stated that, partly owing to the cheapness of coal, and partly to the timidity of owners to adopt it, the use of oil fuel had not been much taken up by steamship owners.

Now however the aspect of affairs was changing. By the use of petroleum he stated that the fires were completely under the control of the engineer on watch, who would regulate them so as to have any pressure of steam he required, without being dependent on his firemen. The great advantage of oil fuel to the shipowner was that he could carry his fuel in a space that was now wasted, namely, a cellular bottom of the ship, or in ballast tanks. As the consumption of oil, compared with coal, was, weight for weight, one half—ten tons of coal, in other words, being only equal to five of oil—the storage of fuel could be made much more compact and easier of access; there was increased speed in fueling the ship; and port charges were avoided, as more fuel could be carried in proportion than formerly. Petroleum was known to exist in all parts of the habitable globe, and it was hardly probable that competition would not bring the fuel within easy reach of the commercial world.

For many reasons oil fuel was of more value to torpedo boats and ships of war than it probably was to merchant steamers. As to the question of fueling our men-of-war at sea during a blockade, he thought that the large tank steamers of the present day could always fuel the fleet even in heavy weather. He maintained that the oil was perfectly safe while on board ship; that it could be stored on shore easily, and in the event of a fueling port being bombarded, shells could not set fire to the tanks; and it could be handled without risk of fire or explosion from the shore to the ships, or *vice versa.*

His object in reading the paper had been to allow the mercantile world in general, and the members of the Shipmasters' Society in particular, to know the progress oil fuel was making; the comfort it was to engineers and all concerned; its pecuniary advantages to the merchant who could avail himself of it; its peculiar adaptability to ships of war; and its special value to large, first class passenger steamers, where cleanliness and the comfort of the passengers were desired. It could be adapted to any boiler, either afloat or ashore.

Water Power Lighting.

The village of Faido, on the line of the St. Gothard Railway, has an electric light plant, erected within the past year, in which water power is used to drive the machinery. The water is stored in a reservoir, above the falls of the stream near the village, and thence is led to the power station through a 6 in. cast iron pipe. The power station is equipped with a turbine, which, with the available head of 145 meters—about 475 feet—develops about 45 horse power. Two constant current dynamos are used, furnishing a current of 160 amperes and 140 volts. One of them only is used in the ordinary work, the other being held as a reserve. The village is lighted by 360 incandescent lamps, working at 120 volts. The street lamps have about 25 candle power each; those in private houses range from 16 to 25 candle power, and those at the railway station from 16 to 32 candle power.

ONE dollar a minute is the charge for using the new telephone line between London and Paris. Distance about 280 miles. Forty cents a minute is the price between New York and Washington, about 240 miles.

Historic Spoons, the Latest Fad.

This is an age of spoons—historic spoons. The *Board of Trade Journal*, Providence, R. I., gives a list of the historic designs which many bear. In Salem, a former dwelling place of witches, the first historic spoon appeared. This spoon, or perhaps the idea, was received with such favor that other spoons came forth.

In this country there are many "collectors." They collect anything, from post stamps to middle-aged armor. Some collect one thing and some give their attention to several things. When historic spoons began to appear, collectors sprang up. They were delighted. Ah, here was something new—spoons, historic spoons of sterling silver and worth. How interesting a collection of spoons all different, and every one a memorial or a reminder of some event of great historic worth.

Manufacturers of spoons saw their opportunity and improved it, and the result to-day is that many spoons are bidding for money in towns and cities from Maine to California. The spoon in Plymouth, of course, is a "Mayflower spoon." In Hartford the Charter Oak is recalled by a spoon with the oak engraved on the handle. Portland, Oregon, has a spoon, design unknown. New Orleans has a spoon with canestalks, a crane, and a cotton bale as embellishments. Portland, Me., engraves the historic observatory on a spoon. The Springfield spoon bears the likeness of Miles Morgan, a pioneer. Chelsea's spoon honors Winnisemmet, a friendly Indian who owned Powder Horn Hill, and sold it for a horn of powder. A powder horn is shown on the spoon. It is a leading spoon.

