SCIENTIFIC AMERICAN

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THE METROPOLITAN TELEPHONE CO.'S NEW CENTRAL STATION AND GREAT SWITCHBOARD.

The Metropolitan Telephone Company, of New York, have recently erected a new central station building in Cortlandt Street, which is of special interest as embodying the latest improvements in telephone central station work and accessories, as well as containing the largest switchboard in the world. At present about 2,500 subscribers use it, but all the connections are prepared for 6,000, and the board can be extended so as to include 10,000. The building is fireproof throughout.

The cellar is excavated under the sidewalk and roadway of the street. In its front end are the terminals of several subway conduits partially occupied by cables. At present forty-nine lead-incased cables enter the building (Fig. 1). Each cable contains about one hundred wires, arranged in pairs, the wires of each pair being twisted about each other.

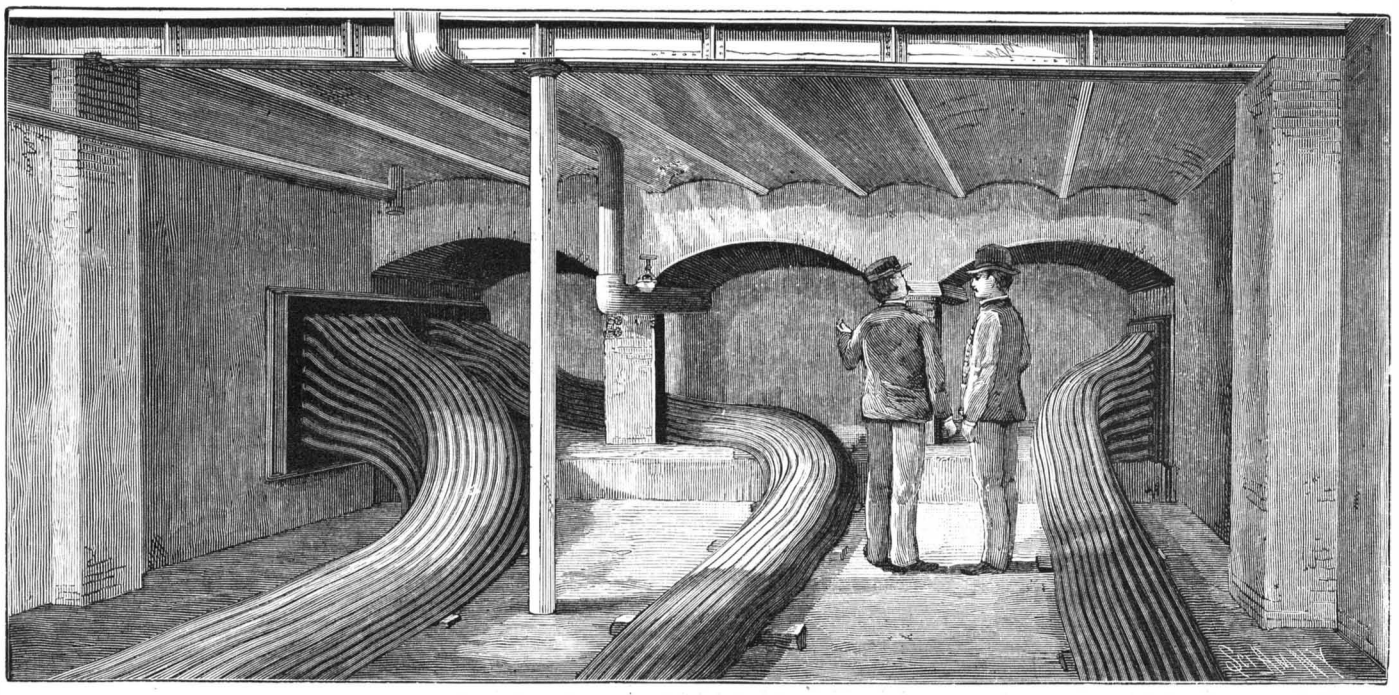

Fig. 1.—CELLAR, SHOWING TERMINALS OF SUBWAYS AND ENTRANCE OF TELEPHONE CABLES.

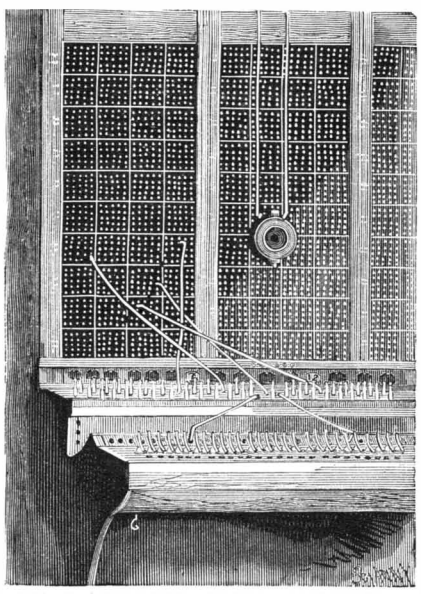

Fig. 2.—ARRANGEMENT OF SPRING JACKS, SWITCHES, AND ANNUNCIATORS ON SWITCHBOARD.

The object of this disposition is to ultimately use the wires in complete metallic circuits, the twisting of each pair being for the purpose of reducing induction. At present ground circuits are generally used, so that nearly one-half of the wires in these subways are idle. The cables run thence to the testing room (Fig. 7). The wires from the street lines are connected to binding screws. House cables run up from this room to the top of the building, where the switchboard is placed. The ends of the street cables are opened, and the pairs of wires are kept separate, and, by testing with a bell and battery, are traced to their out-door terminals. Each pair is numbered, and connected through the box with corresponding binding screws. The same operation is performed in the build-

(*Continued on page* 199.)

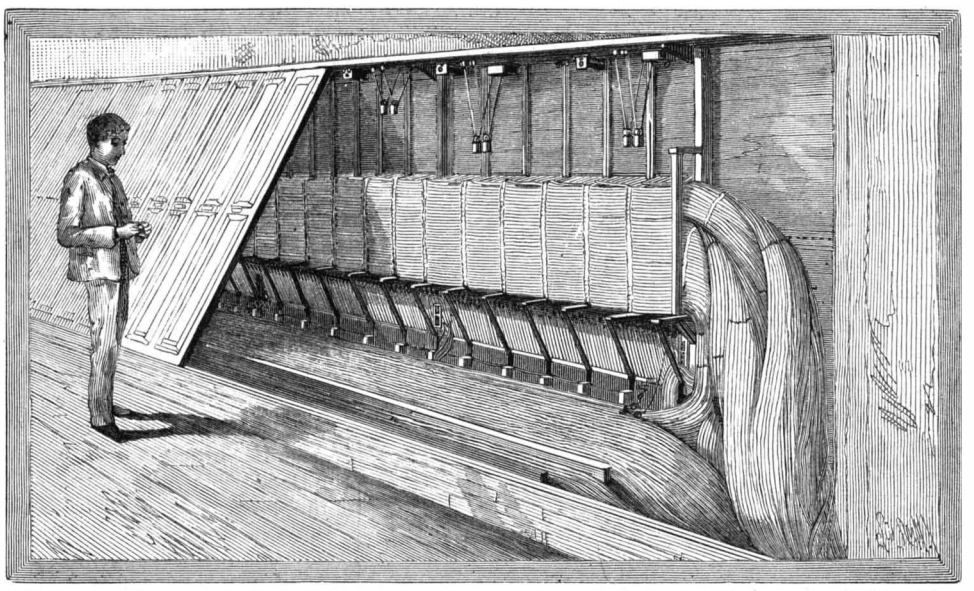

Fig. 3.—REAR VIEW OF SWITCHBOARD, SHOWING CABLES.

