SCIENTIFIC AMERICAN

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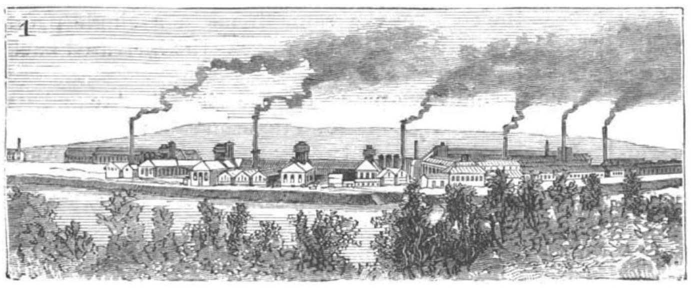

Fig. 1.—WORKS AT BETHLEHEM.

MANUFACTURE OF HEAVY GUNS FOR U. S. NAVY.

Although as early as 1880 the chief of Bureau of Ordnance set forth the necessity of procuring guns of the latest and most approved system, in 1882 Secretary Chandler called attention to the fact that there was not one high-powered gun in the navy. In 1884 there was but one—a 6 inch breech loading rifle. In 1885 one more was added—a 5 inch breech-loading rifle. In 1886 the Navy Department reported its being in possession of fourteen (14) 6 inch and two (2) 8 inch modern breech-loading rifles, and recommended the adoption of the decisions of the Gun Foundry Board as the best means of securing the requisite supply of ordnance.

It will be seen, therefore, that while some forgings had been purchased abroad, and the Midvale and Cambria companies had undertaken and successfully delivered a few for the smaller calibers, no really serious provision was made for this supply until the inauguration of the Bethlehem Company's undertaking to furnish the United States with gun and armor steel and shafting; in fact, the foundation of the present system of supply, and without doubt the two most important events in the history of modern ordnance in the United States, were the researches and recommendations of that able committee, the Gun Foundry Board of 1883 (whose conclusions have been indorsed by every Congress since its report was made), and the conception and completion of the Bethlehem gun and armor plant. The work of the former, united to the efforts of the Hawley Committee on Ordnance and War Ships, secured for the country the gun factories of Washington and Watervliet, while the enterprise and ability, technical and financial, of the latter relieved us from longer dependence upon the rest of the world.

That our readers may become familiar with the method of supplying our navy with its guns, we present a description of the necessary operations to produce the forgings in the steel works and their subsequent assembling at the gun factory, accompanied by interesting sketches made by our artist during recent visits to the Bethlehem Steel Works and the naval gun factory at the Washington navy yard.

Before entering upon its narrative a consideration of what is being done by the government in the manufacture of heavy ordnance and an appreciation of the present state of the art will be best obtained by reference to the report of the Secretary of the Navy for 1890, which gives the following table of forgings ordered, guns completed, and guns now under construction at the Washington gun factory:

Caliber.	Forgings Ordered.	Completed Guns.	Guns under Construction.
4 inch.	35	4	12
5 "	4	2	
6 "	128	77	25
8 "	35	15	2
10 "	25	4	3
12 "	8	..	..
13 "	12	..	.

Fig. 2.—HYDRAULIC GUN CASTING.

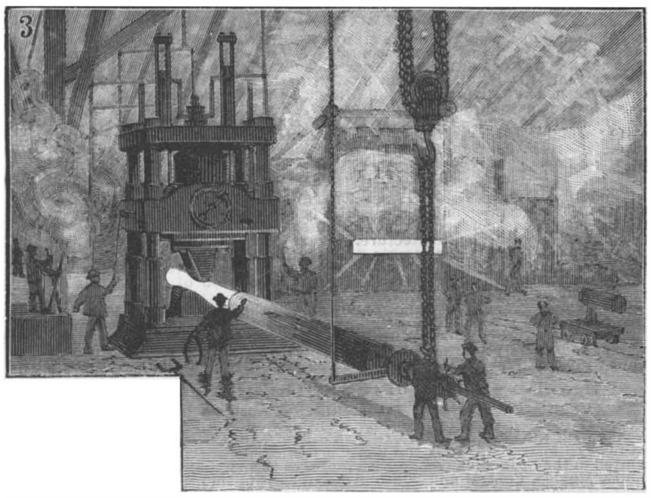

Fig. 3.—HYDRAULIC GUN FORGING.

Of these guns, the 4 inch and 5 inch are rapid-firing guns, employing fixed ammunition, that is, the cartridge case, charge, and projectile are combined in one. The length of the 6 inch gun has been increased from 30 to 35 calibers. The performance of the longer gun has been so satisfactory that 6 inch guns of 40 calibers have been designed and are under manufacture. The 35 caliber 8 inch guns have been tested with such good results that forgings for a 40 caliber gun have been ordered from Bethlehem for a gun to be mounted on Cruiser No. 12. The great advantages claimed for this, as well as for other long guns, is the flat trajectory due to the high velocity, which makes it possible to use the gun successfully at ordinary battle range without giving special attention to accurate measurement of distances.

Of the 10 inch guns, the four that make up the armament of the Miantonomoh are completed, while those for the Maine are in an advanced stage of manufacture.

No 12 inch guns have yet been finished, but forgings for two guns have been received from the Bethlehem Iron Company, and the gun factory is ready to proceed with the manufacture of these guns as fast as forgings are delivered. At the time of our visit the tube, a magnificent specimen of perfect steel, 35 feet long, and weighing about 15 tons, was being turned in the longest lathe of the gun factory.

The design for the first 13 inch gun, 35 calibers in length, has been completed, and the tools for its manufacture are in course of construction. Twelve sets of forgings of this size have been ordered from the Bethlehem Iron Company for the batteries of the three new battle ships.

Even from this hasty review, it is evident that the navy has entered upon a well defined policy which, with the aid of the manufacturing resources developed in the past few years, will enable this department of the United States government to keep pace in providing all necessary armament for any number of ships that our legislators may deem expedient to grant. It is to be hoped that there will be no cessation in this good work and that Congress will continue its appropriations for

(*Continued on page* 133.)

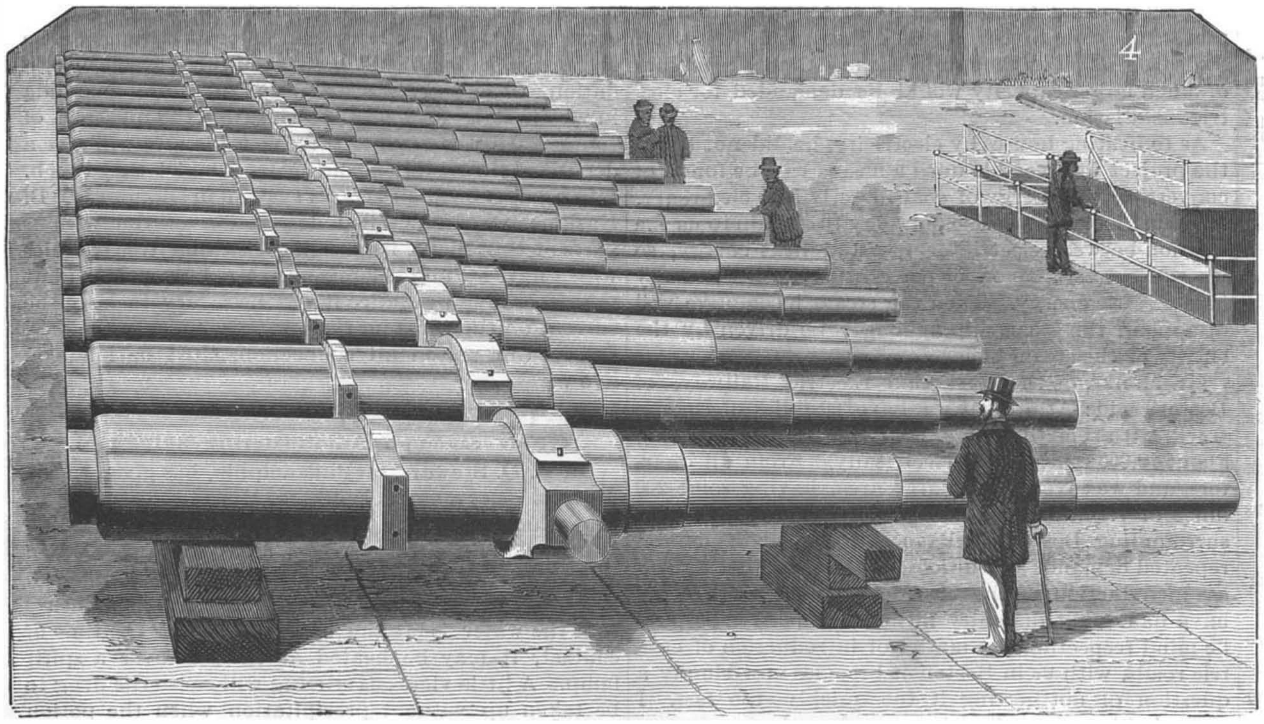

Fig. 4.—A ROW OF FOURTEEN SIX INCH GUNS.

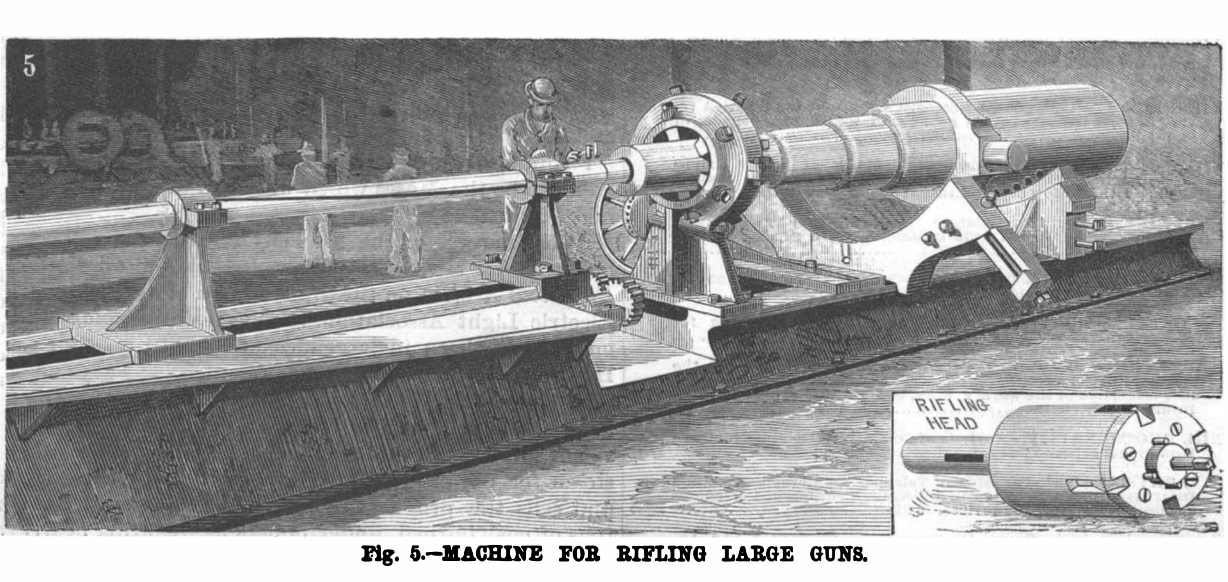

Fig. 5.—MACHINE FOR RIFLING LARGE GUNS.

MANUFACTURE OF HEAVY GUNS FOR UNITED STATES NAVY.

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(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 791.

For the Week Ending February 28, 1891.

Price 10 cents. For sale by all newsdealers.

MEETING OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

The decennial meeting of this association, in Providence, R. I., the 17th, 18th, 19th and 20th instant, called together more scientific and mercantile men and awakened a wider interest than any that have preceded; a notable feature, greater elaboration of technical detail in the papers read, and in the discussions closer adherence to mathematical accuracy. Following is given a transcript of the most notable papers and remarks:

Prof. Elihu Thomson, introduced as the greatest living electrician, said:

In 1889 it was my privilege to visit the Royal Institution, in London, and there inspect the original manuscript records made by Sir Humphry Davy and by Faraday—the two great mains, lying as it were at the foundation of the sign, at least, of electric lighting—to inspect also the apparatus, and even to handle the apparatus which Faraday used in his early experiments. These two mains are coupled with the beginnings of our great industry. Sir Humphry Davy was the first man who ever saw the electric arc; the first man who put two wires together tipped with carbon, drew them apart, and got the flame which we now call the electric arc. He called it the electric arch, I believe, or an arch of flame. I saw the record of this original inscription, and the inscription in Davy's rapid hand that this was a gorgeous experiment.

It was quite a contrast—the difference between Davy's style of recording his experiments and Faraday's; and there is that contrast even to be seen in their work. Davy was, as it were, brilliant—jumping from one thing to another, and getting there by a great leap—while Faraday's was the painstaking work of the scientific investigator who thought out carefully what he was about, and when he had concluded his experiments, wrote out just as carefully what he had obtained. The records of Faraday's are models of neatness; they are models of precision in every way. I recall this as a reminiscence. It is a late reminiscence, but it carries us back to the time when Faraday was at work in the discovery of the action of currents in magnetic fields. It is to Faraday that we owe the discovery of the principle which underlies the generation of current by the dynamo. It was he who moved armatures in magnetic fields. It was he who found that the magnet was capable, under proper conditions, of yielding currents.

Prof. Thomson traced the history of the dynamo from its development down to the present, declaring there to be a demand to-day for dynamos up to 500 to 1,000 horse power where a few years ago it would have been an unusual thing for a 100 or 150 or a 200 horse power machine to be spoken of; and it looks, so he said, very much as though in the near future machines of much larger capacity would be demanded for electric installation.

As to heating houses by electricity, he did not think the project was feasible until a means can be found of converting the energy of coal directly into electricity. We must look for another Faraday to explain to us the relation between electric energy and heat energy, so we can convert 35 or 40 per cent of the heat energy into electric energy. Then the steam locomotive will disappear, the steamship no longer be driven by the energy of the steam boiler.

Mr. Monks, of the West End Electric Railway, of Boston, said: At present we have 60 miles of electric track, with something over 300 cars. We are running about 18,000 miles a day electrically. From all quarters, and we cover a very large area, having some 260 miles of track through the popular towns and cities surrounding Boston, we have constant demands and repeated demands and urgent demands for the immediate introduction of the electric system. Though we have had great difficulty hitherto to pacify the public mind respecting the matter of introduction of electric roads, with us in Boston it becomes now simply a question of not getting it too quickly—too fast. I mean in the sense of saving ourselves the investment of a large amount of money in machinery which next month or next year may be regarded as inadequate. But after all is said and done, we are but in our experimental stage. Much remains to be done to perfect the system in regard to the proper form of car, of rail, and a thousand and one details remain to be perfected.

I think the electrical locomotive or motor car is going to be the Moses which will lead us into the promised land.

At the request of the association, a paper had been prepared by Mr. George Worthington, editor of the *Electrical Review*, on the Organization of the National Electric Light Association, its successful accomplishment having been in large measure due to his efforts. He was too ill, however, to be present.

F. H. Prentiss, of New York, read a paper on Distribution of Steam from Central Stations. He cited a steam company of this city, which he said is supplying steam for power and heating to nearly 700 consumers, and sells the product annually of more than 100,000 tons of coal burned under boilers aggregating nearly 20,000 horse power.

In its distribution of steam through underground pipes, the company has had many obstacles to contend with, the chief trouble having been the securing of absolutely tight joints. This difficulty has been completely removed by the method employed during the last four or five years, as is well attested by the network of pipes on Madison Avenue and the adjoining streets, between Fifty-third and Seventieth Streets, where nearly three miles of pipe are in perfect operating condition and practically without a leak.

The joining of two enterprises together, such as electric lighting and the distribution of steam from central stations, has both its advantages and its defects.

In a combined plant the general expenses of management, superintendence, and so forth, need not greatly exceed the cost for the same items in a single plant alone. An obvious disadvantage is the increased back pressure put upon the engines.

In an exhaustive paper on the Electric Arc and its Use in Lighting, Professor Thomson said:

It was not till about twenty years after its discovery by Sir Humphry Davy that any proposals were made to use it in lighting, and, subsequently, for many years it was occasionally employed either in lecture demonstrations or in obtaining an intense light for some special purpose.

The charcoal points of Davy were touched together horizontally after attachment of the wires to the battery and were then separated. The stream of hot flame which followed or joined the points being deflected by air currents, took the form of an arch or curve which gave the name to the phenomenon. Even with one carbon directly over the other, the curved form of the stream is the rule when the carbons are widely separated. Davy's original experiment was made with a battery of 2,000 cells, with zinc and copper plates about six inches square, the exciting fluid being very dilute sulphuric and nitric acids.

In the electric arc there is a real distillation of the conductors forming it, and this accounts for the variation of color and temperature to be found in different arcs. The copper arc evolves a peculiar green light which is exceedingly trying to the eyes, as those who have experienced its effects well know. Zinc gives a whitish blue, while the carbon arc proper is purplish in tint. The arcs from various metals give in the spectroscope the characteristic lines of the vapor of each metal.

As a curious incident, showing the presence of the metal vapor in the arc, I may mention the fact that when by accident a person has had a portion of his clothing bathed for an instant in a heavy copper arc, caused by a short circuit of heavy current mains, there has been found a considerable deposit of copper, enough, in some cases, to give the reddish color of copper to the surface bathed, which if moistened turns green by oxidation. It also gives a deep blue to dilute ammonia in which it is washed, thus showing the presence of copper. In like manner these metallic arcs will give a deposit of the metal on cold surfaces which they touch.

In a paper on the Ferranti system in London, C. B. Haskins gave a detailed description of the various parts of that plant, its peculiarities, and the troubles which have sprung therefrom. Mr. Law pointed out that in ordinary practice it was necessary to keep the current on the wires for twenty-four hours in the day, and for that reason all connections must be made on live wires.

A New Mode of Administering Sulphonal.