New York has a spoon to revive and perpetuate Knickerbocker history, and one to honor Rip Van Winkle. Washington has two spoons, one showing the executive mansion and one on which the Washington monument is engraved. Of course the Mount Vernon spoon shows the home of Washington. Pittsburg's spoon has an oil derrick and a gas well for ornament. St. Paul combines the falls of Minnehaha and old Fort Snelling on the handle. Milwaukee honors its founder, Solomon Janeau. In Boston there are several designs. The first showed Paul Revere's ride. New London, Conn., places on her spoon a sketch of an old mill, and pays no attention to Pequot history. Lynn's spoon is ornamented by Moll Pitcher and her black cat. The Portsmouth spoon commemorates Wentworth mansion. An "Old Man of the Mountain" spoon is another New Hampshire design. The spoon from Manchester bears the portrait of John Stark, the hero of Bennington. Worcester places Bancroft's face on its spoon handle. Four spoons show how the poet Whittier is esteemed. Haverhill gives his birthplace, and Amesbury his residence, the "Captain's Well," and a "Whittier Head."

Portland, Me., the birthplace of Longfellow, places a medallion portrait of the poet on a spoon, and has also a Priscilla spoon, a Miles Standish spoon, and a Hiawatha spoon. Providence has its Roger Williams spoon.

New Armor Trial.

An interesting test of armor has recently taken place on the Naval Ordnance Proving Grounds at Annapolis, being the trial of a plate made in this country on a new system, that of Mr. H. A. Harvey of Newark, founded on the homogeneous steel of Schneider and adopting the admitted improvements of a nickel alloy, but using a new process of manufacture.

This process is that of decarbonizing the surface of the steel plate so as to give it a very high temper and extreme hardness, with a view to breaking up even the best projectiles. Taking a homogeneous plate of mild steel throughout, or of steel with nickel alloy, the front surface is treated by this process, with a gradual diminution of it in the interior, while the back of the plate remains untouched. The object in not continuing the hardening process throughout is to retain the toughness and tenacity of the mild steel at the back, so that if the projectile should break up the front, the tendency to crack all the way through will be avoided.

The Harvey plate in the present trials was manufactured by Carnegie, Phipps & Co., of Pittsburg. In a preliminary test of the Harvey process, made last February, a plate 10½ inches thick was fired at by a 6 inch gun. Six rounds were fired, half with Holtzer and half with Carpenter or Firminy projectiles. The Harvey plate was very severely cracked by the end of the trial, but the naval authorities had grounds to believe that for a single shot a plate made under this process might resist better than any other ever manufactured. In fact, this armor had shattered two of the Carpenter shells, which had penetrated less than half way, and one of the Holtzer, which did not get quite through. It was accordingly determined to try several other Harvey plates, to be made for experimental purposes by the Pittsburg firm.

In order to test thoroughly, not only the intrinsic strength of the Harvey plate, but its relative efficiency, it was further determined to try no fewer than five plates, two of which should be of homogeneous steel, one of steel with a nickel alloy, and two of the nickel steel manufactured by the decarbonizing Harvey process, all made at the Pittsburg works and each eight feet long by six feet wide, but with a thickness of only three inches. This latter represents the protective decks and shields of some of our war vessels, and is sufficient for illustrating the comparative merits of the systems of manufacture. Of course they could not be attacked by heavy guns, and a six-pounder Hotchkiss rapid-fire gun was substituted. The plates were arranged at a distance of about twelve yards from the gun, and twenty rounds were fired against each plate. The result was the complete destruction of the two steel plates and the penetration of the nickel steel as far as the oak backing, which was entered and injured. But the Harvey plates kept out the projectiles from the oak backing, and though they showed some cracks they completely broke up the projectiles and gained a great triumph.