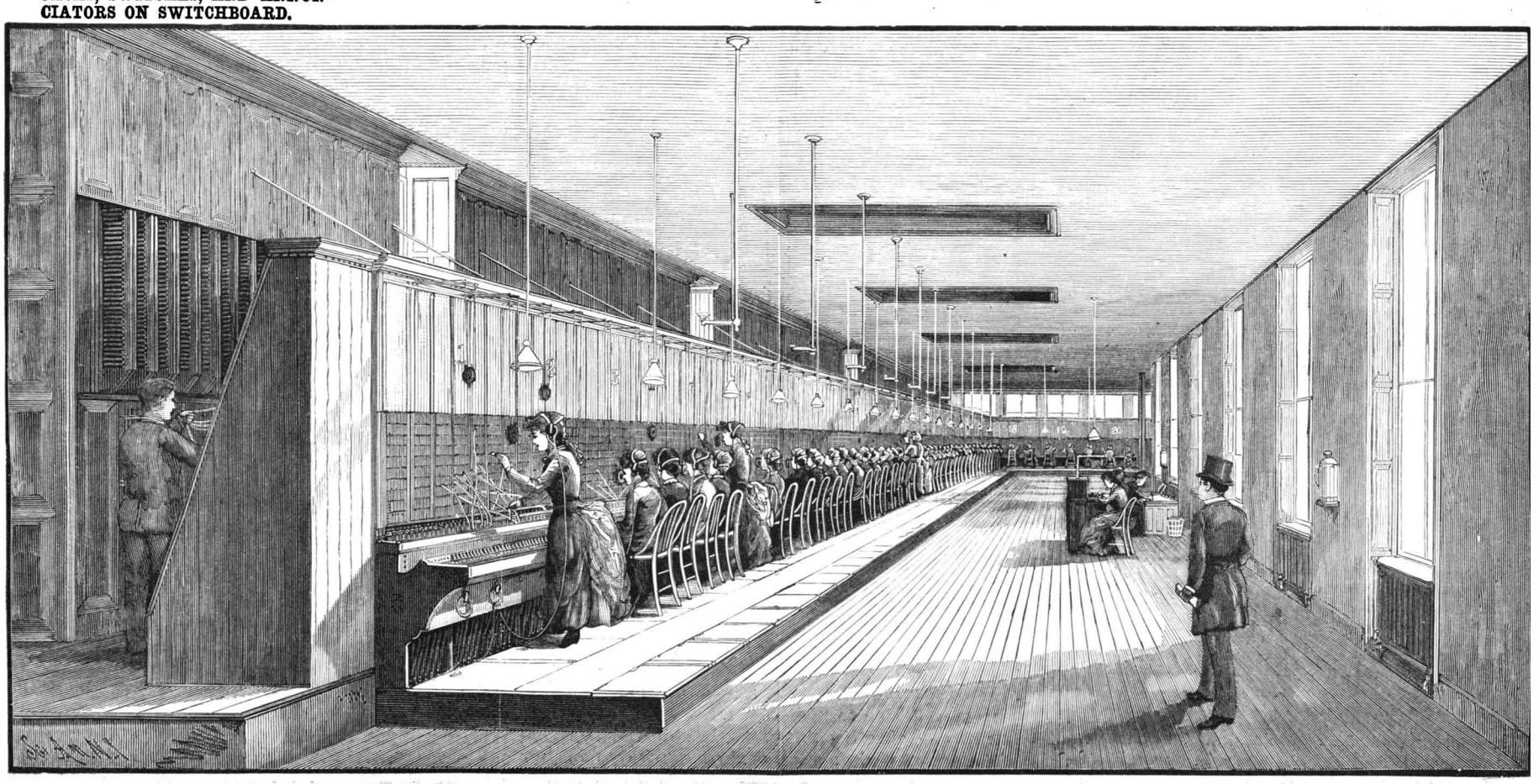

Fig. 4.—NEW CENTRAL STATION OF THE METROPOLITAN TELEPHONE CO., N. Y.—THE GENERAL EXCHANGE.

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NEW YORK, SATURDAY, MARCH 30, 1889.

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(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 691.

For the Week Ending March 30, 1889.

Price 10 cents. For sale by all newsdealers.

THE NEW COMMISSIONER OF PATENTS.

The President has appointed Mr. Charles E. Mitchell, of Connecticut, to be Commissioner of Patents. Mr. Mitchell is a man of the highest ability, wide influence, exalted character, clear judgment, a successful and experienced patent lawyer, and prompt and vigorous in action. No one could be better qualified for the duties of the Commissionership. Mr. Mitchell is about 53 years of age and a native of Bristol, Conn. He is a graduate of Brown University. He has occupied several important public positions, among them that of State Senator, but for the most part his energies have been devoted to the practice of patent law. His nomination as Commissioner of Patents gives general satisfaction. It is conceded on all sides that under his administration the affairs of the Patent Office will be ably conducted.

WAR MATERIAL OF AMERICAN DESIGNING.

The world moves so fast and improvements follow one another in such rapid succession that the work of original designers is often lost amid a maze of modifications, and the imitator becomes famed above the artist. If we turn to modern war machinery, we shall find apt illustrations of this, and in most of the effective material in the great European armaments behold the cunning fashioning of the Yankee inventor. Admiral Porter has told us that the guns at Hampton Roads—the Monitor and Merrimac fight—resounded through the world and announced to the British that their great steam fleet—the finest in the world at that time—was obsolete. The great iron fleets of to-day have been developed from this Monitor germ. The liquid compass, that makes it possible to navigate iron and steel ships, is the invention of Mr. Ritchie, of Brookline, Mass.

The world talks of the Krupp gun, yet how few are aware of the fact that it was only through the invention of the American Col. Bradwell that Herr Krupp was enabled to make his guns effective? Gen. S. V. Benet, Chief of Ordnance, U. S. A., speaking on this subject, says:

"All modern steel guns are of one or two systems, either the Krupp bolt system or the interrupted screw used in the French service. Our guns are of the latter system, which seems to offer the greatest advantages. Like all good modern inventions, it is an American one. So, for that matter, is the Krupp, or rather what gave Krupp's invention the practical value. The great trouble with the Krupp gun was the escape of gas at the breech. This was overcome by the aid of the 'Bradwell plate,' the invention of Colonel Bradwell,* an American who sold Krupp the invention. It consists of a thin steel plate, with elastic edges, that fits in the breech, and the pressure of the gas wedges it tightly against the sides and prevents the escape of gas."

The machine gun, that terrible weapon now so important a part of the great European armaments both on land and sea, is primarily an invention of the American, Dr. Gatling; the French mitrailleuse is a modification of it, so is the Nordenfelt. In June, 1883, Nordenfelt brought suit against Gardner, inventor of the Gardner machine gun, for infringement. Gardner showed that the principles on which the Nordenfelt gun was constructed had long been developed in the American Gatling machine gun and Winchester rifle, indeed long before 1873, when Nordenfelt got his English patent. It may fairly be said that this principle has found its highest development in the automatic gun of the American, Hiram Maxim, a gun which will fire 600 shots a minute; the recoil being utilized to load and fire and to keep a stream of water moving about the barrels for cooling. The disappearing gun mechanism is also his invention. The screw propeller, an invention that makes it possible to sink the motive power of a war ship, within and without, out of range of flying shot, though first tried in British waters, found no favor till Captain Ericsson came hither. The revolver, now in universal use, is, as everybody knows, the invention of Col. Colt, of Connecticut. We may add to the list the dynamite gun, yet in the infancy of its development, and the dynamite cruiser, intended to make up for its shortcomings in point of range, of which an English authority recently said there was not, probably, a ship afloat that would be safe before it. The torpedo, now holding so important a place among war material, was first made practicable and effective during our last war; its cousin, the automobile torpedo, of comparatively recent designing, is also American, though there are several foreign forms of the same.

WANTED—A FIRST CLASS GUN.

Now that we are building a new navy, and Congress, with the people at its back, ready to grant the money, there is more encouragement for inventors of war material than at any time since the civil war. In the matter of ships and guns alone there is a large and rich field for ingenuity. Admiral Porter and other reliable authorities say that among the great modern European fleets, of which we have heard so much, there is not one effective line-of-battle ship—an assertion which recent performances of these unwieldy monsters in sham battle seem to fairly sustain; and there are other authorities, and good ones too, who insist that the big guns of these same fleets are constructed on a false interpretation of the natural laws, and that, when they are put to a severe test, will fail.

"Gun tests in Europe," says a writer—an ordnance officer—"are private affairs. Guns fail without the fact becoming known outside of the small circle of officers assigned to be present at the butts. Who can say how many of these failures there are?"

For long it has been known that there was something amiss at the great gun works at Terre-Noire, and recently the cause has appeared. The French, who long since adopted the American (Rodman) system, began at these works to construct guns on the built-up plan, but there were so many failures—the test being only forty rounds—that the project was given up. And of this Rodman system some of the best authorities say it has no equal, and may be applied to cast steel as well as to iron. By it guns are cast hollow and then cooled down from the interior, so that the interior, being first solidified, is compressed and supported by the contraction of the outer parts when they subsequently cool down. A gun thus made being fired, the compressed inner portions expand under the influence of the powder gas to and beyond their natural diameter, the strain going at once to the outer parts. By this system, it is said, a 200 ton gun may be made just as securely and surely as one of the old 15 in. or 20 in. smooth bore guns.

Mild cast steel is thought by many to offer superior advantages for great-gun making, being stronger and more homogeneous than wrought iron. It is stronger, too, than cast iron, though not more homogeneous. Mr. William Metcalf, for many years connected with the old Fort Pitt foundry, and now engaged in making steel, speaking of the application of this famous system of casting to steel, says:

"If ordnance constructors could only be made to understand that cast steel is only cast iron refined and strengthened; that every rule, every property, every characteristic, of one is common to the other, only differing in degree; if they would realize that Rodman reached the perfection of science in manipulating crystalline metal, American guns of cheap cost and sure value would soon be as far ahead of the composite failures of Europe as the great cast iron Columbiads of our war days were ahead of anything the world had ever seen up to that time. It has cost Europe many millions of dollars to secure a feeling of safety against those old Rodman guns, and yet there is not a really safe, well designed, mechanically constructed great gun in Europe to-day, and it is safe to say there never will be one that is made by hammering or pressing. What America needs is another Rodman to develop his principles again, and so place our armament away in advance of anything that has been done anywhere in the world."