Dr. D. D. Stewart, of Philadelphia, has given to the *Medical News* a new formula for the administration of sulphonal which has yielded very satisfactory results. His method is to give the drug at bedtime, stirred in six ounces of boiling water, or two thirds of a glassful, until the powder is thoroughly dissolved. To insure that the water is at the boiling point at the time of contact, it may be heated at the time over a spirit lamp. A little vigorous stirring will cause the drug to be taken up without precipitation when the potion has been cooled down to the point at which it can be drank. In order to cool the liquid, stirring will assist, but it will be necessary to add cautiously a little cold water. The patient should be encouraged to take the solution while it is yet hot, and to believe that the hotter the dose is, the better are its effects. The process of gastric absorption is facilitated by the hot liquid, especially if the stomach is empty, and the period of "therapeutic incubation" is practically done away with. Sleep results in a few minutes and is of a better quality than under the ordinary, less painstaking methods. In special cases, where the physician desires to obscure the disagreeable flavor of the dose, it may be well to add a tablespoonful of *creme de menthe* or some other cordial, which will also promote the speedy absorption of the remedy.

IT has been calculated that the electromotive force of a bolt of lightning is about 3,500,000 volts, the current about 14,000,000 amperes, and the time to be about $\frac{1}{20000}$ part of a second. In such a bolt there is an energy of 2,450,000,000 watts, or 3,284,182 h. p.

POSITION OF THE PLANETS IN MARCH.

SATURN

is morning star until the 4th, and then evening star. He is in opposition to the sun on the 4th, at 10 h. 20 m. A. M., and is in fine position for observation, being on the meridian at midnight. The observer will find him in the east as soon as it is dark enough for the stars to come out. He is retrograding or moving westward, and seemingly making a slow approach to his former companion Regulus, the bright star on the northwest. His aspect is specially interesting to the telescopic observer, who will find his rings gradually closing around him until they disappear from view in September. Saturn took on a variety of colors during the last month, shining sometimes as a red star and sometimes as a pale yellow star with a leaden tint, but always exhibiting the serene light that marks the difference between a planet and a twinkling star.

The moon is in conjunction with Saturn on the 23d, the day before the full, at 9 h. 2 m. A. M., being 3° 5' north.

The right ascension of Saturn on the 1st is 11 h. 4 m., his declination is 8° 18' north, his diameter is 18".6, and he is in the constellation Leo.

Saturn rises on the 1st at 5 h. 53 m. P. M. On the 31st he sets at 4 h. 49 m. A. M.

VENUS

is morning star. Early risers during the last month were impressed with her beautiful appearance in the southeast, in the morning, where she shone with surpassing brilliancy, continuing to be visible until sunrise, and even after. She will be charming to behold during the present month, though she has lost about one-third of her brightness on account of her increasing distance from the earth. She will not reign alone, for about the middle of the month a rival enters upon the scene to dispute her sway. This is Jupiter, then far enough from the sun to be visible. The two planets will be seen to approach each other until, at the end of the month, Venus rises about an hour and a half before the sun, and Jupiter follows about twenty minutes later. The observer must command a clear view of the southeast horizon in the early morning to enjoy the celestial picture under the best conditions.

The waning moon is in conjunction with Venus on the 6th, at 11 h. 26 m. P. M., being 5° 35' south.

The right ascension of Venus on the 1st is 19 h. 50 m., her declination is 19° 3' south, her diameter is 21".2, and she is in the constellation Sagittarius.

Venus rises on the first at 4 h. 14 m. A. M. On the 31st she rises at 4 h. 7 m. A. M.

JUPITER

is morning star. His presence in the morning sky in near vicinity to Venus, when the month closes, is the most interesting feature on his March record. He is in conjunction with Mercury on the 5th at 2 h. 32 m. A. M., being 1° 26' north, but both planets are then too near the sun to be visible.

The waning moon is in conjunction with Jupiter on the 8th, at 10h. 1m. P. M., being 4° 24' south.

The right ascension of Jupiter on the 1st is 22h. 4m., his declination is 12°46' south, his diameter is 31".4, and he is in the constellation Aquarius.

Jupiter rises on the 1st at 6h. 6m. A. M. On the 31st he rises at 4h. 26m. A. M.

MERCURY

is morning star until the 23d, and, after that time, he is evening star. He is in superior conjunction with the sun on the 23d at 7h. 58m. P. M., when he passes beyond the sun, and reappears on his eastern side as evening star.

The right ascension of Mercury on the 1st is 21h. 50m., his declination is 15° 17' south, his diameter is 5".2, and he is in the constellation Aquarius.

Mercury rises on the 1st at 6h. 3m. A. M. On the 31st he sets at 6h. 56m. P. M.

MARS

is evening star. He enjoys the distinction of being the only planet visible in the west in the early evening, where he may be found till nearly 9 o'clock. He shines with a faint ruddy light as he makes his way eastward and northward among the small stars of Pisces. For this reason the time of his setting varies little during the month.

The three-days-old crescent moon is in conjunction with Mars on the 13th, at 3h. 21m. A. M., being 3° 25' south.

The right ascension of Mars on the 1st is 1h. 33m., his declination is 9° 47' north, his diameter is 5", and he is in the constellation Pisces.

Mars sets on the 1st at 9h. 27m. P. M. On the 31st he sets at 9h. 18m. P. M.

URANUS

is morning star. He is retrograding and apparently approaching Spica, the bright star on the west. He is now visible to the naked eye as a star of the sixth magnitude.

The right ascension of Uranus is 13h. 57m., his declination is 11° 20' south, his diameter is 3".8, and he is in the constellation Virgo.

Uranus rises on the 1st at 9h. 53m. P. M. On the 31st he rises at 7h. 51m. P. M.

NEPTUNE

is evening star. His right ascension on the 1st is 4h. 10m., his declination is 19° 24' north, his diameter is 2".6, and he is in the constellation Taurus.

Neptune sets on the 1st at 0h. 40m. A. M. On the 31st he sets at 10h. 44m. P. M.

Mercury, Saturn, Mars, and Neptune are evening stars at the close of the month. Venus, Jupiter, and Uranus are morning stars.

Fish Remains in the Lower Silurian.

The Devonian has for many years been popularly known as the "age of fishes." During this geological period the ichthyic life of the earth attained a most wonderful development, and it was long the current belief that during this time fishes first appeared upon the earth. The fact that the fauna was most highly differentiated and varied has been a stumbling block to evolutionists, who could find no ancestors in older rocks from which the Devonian forms could have arisen. The discovery of fish remains in the Ludlow (Upper Silurian) rocks of Great Britain and later on in the island of Osel, in the Baltic Sea, carried the fauna back one stage in the geological scale as far as Europe was concerned. The occurrence of certain markings on rocks of Clinton age in New York was long ago known; but it was not until 1885 that fish remains were actually found in America below the Devonian. In that year Professor Claypole described some remains from the Onondaga Salt group of Pennsylvania, and mentioned some minute spines from the Clinton which were thought to belong possibly to fishes.

In 1888 Mr. Matthews noted the discovery of fish in New Brunswick in strata referred to the Lower Helderberg, so that it was known then that fish remains actually occurred in Upper Silurian strata in North America as well as in Europe. This being so, the remains of vertebrates were expected to occur in older rocks than these.

In 1888, in a collection of fossils made near Canon City, Colorado, about eighty miles south of Denver, by Mr. T. W. Stanton, Mr. C. D. Wolcott, paleontologist of the United States Geological Survey, recognized the remains of fish. Their association with fossils of a Lower Silurian aspect was so unusual as to give rise to the belief that the rocks had been disturbed, and that Devonian and Silurian forms had become mingled. Further material being desired, Mr. Stanton was instructed to collect during the past summer in Colorado and to check up his original observations upon the section. This was done, and from a study of the material, Mr. Wolcott concluded the remains were from strata of Trenton age. To verify it, however, he went last December to Canon City, studied the section, and collected material from the fish bed and above it. As a result the announcement was made at a meeting of the Biological Society of Washington, on February 7, that fish remains had been found in strata of Trenton age.

The remains are of the same type as the placoganoid fish from the Upper Silurian of the island of Osel. Two forms have so far been recognized. One is related to the Elasmobranchii, or the sharks, and consists of the outer covering of the notochord. The other is probably one of the Placodermii, a group of extinct Paleozoic fish, and consists of numbers of fragments of the scales.

A study of the invertebrate remains found associated with the fish, by Mr. Wolcott, showed the fauna to be Trenton in its facies. Out of 33 species identified, no less than 21 are identical with forms occurring in the Mississippi valley. This fauna is found 180 feet above the beds with the fish remains.

The discovery here noted is of the greatest interest. It not only carries the vertebrate fauna much farther back in time than any previous record, but it is the first recorded discovery of vertebrates at so low a horizon in the world. As might have been expected, the forms are low types, and represent the possible ancestors of the Devonian forms. It will now be confidently anticipated that other similar remains will be found in other strata of Lower Silurian age.

JOSEPH F. JAMES.

Washington, D. C., February 9, 1881.

History of the Thermometer.

The invention of the thermometer marks an epoch in science, for it alone has permitted of obtaining a knowledge of the laws that govern calorific phenomena. The first idea of it is perhaps due to the celebrated Van Helmont, who devised an apparatus which, to use his words, was "to prove that the water contained in a bulb attached to a hollow rod rises or descends according to the temperature of the surrounding medium."

In the seventeenth century, the necessity of an apparatus adapted for measuring the differences of the temperature was so greatly felt that Galileo, Bacon, Scarpi, Fludd, Borelli, and other scientists of the epoch devoted themselves in this direction to researches that were not always crowned with success. It is not till 1621 that we find a beginning of the solution in the experiments of a Dutchman, Cornelius Van Drebbel This physicist's thermometer consisted of a tube filled with air, closed at its upper extremity and dipping at its other extremity (which was open) in a bottle containing nitric acid diluted with water. According as the external temperature rose or fell, the air in the tube increased or diminished in volume, and consequently the liquid descended or rose.

This instrument, called the *calendare vitrum* (indicating glass) by its inventor, constituted what has since been called an air thermometer, but as its graduation was based upon no definite principle, it was incapable of furnishing any comparable reading.

Along about 1650 the members of the Accademia del Cimento, at Florence, introduced into the thermometer certain improvements that gave it nearly the form that it has to-day; and its principle was based upon the expansion of liquids. The tube was filled with colored alcohol. In order to graduate it, it was taken to a cellar and the place was marked where the liquid came to a rest. Then, starting from this, the portions situated above and below the mark were divided into one hundred equal parts. As may be seen, it was impossible with such a system to construct two instruments that should agree. Nevertheless, it was the only apparatus that was made use of for half a century.

Finally, in the latter part of the seventeenth century, the physicist Renaldini, of Pisa, a professor at Padua, proposed that all thermometers should take the freezing degree of water as a fixed point, and, as a second fixed point, that to which alcohol rises in a tube dipping in melted butter, the intervening space to be divided into equal parts.

From this epoch, then, dates the present thermometer, and the first instrument due to this innovation dates back to 1701. This was constructed by Newton, and was the first thermometer giving comparable readings that had been devised. The liquid that he adopted was linseed oil, which is capable of supporting a higher temperature than alcohol without boiling, and his fixed point of graduation for the upper limit was the heat of the human body, and for the lower, the point at which the oil stops at the moment of its congelation.

A search soon began to be made for a thermometric agent other than oil (which was too feebly expanded by heat and which congeals at but a slightly elevated temperature), and, in 1714, Gabriel Fahrenheit, of Dantzig, almost completely solved the problem in the construction of the thermometer that now bears his name. This was immediately adopted in Germany and England (where it is still employed) and was introduced into France. But along about 1730, scientists gave preference to the one that Reaumur had just devised.

Finally, in 1741, Celsius, a professor at Upsal, constructed the instrument called the centigrade thermometer.

The three last-named instruments are the ones most commonly used, and differ only in the graduation of each.—*La Science en Famille.*

Numerous Uses for Aluminum.

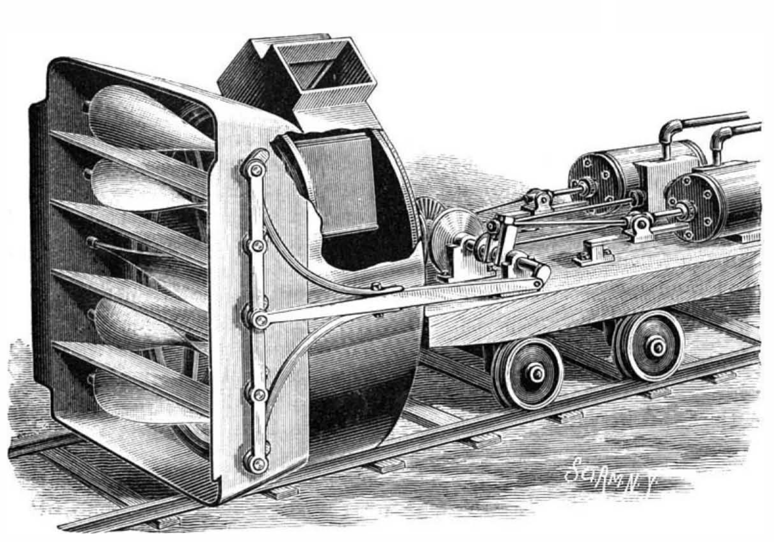
Among the uses for aluminum suggested by Mr. Eugene H. Cowles, president of the Lockport Company, according to *Modern Light and Heat*, are the following: At fifty cents per pound the new metal will compete with copper at seventeen cents, the latter being 3·56 times as heavy as an equal bulk of aluminum. But the electrical conductivity of aluminum that is ninety-eight per cent pure is only seventy-five per cent that of copper, so that one-third more area would be required to do the same work. A reduction of forty-five per cent in weight of motors for electric cars can be secured by using the new metal, which in itself is no small advantage, seeing that the latter promise to come into extensive use in the near future. The coating and lasting qualities of aluminum far surpass those of tin, and it will cover three times as much surface for equal weights, making it necessary to sell tin at sixteen cents per pound in competition with the other at fifty. Nickel at seventy cents would no longer be used for plated ware or coinage, the new metal being much cheaper and cleaner. He expects to see it sell at two to three hundred dollars per ton, and at these figures it will be the cheapest metal next to iron and steel. The price must fall lower and lower as the facilities increase for making the material and the market adapts itself to the absorption of larger quantities of the new metal.

W. BARCLAY PARSONS, chief engineer, is constructing in the Allegheny Mountains of northern Pennsylvania a system of lumber railways, using gradients frequently of 3·5 per cent and at times up to and over 4 per cent. The power used is a Shay engine, a machine with three vertical cylinders driving a horizontal shaft, which is geared to all the wheels, tender included. This shaft is jointed so that the longest rigid wheel base is 56 inches. Such an engine uses the whole weight for adhesion, and at a ratio of ¼ with a weight of 60 tons would develop 30,000 pounds tractive power.

A STEAM SNOW PLOW.

The plow shown in the illustration is designed to work effectively through heavy drifts or deep and solidly packed snow banks, throwing the snow to either side of the track as may be desired. It has been patented by Mr. Arthur Gardiner, of Terrace, Utah Ter. The forward shell of the plow has a circular portion, open at the front and closed at the rear, the front edges of the shell being nearly rectangular in contour and flaring outward, to direct the incoming snow into the smaller or cylindrical portion of the casing. At each side of the flaring portion of the casing the shell is slightly extended, forming a shield to keep the operative parts of the machine free from snow.

Within the flaring end is a series of horizontal partitions, the outer edges of which have a knife edge, to



GARDINER'S SNOW PLOW.

readily cut the snow against which the plow is advanced, and within each of the compartments formed by the partitions a double blade in screw form is horizontally pivoted. The trunnions of the blades extend through the sides of the casing, where they are each connected by a crank arm with a vertical bar secured to the connecting rod of an engine suitably mounted on a truck at the rear. There are also bevel gears upon the drive shafts of the two engines to operate a shaft carrying a conveyer wheel held to revolve in the circular body portion of the casing. The wheel has a solid rear disk, and a forward skeleton disk, and between these disks, some distance from the center of the wheel, are hinged feathering paddles adapted to operate against the snow as the wheel is revolved in either direction. At the top of the casing in which the conveyer wheel revolves are two discharge openings, in which a gate or damper is so arranged that the snow may be directed to either side of the track. The working parts are shown as adapted for use in connection with an ordinary car truck, upon which they are fitted, the car being pushed forward by a locomotive in the usual way.

LONG DISTANCE TELEPHONE CONCERTS.

One of the interesting developments of telephone work is that which is now steadily going on—the transmission of orchestral music over long distances. Our readers will recall the large measure of success attained during the exhibition of the Women's Exchange at the Lenox Lyceum last winter, when, besides the transmission of music from the local theaters, Boston contributed to the entertainment by telephone, in the shape of music and recitations.

This work has been carried on by the American Telephone and Telegraph Company, known as the "Long Distance Company," under the direct supervision of their able engineer and electrician, Mr. F. E. Pickernell, and the results obtained with but a comparatively short experience in so difficult a field are exceedingly gratifying and give promise of still greater success in the near future.

In a lecture recently delivered in the Town Hall at Newton, Mass., Mr. Pickernell described the methods employed in the transmission of music by telephone. His remarks were very forcibly illustrated by the reception in the lecture hall of music transmitted over the long distance lines from the telephone building, at No. 18 Cortlandt Street, New York, and our engraving, made from a photograph taken at the time, shows the arrangement of the performers.