Taken together with the February test of a thicker Harvey plate, this trial makes it clear that still another advance has been made by our naval ordnance bureau in the method of manufacturing armor. It has also practically confirmed the conclusions reached last September and in subsequent tests that an alloy of nickel yields better results than steel without the alloy.

Granite.

According to Census Bulletin No. 45, giving the totals for the United States, it appears that something over 62,000,000 cubic feet of granite, having a total value in round numbers of $14,500,000, were produced by 22,313 workmen from 874 quarries in 1889. To this number of men over $9,600,000 in wages were paid. The total expense of producing the entire granite output amounts to over $11,500,000, thus indicating a profit to the producers of about $3,000,000. The total capital invested is over $19,000,000, of which something more than one-half is the value of land. The great bulk of granite comes from the New England States. Its principal uses are as follows:

BUILDING PURPOSES.

Solid fronts.	Lintels.	Pilasters.
Foundations.	Broken range.	Belting or belt courses.
Cellar walls.	Sills.	Rubble.
Underpinning.	Kiln stone.	Range.
Steps.	Capping.	Ashlar.
Buttresses.	Columns.	Forts.
Window sills.	Plinths.	Dimension.

STREET WORK.

Paving blocks.	Road making—	Basin heads or catch-basin corners.
Belgian blocks.	(a) Macadam.	
Curbing.	(b) Telford.	Sledged stone.
Flagging.	(c) Concrete.	Crushed stone.
		Breaker dust.

CEMETERY, MONUMENTAL, AND DECORATIVE PURPOSES.

Statues.	Gravestone sockets.	Mausoleums.
Monuments (entire).	Grave markers.	Urns.
Monument bases.	Cemetery posts.	Wainscoting.
Monument dies.	Cemetery rails.	Dados.
Monument shafts.	Cemetery coping.	Fountains.

BRIDGE, DAM, AND RAILROAD WORK.

Culverts.	Buttresses.	Riprap.
Aqueducts.	Bridge covering.	Approaches.
Dams.	Capstone.	Towers.
Wharf stone.	Rails.	Bank stone.
Breakwater.	Ashlar.	Parapets.
Jetties.	Ballast.	Docks.
Piers.		

MISCELLANEOUS.

Millstones.	Posts.	Refuse stone.
Levelers—rollers.	Engine and mach. beds.	Block granite.
Grout.	Random.	Boundary stone.
Walls (fences).	Yard stock.	Horse blocks.
Watering troughs.		

BLASTING.

The Knox system of blasting rock is used with general satisfaction in many of the larger quarries. A round hole is first drilled to the required depth, and into this is driven a reamer, which produces V-shaped grooves at opposite sides to the entire depth of the hole. The charge is then inserted, and the tamping is done in the usual manner, except that instead of driving the tamping down upon the top of the charge, an air space or cushion is reserved between the charge of powder and the tamping, and as far above the charge as possible. The explosive has, therefore, the greatest possible chance for expansion before actually breaking the rock, the tamping being put down only to a sufficient depth to insure firmness of position. The result of this method is that the force of the explosive is directed in the line of the grooves, and no shattering of the rock occurs if it be solid, such as is common in ordinary blasting operations, and, as a consequence, quarrymen are enabled to get out stone of rectangular shape without waste or loss of valuable rock.

Very large blasts or mines are sometimes fired in quarrying granite. A shaft is sunk to the required depth, and from it drifts are run in various directions. These chambers, or drifts, are then charged with explosives and fired. In 1887, at Granite Bend, Missouri, stone enough was broken with one blast to supply the demands of a firm for fifty years. The shaft, which was 85 feet deep, had chambers running in several directions from the bottom, and was charged with 32,700 pounds of black powder.

The explosive used for breaking out dimension stone is black blasting powder.