POSITION OF THE PLANETS IN APRIL.

VENUS

is evening star until the 30th, and then morning star. She is in inferior conjunction with the sun on the 30th, at 9 h. P. M., passing between the earth and sun, and reappearing on the sun's western side. Her charming presence in the western sky will be greatly missed, for she has reigned there without a rival for many months, but she will be equally brilliant in the eastern sky as morning star, passing through the same phases in reversed order. Venus sets on the 1st at 9 h. 35 m. P. M. On the 30th she rises at 4 h. 33 m. A. M. Her diameter is 43″.2, and she is in the constellation Aries.

JUPITER

is morning star. He is on the meridian on the 1st, at 6 h. 32 m. A. M., and at the close of the month will rise soon after 11 o'clock in the evening. His size and brilliancy are increasing as he approaches the earth, and he is at this stage of his course a beautiful star from midnight till dawn, well worth the trouble of rising early to behold. Jupiter rises on the 1st at 1 h. 11 m. A. M. On the 30th he rises at 11 h. 20 m. P. M. His diameter on the 1st is 37″, and he is in the constellation Sagittarius.

SATURN

is evening star. He is on the meridian on the 1st, at 8 h. 23 m. P. M., is retrograding, and slowly increasing his distance from Regulus. On the 13th he is stationary, and on the 17th he changes his course, moving eastward and approaching the bright star. Saturn sets on the 1st at 3 h. 25 m. A. M. On the 30th he sets at 1 h. 32 A. M. His diameter on the 1st is 18″.2, and he is in the constellation Cancer.

URANUS

is morning star until the 9th, when he becomes evening star. He is in opposition with the sun on the 9th, when he is at his nearest point to the earth, as far from the sun as possible, rising at sunset and setting at sunrise. He may be readily found on account of his vicinity to Spica, the brilliant star that rises about sunset in the southeast at the time of his opposition. Careful observers will find Uranus about 2° north of Spica, shining as a star of the sixth magnitude. A small telescope will transform the tiny star into a small sphere of a

* According to the patent, this should be Broadwell.

delicate green tint. Uranus rises on the 1st at 6 h. 54 m. P. M. On the 30th he sets at 4 h. 5 m. A. M. His diameter on the 1st is 3".8, and he is in the constellation Virgo.

MERCURY

is morning star until the 25th, and after that time evening star. He is in superior conjunction with the sun on the 25th, passing beyond the sun, and reappearing on his eastern side to pursue his short course as evening star. Mercury rises on the 1st at 5 h 6 m. A. M. On the 30th he sets at 7 h. 24 m. P. M. His diameter on the 1st is 5".6, and he is in the constellation Aquarius.

MARS

is evening star. He approaches the sun with laggard steps, and ceases for the present to be of any account for terrestrial observers. Mars sets on the 1st at 8 h. P. M. On the 30th he sets at 7 h. 54 m. P. M. His diameter on the 1st is 4".2, and he is in the constellation Aries.

NEPTUNE

is evening star. He sets on the 1st at 10 h. 16 m. P. M. On the 30th he sets at 8 h. 27 m. P. M. His diameter on the 1st is 2".5, and he is in the constellation Taurus.

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

The Cause of Earthquakes.

At a recent meeting of the Manchester Geological Society, Mr. Thomas Oldham read a paper on "The Cause of Earthquakes, of Dislocation and Overlapping of Strata, and of Similar Phenomena." The author said this was a subject which had caused much perplexity and doubt in the minds of many eminent geologists, in endeavoring to account for the cause of some of the greatest phenomena in nature continually taking place. These were the cause of earthquakes, the dislocation and overlapping of strata, and the submerging and upheaval of continents, etc.

The hypothesis he intended to submit was based upon purely physical laws, and he had often felt surprised that such views had not previously been promulgated. He must premise by stating it had been ascertained that this globe is about nine miles smaller in diameter at the poles than at the equator; in the next place, it was known that the globe rotates on its axis at about 26,000 miles every twenty-four hours, which is nearly equal to the speed of a cannon ball.

Another thing that had been ascertained was that the axis of the globe is gradually altering by becoming more oblique, and that it requires about 39,000 years before this alteration arrives at its maximum. When they took into consideration the great velocity at which the globe rotates, it was evident that a large amount of centrifugal force must be exerted, and as Nature never did anything without a motive, it would be seen that this force is the cause of the globe being nine miles different at the equator and the poles. As the axis got gradually more oblique, so the direction of the equator would alter.

It is supposed that the crust of the earth is only about fifteen or sixteen miles in thickness, and below that distance there is a mass of incandescent minerals. This has been proved, in one way by mining, where they find in sinking the first 1,000 feet the temperature rises very considerably, and becomes greater as they get lower. In order to bring these things practically before them, he would suppose a model to be made to represent the globe in exactly the same proportions as they stood toward each other, and for this purpose he would take a mass of some plastic material, say potter's clay, of sufficient consistency to allow of its being formed into a sphere of about 9 feet in diameter; he would then pass an iron rod through it, and connect the whole with a steam engine to obtain the required motion. If they gradually raised one end of the axis, the equator would get more oblique, and more toward the north or south as the case might be. It is known that centrifugal force acts not only at right angles to the earth, but has also a lateral motion.

Astronomers told them that the deviation of the axis arrives at its maximum every 39,000 years, so that consequently the south pole, when the climax occurs, would occupy the place where the north pole is now.

It was supposed that the last great climax was a glacial one, and there are plenty of evidences to prove this. In the river Amazon, which is now exactly on the equator, there are many evidences of glaciers, and in like manner these are also come across in northern latitudes. When they looked upon human life in comparison with geological ages, the life of a man seemed but an atom, and their historical records only went back 2,000 years, anything further being purely legendary. It was supposed that at one time the spaces now occupied by the Atlantic and Pacific Oceans were large continents, and when naturalists go up mountains, they frequently come across beautiful specimens of conchology which could only have got there by the upheaval of oceans. These changes, the author concluded, were the source of much perplexity to geologists, and were of great interest.

Northern Pacific Railway—Canadian Extensions.

There is a new factor in Canadian railway enterprise in the introduction of a series of lines promoted by the Northern Pacific. This company, whose transcontinental line from Tacoma on Puget Sound to Duluth on Lake Superior is the main competitor of the Canadian Pacific, proposes to construct a series of railways in Canada which will afford a new outlet from the great Canadian Northwest wheatfields to the Atlantic, and will seriously interfere with the existing arrangements of the Canadian railways, and completely destroy the monopoly held by the Canadian Pacific over certain districts in the Northwest.

The question of the level crossings of the Northern Pacific extensions in Manitoba, bitterly fought through all the courts of law, and settled adversely to the Canadian Pacific, has stirred up an amount of irritation against the latter company which is not shared alone by the Northern Pacific, and this year that railway is promoting a series of acts in the different legislatures that point to a very important increase in the mileage and importance of these Canadian extensions.

The Northern Pacific lines actually built or building comprise at present three lines in Manitoba, the first from Winnipeg city to the boundary line due south about 65 miles, where it connects with a branch of their railway, forming an independent line between Winnipeg and St. Paul. This line is finished and working. By an arrangement with the Hudson's Bay Company the railway secured an excellent block of land in the heart of the city of 30 acres with a water frontage on the Assiniboine River, on which elevators and warehouses have been built, and extending across to Main street, on which the company propose this season to build a capacious central hotel with a first-class railway station and running shed behind it for their trains, forming for both purposes decidedly the best location in the city.

Branching from this line immediately south of the Assiniboine River, which is the southern limit of the city, the second line turns off, and running due west again crosses the Assiniboine in 60 miles, and in five miles more reaches Portage la Prairie, where it crosses the main line of the Canadian Pacific to a junction with the Manitoba and Northwestern Railway, which commences at Portage, and is now open about 250 miles in a northwest direction toward the comparatively well settled farming district of Prince Albert on the Saskatchewan River. This line, 65 miles long, is graded, and the rails will be laid early this spring. A third line, on which at present but little work has been done excepting the acquisition of the right of way, commences at Morris on the first line about 20 miles north of the International Boundary, and runs northwest about 130 miles to Brandon, where a second crossing of the Canadian Pacific enables it to form a junction with the Northwest Central Railway now making to Battleford. All these lines are building or built under the authority of acts passed by the Manitoba Legislature, but as the Canadian Pacific have raised the question of the validity of these charters (although the only two branches they have constructed themselves in Manitoba have been under the same authority), the Northern Pacific have an act before the Houses at Ottawa giving them the fullest powers, which doubtless will become law, and overrule these objections.

Besides this, they are obtaining power in the local legislature to extend a branch from the Morris and Brandon Railway to the Souris coal field in the southwest of the province; and in the Quebec Legislature they have three bills, which, if presented and completed, will give the Northern Pacific and the Grand Trunk—for it is an open secret that they are working together in these extensions—a new line from Ottawa direct to a port on the Gulf of St. Lawrence, 500 miles nearer to Europe than Quebec or any other Canadian port excepting Halifax, and open for a much longer season than any part of the St. Lawrence. For the interest of Canada this extension to the peninsula of Gaspe is very desirable, and it places the whole Atlantic connection between Canada and Europe on a much better footing than it now is, bringing the nearest port to a point only 2,000 miles distant from Ireland, and opening up to commerce the excellent harbor of Gaspe, one of the finest and most capacious ports in existence, but at present useless for general commerce.