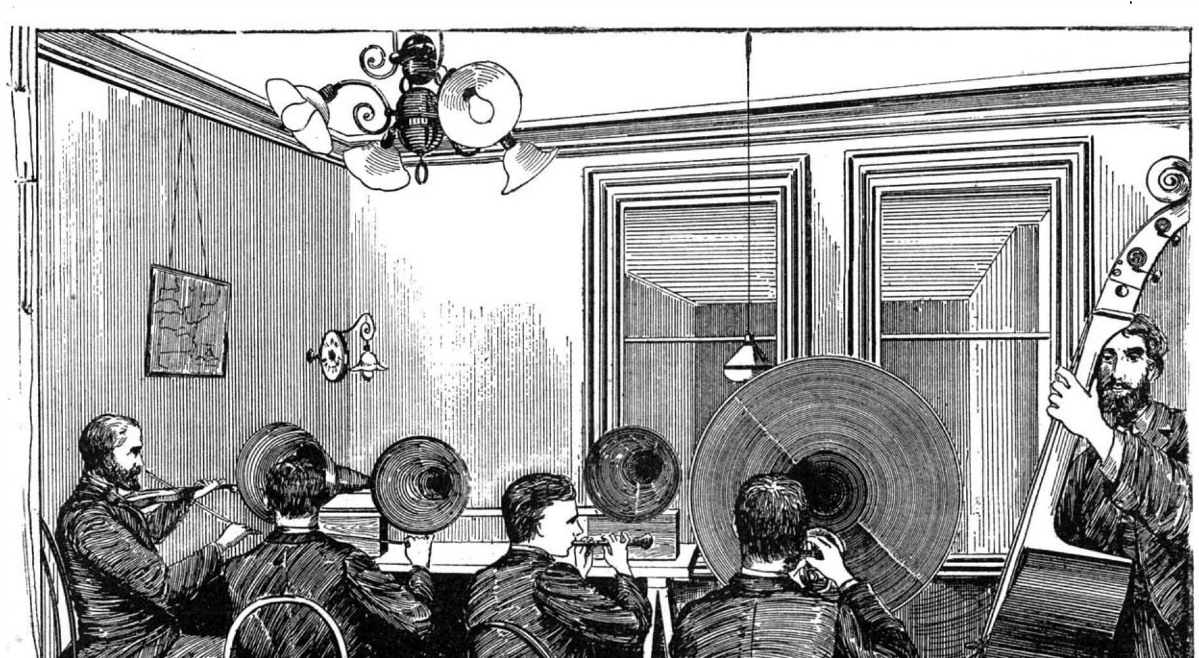
In transmitting music of this kind, it has been found desirable to have a separate transmitter for every instrument, and further, that, where a considerable number of instruments are used, it is necessary to so arrange the induction coils that their joint resistance will bear a fixed ratio to the resistance of the receiving instruments and line, all the induction coils being connected by the same line in multiple series. For this class of work the storage battery is admirably adapted for operating the transmitters, and by using cells of this type, it is possible to run 20 long distance transmitters from the same battery without drawing a current sufficiently heavy to injure the storage battery.

By using separate transmitters for each instrument, due prominence may be given to each of the instruments at the receiving end. If one transmitter is arranged to transmit music emanating from 50 instruments, it has been found that it must be so adjusted that the average result will be fair. Under these conditions, the lighter violin parts are heard but very indistinctly, while the heavier parts produce very great noise, but the purity of the sound is affected. This, of course, gives very unsatisfactory results.

At the receiving station, when it is desired to fill halls of considerable size, as many as six loud-speaking receivers are used. These are connected in multiple series, so that their joint resistance bears a definite ratio to the resistance of the transmitters. These are distributed about the hall, being usually attached to the chandeliers. On the occasion above referred to, the music transmitted from New York over a distance of 250 miles was listened to by an audience of over 1,000 persons.

When we add that similar entertainments have been given with music transmitted over a distance of no less than 460 miles it will be clear that if the same progress is made in the future as that characterized by the work of the last few months, the telephone will occupy

an important position in our future entertainment, both public and private.—*Electrical Engineer.*

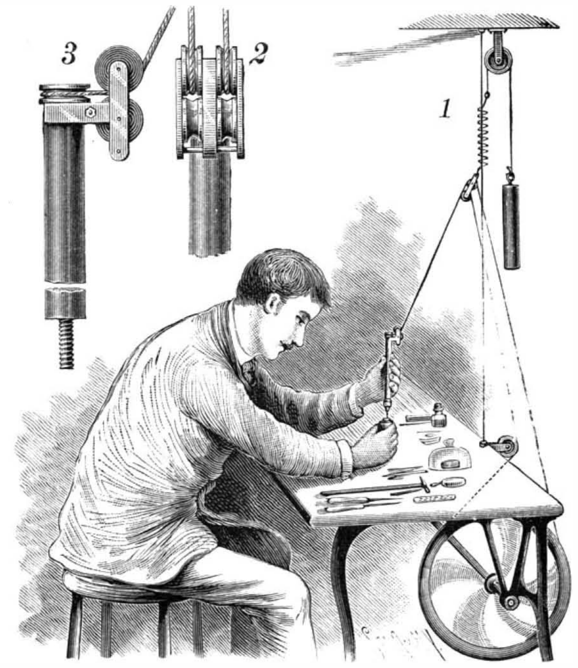


A LONG DISTANCE TELEPHONE CONCERT—PERFORMERS IN NEW YORK, AUDIENCE AT NEWTON MASS.

ONE of the latest proposed applications of electricity is a policeman's club that contains a galvanic battery. When the rowdy seizes the club, thinking to wrest it from the policeman, the rowdy receives an electric shock, which astonishes and paralyzes him, rendering his capture easy.

A DRIVING MECHANISM FOR HAND DRILLS.

A simple and economic mechanism is shown in the cut whereby a drill may be driven at a high speed, and at the same time be conveniently held to work on the top, bottom, or sides of objects. It has been patented by Mr. J. W. Knapp, of Cross River, N. Y. The drill is held by a suitable chuck on the lower threaded end of a shaft adapted to revolve in a small casing, the upper end of the shaft carrying a horizontal grooved pulley, near which a bracket on the casing affords support for the journals of four grooved pulleys, as shown in Figs. 2 and 3, the pulleys being journaled in pairs. In Fig. 1 a driving pulley, to be rotated by a treadle or other approved means, is shown journaled



KNAPP'S DRIVING MECHANISM FOR HAND DRILLS.

beneath the work table, on the outer edge of which is an idler or guide pulley, above which, and suspended from the ceiling, is a frame carrying two pulleys. This frame is attached to the lower end of a spiral spring, a cord from the upper end of which passes over a pulley near the ceiling, the other end of the cord having a weight to counterbalance the spring. A guide rod extends from the ceiling to the table, passing down on the inside of the spiral spring, to keep the pulleys in the suspended frame in proper alignment with the driving pulley. The endless driving belt passes from the idler over one of the upper pulleys, thence to engagement with one of the pairs of pulleys on the bracket of the drill casing and the pulley on the drill shaft as shown in Fig. 3, over the other upper pulley, and again around the driving wheel. By means of the two pairs of pulleys in the bracket of the drill casing, the driving belt is always led to engagement with the pulley on the drill shaft, without regard to the position in which the drill is held, and by means of the balanced spring supporting the frame carrying the upper pulleys, the amount of tension will be constant upon the belt, as regulated by the weight, no matter how much lower or farther away the drill is taken. This mechanism is especially adapted for use with jeweler's tools and for dental purposes, as well as with an ordinary drill for working metal or wood.

The Treatment of Dandruff.

Dr. Edward Clarke, in the *Lancet*, states that he has had good results in persistent dandruff from the following treatment: The scalp should first be thoroughly washed with soap and hot water and then thoroughly dried with a warm and soft cloth; there should then be rubbed into the scalp a glycerole of tannin, of the strength of ten to thirty grains to the ounce. Very obstinate cases will require the higher strength of tannin. This process should be repeated twice a week at first, once a week afterward. If tannin fails, as it will in some cases, then resort is had to resorcin. After the formation of dandruff has ceased, the head should be rubbed daily with olive oil containing, to the ounce, ten grains of carbolic acid and a drachm of oil of cinnamon.

ONE volt of electromotive force is generated for every 100,000,000 lines of force cut per second.

Opaque Engraving of Glass.

In *Dingler's Polytechnic Journal*, Mr. Lainer gives two formulas that permit of preparing solutions for the opaque engraving of glass at a relatively low cost.

I. Two solutions are mixed, one of 10 grammes of soda in 20 grammes of water and the other of 10 grammes of carbonate of potash in 20 of water. To this is added 20 grammes of concentrated hydrofluoric acid, and then a solution of 10 grammes of sulphate of potash in 10 of water. On adding a small quantity of hydrofluoric acid, the appearance of a fine grain is obtained upon glass.

II. The second formula consists of 4 cubic centimeters of water, 1½ grammes of carbonate of potash, 0·55 cubic centimeter of dilute hydrofluoric acid, and 0·5 cubic centimeter of sulphate of potash. The desired degree of opacity of the glass is obtained by the alternate addition of hydrofluoric acid and carbonate of potash.

There is a still simpler process, due to Mr. Kampan, of Vienna.

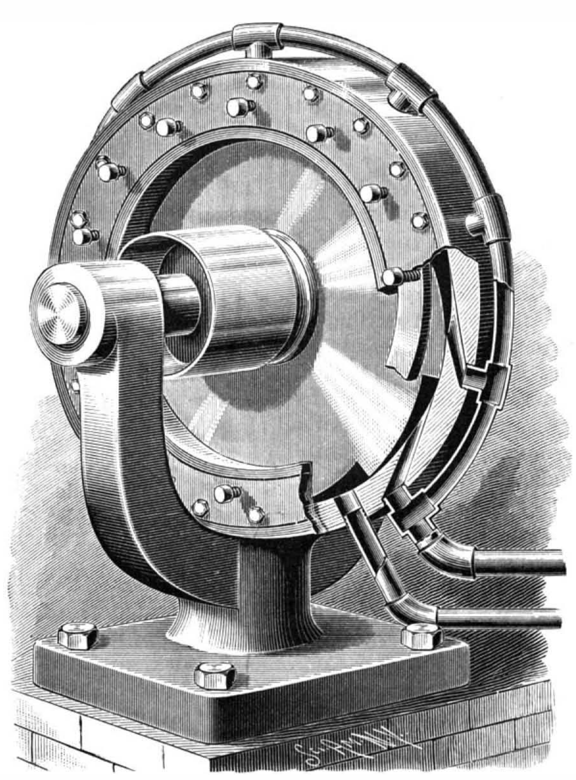
Hydrofluoric acid is neutralized with a few crystals of soda, and the fluoride of soda thus obtained is diluted with five or six times its volume of water. A good proportion is obtained with 240 cubic centimeters of commercial hydrofluoric acid, 600 grammes of powdered crystals of soda, and 100 cubic centimeters of water. The bare surface of the glass is submitted for a few minutes to the action of the ordinary solution employed for engraving (one-tenth of hydrofluoric acid), and then the plate, after being washed, is dried with a sponge. After this the preceding solution is poured upon it for opaque engraving, and allowed to remain for an hour. The liquid is then poured off and the surface is washed with water. The water is left upon the glass until a thin pellicle of silicate forms upon the surface. By varying the duration of the action of the solution, various degrees of opacity may be obtained. If the latter is too great, it may be diminished by a new solution of hydrofluoric acid for engraving.—*Revue Industrielle.*

The Steam Haulage of Canal Boats.

At a meeting of the Railway Union, in Berlin, Herr Wiebe described some experiments recently made on two lengths of the Oder and Spree canal, 3½ miles long in all, with a view to ascertain the best method of towing large boats. The submerged chain system is, he states, unsatisfactory, nor has the endless rope system of traction given entirely satisfactory results when practically tested during the course of the experiments, though a great many types of supporting post and pulleys were tried. The difficulty encountered arose from the rotation of the rope as it moved onward, which tended to twist the boat painter about the rope, and the form of connection between the rope and the painter could not be depended on to stop this action. Further experiments were then made by attaching the rope to the center of gravity of a heavy towing car, running behind and drawn by a light locomotive, such as is commonly used in mines. If the rope is attached directly to the locomotive, trouble may arise from the side pull of the rope tending to overturn the engine. It is for this reason that the towing car was adopted in the experiments in question. This plan is stated to have proved satisfactory, and boats have been towed by it at the rate of from 10 ft. to 12 ft. per second, though a speed of 5 ft. will in general be sufficient. The tension on the tow rope in starting three heavy coal barges was as much as 1,764 lb., but rapidly decreased as the boats gathered way.

AN IMPROVED ROTARY ENGINE.

The engine shown in the illustration, and which has been patented by Mr. Laban J. Everest, is very simple in construction, and designed to be durable and effective in operation, utilizing the motive power to the greatest advantage. The frame supports a cylinder made in the shape of a ring having an annular recess, closed at one side by a ring-shaped head, while the outer edge of a piston extends centrally into this recess on the inner side of the cylinder, the piston being made in the shape of a wheel on a shaft turning in suitable bearings of the frame. The wheel-shaped piston has recesses or buckets in its periphery, against



EVEREST'S ROTARY ENGINE.

which the steam is tangentially directed through angularly arranged inlet ports in the cylinder. The outer ends of these ports are connected by short branch pipes with a pipe extending almost entirely around the cylinder, the latter pipe being connected at one end with the steam supply source and closed at its other end. The series of inlet ports follow each other at equal distances around the cylinder, and following them is an exhaust port connecting with a pipe leading to the outside. By this arrangement all but one of the buckets in the periphery of the piston are kept constantly filled with live steam, each discharging as it reaches the exhaust port. To insure the steam-tight rotation of the piston in the annular recess of the cylinder, packing rings are provided, to be pressed against the sides of the piston by set screws placed at suitable distances apart in each outer side of the cylinder.

For further information relative to this invention address Messrs. Everest & Betterman, No. 1437 North 24th Street, Omaha, Neb.

THE JAMAICA EXHIBITION.

This "isle of springs," as its native name signifies, has had a somewhat checkered career. Discovered by Columbus on his second voyage, in 1494, it remained in possession of the Spaniards for upward of a century and a half, during which period the native Indians were—as was usual in the early days of colonization—almost exterminated, and the importation of African blacks was commenced—a sowing the seeds of slavery of which the British empire had to rid itself at a fearfully large cost. The negro population in the West Indies is happily now the only memento of what has been well called "a kind of incubus upon the empire throughout the eighteenth century."

In 1655 Admiral Penn and General Venables captured the island, as an attempt to compensate for the lack of success which had attended their expedition against Hayti. Thus Jamaica became a British possession at a time when England was beginning to feel her supremacy at sea, and to supersede Spain and Portugal as a colonizing power. It became one of the foundation stones of the Greater Britain of to-day.

Six years after its conquest regular government was established in Jamaica under Colonel d'Oyley; but the later prosperity of the island is due in great measure to the wise and energetic policy of Sir Thomas Modyford, who was sent out as governor during the reign of Charles II. During the following years it was the resort of numerous buccaneers, who there found a coign of vantage from which to conduct their marauding expeditions. In 1782 it was saved from a threatened invasion of the combined fleets of France and Spain by the memorable victory of Rodney over the Compte de Grasse, for which he was raised to the peerage. A marble statue by Bacon was erected to him in the then capital, Spanish Town, but it has recently been removed to Kingston, and now overlooks the bay, the finest of Jamaica's thirty harbors, all capable of affording shelter to large vessels. Other important features in the history of the island have been invasions by the Picaroons of Cuba, occasional rebellions on the part of the blacks, political differences with the home government, hurricanes, earthquakes, the largest of which almost totally destroyed Port Royal in 1692, and the Gordon rising in 1865.

The climate of Jamaica, which is equable, has been compared to that of the Riviera; it is also varied, as the high lands offer a pleasing relief to the heat sometimes felt on the seaboard. The vegetation is in parts typical of tropical luxuriance, and in parts mountainous rocks rise bare and rugged; the river scenery, too, with its numerous waterfalls, is very picturesque. The sea teems with fish, song birds abound, and the island is a veritable happy hunting ground for the naturalist and botanist, as Gosse and Kingsley have testified. To the hospitality of its inhabitants Mr. Froude has lately borne witness.

Situated as it is on the highroad to the South American continent, its importance would have been greatly increased had the Panama canal become a reality.

The existing railroads in the island are being extended, and Kingston will shortly be connected by a short line with Montego Bay and Port Antonio on the north coast. Road making is being rapidly pushed on, and must materially increase the chances of successful transport of fruit and other produce to European markets.

That there is plenty of scope for the further development of the natural resources of the island is evident when we read that three-fourths of the arable land is at present lying fallow.

Those who inaugurated the Jamaica exhibition had two objects in view—the demonstration to the world at large of the natural resources of their island, which

THE EXHIBITION BUILDING, JAMAICA.

are undoubtedly most varied, and which place Jamaica at the head of the British West Indian Islands, and the introduction into the island of the latest improvements in machinery for the further development of these products. The glories of the sugar plantations have been dimmed by a series of circumstances over which the Jamaicans had but little control, *e. g.*, the bounties granted by France and Germany for beet root sugar and the increase in the cost of labor (a result of the emancipation of the slaves), etc. The loss to the island on this score is not so great as has been stated, for it is said that not more than five per cent of the total population are interested in the production of the sugar cane. There are, moreover, other products in the island besides sugar, such as rum, tea, coffee, cocoa, tobacco, annatto, pimento, beeswax, lime juice, and fruits of all kinds, including oranges, bananas, mangoes, pineapples, and many of which the names are almost unknown in England—"sweet sop," "cherimoyer," "star apple," and the "alligator pear," all of which are said to be of excellent flavor. In addition to the fruits, turtle, both prepared and dried, and tortoise shell, are all capable of yielding fair profits. Already the fruit trade with America is progressing, and when the transport to the coast is rendered easier by the completion of the new roads under construction, and the art of packing is better understood, it is hoped that large cargoes of fruit will be successfully shipped to England and the Continent, and these native products of the island become one of its most staple supports.

Time was when oranges were obtainable in England only during the winter months; now, thanks to powerful steamships, this acceptable fruit is to be had almost all the year through, and there is no reason why a large number of them should not come from Jamaica, where the orange tree grows luxuriantly without cultivation.