Drills driven either by steam or compressed air are in use for making blast holes in all the principal quarries. The drill is connected with the piston, which is supported by a portable iron tripod, carrying the necessary appliances for regulating its movements. A flexible pipe conveys the motive power in the form of compressed air or steam.

Steam channeling machines, common in large marble and sandstone quarries, are used on granite by a few quarriers chiefly for making end cuts in stone of exceptional structure, but only to a limited extent, since the great hardness of granite renders the process very slow and expensive.

CUTTING, POLISHING, AND ORNAMENTING GRANITE.

Owing to the great obduracy of this stone, and the fact that the different minerals composing it vary greatly in hardness, the chief work of shaping it is still performed by hand, probably by much the same process that was used by Egyptian stonecutters more than three thousand years ago. Improvements and inventions have, however, been made from time to time in hand tools, and extensive machinery is now in use for producing certain forms and kinds of finish.

The most important improvements include the more extended adoption of lathes for turning and polishing columns, urns, etc., and new devices in power machinery for plain polishing. Greater economy and speed are now obtained by the general use of chilled iron globules and crushed steel as abrasive materials and of the pneumatic tool for the ornamentation of surfaces.

Granite for columns, balusters, round posts, and urns is now worked chiefly in lathes, which, for the heaviest work, are made large enough to handle blocks 25 feet long and 5 feet in diameter. Instead of being turned to the desired size by sharp cutting instruments, as in ordinary machines for turning wood and metal, granite is turned or ground away by the wedge-like action of rather thick steel disks, rotated by the pressure of the stone as it slowly turns in the lathe. The disks, which are six or eight inches in diameter, are set at quite an angle to the stone, and move with an automatic carriage along the lathe bed. Large lathes have four disks, two on each side, and a column may be reduced some two inches in diameter the whole length of the stone by one lateral movement of the carriages along the bed. The first lathes for turning granite cut only cylindrical or conical columns; but an improved form is so made that templets or patterns may be inserted to guide the carriages, and columns having any desired swell may be as readily turned. For fine grinding and polishing the granite is transferred to another lathe, where the only machinery used is to produce a simple turning or revolution of the stone against iron blocks carrying the necessary grinding or polishing materials.

Blocks are prepared for lathe work by being roughed out with a point, and by having holes chiseled in their squared ends for the reception of the lathe dog and centers. This principle of cutting granite by means of disks revolved by contact with the stone has been also applied to the dressing of plain surfaces, the stone worked upon being mounted upon a traveling carriage and made to pass under a series of disks mounted in a stationary upright frame.

Tracery and lettering for polished granite are usually first drawn upon paper, which is firmly pasted to the surface and the design chiseled through it to the requisite depth in the rock.

Statues, capitals, keystones, and, in general, all highly ornamental designs, are worked out with chisels from detail drawings or plaster casts. It is necessarily a slow process, owing to the hardness of the rock, and the cost of such work is consequently great. The MacCoy pneumatic tool, however, which has been recently patented and successfully applied to this purpose, gives promise of superseding much of the tediousness of the hand process. This instrument is connected to a flexible pipe, supplying the compressed air or steam by which it is driven, and works at a remarkably high rate of speed. It may be moved to any part of a surface, and works with a celerity unapproached by other means.

Large Steam Pipes Composed of Small Ones.

The immense steam pipes which are necessary for the large sized engines in use at the Ferranti stations are composed of numerous smaller pipes bunched together to give the required carrying capacities. This arrangement of the pipes was thought necessary on account of the numerous accidents which have lately occurred from the bursting of large steam pipes in various parts of the world. Just how this arrangement will be accepted by engineers remains to be seen. While there are several good points about this kind of steam pipe, there appear to be also several poor ones. The increased cost necessary for its construction and the larger amount of surface exposed for condensation would appear to be somewhat against its being commonly employed. Of the increased safety assured by its use, *The Stationary Engineer* thinks, there can be no doubt, but whether or not it can be called a commercial success is not so plainly evident. Those who have had experience with it appear to think it answers every requirement.