The Northern Pacific during the last twelve months have very much improved and consolidated their system, and though the total mileage is not much increased, only 77 miles during the year, many of the short lines built are of great importance to the whole system. The short line from Pasco to Kennewick substitutes an all-rail route for their through traffic for an objectionable ferry over the Columbia River, the bridge over which consists of nine steel spans of 250 feet each and one drawbridge of 235 feet opening.

The rapidly increasing ocean traffic from the Pacific has necessitated some extensive alterations at Tacoma, the western terminus, where nearly three miles of additional sidings with other conveniences and extensions have been made during the year. The increasing development of the mining industry of the eastern slope of the Rocky Mountains has required a complete rebuilding and remodeling of the station and yards at Helena, which is now the principal intermediate station on the transcontinental line, and where six miles of additional siding accommodation has been made. An important line, the Central Washington, is under construction through what will shortly be a new State, and a line from Cheney to Devonport, 40 miles long, is nearly complete. Altogether, the past year has been a prosperous and important epoch in the development of the Northern Pacific.—*Engineering.*

Prizes for New Inventions.

A grand exhibition of safety apparatus is to be held at Berlin next summer, and the magnitude and importance of the undertaking is beginning to be appreciated. Until recently its character and scope were misunderstood. It is not to be a mere collection of apparatus and devices for the protection of the persons of workpeople, brought together to promote the interests of a small number of manufacturers. It will be rather a great industrial exhibition, superior to any yet held in Germany. A number of industrial operations will be carried on within the spacious building now in course of erection. Among these will be spinning, paper making, corn grinding, brewing, chocolate making, shaft sinking by the Pœtsch freezing process, and other mine engineering work. This exhibition may be justly regarded as international.

Prizes have been offered for the following inventions: A prize of $2,500 for a satisfactory means for preventing the inhalation of dust in mills for grinding basic slag, a prize of $1,000 for a similar means applicable to the mercury vapor in mirror factories, and several smaller prizes for a more efficient brake for the wheels of brewers' drays.

Analyzing Steel and Iron for Structural Purposes.

The extreme accuracy required in the chemical analysis of steel and iron for structural purposes has become so great that chemists find that the errors of weighing, also those which are personal to the operator, and those due to the process employed, are sufficient to cause considerable confusion in a comparison of the results of analyses. To remedy the evil, the *Railway Review* states that Prof. J. W. Langley has proposed that a system of international standards of iron and steel be obtained, and his plans have met with approval. The method of procedure is to have a number of ingots of steel cast in lots whose composition shall be as near as possible 1·3, 0·8, 0·4, and 0·15 per cent of carbon respectively. These lots are kept separate. The skin of each ingot is to be removed and the metal then cut into fine shavings, which shall be crushed, sieved, and intimately mixed. These shavings shall then be hermetically sealed and an equal portion sent to each of the five countries which have entered into the plan, namely, Sweden, Germany, England, France, and the United States. The committee in each country shall then carefully analyze their samples, and averages of all the analyses of each lot be taken as the correct ones. The remainder of the metal in the hands of the committee shall then be held for distribution in the countries in which they are located. A chemist, by an analysis of a sample thus obtained, can find a factor by which he must multiply his results to make them agree with the international standard.

The Decimal or Metric System.

The metric system is about 100 years old, it having been first proposed in 1790. Since its introduction it has been adopted by the following countries: France, French Colonies, Holland, Dutch Colonies, Belgium, Spain, Spanish Colonies, Portugal, Italy, Germany, Greece, Roumania, Mexico, New Granada, Ecuador, Peru, Brazil, Uruguay, Argentine Confederation, Chili and other South American States, Austria, Norway, Sweden, Switzerland, Venezuela, Hayti, Mauritius, Congo Free State.

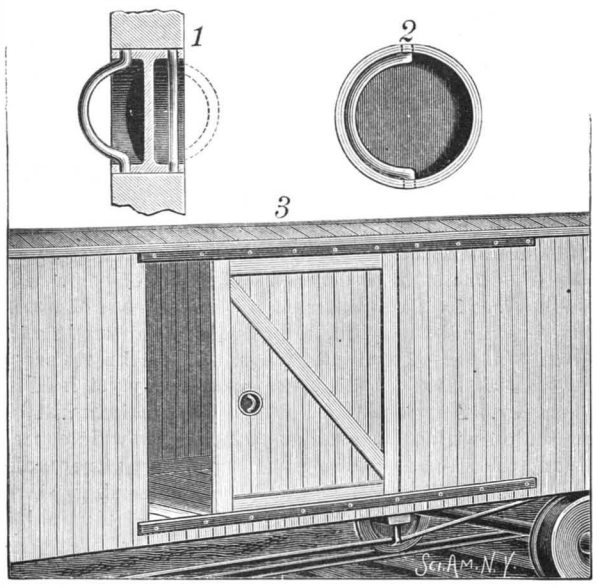
Its use is permissive in Great Britain, India, Canada, and the United States.

There are no tables connected with this system; none are necessary; one unit is tenfold another unit. The whole system can be stated in a single sentence: Measure of lengths, in meters; measure of capacities in liters; measure of weights in grammes; using decimal fractions for divisions. The measure for land is the square of the measure for length, the square of a chain of ten meters giving 100 square meters as a unit for land measure; and the square of 100 meters is the agrarian unit, equal to about two and a half acres.

THE hygroscopic quality of table salt, and its tendency to pack together in cruets and containers, may be entirely overcome by thoroughly drying the salt and intimately mingling with it a small percentage of dry corn starch or arrowroot. From 8 to 10 per cent is amply sufficient for the most humid atmosphere (as on the sea coast), while a much less percentage of the starch is sufficient for inland points.—*St. L. Med. and Surg. Jr.*

IMPROVED HANDLE FOR SLIDING DOORS.

A door handle constructed upon the general principle of drawer pulls, in which the handle is in the form of a hinged ring pivoted to a concave or recessed plate, so as to close inside of the same, is illustrated herewith, and has been patented by Messrs. Peter Scheer and John G. States, of Bliss, Neb. A circular band of the

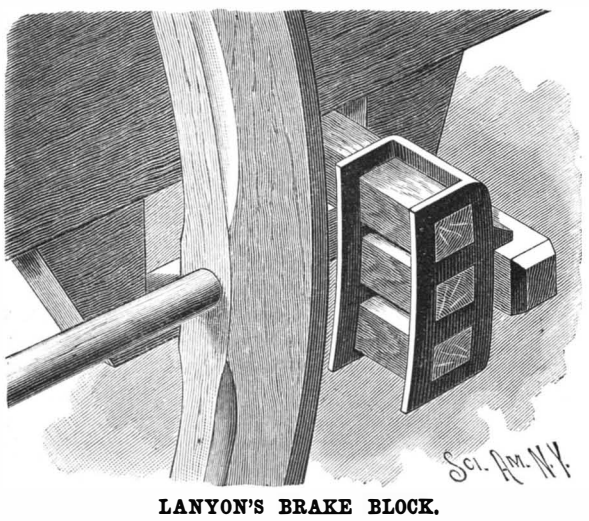


SCHEER & STATES' SLIDING-DOOR HANDLE.

thickness of the door, as shown in Fig. 1, forms a part of the handle, this band being divided by a transverse partition. Upon opposite sides of this partition the band is fitted with two hinged or pivoted loop-shaped independent handles, arranged so that they may be turned out for operating the door, or swung into the band, where they will not come in contact with the door casing, and so that if either handle should strike the casing it will readily swing into its recess out of the way. The band may be secured in the door by screws or otherwise, and its central partition may be cast integral with the band.

AN IMPROVED BRAKE BLOCK.

A brake block which combines separated wooden rubbing or bearing blocks with a metal frame by which they are carried is illustrated herewith, and has been patented by Mr. Robert H. Lanyon, of Carterville, Mo. The frame is of sufficient width to receive the tire portion of the wheel for any desired distance on



LANYON'S BRAKE BLOCK.

its periphery, to which the frame is curved to conform, and each side of the frame has a series of rectangular openings adapted to receive separated wooden blocks. The back of the frame has a slot in it for a bolt by which the brake block may be attached to the usual brake beam, the back also having a lug adapted to rest on top of the beam, serving to keep the brake block from turning upon the bolt. The separate wooden blocks can be readily placed in position and easily replaced when worn, the spaces between them serving to catch mud or grit from the wheel and thus cause the brake, when applied, to take a firm hold.

Kansas Salt.

In a recent interview with Prof. M. Swenson, the *Item* obtained information as to the Kansas salt mines which is interesting.