The exhibition is held under all the favorable auspices that official sanction and guidance can give. The president, and in fact originator, is Sir Henry Blake, the governor. Its commission was appointed by law and approved by the Secretary of State, and it was opened on the 27th of January last by his Royal Highness Prince George of Wales.

For the above and our illustration we are indebted to the *Graphic.*

The following is from a letter in the *N. Y. Times:*

The exhibition building of the Jamaica Industrial Exhibition, which was formally opened January 27, in the form of an immense cross, occupies the central point of the plain of Liguanea, and the grounds cover twenty-three acres, which are broken up by walks and drives. The grounds are about a mile and a half from the harbor and about 200 feet above the sea level. The long arms of the building point east and west, and at the intersection rises a great dome 100 feet high. The cupola is gilded and finished to the ground in decorations of the Moorish order. The nave has a circular roof 54 feet high, supported by long lines of pillars. The building is lighted throughout by electricity, and from the top of the dome at night a great electric search light throws its glare far out over the harbor.

In the main hall of the exhibition, Jamaica reserves the central spaces for herself. Canada has the largest area, having two of the central compartments and three on each side of the main hall. England, France, Germany, Austria, and the United States come next, in the order mentioned. The display in the United States court is anything but creditable to the country, and owes whatever credit it deserves to the enterprise of private individuals. It occupies one of the central and one of the side compartments, with a small space in the gallery. The firm of G. J. De Cordova, of New York, represents a number of United States firms, who have some exhibits, and Mr. De Cordova is one of the exhibition commissioners.

Among the business houses of the United States which are represented by exhibits are Schwarlzer & Co., who make a display of desks of American manufacture elegantly finished in walnut, cherry, and oak. They also show a handsome suit of bedroom furniture in oak, which is a revelation to some of the other exhibitors of goods of the same character. A toilet set of oxidized silver, consisting of ewer, basin, and soap cups, beautifully chased, is exhibited by Simpson, Hall, Miller & Co.

The Singer Manufacturing Company exhibits a sample of its machine with a vibrating shuttle that interests the ladies as something not seen here before. It has a table cover leaf, three drawers, and automatic bobbin winder, with a full not of all attachments. Its new drop cabinet machine is the first of its kind seen in Jamaica. The company also exhibits a machine for manufacturing purposes which takes 2,000 stitches a minute, and is adapted to work on heavy cloth and leather fabrics.

Burroughs, Wellcome & Co., New York and London, exhibit the Stanley medicine chest, a facsimile of that used by the explorer in Africa. Lascelles, De Mercade & Co. have erected a pavilion opposite machinery hall for the exhibition of their New York and London firms. The building is in the shape of a T and was built by the Harvey Lumber Company of Chicago. It was sent to Kingston in sections all ready for the carpenters, and is a model structure. The roof is of corrugated tiles and is surmounted by three flagstaffs, from which float the stars and stripes, the Jamaica and the English flags. The interior is finished in Georgia pine, with a very fine effect.

Among the more notable American exhibits here are these: Edmund C. Cole, of New Haven, Conn., has a splendid assortment of buggies and carriages; Aspinwall & Co., a fine display of enamels; the Ansonia Clock Company makes a creditable exhibit of its clocks and bronzes; Simpson, McIntyre & Co., an exhibit of butter; the Binghamton Oil Refining Company shows a variety of the manufactured products of petroleum; Mackellar, Smith & Jordan, the Philadelphia type founders, send a display of American type tastefully arranged in the large show cases, and a number of books, pamphlets, and newspapers that speak in the highest terms for the progress of the typographical art in the United States. The Edison Mimeograph Company exhibits its wonderful copying machines, and the National Typewriter Company has a corps of operators working their machines. The Domestic Sewing Machine Company's exhibit is the wonder of the women folk, and the Sheperd Hardware Company send for inspection a great variety of ice cream freezers, just the thing for this climate.

The Cannon Hollowware Company displays kitchenware, and the Sidney School Manufacturing Company has a well arranged exhibit of school furniture of all kinds. The Archer Company shows an American barber chair that suggests peace and comfort, and the Amberg File and Index Company's display of letter files and cabinets is a notable collection.

Concerts are to be given in the pavilion on the Wilcox & White organs and on the instruments of the Chicago Cottage Organ Company, both of which make fine displays. Carr & Co., of New York, make an exhibit of agricultural machinery that is specially interesting, as it is adapted for the preparation of the products of this island. Marburg Brothers, of Baltimore, have a tasteful exhibition of various brands of their tobaccos, and the stoves shown by L. Bennett & Sons should tempt the natives to discard the use of oil stoves, which are now in general use.

Natural History Notes.

How the Muskrat Breathes under Ice.—Animals that breathe by means of lungs can prolong their stay under water only through special anatomical arrangements, or by having recourse to some extraneous means. Mr. W. Spoon, of the Elisha Mitchell Society, who has hunted the muskrat in winter, asserts that the animal, when obliged to traverse, under ice, a pond so wide that it cannot keep up its breathing, stops from time to time and exhales the air from its lungs. This air, being confined by the ice, becomes oxygenated in contact with the water, and the animal, taking a fresh inspiration, dives in order to begin its swimming again a little further along. It appears that other observers have found that if this air is dispersed through the ice being struck, the animal is killed through asphyxia.

Absorption of Organic Matter by Plants.—In a communication from Prof. Calderon, of the Institute of Las Palmas, Canary Isles, he contests the ordinary view that the nitrogen of the tissues of plants is derived entirely from the nitrates and ammoniacal salts absorbed through the roots. He does not, however, adopt the old theory that the source is the free nitrogen of the atmosphere, but rather the nitrogenous organic matter which is always floating in the air. The nutrition of plants he divides into three classes: *necrophagous*, the absorption of dead organic matter in various stages of decomposition; *plasmophagous*, the assimilation of living organic matter without elimination, or distinction of any kind between useful and useless substances, such as the nutrition of parasites; and *biophagous*, the absorption of living organisms, such as that known in the case of insectivorous plants. A further illustration of the latter kind of nutrition is, according to Prof. Calderon, furnished by all plants provided with viscid hairs or a glutinous excretion, the object of which is the detention and destruction of small insects. To prove the importance of the nitrogenous substances floating in the air to the life of plants, he deprived air of all organic matter in the mode described by Professor Tyndall, and subjected lichens to the access only of this filtered air and distilled water, when he found all their physiological functions to be suddenly suspended. —*Nature.*

Life of Lichens during Winter.—Of all plants, lichens are the ones that most easily endure the lowest temperatures. They are met with in profusion in the polar regions and at the highest altitudes, where no other plant can subsist. The causes of this peculiar resistance being unknown, Mr. H. Jumelle decided to ascertain how, from the standpoint of gaseous exchanges with the atmosphere, the lichens of our country behave during the winter. The study of this point was evidently capable of throwing light upon the question of the resistance of these plants. The results obtained by Mr. Jumelle, and recently communicated to the Society of Biology, are as follows:

In our country, when the temperature descends below zero, lichens enter upon a retarded course of life due less to the lowering of the temperature than to a loss of water. In lichens that grow under shelter and on the ground, the loss of water being less, the gaseous exchanges will be merely decreased, and remain sensible. On the contrary, in lichens living upon trees and exposed to the air, desiccation occurs to a considerable extent, and life is then so retarded that, in darkness as well as in light, the gaseous exchange no longer becomes appreciable. If, by chance, the lichen contains a notable proportion of water, the freezing of the latter produces an effect analogous to that of desiccation, and the gaseous exchanges are again of the feeblest character.—*Revue Scientifique.*

How the World Appears to the Lower Animals.—In addition to the organs of hearing, touch, and smell, Sir John Lubbock has found upon the antennæ of insects certain organs that seem to be connected with senses that we know nothing about.

Experiments made upon certain fresh water crustaceans show that they are sensible to sounds corresponding to more than 40,000 vibrations per second (sounds that we cannot hear), and to ultra-violet rays that we cannot perceive. Now all the rays that we can perceive appear to us with definite colors, and it should be the same with these animals; so that it is probable that they see colors that are unknown to us and that are as different from those that we are familiar with as red is different from yellow or green from violet. It would result from this that natural light, which seems white to us, would appear colored to them, and that the aspect of nature would be entirely different to them from what it is to us. It is possible, therefore, that to certain animals nature is full of sounds, colors, and sensations that we have no idea of.

The Longevity of Animals.—What is the maximum longevity of animals? It has been found that the herbivores, especially those that are compelled to work, are generally longer-lived than the carnivores. Thus, an ass died a few years ago at Cromarty at the age of 106 years. It had belonged to the same family since 1779. We have a record of several horses that reached the age of 40, 50, or more years. A tow horse died at Washington at the age of 62 years. Another horse died at New York aged 38 years, and had worked up to nearly its last moment. At Philadelphia there was a mule that reached the respectable age of 42 years. Another mule, aged between 40 and 45 years, is still working at a place near San Francisco. A ewe, born at Kalinowitz in 1829, remained fertile for twenty years, and died in 1850. As for carnivores, a Spanish slut recently died in America at the age of 28 years, and the case is cited of a cat that died at the age of 22 years and 2 months.—*La Nature.*

The Color of Batrachians.—According to the researches of Mr. Ponchet, the green and golden coloration of the batrachians is produced by yellow chromoblasts and blue iridocysts, the mixture of which gives an impression of green upon the retina. Black chromatophores contained in the derma and epidermis are, by extending in a network, capable of covering the other chromoblasts, to a greater or less extent, and of giving all the shades between dark brown and yellowish green or light blue.

In a note presented by Mr. Chauveau, in the name of Mr. Abel Dutartre, the latter describes the principal conditions that govern the motions of these black chromatophores. He first studies the action of the different rays of the spectrum, and demonstrates that white light and yellow cause a contraction of the black chromatophores and render the color of the animal lighter, while blue light and violet leave the animal more or less dark. Then, examining the influence of the bottom, he finds a curious case of mimicry, viz., that the coloration of the animal remains light when it is placed upon a light bottom, while it remains brown when it is placed upon a dark bottom. Finally, Mr. Dutartre's researches on the influence of the nervous system upon the changes of color in the batrachians have shown him that an excitation of the bulb gives rise to a lighter coloration, even though such excitation takes place after the spinal marrow has been cleft in the center. Hence it follows that it is not the nerves of animal life that act upon the coloration of batrachians, but rather the sympathetic nerve.

Effects of Heat and Pressure on Rocks.

The author has continued his researches on the effects produced upon rocks in contact with gases suddenly developed by means of such explosives as guncotton and dynamite. Temperatures of 2,500°, and pressures of 1,100 atmospheres, thus obtained, have been sufficient to fuse and pulverize the rocks experimented upon in a very marked manner. The results lead M. Daubree to believe that the perforated pipes or *diatremes*, diamantiferous, volcanic, or otherwise, and much of the subaerial dust and oceanic deposits are formed by such actions as he has obtained in the laboratory. He also shows that rocks may acquire an apparent plasticity under the influence of pressure.

MANUFACTURE OF HEAVY GUNS FOR U. S. NAVY.

(Continued from first page.)

ships of all classes. We have before stated that in 1886 the navy department was in possession of but fourteen 6 inch rifles. The immense progress made in the past few years will be readily appreciated when it is recalled that our artist saw an equal number of these guns (Fig. 4) placed in a row ready for shipment.

The Bethlehem Company's works (Fig. 1) are situated at South Bethlehem, Northampton County, Pa., on the Lehigh River, 87 miles from New York by way of the Lehigh Valley Railroad and Central Railroad of New Jersey, and 55 miles from Philadelphia via the North Pennsylvania branch of the Philadelphia and Reading Railroad.

Their property covers an extent of about 1¼ miles in length by ¼ mile in width, of which about 20 acres are under cover. The works comprise offices, boiler houses, blast furnaces, puddle mill, merchant steel mill, Bessemer department, with converters, furnaces and rolls, chemical and physical laboratories; but the most interesting department is that where the ordnance and armor plate are made, by means of powerful hydraulic presses, the 125 ton hammer, and their accompanying appliances.

The steel for the manufacture of the gun forgings is manufactured in open hearth furnaces burning gaseous fuel. When necessary the contents of four furnaces of various sizes can be united to cast an ingot of 100 tons, but that size furnace is usually employed which is most suitable for the work in hand.

When the furnace has been raised to a suitable temperature, the charge, previously determined upon, is entered and subjected to a fusion of several hours. The combustion of the previously heated gases and air, whose volumes are regulated by valves and dampers, develops an intense heat. Frequent tests are made while the conversion is going on, to determine the condition of the metal in the bath. When satisfactory, it is tapped into a ladle lined with refractory material and transferred to the flask, in which it is subjected to fluid compression. The flask is then moved to a position under the movable head of the casting press (Fig. 2) and hydraulic pressure applied to the metal until the requisite compression is obtained.

This press consists of massive head and base, held together by four forged steel columns or bolts secured with nuts. A movable head carries the ram to which the hydraulic pressure is applied.

An eye witness of the operation has thus described it: "I saw 30 tons of boiling steel put into a vertical cylinder, perhaps 40 in. in diameter. A piston, with a gradually increasing pressure, running up in thirty-five minutes to six tons per square inch, was thrust upon that boiling column, and out from the sides darted fine jets of blue-burning gas. When the cylinder was so far cooled that contraction no longer went on, the pressure was removed."

When cooled and reheated, the ingot thus cast is taken to the forging press (Fig. 3) and there rough-moulded into the forms which enter into the final fabrication of the gun.

Bethlehem's hydraulic forging presses are the most powerful yet built. They were designed to produce any forgings that would probably enter into the heaviest battle ships and their engines and armaments, and have already produced many of the largest forgings thus far required in this country.

In shaping the larger pieces the requisite reheatings are made in special gas furnaces conveniently located.

Senator Hawley has given a spirited account of this impressive operation. "I saw a cylindrical ingot of steel 42 inches in diameter and 92 inches (7 feet 8 inches) long, weighing 16 tons, taken easily from the glowing furnace and carried quickly and gently to the forge, where one end was laid upon an anvil between two uprights, a frame of strong pillars and crossbeams. Close above the white and sparkling metal hung a hammer head adjustable to the bulk of the metal to be forged. The face of the ram that bears upon the steel was, perhaps, two feet long and eight inches wide. Its longer dimension coincided with the axis of the steel cylinder. Near by stood a lad to control the ordinary levers or throttle bars by which steam or hydraulic power is applied.

"The lad pulled the lever, the hammer went down gracefully and silently, with a pressure of 3,000 tons, six or eight inches into the cylinder, and the mass of 16 tons gave way, spread, and flowed from end to end as dough gives way under the fist of the baker. After each successive pressure the cylinder was revolved a few degrees to be ready for the next, as the blacksmith turns the rod with his left hand for successive strokes of the hammer."

After their reduction to approximate dimensions the forgings are oil-hardened and annealed, numerous test pieces being taken out during all the steps of the manufacture and very carefully analyzed and subjected to physical tests. Naval inspectors watch all these operations carefully, securing a complete history of the metal at all its various stages. The parts are then transferred to the machine shop to be machined to the dimensions required by the very rigid specifications laid down for the guidance of the inspecting officers.

The machine shop, which is well lighted by electricity, contains lathes, planers, boring mills, slotters, drilling machines, shapers, etc. Among these are: a planer in which 13 feet by 13 feet by 50 feet 10 inches can be planed; 10-foot face plate lathe; boring mills of the most recent design, and some of the most powerful lathes in existence. The building containing these tools is 641 feet in length by 116 feet in width and is served by pneumatic traveling cranes, 60 feet span and 45 feet hoist, with lifting capacities of from 25 to 100 tons.

This machining is followed by another rigid inspection for dimensions and surface defects, when forgings are shipped in sets to the gun factory for fabrication into the finished gun. On their receipt at the gun factory they are again carefully inspected before proceeding to the various stages of boring, turning, shrinking together, chambering and rifling, which operations will be fully described in a subsequent article.

Plaster Casts.

Have the following articles on your bench ready for use:

1st. *Soap Varnish*, made by dissolving English white Castile soap in soft water to the consistency of milk.

2d. *Dredge Cup.*—Take a half-pound baking powder can, and have your tinner make a cover for it, having the entire top part made of strainer wire, such as is used on milk pails. Keep this cup always filled with fine, strong plaster.

3d. *Bottle of Mixing Solution.*—Consisting of soft water and two per cent of alum, or borax, or sulphate of potash.

4th. *Pepper-box*, filled with fine, powdered soapstone, and a jeweler's extra soft bench brush.

We will suppose you have a perfect impression for full mouth. Coat the impression with soap varnish, brushing it in thoroughly till a good lather forms; now rinse off with cold water and it is ready to pour. Next pour in your bowl the right quantity of mixing solution, then add the plaster, shaking it in carefully from the dredge cup till it comes a little above the surface of the solution; stir a little. If not thick enough, shake in more plaster, for to have a good, smooth, hard model it should be worked as thick as possible, and it can be worked very thick, as the solution used causes it to set slowly. Now fill the impression slowly, tapping the bottom of the cup to make the plaster settle and drive all air to the surface. When the model is hard enough, separate it from the impression and let it stand to dry. Shake the soapstone over it thickly and polish with the jeweler's brush till perfectly smooth. A model made thus, and then before packing covered with the tin-foil, or liquid tin, gives a plate as smooth as when vulcanized on solid metal cast.—*Dr. Wm. Steele, in Items.*

Foreign Patent Sharks.

Messrs. Wm. P. Thompson & Company, agents for European patents, call attention in a circular letter to a system of imposition upon American inventors who are captured by the "cheap" work offered by alleged attorneys, who flood the country with circulars fishing for prey. There are so many shark schemes practiced upon the inventor—and it is usually only those who can least afford the loss who are caught—that the only safe plan, as the *Electrical Review* truthfully remarks, is to deal with attorneys who are recommended by people you know or who have some other equally reliable indorsement. Beware of the man who wants to sell your patent at a fabulous price, if you will only pay 20 or 30 dollars for advertising expenses. Beware of the man who in a flaming circular offers to do professional work for almost nothing. You can be assured he has some sinister motive in making the proposition, and before you get through with him you will find him dear enough.

The following is quoted from the letter.

We think it right to expose to you the full particulars, as far as we have been able to ascertain them, of an organized system by which, on an average, at least 20 American patentees per week are grossly victimized. Certain individuals in this country, who have lately got themselves registered as patent agents, have circulars sent round from places in New York or Washington, usually in the name of some high-sounding company. These circulars are sent to every patentee the moment his name appears in the Official Gazette of the United States Patent Office, offering to procure European patents for them at what they please to term cost price, or seemingly without any profit to themselves, and afterward to negotiate the sale of such patents. They also sometimes publish statements of the number of companies which they make appear to have floated for purchasing patents, whereas we do not believe that one solitary individual has ever received a penny from them by the sale of his patent. We have letters from patentees in America complaining that they have sent $20 for provisional protection to some of those gentry, but have never got a reply or acknowledgment of any kind whatever. The French patents, if applied for by them at all, are, of course, in every instance, absolutely null and void, owing to the prior publication of the United States patents in America. The German patents, if applied for at all, are refused for a similar reason. The English patents are at least nine times out of ten null and void, owing to sufficient information having been set forth in the United States *Gazette* to enable a person to work the invention. As, too, the provisional specifications of these patents are simply copied from the Gazette already published in Great Britain, it is very doubtful whether *in any case* the patents can be upheld, as it is certain that everything contained in the provisional specification had fallen into the public domain before the date of application.

These bogus companies, of course, hand the patents over to the individuals who are really the company, stating that they have put the patent into the hands of a high-class firm of English patent agents. Now, if this system is to continue, in a very short time two results will follow: (1) Every patentee who has paid a reasonable fee for a patent to his American patent agent, on getting these circulars, not knowing the actual facts of the case, will at once consider that he has been imposed upon by his American patent agent. (2) As the inventors in all these bogus cases will have simply lost their money without any return whatsoever, in a short time European patents will be looked upon as nothing but sinks in which all money invested in them is lost. The success of these men shows also that American patent agents do not sufficiently explain to their clients the value of European patents, otherwise the clients would have taken out the patent through their own agents, and in proper time, instead of falling into the hands of these harpies.

Edison's Explanation of the Ampere and the Volt.

During a recent examination a lawyer put the following question to Thomas A. Edison:

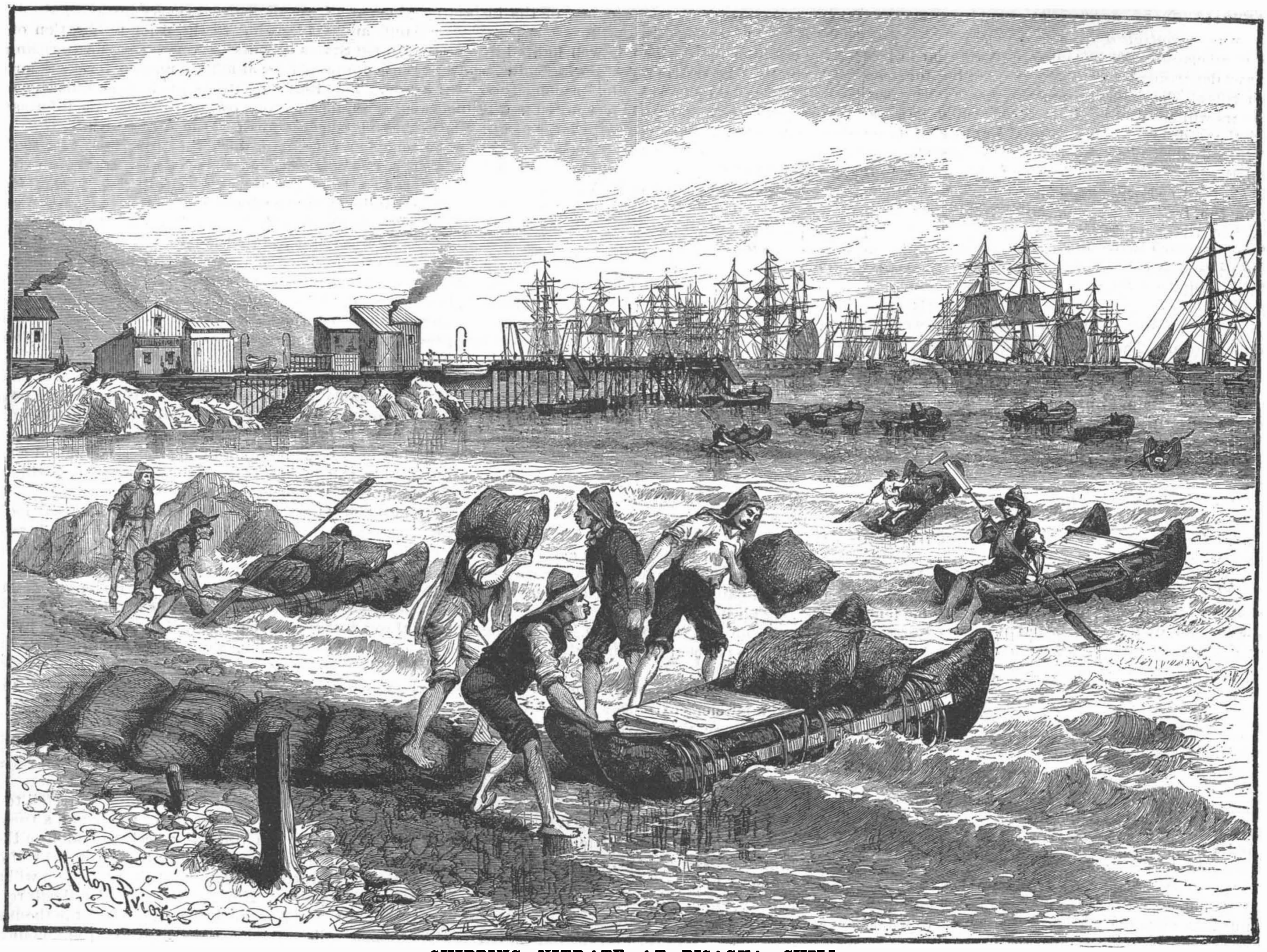
"Explain what is meant by the number of volts in an electric current?" To which he replied:

"I will have to use the analogy of a waterfall to explain. Say we have a current of water and a turbine wheel. If I have a turbine wheel and allow a thousand gallons per second to fall from a height of one foot on the turbine, I get a certain power, we will say one horse power. Now the one foot of fall will represent one volt of pressure in electricity, and the thousand gallons will represent the ampere or the amount of current. We will call that one ampere. Thus we have a thousand gallons of water or one ampere falling one foot or one volt or under one volt of pressure, and the water working the turbine gives one horse power. If, now, we go a thousand feet high, and take one gallon of water and let it fall on the turbine wheel, we will get the same power as we had before, namely, one horse power. We have got a thousand times less current or less water, and we will have a thousandth of an ampere in place of one ampere, and we will have a thousand volts in place of one volt, and we will have a fall of water a thousand feet as against one foot. Now the fall of water or the height from which it falls is the pressure or volts in electricity, and the amount of water is the amperes. It will be seen that a thousand gallons a minute falling on a man from a height of only one foot would be no danger to the man, and that if we took one gallon and took it up a thousand feet and let it fall down it would crush him. So it is not the quantity or current of water that does the damage, but it is the velocity or the pressure that produces the effect."

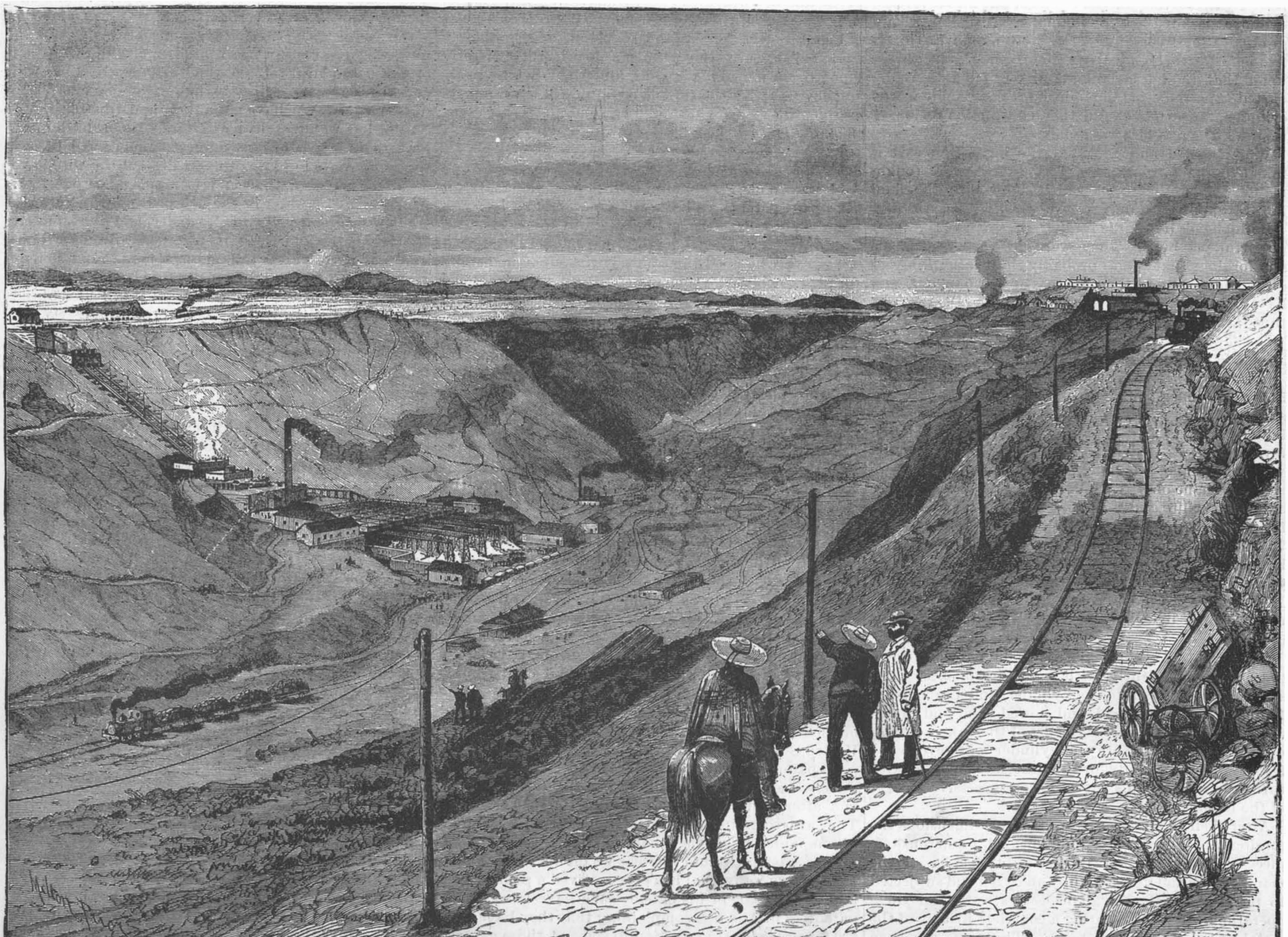
Cleanly and Orderly Workshops.

There is no doubt about it, cleanliness about a shop is one of the rules which should be most rigidly enforced. There is no excuse for permitting piles of rubbish, scraps, etc., to lie around on the floor and benches, neither should the machinery be allowed to remain covered with grease and dirt. Clean machinery tends toward the keeping of everything in the best order. Dirt and grease often hide indications which if observed in time might prevent a breakdown, and an attendant loss of property, and possibly a loss of life or an injury to the workmen. Workmen should take pride in keeping their benches and surroundings as free from litter as possible. It is an unpleasant sight to go into a shop and observe a workman who desires some particular small tool rummaging over the numerous scraps, tools, etc., which cover the machine or bench at which he is working in order to find the tool he desires to use. Each workman should have a particular place for each tool, and return it to its proper place as soon as he is done with it. It is a very simple matter, adds the *Railway Master Mechanic*, to clean up a bench at least once a day, but when it is neglected from day to day, it soon presents an untidy and unsightly appearance.

N. F. BURNHAM, the inventor of the turbine water wheel bearing his name, died at York, Pa., on the 22d ult. His inventions and improvements, covering a period from 1859 to 1888, will be a lasting memorial of his mechanical skill.



SHIPPING NITRATE AT PISAGUA, CHILI.



THE NITRATE OF SODA MINES AND WORKS IN CHILI.

THE CHILIAN NITRATE OF SODA MINES AND WORKS.

The two nitrate oficinas or establishments of Jaz Pampa and Paccha count among the most important, and are undoubtedly the most picturesquely situated, of any on the pampas or plains of Tarapaca. They are built on opposite sides of a deep quebrada or gulch, through which the Nitrate Railway passes. Indeed, the word Jaz, a local term implying divided, is here used to denote the fashion in which the level surface of the pampa has been rent apart by some bygone convulsion of nature.

Advantage has been taken of this natural formation to lay out the oficinas of the Jaz in such wise as to obtain unusual facilities for commodious and economical working. The caliche or raw material of nitrate, having been extracted from the calicheras or pockets situate on the pampas, is brought to the crushers erected at the edge of the gulch or summit of the maquina, and, being run through them, falls into the boiling tanks below. The nitrate in solution flows into the bateas or precipitating tanks, where on cooling it crystallizes, while the earthy refuse, or ripio, left in the boiling tanks, is cleared out by hand, and shot from tip cars into the valley below.

The washed and prepared nitrate is then bagged and transported to the shipping port of Pisagua, where a fleet of vessels is generally anchored to receive and convey the product to all parts of the world. At this port there are piers alongside of which launches are brought into which the nitrate bags are dumped and towed out to the ships. Quite a large part of the shipment, however, is effected by means of balsas or small floats, consisting of a pair of tubular skins, lashed together and inflated with air. These balsas are very buoyant, very light, easily propelled. The manner of loading and propelling them is clearly shown in our engraving. The native boatmen are exceedingly dexterous at the business, and are satisfied with earnings of a few cents a day.

We are indebted to the *Illustrated London News* for our engravings.

SIMPLE MILLING ATTACHMENT FOR FOOT LATHES.

The plan of making one machine answer the purpose of several separate machines for different purposes is not advisable, for many reasons; but when a simple and useful attachment, like that shown in the engraving, can be readily and cheaply made without altering the lathe, and arranged for use without waste of time, it is desirable, especially when the use of such an attachment effects a great saving of time, and takes the place of files in many kinds of work.

The milling attachment here shown is applied to the small engine lathe (8 inch swing, 42 inch bed) made by W. C. Young & Co., of Worcester, Mass., as this lathe is well fitted for the purpose, but it may of course be applied as readily to other lathes fitted with the same slide rest, and with some changes it may be adapted to almost any engine lathe.

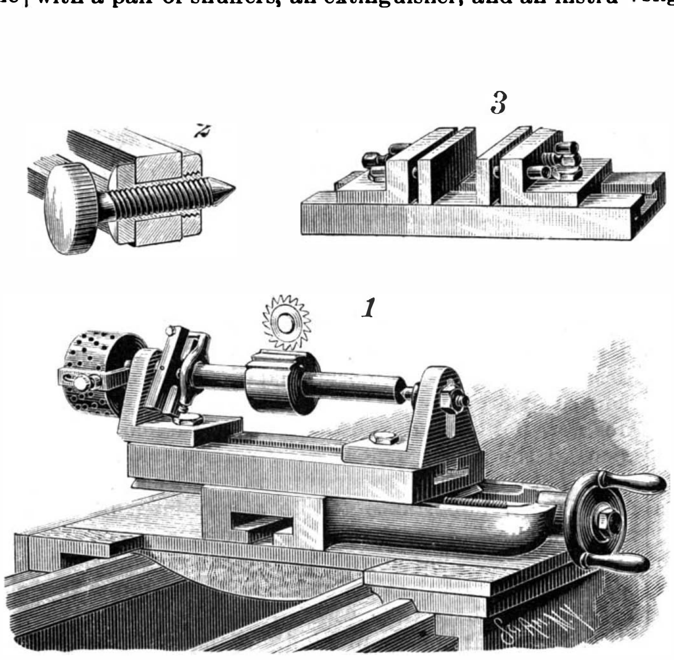
The slide rest illustrated is inverted, and the part which is designed to hold the tool post is secured to the lathe carriage by the bolt that commonly holds the slide rest in the position of use. The bottom of the slide rest, which is thus placed uppermost, forms a bed of sufficient size for receiving work as large as would usually be done in a lathe, and the T slot furnishes a ready means of securing the work or the holders for the work. In Fig. 1 two angle plates are shown secured to the slide rest by bolts entering the T slot. The upright portions of the angle plates are slotted to permit of adjusting the centers at the desired height. The fixed center is held in place in one of the angle plates by nuts on opposite sides of the plate. The movable center is supported in the other angled plate by a sleeve which passes through the slot in the plate.

The inner end of the center carries an H-shaped bar, which clamps the end of the dog on the mandrel which holds the work. The outer end of the movable center is provided with small cylinder divided like an index plate. The outer nut on the sleeve which supports the movable center has a slotted right-angled arm, which extends outwardly and along the face of the graduated cylinder. In the slot of the arm is clamped a sleeve, in which is inserted a screw with a conical point, which may be inserted in any of the holes in the graduated cylinder, the screw being adjustable along the slotted arm to bring it opposite any series of holes as may be required.

The division of the cylinder may be effected with sufficient accuracy for most purposes by means of dividers, but more accurate results may be secured in the manner described in SUPPLEMENTS No. 317, 732, 740.