About eighteen months ago, while boring for natural gas at Hutchinson, the machine passed through a vein of salt about 400 feet thick. Oil was found some distance below this vein. Kansas went wild at the discovery of oil, but the excitement soon died away, as the supply was too insignificant for profitable working. Attention was then turned to the salt vein, situated 350 feet below the surface. Surveys and borings made over a large extent of country indicate that the vein is over 300 miles long, 25 miles wide, and 400 feet thick, and that it is composed of the purest quality of rock salt.

Steps were at once taken to utilize some portion of this vast deposit, and there are now in operation eight large salt companies at Hutchinson, besides numerous others in Sterling, Anthony, and other Kansas towns.

The way of obtaining the salt is not by mining, as at Avery's Island, although preparations are being made to resort to that system. The present method is to bore a hole down into the salt bed. In this hole a double pipe is inserted. Through the inner tube water is pumped down into the salt, and in the form of concentrated brine is forced up through the space between the inner and outer tube. The brine is evaporated in open tanks of enormous size. One of these, built at Fort Scott recently, is 80 feet in length by 30 in width. Fire is applied under the tanks, but very little fuel is required, as the brine is already highly concentrated. As the water is evaporated the salt is raked up on the flaring sides of the pan, where it is dried and put up in barrels or other packages. Kansas salt now monopolizes the Kansas City market, where it is laid down, freights paid, at $4 a ton. The rapid development of the new salt industry has given great encouragement to the packing interests of the State, and some of the largest packing houses of the country have been established at Hutchinson, Wichita, and other points where cattle, hogs, and salt are all convenient to the packers.

Nitrogen.

There is a substance which is invisible, which has neither odor nor taste, and in fact possesses no qualities of matter except weight and bulk, says the *Journal of Chemistry*. This is the gas nitrogen, which constitutes four-fifths of the atmosphere which surrounds us. It is apparently a dead and inert form or manifestation of matter, and yet it is perhaps one of the most important and useful of the elements, and if it should vanish from the universe, life would cease to exist. This apparent paradox is explained by the fact that by its combination with other elements the remarkable characteristics of nitrogen are awakened into action. The gas is neither poisonous, corrosive, explosive, nutritious, nor medicinal; but combined with carbon and hydrogen it forms the deadly prussic acid; with oxygen and hydrogen, the strong corrosive nitric acid; with hydrogen alone, the strongly basic alkali ammonia; with carbon, hydrogen, and oxygen, the terrible explosive nitro-glycerine; and with the same elements in varying proportions, it forms the albuminoids, the gelatines, the glutens, and other strength-giving elements of our food, or the indispensable medicinal agents quinine, morphine, atropine, strychnine, veratrine, cocaine, and many others.

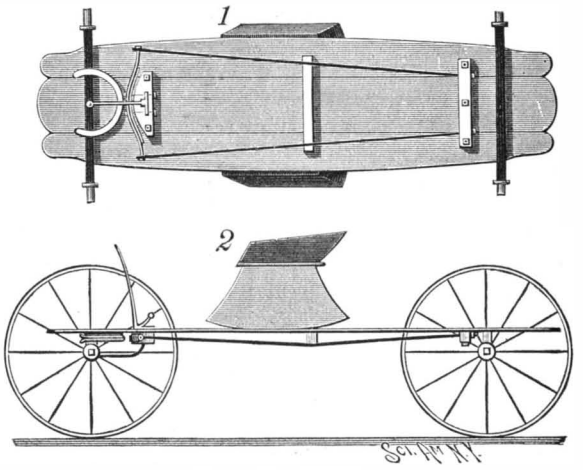
Although nitrogen is tasteless, it forms an indispensable part of the flavors of the peach, plum, apricot, and other delicious fruits, as well as coffee, tea, chocolate, and tobacco. Without smell, it is found in many of the most powerful and delicious perfumes, as well as in the nauseating odors of putrefaction, Present in immense quantities in the air, it furnishes little or no support to vegetation, but combined with other elements the amount present in the soil determines its fertility and the amount of crops that may be raised upon it. Colorless and invisible, nearly every dyestuff or coloring matter known contains it in a greater or less proportion. Harmless and powerless by itself, when combined with another non-explosive gas, chlorine, it forms the most powerful explosive known, of which a ray of sunlight is sufficient to arouse the terrible destructive power.

And yet, notwithstanding the pre-eminent importance of this element in the affairs of life, there are but few of its combinations which we can form directly. Millions of tons of nitrogen are all about us, but not a grain of morphine or theine, gelatine or albumen, aniline or naphthaline, can we make from it. Only the mysterious vital force working in the natural laboratory of the vegetable and animal organism can build up most of these molecules from their ultimate elements, and place the atoms of nitrogen in their proper position like the beams or stones of a building. Our wonder at the marvelous powers displayed by these organisms is none the less when we see what simple, common, and uncharacteristic elements are used by them in making up their wonderful products, and we can only say that it is a part of the great and unsoluble mystery of life.

Neither can we explain satisfactorily from a chemical standpoint the properties and reactions of this strange element. By itself it is nothing, but united with other elements, some almost equally inactive, the combinations thus produced manifest the most powerful and positive chemical and physical properties. It is like the springing into life of dead matter, but there is no system of chemical philosophy which can give a reason why it is so. It is the part of the chemist to observe and record the facts connected with the properties of different forms of matter, and in time we may from these facts construct a rational theory, but we are still a long way from a clear comprehension of the phenomena of the universe. There are about as many things in heaven and earth still undreamt of in our philosophy as there were in Shakespeare's time, and the further we advance toward the end, the more the field widens and appears to be of illimitable extent.

AN IMPROVED BUCKBOARD.

The construction of the vehicle herewith illustrated is designed to remedy the tendency in buckboards to become permanently deflected. It has been patented by Mr. James W. Lawrence, of No. 372 Broome Street, New York City. Attached to the under side of the board, near opposite ends, are two cleats, the cleat near the front axle having a convex forward surface, tc which a semi-elliptical spring is secured by bolts. To the extremities of the spring are attached rearwardly extending rods, which pass through the cleat near the rear axle, the ends of the rods being threaded, and having nuts for regulating their tension. Near the center of the board, and secured to its under surface, is a bridge piece, arranged to rest upon and deflect the rods, which act as truss rods, and serve to support the center of the board with greater or less pressure, according to the tension upon the spring. The contact of the spring with the convex cleat varies with the load, an increase of load bringing more of the spring into contact, rendering less of the spring active, and making it stiffer in its action to support the heavier

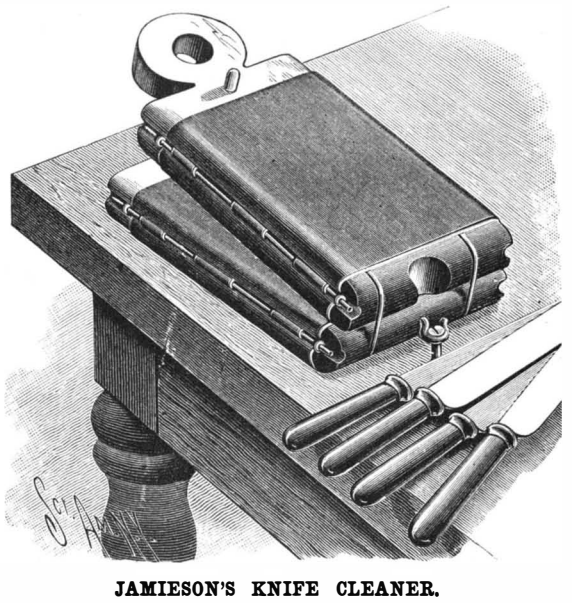


LAWRENCE'S BUCKBOARD.

load. Any deflection which should remain after overloading may be corrected by increasing the tension of the rods by turning the nuts upon their threaded ends.

AN IMPROVED KNIFE CLEANER.

A device to facilitate the cleaning and polishing of knives, by which the knife blades may be cleaned while wet and afterward be dry-polished, is illustrated herewith, and has been patented by Mr. Robert W. Jamieson, of Prince Albert, Saskatchewan, Northwest Territory, Canada. It is made with two blocks hinged together at one end to be turned and present differing opposing faces to each other, one face of each of the blocks having a woolen fabric covering, which will hold a knife-brick powder or similar material for the first cleaning of the knives, and the other face of each of the blocks having a leather or similar covering adapted to impart a bright finish to the knives. The cleaning fabric facings are preferably held to the blocks by pins passed through opposite edge portions, the pins being held in eyes within longitudinal grooves, so that the fabric may be readily removed when worn and replaced by new facings. One of the blocks has at its back end a hook adapted to engage a screw set into a table or other support, the other block having a recess at its back end to pass over this hook when the blocks are reversed. On one of the blocks is a projecting handle



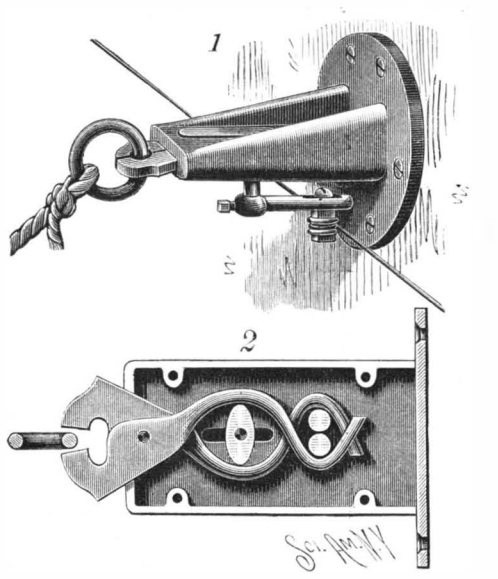
JAMIESON'S KNIFE CLEANER.

by which to press the cleaning or polishing faces together on the knife blade passed between them, and near this handle is a dowel adapted to enter a hole in the other block to bring their facings into operative position and steady the two blocks.