Taps, reamers, and cutters may be fluted by the aid of this simple and easily made apparatus, the cutter being carried by the lathe either on a mandrel between the centers or projecting from a chuck on the lathe mandrel.

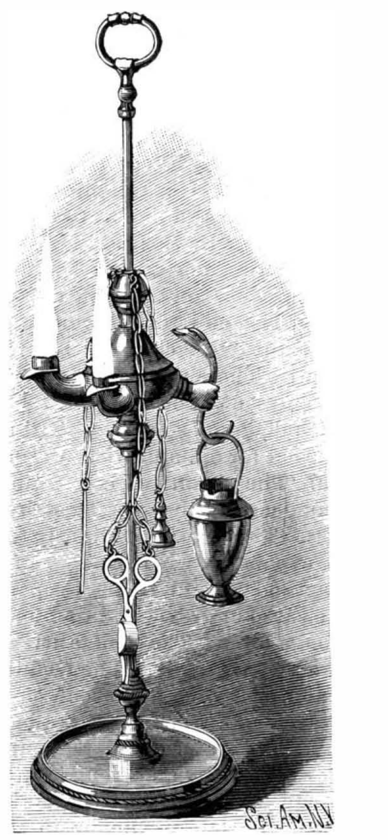
For plain work, the simple vise, shown in Fig. 2, may be used. If the work to be done is too large to go between the slide rest and cutter, it will be necessary to raise the head of the lathe. If, on the other hand, the slide rest is too low, it may be raised by inserting washers between the rest and lathe carriage. To facilitate placing these washers, they should be slit from the center outward to the periphery, to allow of putting them in place without removing the bolt from the slide rest and lathe carriage.



MILLING ATTACHMENT FOR FOOT LATHES.

OLIVE OIL LAMP.

The lamp shown in the engraving was recently purchased in the *Mercato Vecchio* at Florence. These



OLIVE OIL LAMP.

lamps are used not only in Tuscany, but in many of the other provinces of Italy, and form an article of commerce not only for actual use, but being so artistic, large numbers are sold annually to European travelers as souvenirs. They are quite inexpensive, considering the amount of material and the work put upon them, the larger ones costing only $1.35 complete, while small ones may be purchased for 75 cents. They show an amount of hand work which is seldom seen in American goods of the same class.

These lamps are made in several different designs and with one, two, three, or even four beaks. The lamp illustrated is 22 inches high and is made throughout of cast brass, with the exception of the extra oil carrier, which is of copper. Every lamp is provided with a pair of snuffers, an extinguisher, and an instrument for picking the wick. These three articles are suspended from the lamp with brass chains having brazed links. The lamp font is tinned on the inside to prevent corrosion, and is arranged to slide up or down the rod. The wicks, which are of wool, pass through small brass tubes inserted loosely in the beaks. The supply of oil contained in the font being limited, the small oil reservoir holding a charge of oil is suspended from the lamp. The olive oil, which is very cheap, costing only 8 to 10 soldi (8 to 10 cents) the liter, is manufactured from small olives or those unfit for eating. These lamps give a soft, pleasant light.

Food before Sleep.*

Many persons, though not actually sick, keep below par in strength and general tone, and I am of the opinion that fasting during the long interval between supper and breakfast, and especially the complete emptiness of the stomach during sleep, adds greatly to the amount of emaciation, sleeplessness and general weakness we so often meet.

Physiology teaches that in the body there is a perpetual disintegration of tissue, sleeping or waking; it is therefore logical to believe that the supply of nourishment should be somewhat continuous, especially in those who are below par, if we would counteract their emaciation and lowered degree of vitality; and as bodily exercise is suspended during sleep, with wear and tear correspondingly diminished, while digestion, assimilation and nutritive activity continue as usual, the food furnished during this period adds more than is destroyed, and increased weight and improved general vigor is the result.

All beings except man are governed by natural instinct, and every being with a stomach, except man, eats before sleep, and even the human infant, guided by the same instinct, sucks frequently day and night, and if its stomach is empty for any prolonged period, it cries long and loud.

Digestion requires no interval of rest, and if the amount of food during the twenty-four hours is, in quantity and quality, not beyond the physiological limit, it makes no hurtful difference to the stomach how few or how short are the intervals between eating, but it does make a vast difference in the weak and emaciated one's welfare to have a modicum of food in the stomach during the time of sleep, that, instead of being consumed by bodily action, it may during the interval improve the lowered system; and I am fully satisfied that were the weakly, the emaciated, and the sleepless to rightly take a light lunch or meal of simple, nutritious food before going to bed for a prolonged period, nine in ten of them would be thereby lifted into a better standard of health.

In my specialty (nose and throat) I encounter cases that, in addition to local and constitutional treatment, need an increase of nutritious food, and I find that by directing a bowl of bread and milk, or a mug of beer and a few biscuits, or a saucer of oatmeal and cream before going to bed, for a few months, a surprising increase in weight, strength, and general tone results; on the contrary, persons who are too stout or plethoric should follow an opposite course.

Soldering of Glass and Porcelain with Metals.

Mr. Cailletet has recently made known to the Societe de Physique a process of soldering glass and porcelain with metals. Mechanists, physicists, and chemists will appreciate the practical importance of this process, which permits of adapting any metallic object whatever (cock, tube, conducting wire, etc.) to experimental apparatus in such a way as to prevent any leakage, even under high pressures.

The process is very simple. The portion of the tube that is to be soldered is first covered with a thin layer of platinum. This deposit is obtained by covering the slightly heated glass, by means of a brush, with very neutral chloride of platinum, mixed with essential oil of chamomile. The oil is slowly evaporated, and, when the white and odoriferous vapors cease to be given off, the temperature is raised to a red heat. The platinum is then reduced and covers the glass tube with a bright layer of metal. On fixing the tube thus metallized, and placed in a bath of sulphate of copper, to the negative pole of a battery of suitable energy, there is deposited upon the platinum a ring of copper, which should be malleable and very adhesive if the operation has been properly performed.

In this state, the glass tube covered with copper can be treated like a genuine metallic tube and be soldered by means of tin to iron, copper, bronze, platinum, and all metals that can be united with tin solder.

The resistance and strength of such soldering are very great. Mr. Cailletet has found that a tube of his apparatus for liquefying gases, the upper extremity of which had been closed by means of an ajutage thus soldered, resists pressures of more than 300 atmospheres. The tube, instead of being platinized, may be silverized by raising the glass covered with nitrate of silver up to a heat bordering on red. The silver thus reduced adheres perfectly to the glass, but numerous experiments have caused platinizing to be preferred to silverizing in the majority of cases.—*La Nature.*

Eczema from the Virginian Creeper.

The *Lancet* (London) relates a number of unmistakable cases of eczema produced from gathering leaves of the Virginian creeper. The effect, rash, heat, and irritation of the skin, is the same as that caused by ivy and dogwood on some persons.

* Dr. Wm. T. Cathell, in the *Maryland Medical Journal.*

Progress of Steam Navigation on the Great Lakes.

Census Bulletin 29 says: It is probable that the history of marine architecture does not furnish another instance of so rapid and complete a revolution in the material and structure of floating equipment as has taken place on the great lakes since 1886.

The facts show not only radical changes that have taken place in the class of vessels used for transportation on the great lakes, but an increase in the tonnage and valuation during this brief period. In 1886 the net tonnage was 634,652, in 1890 it had reached 826,360, an increase of 191,708 tons. The estimated value of these vessels in 1886 was $30,597,450, and in 1890 the aggregate valuation was $58,128,500, an increase compared with 1886 of $27,531,050. Sailing vessels are fast giving place to vessels propelled by steam.

In 1886 there were but 21 propellers of over 1,500 tons burden. In 1890 there were 110 propellers of this class. But the tonnage of vessels of this class has increased more rapidly than their number. Thus the total tonnage of the 21 vessels of over 1,500 tons burden in 1886 was 34,868, while the total tonnage of the 110 vessels in 1890 was 188,390; that is to say, the percentage of increase in the number of vessels is 423 81, while the percentage of increase in tonnage is 440·29. The total value of this class of vessels in 1886 was $2,645,000; in 1890 it was $15,000,092, showing an increase for the four years of 570·59 per cent. A comparison similar to this for any of the classes of vessels, when taken in connection with well known facts relative to the ownership of these large vessels, clearly shows that the traffic of the great lakes is rapidly coming under the control of companies having at their command large capital.

The same conclusion may be arrived at if the changes in the material made use of in the building of new vessels are considered. Steel is more generally used for large vessels than iron, composite, or wood. In 1886 there were but 6 steel vessels afloat on the lakes, with an aggregate tonnage of 6,459 tons and an aggregate value of $694,000. From the corresponding data for the year 1890, it appears there are now 68 steel vessels afloat on the lakes, with an aggregate tonnage of 99,457 tons and an aggregate value of $11,964,000. This shows an increase in number of vessels of 1,033·33 per cent, in tonnage of 1,439·82 per cent, and in valuation of 1,623·99 per cent. Iron and wooden vessels have barely held their own during these years. Vessels built of composite, on the other hand, show a marked increase, both in number, tonnage, and value.

These facts indicate that a new factor is being introduced into the problem of transcontinental transportation.

Economic Steaming.

Certain remarkable economical results have been obtained by M. August Normand, of Havre, with the engines of a torpedo boat constructed by his firm, which were made the subject of a paper which he read before the French Institution of Civil Engineers on the 5th of December last. The following abstract, for which we are indebted to the *Engineer*, will be found interesting:

M. Normand has recently delivered to the French government three single screw torpedo boats, Nos. 126, 127, and 128, and one twin screw boat, the Avant-Garde. The consumption of fuel at slow speed—ten knots—was found to be so small in the case of Nos. 126, 127, and the Avant-Garde, that it was deemed advisable to carry out a trial with No. 128 with exceptional care, and for this purpose the boat made two runs on successive days, of eight hours each.

M. Normand puts down the consumption at 0·5 kilo. per horse per hour, which means about 1·25 pounds of coal per English horse power per hour; an extraordinarily low figure, when it is borne in mind that the engines are compound, not triple expansion. The trials were carried out by an official committee. The principal dimensions of the boat are as follows: Length over all, including the rudder, 121 feet; beam, 13 feet 2 inches; mean draught, 3 feet 9½ inches; displacement, about 79 tons.

The boiler is of the locomotive type, but presents many peculiarities. There are 317 tubes, 8 feet 8 inches long and 1½ inches diameter. These tubes are rolled into the plates, and fitted at the fire box end with bell-mouthed ferrules. The grate surface is a little over 30 square feet. The total heating surface is 1,425 square feet; the pressure 143 pounds per square inch. A deep hanging bridge is worked into the flat crown of the fire box, and a fire brick bridge curves back over the grate. Thus a species of combustion chamber is formed, which, with the bell-mouthed ferrules, perfectly protects the tube ends and tube plate and prevents leakage. These boilers, we understand, give no trouble whatever. The total weight of the boiler, with water and all fittings and accessories, is nearly 16 tons. Of this the water represents about 4·5 tons, and the grate bars and bearers about 17 cwt. The external fire box crown is brought down lower than usual, and to provide steam room a steam drum about 2 feet in diameter has been added to the barrel of the boiler. In the water space at each side of the fire box thin plates are placed to permit the quiet descent of water between them and the outer shell plate, while the steam and water together can rise unhindered at the fire box side. The tubes are of brass, with copper ends next the fire box.

The engines are intended to indicate 900 horse power when making 320 revolutions per minute. They weigh complete, without water, about 12 tons. The water in the condenser and hot well adds about 1·25 tons to this. The water circulates automatically through the condenser when the boat is in motion. A small centrifugal pump is provided to maintain the circulation when the boat is not moving through the water. The cylinders are 17·3 inches and 27·24 inches by 17·3 inches. The valve boxes are placed between the cylinders. They are cast in one with the small cylinder. The cylinders are jacketed all over. The jackets are supplied direct from the valve chest of the high pressure cylinder, and the drain pipes are fixed at the lowest points, so that the jackets can be kept quite clear of water. At each end of the high pressure cylinder is fixed a small relief valve, which opens if the compression becomes excessive, as may be the case when the engines are running linked up. If it were not for these valves, the engines must when running at full speed have too little compression, but by their aid M. Normand is able to give ample compression at full speed, and yet run no risk at low speeds when working very expansively. The valves open at each stroke, permitting the surplus steam to escape into the chimney before the admission port opens. These valves have worked satisfactorily up to the present. The frames of the engine are of gun metal, with diagonal steel ties. The slide bars are of bronze, grooved for oil, and with water circulation through them. The piston and connecting rods are of steel. The condenser tubes are fixed by rolling into the tube plates. They are bent slightly to permit contraction and expansion. No packing of any kind is used. This method is said to answer perfectly. The feed water is cleared of grease and dirt by being passed through a sponge filter. The sponge arrests the grease, but lets the water pass freely. The feed is next passed through a heater consisting of a sheaf of tubes rolled into plates at each end. The sheaf is placed in a copper vessel. The feed water circulates round the tubes. A special valve worked by an eccentric on the after end of the crank shaft admits, during the period of expansion, steam from the large cylinder to the heater at each stroke. This steam moves through the tubes in a direction opposite to that in which the water moves. The water at slow speed is raised to a temperature of about 158° Fah.; at full speed it is heated to 212° Fah. The water resulting from the condensation of the steam passes by a steam trap to the condenser. A second and similar trap drains the jackets, and the hot water is passed through a copper coil in the hot well, so that it gives up its heat to the feed water before entering the condenser.

The accompanying table gives the results of the trials for economy:

	First Day.	Second Day.
Total number of revolutions	67,000	64,577
Speed in knots	10·819	10·412
Consumption of coal:		
Total during eight hours	926 lb.	881 lb.
Per hour	127 lb.	1[illegible]0 lb.
Per hour and square foot of grate	7·5 lb.	6·5 lb.
Per knot	11·75 lb.	10·75 lb.
Per knot at ten knots	10 lb.	10·2 lb.
Water per hour	1,988 lb.	1,988 lb.
Indicated horse power	119·95	112·33
Coal per horse per hour	1·054 lb.	0·979 lb.

The extreme economy obtained during these trials is attributable to two causes. In the first place, the boiler was very economical. In the second, the engines used the steam supplied to them to the best advantage. The report of the commission estimates the theoretical value of the fuel, which was special torpedo boat briquettes from Anzin, at 16 pounds of steam to the pound of fuel. The boiler actually made 12 pounds per pound of coal, so that the efficiency was 75 per cent, a very excellent result. During the trial the grate area was reduced by fire tiles to a little over 17 square feet, the fans were not worked, and the stokehold hatches were open all the time. The heating surface stood in the ratio of 81·6 to 1 of the grate surface. M. Normand attaches much importance to the arrangement of the tubes in the tube plates, and he cites a very remarkable experiment made with a locomotive boiler. A cock was fitted on the shell of this boiler, and from the cock a small bore tube was led down through the water to a point in close proximity to the tube plate of the fire box. When the boiler was worked at full power with a sharp draught, no water could be got from the cock, nothing but steam. This is a highly suggestive experiment, and does much to explain why tubes become leaky when forced draught is used. M. Normand classifies the causes of the exceptional economy of his engines under four heads: First, the great economical efficiency of the boiler; second, the complete compression in the small cylinder, by which clearance was eliminated; thirdly, the heating of the feed water; fourthly, the superheating of the steam due to throttling.

Revolutions per minute, 135·7. Mean pressure, small cylinder, 19·3 pounds; indicated horse power, 51·72; boiler pressure, 60 pounds; ditto in intermediate receiver, 8·5 pounds; vacuum, 22 inches; temperature of feed water, 178° Fah. Large cylinder, average pressure, 9 pounds; indicated horse power, 62·60. Total indicated horse power, 114·32.

As the boiler produced 12 pounds of steam for each pound of fuel burned, and the consumption was 1·25 pounds nearly per English horse power per hour, we have $12 \times 1·25 = 15$ pounds as the weight of steam used per horse per hour. This is an extremely small consumption, but not impossible. It has been exceeded with some pumping engines, for example. But it appears yet smaller when we consider that the pressure during the trial did not exceed 60 pounds above the atmosphere. We see no reason to doubt the substantial accuracy of the report. The diagrams were taken every half hour; the briquettes put on board before the eight hours' run were weighed, those left unburned were weighed after the run, and the difference was the consumption. The feed water was not measured, however, and the evaporation of 12 to 1 has been deduced from that of a Scotch boiler in the steamship Chasseur, which was found by actual experiment to make 9·29 pounds of steam per pound of coal. We believe that the actual efficiency of the torpedo boat boiler has been underestimated.

The heating surface for the power was enormous; the rate of combustion, very slow. The firing seems to have been conducted on the principles with which our own engine trials under the auspices of the Royal Agricultural Society have made us familiar, the briquettes being carefully broken into small pieces. The feed water was raised to a high temperature. Under the circumstances, we think we may take the evaporation as more nearly 13 pounds than 12 pounds of water per pound of fuel, and the consumption then becomes $13 \times 1·25 = 16·25$ pounds, which is not exceptional, although very good. Nothing is known with certainty as to the consumption when the boat is running at full speed. It is, of course, considerably in excess of that reported for the low speed.

The entire experiment is very instructive, and the results all go to teach the same truth, namely, that maximum economy can only be had by using dry steam and neutralizing the effect of clearance. The performance of the machinery as a whole reflects very great credit on M. Normand.

The Dangerous Alternating Current.

Humidity reached pretty nearly high water mark as midnight approached last night, and several things resulted.

One was the display of three electric lights on Broadway, opposite St. Paul's chapel, that nobody will ever pay the electric light company for. Some high tension wires run on poles on the west side of the street in front of the chapel, and trees in the churchyard extend their branches over the sidewalk and very close to the wires. The trees and their branches were soaked with water, and therefore good conductors of electricity. The saturated atmosphere between the branches and the wires completed the circuits, and the result was three brilliant electric arc lights, which blazed, sputtered, went out, and blazed again, until finally the branches were burnt off and dropped to the street. During the display a considerable number of people gathered at the corners and watched it curiously.