INDIA rubber is being tried as a substitute for asphalt in pavements in Berlin, and the result is said to be good, but expensive.

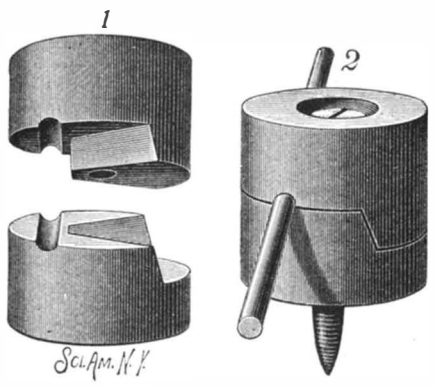
IMPROVED DEVICE FOR DETACHING ANIMALS.

A device by means of which animals may be simultaneously released from their fastenings in stalls in the event of fire, or as may be otherwise desired, without the necessity of the operator entering the several stalls,



KUBATZ'S DEVICE FOR DETACHING ANIMALS.

or even the building, is illustrated herewith, and has been patented by Mr. Ignatz J. Kubatz, of No. 164 East Ninety-seventh Street, New York City. The body of the device consists of a casing, permanently attached by means of a flange to the front of the stall or any suitable support within or adjacent thereto, as shown in Fig. 1. In the top and bottom plates of the casing are longitudinal recesses covered by a cap plate, the cap plate of the lower section sliding longitudinally. A pintle is passed up through an aperture in the sliding plate, and between the top and bottom plates an elliptical cam is rigidly fastened to the pintle, a lever being secured to the lower end of the pintle. Gripping fingers are pivoted near the outer end of the casing by a pin adapted to travel in the slots in the casing, and two stops are arranged side by side near the rear end of the casing, the gripping fingers being so bent upon



BROWN'S INSULATOR.

themselves as to form a central circular section surrounding the cam, as shown in Fig. 2, the forward ends of the fingers being hook-shaped, and the fingers being so pivoted that they are free to move one upon the other to close or open the hook section. When the device has been fixed in the several stalls, a rope, chain, or wire is attached to the several levers operating the pintles to which the elliptical cams are secured, such rope or chain leading to any desired point inside or outside of the barn. The normal position of the lever is parallel with the casing, and the cam is then in position to allow the outer ends of the fingers to be closed to retain the ring of a hitching rope. By pulling the rope, the levers are brought to a right angle to the axis of the casing, and the cam transversely thereto, which forces apart the gripping fingers, dropping the ring therefrom. To attach the animals again, the ring is inserted between the fingers and the lever swung back to its normal position, the striking of the lever upon the flange causing the cam-carrying pintle to travel forward in the casing and close the hooked ends of the gripping fingers upon the ring.

IMPROVED HOOD FOR STOVES OR RANGES.

The illustration herewith represents a device for conveying the steam, smoke, and disagreeable odors arising from a stove or range in cooking or washing to the chimney, thus preventing their spread through the house. It has been patented by Mr. Hermann Neef, of Jefferson City, Mo. A cone-shaped hood is employed large enough to cover a portion of the top plate of the stove, this hood being detachably connected with a telescopic pipe section by means of a bayonet joint. The outer lower edges of the hood have grooves, in each of which is held a removable wing, which may be turned back upon the hood when not in use, and which project downward and outward from the hood when in use, forming an enlargement of the hood, so that nearly the whole top of the stove may be covered thereby. The hood may, if desired, be furnished with wire gauze ventilators, and a damper is provided to cut off the connection between the telescopic pipe sections and the main stove pipe when the fire is being kindled. The hood is counterbalanced and held in any desired position of adjustment by a weight and a wire rope passing over pulleys and down through the pipe sections, the extremity being attached to the inner surface of the lower pipe section, while the pulleys may be attached to the ceiling of the apartment.

AN INSULATOR FOR ELECTRICAL CONDUCTORS.

An improved insulator for receiving electrical conductors and holding them firmly, without the necessity of using binding wires or of twisting them together, is illustrated herewith, and has been patented by Mr. Warren C. Brown, of Tarrytown, N. Y. The insulator consists of two halves, which together form a cylinder with a transverse aperture for receiving the wire, and an axial countersunk hole for receiving the screw supporting the insulator. The halves each have a semicircular groove, which, when the two grooves are clamped together, forms the transverse aperture for the wire.

A NOVEL NUT LOCK.

The nut lock is one of the inventions which depends for its commercial value quite as much upon the facility with which it can be manufactured as upon the simplicity of its application and its effectiveness in service. Any device costing much more than a common bolt and nut, together with an ordinary set nut, is likely to fail of general adoption.

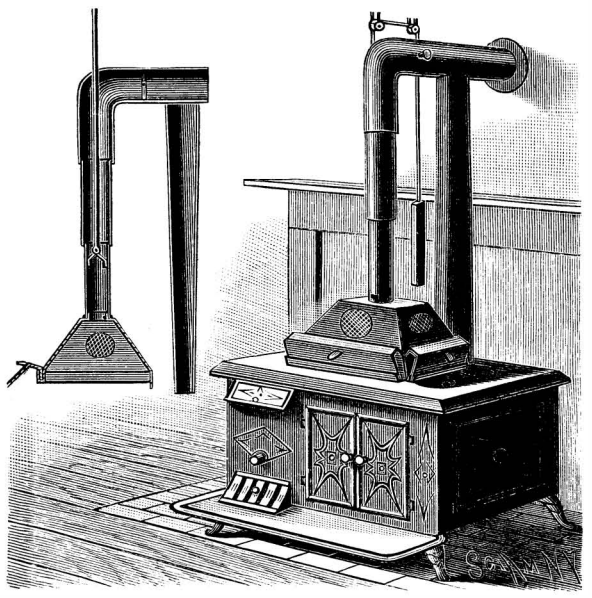
The nut lock invented by Thomas W. Patten, of 517 West Baltimore Street, Baltimore, Md., and which is shown in the annexed engraving, has the important qualification of low cost, as well as the advantage of being as readily applied as an ordinary nut and washer. It has also the further advantage of being perfectly secure, while having the same external appearance as an ordinary nut and washer.

The washer, which is placed under the nut as usual, is provided with an eccentric boss which is bored to fit the bolt loosely, and is furnished on its inner periphery with transverse teeth or notches extending from the thinnest to the thickest part of the boss. The nut is provided with an eccentric recess for receiving the eccentric boss of the washer, and the outer circumference of the recess is provided with transverse serrations for engaging the boss.

When the nut is turned upon the bolt, the friction of the washer upon its bearing causes the washer to remain stationary, while the further turning of the nut clamps the washer to its seat, and by engagement with the eccentric boss moves the washer edgewise, so as to bring its teeth into engagement with the threads of the bolt and cause them to cut into the threads transversely, thereby giving the washer a firm hold on the bolt. The teeth of the nut by engagement with the boss of the washer prevent any back motion of the nut.

AN IMPROVED ROTARY HARROW.

The accompanying illustration represents a self-cleaning harrow, each section of which revolves upon its own axis to clean itself of rubbish as it moves along, while each set of harrow teeth is free to conform to any irregularity there may be in the ground. This invention has been patented by Mr. Asa C. Brown, of Eugene City, Oregon. The harrow teeth are supported by truss wheels, bolts passing through apertures in the head of the teeth, as indicated in two of the small figures, and the construction admitting of the employment of several sets of teeth in each wheel. A central sectional view of one of these truss wheels, in connection with a portion of the harrow frame, is shown in the illustration, each wheel being mounted to turn freely on a gudgeon held within a block, and this block being mounted to tilt within a box forming part of the main frame. Just above the rear of each of the wheels there is mounted an anti-friction wheel or roll, each roll being firmly supported by the main frame, by which the gudgeons are relieved of undue

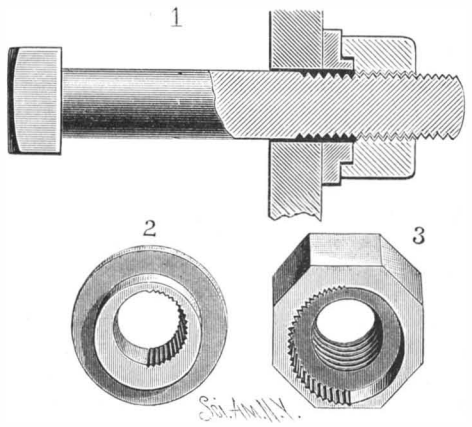


NEEF'S STOVE HOOD.

strain. With such a harrow each wheel is free to revolve independently of the other wheels, and each wheel is free to tilt so that the harrow teeth will conform to any irregularities in the ground at right angles to the line of draught. A small pair of wheels with seat for a driver may be attached if desired.