The moisture-saturated atmosphere occasioned an alarm of fire at about the same time. The Pennsylvania Railroad ferry slips at Cortlandt Street are lighted by electricity, and the wires run under the roof within a few inches of the wooden rafters. These wires were evidently badly insulated, if insulated at all, for fire broke out at nearly the same moment at three points in the roof just above them at the time when the fog from the river was thickest. An alarm was sent out, and the first engine that arrived quenched the flames within less than a minute with no appreciable damage. The new fire boat New Yorker steamed up immediately afterward, but there was no use for her.

While the *Sun* reporter was talking to the policemen on duty at the ferry, immediately after the fire, a newly erected telegraph pole suddenly broke into flame in front of the ferry house on the west side of West Street. The flame flickered and went out before an alarm could be sent. The same wires which fired the ferry house hung on this pole. They were strung to it on glass insulators set at least three inches from the wet wood. The current apparently jumped to the pole through the medium of the water-saturated air, forming an arc and firing the wood.

From Fulton Street to the Battery the wires kept sizzling here and there, sometimes sending out a spurt of flame as big as an average sized Derby hat, and sometimes dwindling down to a spark.—*N. Y. Sun, Feb.* 17.

Cement for Microscope Slides.

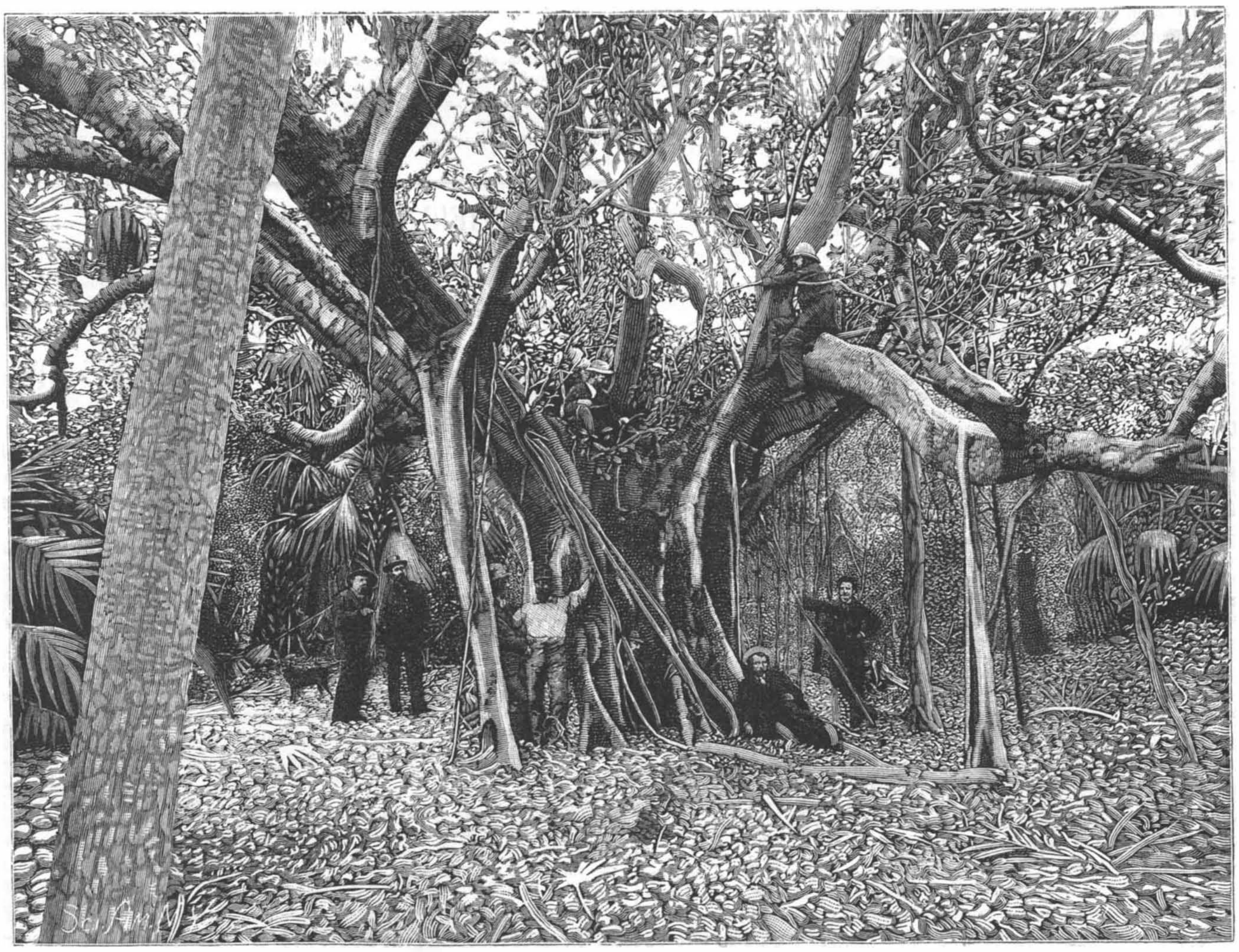
Take a tube of Winsor & Newton's flake white, as used by artists, and mix with an ounce of Berry's oil finish varnish. It makes a most durable cell, and one with which a cell can be rapidly built. The materials can be obtained at any drug store.

The Bell and Drawbaugh Telephones.

H. C Andrews, of New York City, is counsel for the Drawbaugh claims on the telephone. He was seen a few days ago by a representative of *Modern Light and Heat* in regard to the rumor that the Bell Telephone Company might seek to continue its monopoly after the expiration of its patents by admitting the priority of Drawbaugh's claim for a patent on the carbon transmitter and then purchasing his rights. He said that it would not do the Drawbaugh claims a bit of good if they were admitted by the Bell Company, for the United States Patent Office, and not the Bell Company, was the contestant. He admitted, however, that if Drawbaugh's claim to a patent on the carbon transmitter were now established and his rights were bought up by the Bell Company, the monopoly on the transmitter could be continued for many years to come. That there had been any negotiations to that end he denied positively.

AN AMERICAN BANYAN TREE.

Probably nothing in the way of natural growth affords greater interest to the young student of geography than the banyan tree, with its huge arms extending out in every direction, and dropping down shoots, which in turn change into trunks, and instead of remaining a cumbrous dependent, become a support to the parent branch and furnish it sustenance and life—a curious and interesting provision which leads to one of the most extraordinary growths that we have in nature. The parent tree multiplies itself and becomes a group and then a grove, until it spreads over a tract of land large enough to shelter an army. We published some weeks ago a description and illustration of a remarkable banyan tree that has for many years attracted the attention of visitors to the island of Nassau, but in the accompanying engraving we illustrate a fine example of this tree, and this specimen is to be found upon this continent. In this land of many climes, there are a variety of growths which are not generally known. This is especially the case in southern Florida, where many of the tropical genera are indigenous. The banyan or rubber tree is one of this number. Our illustration is from a specimen at Palm Beach, Lake Worth, Florida, and is from a photograph by Mr. Wm. H. Jackson, of Denver. There are very few of them known, however, now in Florida, and this tree is probably the largest of its kind in North America.



AN AMERICAN BANYAN TREE.

The Annual Report and Annals of the Astronomical Observatory of Harvard College.

The report of the director of this observatory indicates an extensive range of work in both hemispheres, and the elaborate celestial tables issued as the "Annals" are the best evidence of its work. The observations are now executed in three fields, Massachusetts and California in the United States and at Chosica, Peru. The latter station will probably be abandoned for Arequipa, where a drier air and better climatic conditions prevail. The accumulation of photographic plates is noted, some twenty-seven thousand being now stored in Cambridge. By the application of photography a record is now obtained for the benefit of future generations of astronomers that goes back to 1885. Thus the observers of to-day have witnessed the establishment of an epoch, the birth of the new astronomy, where photography does the recording and the gelatine plate supplants the eye of the observer with its inevitably varying personal coefficient. Besides the volume of annals, a number of special publications on various subjects, by the members of the observatory staff, are noted, most upon pure astronomy, but some touching on photography and horology.

Electricity in Law.

One of the effects of the rapid introduction of electrical inventions during the last quarter of a century, says the *Pittsburg Dispatch*, has been to open up entirely new fields of litigation for the lawyer and new questions for the bench. This in a general way is true of every new creation of industrial property, but with electricity many of the problems to be solved are quite novel, and a judge has often to go wide of practice or precedent before he can determine the legal principle proper to apply in the case before him.

Thus, for instance, in Pennsylvania the question has recently been adjudicated upon whether a local electric light company was a manufacturing concern. The court says it is not, and yet all that it does is to make current for sale.

A similar point is that raised as to the dutiability of electric current. The law officers of the Treasury say it is intangible, and therefore pays no duty ; yet it can be measured to the minutest fraction. The Western Union Company has had many a fight as to whether pole lines had any right on the public highway, and Massachusetts says they have, as transporting messages is part of the work of intercourse for which roads are laid out and maintained. The American Bell Telephone Company for years spent hundreds of thousands of dollars in defending the abstruse doctrine that telephonic speech can only be transmitted by an undulatory current, that a make and break current would not do it, and that other devices are simply a juggle to get around Bell's patent. In electric lighting, millions of investment have hung on a "filament" and on the exact meaning that the courts might attach to the word.

Among the latest legal fights is one that probably the United States Supreme Court will have to settle, namely, whether the telephone companies or the electric railway companies have the right to use the earth as a "return" circuit. The telephone people claim that the leakage from the railway throws their service out of gear and renders the instruments useless. The railway people reply that their telephonic friends have a remedy in metallic circuits and that no one electrical interest anyhow can "own the earth." Already this dispute has cropped up in nearly a score of States, and the increasing number and magnitude of the electric roads renders it more and more important. In the meantime, the telephone companies as far as possible are putting their metallic circuits in, with a marked improvement in the service. New questions thus crop up every day. In the use, for example, of the alternative currents now becoming so common, not a little has depended on the patentability of the principle of transforming the current, and on whether a "step up" was equivalent to a "step down," in other words, whether raising the voltage and decreasing the amperage was a simple and inevitable converse to decreasing the volts and raising the amperes. Another point around which legal controversy has gathered is the fine one as to where "low" potential ends and "high" potential begins.

[The points here given, with many others of equal importance, were discussed in a very able address recently delivered by Hon. John S. Wise, at the fourteenth annual meeting of the New York State Bar Association, at Albany.]

The Relations of Men of Science to the General Public

was the title of the address of T. C. Mendenhall, as retiring president of the American Association for the Advancement of Science, at its annual meeting in Indianapolis for the year 1890. The main points of his theme were :

1. The particulars in which scientific men fail as exponents of science among their fellows. Under this head is named, with proper qualification, the fact that such men are sometimes unable, or unwilling, to present the results of their labors in form intelligible to intelligent people.

2. Men of science are liable to fall into the error of assuming superior wisdom as regards subjects outside the lines of their specialties.

3. Men of science are not always reasonably free from egotism in matters relating to their specialties, particularly in reference to authority and attainments in the same.

4. Another element of weakness in scientific men is that they are often less "practical" in their work than they should be. Sometimes they even despise the useful and practical in science, and their dignity is disturbed when an honest and innocent layman asks what the use of this or that discovery is. This we deem one of the most important points of the address, because the fault is so commonly noticed and spoken of by intelligent laymen. We have ourselves been recently ashamed of some of our prominent scientific men for grievous errors in this way.

5. The last point of the paper is the demand which the public may justly make upon the man of science, that his interest shall not be less in public affairs than that of other men. The paper, as a whole, is well calculated to call the attention of scientific men generally to a line of usefulness and an opportunity for good not duly appreciated heretofore.—*Sidereal Messenger.*

Lubec Channel, Maine.

The report of Lieut.-Col. J. A. Smith, Corps of Engineers, upon the preliminary examination of Lubec Channel, Maine, shows that this channel is worthy of improvement, which is concurred in by the Chief of Engineers. The improvement proposed is the excavation of a channel with a width of 500 feet at its narrowest place, increased to a width of 650 feet to make room in the bend, and 12 feet deep at mean low water, at an estimated cost of $231,000.

Lubec Channel lies between the township of Lubec, on the extreme eastern boundary of the State of Maine, and Campobello Island, of the province of New Brunswick. At its narrowest place, which is between the village of Lubec and a point of the island, the distance is but 805 feet from high water on the end of Gun Rock to high water mark on the Campobello shore. Between the natural contours of mean high water on the respective shores the width is 960 feet, and between contours of mean low water the distance is but 390 feet.

After passing Lubec, going southward, the channel leads into a small bay known as Quoddy Roads, which forms a good anchorage in northerly and northwesterly storms. When a storm changes from westerly to easterly directions, vessels which are at anchor in the roads are seriously endangered, and must accept the alternative of trying to ride out the storm or to escape through the narrows into the protected waters above.

RECENTLY PATENTED INVENTIONS.

Railway Appliances.

SIGNALING APPARATUS. — George B. Williams, Portland, Oregon. This invention provides a conductor's signaling valve in which the exhaust from the signaling pipe is automatically regulated by means of a trigger device, with other novel features, forming a simple and durable apparatus designed to transmit accurately and promptly signals from the conductor to the engineer of a train by means of compressed air, the apparatus being also adapted for employment in signaling work with stationary plant.

RAILWAY RAIL FASTENING.—Thomas J. Bush, Lexington, Ky. By this invention, diagonal intersecting holes are bored in the tie to receive interlocking bolts which pass through sloping clamp plates and through slotted plates on top of the tie, thus affording a uniform and level foundation for the rail, which is prevented from settling into the tie and shifting out of gauge.

DIE FOR MAKING BOLTS. — The same inventor has also obtained a patent for a machine for making interlocking bolts, such as required in this rail fastening, the machine comprising a die and a punch or mandrel to face off and recess the end of the bolt to form a locking shoulder, the invention being an improvement on a former patented invention of the same patentee.

ELEVATED RAILROAD. — John N. Valley, Jersey City, N. J. Two patents have been granted this inventor for structures adapted for passenger or freight carrying purposes, and also for use in timber lands for getting out logs, or in mines, etc., the improvements relating mainly to the mode of suspending and bracing the track rail from a stringer sustained by struts, and in a method of laying or fastening the track rail sections on the sleeper to maintain its straightness both ways, for promoting greater ease of travel of a carriage or trolley and giving increased durability to the entire structure.

Electrical.

POTENTIAL REGULATOR. — Alvirus L. Ellis, Kansas City, Mo. A pair of electric motors is connected with the potential controlling devices and with the main circuit, and a circuit controlling magnet and armature are arranged to send the current to one or the other of the motors, thus operating the potential controlling device in accordance with the requirements of the circuit, the arrangement being applicable in a circuit carrying either a direct or an alternating current.

Agricultural.

POTATO PLANTER.—Ferdinand Storck, Buena Vista, Col. In this frame a vertically adjustable standard carries a plow with which is connected a seed tube, while there are adjustable covering plows in the rear of the main plow, with other novel features, by means of which potatoes may be planted in a straight line and with the hills at equal distances apart.

PLOW AND FERTILIZER DISTRIBUTER. —Silamon McLean, Mineral Springs, S. C. In this machine the fertilizer hopper is independent of the plow beam, and may be readily removed therefrom, while the distributing section in use normally sustains all the weight of the fertilizer, and the plows may be raised and lowered at the will of the operator, the machine being adapted to distribute either damp or dry fertilizer, placing the material at the bottom of the furrow and thoroughly incorporating it with the soil.

COTTON STALK PULLER. — Lewis L. Womack, Zephyr, Texas. This machine has a pulling wheel journaled near the ground on the lower end of a short vertical axle, and operated by gearing from the main horizontal axle, the stalks being received between teeth and the rim of the wheel, and as the machine advances, the stalks are pulled up and discharged at the rear of the machine.

CHURN. — James McBride, Bavington, Pa. This invention covers an improvement in what are known as "barrel churns," and provides a churn that may be easily operated, in which the cream may be readily placed and removed, and which is designed to quickly and thoroughly do its work, the body of the churn being given an end over end motion if desired, or rotated in a horizontal position.

CATTLE STANCHION.—The same inventor has obtained a patent for a stanchion to which an animal may be quickly and readily secured, while at the same time great freedom of movement is allowed, means being provided in connection therewith for preventing the animal from fouling the floor of the stall.

HAY PRESS. — John B. Foresman, Foresman, Ind. In connection with the baling chamber is a revolving feeding chamber, feeding rollers lying near the edges of feeding wings and forcing material into the baling chamber, the baling operation being continuous, and the bales of hay and straw being compacted and banded and automatically ejected from the machine.

Miscellaneous.

BRUSH SCRAPER FOR PAINT PAILS.— David F. Brown, Omaha, Neb. This is an attachment adapted to clamp the edges of the bucket, and made of spring wire, having an inner scraper portion and an exterior clamping portion with spring bows which engage the rim of the pail or bucket.

SAMPLE CASE —Henry Noee, Chicago, Ill. This is a case for the display of carpet samples, providing for the arrangement of a large number of various patterns within a small compass, the samples being readily changed, and arranged for display by turning them over as the leaves of a book, without liability of scattering or soiling them.

BURIAL APPARATUS.—Nicholas Brickell, Poplar Grove, Ark. A knock-down frame is adapted to be placed over a grave, with parallel tracks, and a carriage forming a bier running on the tracks to receive the coffin, the carriage having pivoted handles, to facilitate lowering a coffin or casket to the bottom of a vault or a grave.

ATOMIZER. — Edward T. Kassel, New York City. This is a device for spraying perfumery and antiseptic or other liquids, for toilet, medicinal, or surgical uses, the device allowing strictly localized applications of antiseptic or other fluids by one hand of a surgeon while leaving his other hand free to perform an operation.

FOUNTAIN INKSTAND. — James V. Bergen, Austin, Texas. This invention provides an attachment for inkstands designed to be simple and durable in construction, and by means of which the ink is confined in air and dust proof reservoir which can be easily cleaned when desired, the operator only having to remove a cover to get at all the parts.

ADJUSTABLE BOOK REST.—Charles W. Bccannon, New York City. This support has a foot piece attached thereto by hinges, the lower edge of the support having a ledge to serve as a stop for the book, and the support being provided with triangular bails of different sizes hinged to its back or lower surface, whereby it may be set at any desired angle, the device being also adapted for use as a writing desk or table.

ADDING MACHINE.—Gideon B. Massey, Mamaroneck, N. Y. (deceased, Sarah R. Massey and Stanley A. Bryant, administrators). A series of number wheels are operated simultaneously by slides having numbers corresponding to those on the wheel, there being also a "carrying" mechanism, and a novel printing and paper feeding mechanism, for obtaining an accurate total of a series of large numbers, so that the total and the sum added are recorded every time an addition is made.

CASH REGISTER. — This is another patented invention of the same inventor for the construction of a check-printing machine which will print, number, and cut off checks in succession, and at the same time produce a continuous record of the numbers of the checks, an indicator being provided for showing the position of the check-numbering wheels.

AUTOMATIC WEIGHER AND PACKER. —John A. Ostenberg, Des Moines, Iowa. This is a machine for weighing starch, spices, and similar material, and discharging it into boxes, bags, or other packages, a standard carrying a sleeve with a series of weighing scales, while a circular hopper discharges through shaker spouts into the boxes of the scales, and a mechanism is provided for shutting off the supply of material when the proper amount has been fed.

TRANSPOSING KEY BOARD. — Anders Holmstrom, New York City. Combined with a movable transposing key board is a latch device, allowing the key board to be latched when adjusted to any desired position, preventing accidental movement and holding the keys in proper relation to the action stems for playing the instrument, and allowing change of pitch of tone for obtaining different musical effects by fingering the same keys.

STREET LETTER BOX. — Ira G. Lane, New York City. This is a box designed to be entirely of iron and having a neatly finished connection with the ordinary lamp post, with a top hood forming a newspaper or package compartment, and a hinged drop lid provided with a swinging tray, while the discharge opening is partly in the front and partly in the bottom, the front and bottom doors being coupled together for simultaneous operation.

HOUSE DOOR LETTER BOX. — This is another patent by the same inventor for a box to be placed on the inside of a door or partition wall, and provided with an interior bar to prevent abstraction of mail from or at the drop lid or inlet opening, and also to facilitate the passage of mail into the box, while an alarm device is connected with the box to give notice whenever the drop lid is opened.

MEAT HOLDER. — Robert W. Randle, Portland, Ind. This is a device adapted to hold a ham or joint of meat while being carved, having a series of upright fixed clamping fingers, and a pivoted and adjustable clamping arm, with a lever for closing the latter toward the fingers, and a catch to hold it when closed, there being a removable cover inclosing the whole, and a ventilating screen.

MEASURING VESSEL.—Henry W. Laun, Englewood, Ill. This is a transparent vessel protected by a jacket, whereby liquids may be measured without the use of an additional measuring cup, there being a graduated scale on the side of the liquid receptacle, and a faucet partly in its bottom and partly in its side.

CLOTHES DRIER. — Mary L. W. Martinot, New York City. This device consists of a square drying chamber, having a heat flue in the bottom and outlets in the top, with parallel slideways on its inner walls, and clothes-holding trays formed of slats, and other novel features, being especially adapted for use with oil or gas stoves, etc., providing means whereby clothes may be quickly dried indoors without danger from too much heat.

WATER CONDUCTOR FOR TURBINES.— John Graham, Minneapolis, Minn. This conductor has a siphon pipe inserted in the water reservoir, a novel description of readily operated valve at the mouth of the pipe beneath the water level, a vent valve at the top of the siphon, a pipe from the trunk pipe below the head on the long leg of the siphon connecting with a suitable pump, and a gate valve at the lower end of the trunk, where water is supplied to the turbine.

FORCE PUMP.—Frederick F. Danaher, Brooklyn, N. Y. This is an improvement in that class of devices known as plumbers' force pumps, designed for convenient and expeditious application to a sink, or for other uses of a similar nature, the invention covering a novel construction and combination of parts.

TREATING POTASSIC SALTS. — Bernhard Peitzsch, Stassfurt, Germany. This invention consists of a process of treating potassic raw salts, as found in a mineral state at Stassfurt, to manufacture therefrom potash, soda, hydrochloric acid, magnesia, gypsum, and sulphur or sulphuric acid, the process allowing of the direct manufacture, without any waste products.

DISINFECTING PAVING COMPOSITION. —John Fottrell, New York City. This invention provides for the use of carbolic acid in connection with a body of Portland or any suitable cement, the acid being thoroughly mixed with the cement in proportions varying according to the locality where such pavement is to be laid, after which the cement is applied, mixed with water, in the usual way.

BICYCLE CRANK. — William Blakely, Bournemouth West, England. The crank arm is formed of a shell of stamped steel plates clamped upon a wood core, the axle journals being fluted and the flutes filled with agate or other hard material, while the metal shell has an eye notched to correspond with the flutes of the axle, the construction forming a light and very stiff shaft or axle, not likely to spring or bend under the weight of a heavy rider.

CHECK HOOK. — Karl G. Bareis, Madison, Wis. This invention consists of a hollow post adapted to be secured to the back pad or saddle of the harness, with an arm to be opened or closed on the post to insert and retain the check rein in place, making a simple and efficient device, which is ornamental in appearance.

VEHICLE POLE ATTACHMENT.—Henry W. Roberts, Duncan, Mich. A spring-pressed bolt is fitted to slide in a post on the holdback, the base plate of which the bolt is adapted to engage, forming a safety attachment designed to conveniently and securely fasten the ring of the neck yoke to the holdback of the pole or release it when desired.

DUMPING CART. — Timothy Flanigan, Chicago, Ill. This is a cart especially designed to carry garbage and half-liquid substances, as well as for ordinary purposes, the closed dumping body on the frame in the rear of the seat having a door, with a locking mechanism, and there being a connection leading from the lock to the driver's seat.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

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Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(2856) F. P. R. asks: What substance will make gold leaves adhere permanently to paper, and what is the mode of its appliance? A. Glaire, which is pure albumen, is sometimes used. It is made by shaking up the white of an egg with a few drops of ammonia, and drawing off the clear liquid, which has subsided on standing. This is painted on the lines, and by slight heat, as of a hot iron, the leaf adheres. Gold size is used on thick paper, or thick gum arabic water may be used. The illuminators of to-day cannot get as good results as did the old workers of the middle ages. The old gilding is never equaled now.

(2857) D. B. P. asks: What preparation is suitable to be placed on boxwood, for the purpose of photographing on, preparatory to engraving? A. See SCIENTIFIC AMERICAN SUPPLEMENT, No. 576, page 9203, for formula and particulars.

(2858) H. G. L. asks: What is the law for the magnetic field? A. The field developed by an electro-magnet varies directly as the current strength and directly as the number of convolutions of wire.

(2859) I. S. B. asks for a formula for making corn remedy, either liquid or plaster. A.

Salicylic acid	30 grains	gr. xxx.
Cannabis Indica (Indian hemp)................	5 grains	gr. v.
Castor oil..............	½ drachm	ʒ ss.
Collodion..	½ ounce	℥ ss.

Mix and apply morning and evening for four days. Then soak the feet in warm water. If this be done faithfully, the corns are removed without any difficulty. 2. How is sticking plaster made, such as surgeons use for drawing together the edges of wounds? A. Adhesive plaster:

Litharge.	5 ounces	℥ v.
Olive oil....................	12 ounces	℥ xii.
Water.....................	8 ounces	℥ viii.

Put the water and litharge into a copper pan. Mix together with a spatula, add the oil, and boil, stirring constantly. This process takes from 4 to 5 hours, but it can be hastened to 20 or 30 minutes by adding an ounce of colorless vinegar. To make resin or strapping plaster, used in retaining the lips of recent cuts and wounds in contact: Mix by a moderate heat 1 ounce of resin to 5 ounces of litharge plaster (as given above) and spread upon muslin. 3. How is court plaster made? A. Bruise a sufficient quantity of isinglass, let it soak in a little warm water for 24 hours, expose it to heat over the fire till the greater part of the water is dissipated and supply its place by proof spirits of wine, which will combine with the isinglass. Strain the whole through a piece of open linen, taking care that the consistence of the mixture shall be such that when cool it will form a trembling jelly. Extend a piece of black or flesh-colored silk on a wooden frame, and fix it in that position by means of tacks or twine. Apply the isinglass—after it has been rendered liquid by a gentle heat—to the silk with a brush of fine hair. As soon as this first coating is dried, which will not be long, apply a second and even a third. When the whole is dry, cover it with two or three coatings of balsam of Peru. In Remington's *Pharmacy* will be found a cut of a machine for spreading plaster.

(2860) J. E. S. asks: 1. What is the derangement that causes itching in chilblains? A. The derangement is usually due to an inactive skin and poor circulation, as a consequence of warming hands and feet before the fire when they are cold and damp. 2. Why do they reoccur in the same spot? A. They occur in the extremities, where the circulation is poorest, and are red swollen patches which are the seat of severe itching and tingling. 3. What is the best remedy for the same? A. Increase the activity of the skin and general circulation by a generous diet, active exercise and friction. Rub on soap liniment, or equal parts of tincture of camphor compound and tincture belladonna applied night and morning. See next query.

(2861) R. P. B. says: About two years ago I saw in your paper a cure for chilblains which I tried with success. I have not had a return of them till now. I have a slight touch of them, and have forgotten the cure. A. *a.* Equal parts of tincture camphor compound and tincture belladonna, to be rubbed in night and morning. *b.* A saturated solution of salt in warm water is also good. *c.* Local faradization of the parts is also good. 2. After a cold the glands of my neck swell quite badly. Can you tell me the cause and what will stop it? A. The causes of gland enlargement are manifold. Hereditary predisposition and impairment of health are predisposing causes, but it is local irritation or inflammatory disease in organs or tissues with which these glands have a connection that the source of enlargement may frequently be traced. Treatment is to bring up the general condition of the system by use of iodide of iron in the form of pills or sirup (internally) and an external application of tincture of iodine over the swollen parts. If much pain be present, a useful liniment is one of equal parts of chloroform, belladonna liniment, laudanum, and spirits of camphor. See preceding query.

(2862) C. G. C. says: Would you kindly inform me of the medicinal properties, uses, doses, etc., of salol and exalgine? A. Salol (C_6H_4 (OH) $CO.OC_6H_5$) is a derivative of salicylic acid. One atom of hydrogen is replaced by the phenyl group. In the small intestine salol is broken up by the pancreatic juice, and yields 36 per cent phenol and 64 per cent salicylic acid. Salol is largely used as a substitute for salicylic acid in rheumatism and neuralgic affections, and as an internal antiseptic in the treatment of typhoid fever, etc. Dose—1 to 2 grms., or 15 to 30 grains, smaller doses being preferable. Exalgine is a derivative of the aromatic series discovered by Brigonnet. It is prepared by the action of methyl iodide on sodium acetanilide. In its physiological action it resembles antipyrine. It is used more for the relief of neuralgic pains than it is to reduce fever. It is also said to decrease the amount of sugar in diabetes. Dose for an adult 10 grains.

(2863) W. J. R. asks: 1. What is chloride of calcium? A. A chemical salt, a compound of chlorine and calcium. 2. Is it liquid or solid? A. Solid, easily soluble. 3. Where can it be obtained in large quantities, and at what price? A. At any wholesale druggist's; 10 cents a pound upward, according to quality. 4. Is it ever used to absorb moisture, and with what success? A. Yes; with good success. 5. What is the best substance known for absorbing moisture? A. Phosphoric anhydride, the pentoxide of phosphorus.

(2864) A. W. L. says: Will you please tell me what horse leek is? In reply to query No. 12, June 14, 1887, SCIENTIFIC AMERICAN, the name is used. I have searched almost everywhere for the information without obtaining satisfactory result. A. Horse weed we think is the term you mean. It is called also Ambrosia trifida, horsecaws, bitterweed. It is an annual, flowers in August and September. It is found in low grounds from Canada to Georgia, and west to Louisiana and Arkansas. An infusion made from this weed has been recommended locally in mercurial salivation. *Sempervereum testorum*, or house leek, is indigenous to the Alps. It now grows throughout Europe on old walls and houses and is cultivated in North America. The leaves have an acidulous taste and contain malates. House leek is refrigerant, antispasmodic, astringent. Its expressed juice was once used in dysentery and hysterical disorders. Externally it is used as a dressing for ulcers and chronic skin diseases and hemorrhoids. It is also used to soften corns and warts.

(2865) Oakland asks how to solidify pure charcoal (spherical or spheroid) for filtering purposes. A. Mix charcoal dust with molasses, press into shape, and bake at a red heat in a closed vessel. The block should be embedded in charcoal dust. There must be some outlet provided for gases; the closing of the vessel must not be hermetical. Sand or ground pumice may be mixed into the composition to increase its porosity.

(2866) R. N. asks: What acid or acids will dissolve pure gold into a soft, spongy mass? A. Gold is dissolved by a mixture of hydrochloric acid with an oxidizing agent such as nitric acid. On evaporation it may be thickened, but with danger of decomposing the soluble chloride of gold.

(2867) A. J. W. asks: Will you please inform me of a cure for red pimples in the face? A. Pay strict attention to diet and habits of life, avoid rich, highly seasoned, indigestible foods, take ordinary tonics, and especially arsenic. The most efficient local application is a saturated solution of boric acid in alcohol, washing the face but once a day in warm water. Dry with a soft towel and apply the solution. This (the boric acid solution) may be applied three or four times daily. Rochelle salts in water are also a good external application.

(2868) N. O. P. asks: Can you tell me of any medicine that will reduce flesh without injury to health? I have tried all kinds of exercise, but I keep gaining all the time, till I am commencing to feel clumsy. A. Systematic exercise, strict attention to diet, avoiding starches, sweets, malt liquors, wines, etc. Drink freely of alkaline mineral waters, and take (if an adult) ¼ grain of potass. permanganate twice daily.

(2869) A. G. asks: Can you tell me how to congeal gasoline so it will be thick like lard, and it looks white, just about like lard? A. Some petroleum can be thickened by emulsion with aqueous extract of slippery elm bark or with a strong solution of glue. We doubt if you will succeed with true gasoline.

NEW BOOKS AND PUBLICATIONS.

FINANCIAL REVIEW. Annual. 1891. William B. Dana & Co. Office *Commercial and Financial Chronicle.* New York, N. Y. Pp. 156.

This work is an excellently arranged and systematized review of the railroad business of the country for the past year. It gives the finances of each road in a detailed statement, with a tabular statement in brief at the top of the pages of the statistical part. It is preceded by treatises on the past year, business and speculation, and general financial and commercial topics. Numerous railroad maps are given to show the routes of the different railroads described. The statements of highest and lowest prices of railroad bonds in New York (monthly for five years), and of stock and bond quotations in this city and other markets, Boston, Philadelphia, and Baltimore, is a particularly attractive feature.

THE CRYSTAL BUTTON, OR ADVENTURES OF PAUL PROGNOSIS IN THE FORTY-NINTH CENTURY. By Chauncey Thomas. Edited by George Houghton. Boston and New York: Houghton, Mifflin & Co. 1891. Price $1.25.

This work is offered as a companion piece to Edward Bellamy's "Looking Backward." It very ingeniously depicts the supposed advances in science and art that are to come, and treats of governmental relations to the people, which, like all his class of writers, he depicts as very uncomfortably close. The less governed the best governed is a maxim foreign to all this school from the days of Sir Thomas More to the Bellamy epoch. It is very graphically written, and will be found interesting reading.

PRELIMINARY SURVEY AND ESTIMATES. By Theodore Graham Gribble. London: Longmans, Green & Co. 1891. Pp. xx, 420. Price $2.25.

The subject of rapid survey of large regions of uncivilized country, the preliminary work of reconnaissance and kindred subjects form the topics of this work. The practical way in which so eminently practical a subject is treated, and the description of the application of special methods to what may be called the rough work of surveying and topography, give its value to the work and indicate its general scope. We believe the work will be acceptable to many civil and military engineers.

A YEAR BOOK OF FACTS ON DRY GOODS.—The Textile Publishing Company, New York City, have issued a year book for 1891, containing statistical tables important to the dry goods trade. It contains a valuable compendium of the new tariff law and abstracts of the banking, interstate commerce, and recent decisions by the Treasury officials and Board of Appraisers.

TO INVENTORS.

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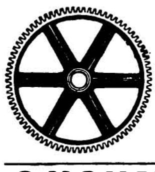

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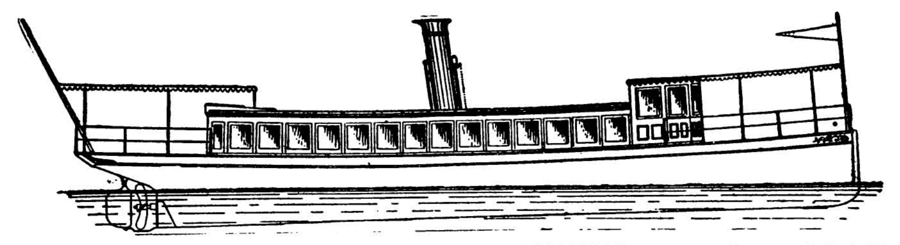

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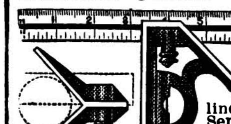

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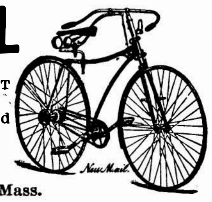

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