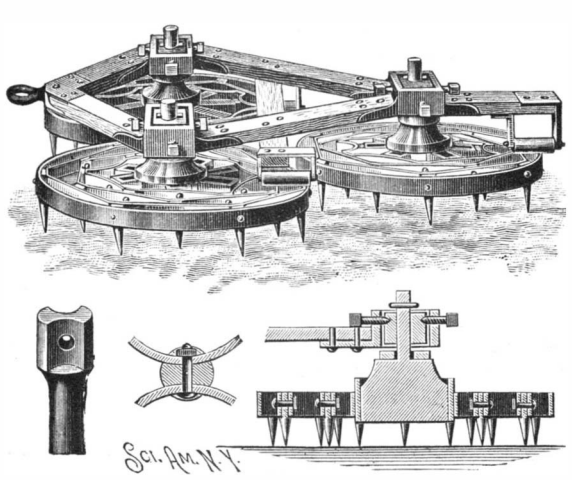
AN IMPROVED PLANT NEST.

The illustration herewith represents a simply made nest for facilitating the handling of large numbers of plants, taking the place of earthen pots, giving each one separate soil and drainage, and facilitating transplanting without disturbing the soil and roots. It has been patented by Mr. Louis Vaughan, of Blair, Neb. These nests may be made by boring nearly through a

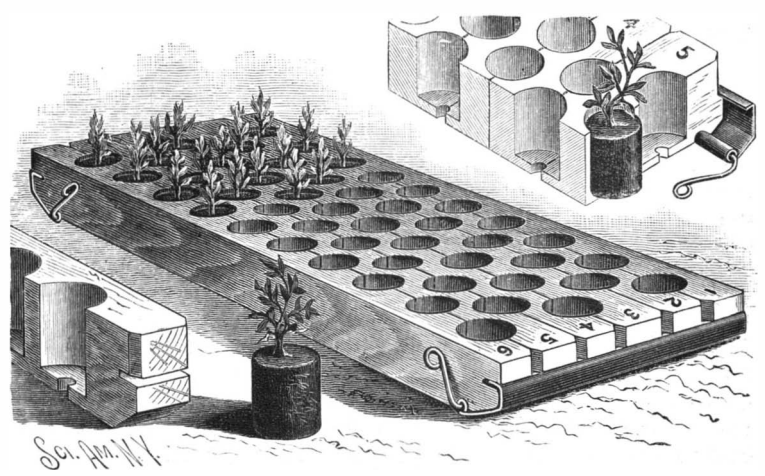


PATTEN'S NOVEL NUT LOCK.

plank to form cavities large enough for the pots or cells, leaving enough wood to form bottoms, in which small perforations are made for drainage. Sections are then made by slitting the plank perpendicularly through each row of cells, chamfers being cut from the top down, on the line of each slit, to a rectangular groove running across the ends of the nest or plank. Semicircular grooves are also made across the bottom of the plank near each end, each of these grooves, with the one running across each end, receiving a piece of sheet metal to form a guide and foot, through which a piece of spring wire is passed lengthwise, the ends thereof being curved to form clamps holding the sections together. The elasticity of these spring clamps permits the sections to swell and shrink without injury to the nests, and the bend or foot of the sheet metal piece holds up the sections from the table or shelf on which they may stand, to allow for free drainage and circulation of air.



BROWN'S ROTARY HARROW.



VAUGHAN'S PLANT PROPAGATING NEST.

Clear Off the Barnacles.

The following, from the *American Artisan*, to business men is worthy of the consideration of a good many manufacturers and merchants who are complaining of the stagnation of trade in their respective lines:

Whatever your business, whether mercantile or manufacturing, if you are not progressing, you are at a standstill or receding. This should not be in these times of competition and hustle. Either you are in the rut of old fogyism, in the wrong line or position, or you are indifferent to business success. Possibly, like an old ship, you have attracted barnacles by inactivity, or your energy has become stagnated like the inactive pool, or keener and more go-ahead rivals have depressed you, and, thus shorn of your old time powers, you have contracted the not-up-with-the-times fever and are going to the wall. Now, whatever is the matter, you should either stop business or overhaul the ship, for, as a writer aptly says, "Old ships lying at anchor may have the appearance of soundness and the outward evidence of strength, usefulness, and sea-going qualities, but when carefully examined for a sea voyage are often found to be covered with barnacles and to be affected with dry rot. When such a vessel, no matter what good it has done or what use it has been in the traffic and carrying trade, is condemned, it is at once replaced by a new or more modern one that is in perfect order and fully seaworthy. What is true of vessels is often true of men also, and especially of merchants in trade who have been anchored too long in old-time ways and methods of doing business, and, consequently, do not keep up with the progress and spirit of the age."

Progress of Electric Installations in London.

In electrical engineering, or the practical application of the science to the larger classes of work, the United States have usually been considered in advance of England. The electric light has hitherto been used here with a profusion unknown abroad, and electric railways are multiplying so rapidly that it is impossible to keep a reliable census of their number. But recently the English engineers seem to have taken a lesson from our experience, and in London some very important developments are in progress. One of these is the introduction of alternating current lighting from central stations.

The House to House Electric Supply Company have just completed a station at West Brompton, using the Lowrie-Hall system of alternating current supply. Babcock & Wilcox boilers supplied by Worthington pumps are used for generating steam for three compound engines of 250 horse power. These drive the dynamos by rope belts, seven 1½ inch endless ropes being used for each dynamo. The ropes run in as many grooves turned in the flywheel rim of the engine and face of the driving pulley of the dynamo. Each dynamo can give an output of 100,000 watts at 2,000 volts potential, with 10,000 alternations per second. The lighting circuit is carried underground. The leads are inclosed in iron pipes 3, 4, and 5 inches in diameter, and for one mile distance a loss of two per cent is expected. Transformers are used to reduce the potential, and a very ingenious meter is employed. It consists of a secondary battery in circuit with a decomposition cell and the lamps and connections of the house. The alternating current, when a lamp is lighted, passes through the two cells without any effect, but the secondary battery begins to act on its own account, and as lamp after lamp is thrown into circuit, it acts more strongly, precipitating metal in the decomposition cell. This metal is weighed from time to time as in the Edison meter, and gives the amount of energy used. The other details of the plant show much ingenuity, and indicate a probability that London may yet lead us in central station alternating current lighting. The new station partly occupies a piece of land 470 feet by 60 feet, room being left for extension.

This is not all. The metropolitan company propose, within a short time, to have a station on the Westinghouse plan, for 25,000 lights, in operation in Sargent Street. This will bring the leading American alternating current system face to face with the English one, just described as installed at West Brompton.

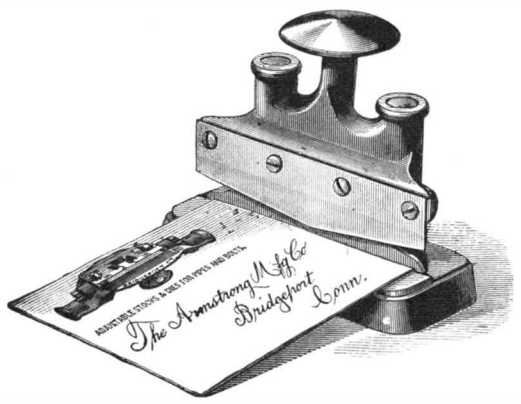
Electric traction is also advancing in London. A new underground railroad crossing under the Thames is in process of construction. It is called the Southwark subway. It consists of two tunnels, of segmental iron plates, 10 feet 6 inches in diameter and three miles long. The cars are to be driven by electricity, the current being taken from overhead conductors of Dr. John Hopkinson's system. The generating plant of over 1,000 mechanical H. P. is placed at one end of the line, and three large Edison-Hopkinson dynamos are to be used as generators. Fourteen locomotives, each of 100 H. P., are to be used, each capable of taking a train with 100 passengers at 25 miles an hour. As there are six stations, powerful engines are needed to start the trains quickly. It is proposed to give but three minutes' headway.

Finally the principal underground line, the Metropolitan Railway Company, are about to try storage battery locomotives, with a view to ultimately adopt electricity in place of steam. The use of accumulators is to be experimental only, the ultimate end being the adoption of a continuous conductor system. One trouble has been with the brake question, and the *Electrical Engineer* alludes to the Widdifield & Bowman electric brake, recently described by us, as being of interest in this connection.

For underground railroads, the conductor system of supplying current is peculiarly available, because the wire will never be coated with ice. The electric engine seems the perfect solution also of the ventilation question, that has given so much trouble in the London underground lines.

ARMSTRONG'S ENVELOPE CUTTER.

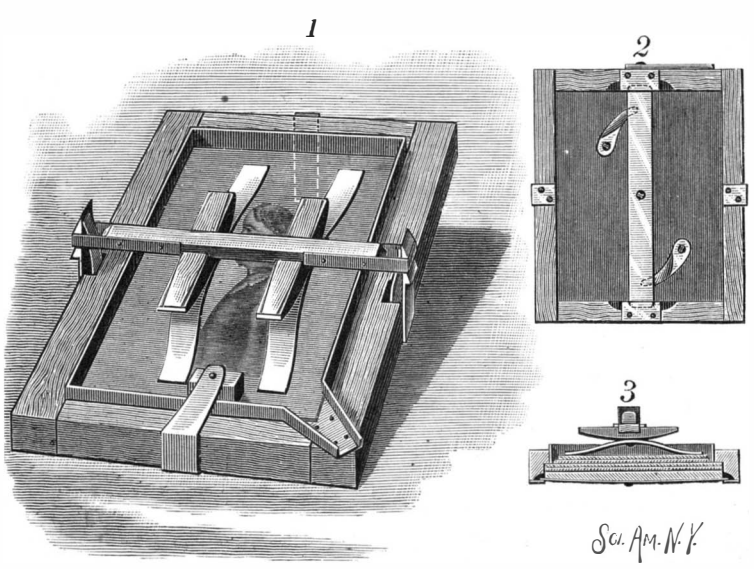
The accompanying illustration shows very clearly the operation of this ingenious envelope cutting machine. With a single stroke the movable knife cuts off the end of the envelope, without any injury to the contents of the envelope, and the springs instantly return the knife to its original position, enabling the operator to open the envelopes as fast as they can be fed to the cutter. The envelopes are opened much more rapidly and perfectly than in the old fashioned way, where mutilation of the contents is of ordinary occurrence. The cutter is handsomely finished and is placed on the market by the Armstrong Mfg. Co., the well known manufacturers of hardware specialties, of Bridgeport, Conn.



ARMSTRONG'S ENVELOPE CUTTER.

AN IMPROVED PHOTOGRAPH PRINTING FRAME.

A transferring and printing frame more particularly designed to be used in producing and transferring picture films to celluloid sheets is illustrated herewith, and has been patented by Mr. Cornelius T. Cain, of Owensboro, Ky. Fig. 1 is a face view of the frame as in use, Fig. 2 being a rear view, and Fig. 3 a vertical longitudinal section. The frame is recessed in its rear to receive the plates and clamping board, and has a ledge arranged as a lining along its inner sides projecting slightly above the front surface to form a trough, having a spout, to facilitate running off the solution used in preparing the celluloid plate or card. The rear clamping board is faced with a sheet of rubber, and has centrally pivoted to its back a turn-buckle spring bar, to hold the celluloid plate firmly in position and to make a close joint with the trough as formed by the ledge. There are also cams which give increased tension to the spring bar, and lock or hold it when engaged with the clips. A spring clamping device is also applied to the front of the frame, and is adjustable up or down to suit different thicknesses of the glass or plates. The frame has at one end a spring pressure device, with soft or rubber bearing block, to hold the transfer in position on the celluloid plate before clamping it down, and at the opposite end is a pivoted leg that may be turned down to hold the frame in an inclined position to keep the solution at the bottom preparatory to putting the glass plate down. The process for which this frame is especially adapted consists in preparing a picture film or transparency by the collodio-chloride or by the ordinary wet collodion process, toning and fixing the picture film, drying it, and applying thereto a celluloid card that has been flowed with a solution of gum camphor and alcohol, allowing the card to dry and stripping it from the glass. Pictures thus made not only present all the fine details in strong relief, but have a remarkable beauty and softness of finish.



CAIN'S PHOTOGRAPH TRANSFERRING AND PRINTING FRAME.

A Valuable Blue Rediscovered.

Prof. Fouque, of the College de France, at the last meeting of the Academy of Sciences (February 18), read an important memoir on the blue pigment used by the ancient Romans for wall decorations. It is a magnificent color, as bright to-day as when first applied, and is found in the fresco paintings of Pompeii and other monuments dating from the Roman period. Its production is one of the lost arts, as there is no record of the pigment being used after the invasion of the barbarians. Modern chemists have more than once tried to ascertain the nature of the compound, but beyond the point that it contains copper, nothing definite was discovered. M. Fouque thinks the lack of success is owing to the fact that the ancients followed no exact rules or proportions. Having secured comparatively copious specimens of the cæruleum—such is the old name of the pigment—he has succeeded not only in analyzing it, but also in finding a process for making it regularly in quantities. The compound is, according to M. Fouque, a quadruple silicate of copper and silica, which may be prepared with silica, oxide of copper, and lime, with or without any fluxes. The ancients simply made it with sand, calcined or roasted copper, and lime, but kept to no regular proportions. He worked differently and managed to obtain an exact chemical combination, which is neither a glass nor an enamel, but a crystalline substance of the composition already mentioned. The crystals are perfectly definite, and strongly dichroic, appearing deep sky-blue when viewed from the surface and pale rose edgeways. The only difficulty in the preparation is the heating. A bright red heat is necessary to effect the combination, but on heating too much the blue color is lost and an aventurine green glass is obtained—a circumstance which must have rendered the process a delicate one in old times. Nowadays, however, with the means at our disposal, the difficulty is trifling, and kilogs. of the cæruleum could easily be made in the College de France laboratory. It is a very stable pigment, so far as chemicals are concerned, as it stands, unaffected, boiling with sulphuric acid or potash lye, as well as quicklime and hydrogen sulphide. That it will be air and water proof is abundantly shown by the old fresco paintings. M. Fouque considers, therefore, it would be a great boon to the arts to produce the blue commercially, and promised his assistance to any French manufacturer who will undertake the fabrication. While examining the fine specimens of the rediscovered blue presented by M. Fouque, M. Berthelot, who is well versed in ancient chemical lore, remarked the cæruleum in question was no doubt the Alexandria blue, known in Egypt about the beginning of the Christian era, and taken to Pouzzoli, whence its use spread all through Italy. He agreed with M. Fouque that the pigment was unknown to the Assyrians and ancient Egyptians, and is no doubt a most valuable one.

Myrtol.

Myrtol is a perfectly clear fluid, and represents that constituent of oil of myrrh which boils at 160° to 170° C. Linderm is the only clinician who has instituted any detailed trials with myrtol. Eichhorst himself was first to apply it in gangrene of the lungs. The results which he obtained were so surprisingly favorable that he has used the drug in numerous cases, and is now convinced that, as a disinfectant of the air passages, myrtol has not its equal. The drug is best given in gelatine capsules (à 0·15, prepared in Paris, or by Pohl, of Schönbaum-Danzig). If a capsule is crushed, the peculiar odor clings to the room for a long time, and if a capsule is swallowed, the breath emanates the characteristic odor for many hours, and often for a couple of days. In putrid bronchitis and pneumonic gangrene two to three capsules should be taken every two hours to deodorize and disinfect the parts. The effect is rapid, and a few capsules suffice to remove the bad odor, and often to produce a permanent improvement. The drug is, however, apt to cause a temporary loss of appetite. Myrtol has also been tried against tuberculosis, but the drug has proved utterly useless against the bacillus tuberculosis.—*Therapeutic Gazette.*

Correspondence.

Inflammable Gas from Steam Boilers.

To the Editor of the Scientific American:

In your issue of January 5, I noticed paragraph 87, wherein F. S. W. states that gas forms in his hot water heater, or rather radiator, which burns on opening the air cock, and suggests that steam boilers may be exploded thereby.

We had a hot water heater put in our house last spring, with eight radiators. The upper one in third story has an open pipe leading through the roof, in case the water should boil. The usual tank is attached, which holds about seven gallons. Now, as the water slowly wastes away, we replenish it with two or three gallons, having first to open the air cock to let out the air, or what I supposed to be such, so that the water would rise to take its place; but ever since the fire was started I noticed that the air smelled gassy; so (before the water was put in the tank), in order to guard against a possible explosion, I took a small brass tube, about 8 inches long, and, bending it U-shape, fastened one end to the cock and flattened the other end about a gas jet, and on applying a lighted match quite a little explosion popped up, which, had the match been applied to the large hole in the cock, the flame might have followed in, and, as there was about two gallons of the gas, it seems to me that the radiator itself might have been exploded, and I should have been unable to write the result. JOHN P. NESSLE.

Newark, N. J.

Changes on Saturn.

To the Editor of the Scientific American:

Good views have been secured with the 10 inch equatorial of this observatory of the new "white region" on Saturn's ring announced by Dr. Terby from Europe.

I also have the pleasure to anounce the interesting additional discovery, just made by myself, that this "white spot" is variable in brightness. Pulsations of its light at irregular intervals of a few minutes are noticeable with careful scrutiny.

The cause of this new phenomenon is yet unknown, but the fact that telescopically visible changes are going on in this wonderful ring system of Saturn is of the highest scientific interest. The "white region" is situated on the rings, close to the dark shadow cast by the gigantic globe of Saturn upon the rings.

WILLIAM R. BROOKS.

Smith Observatory, Geneva, N. Y., March 19, 1889.

The Disarmament of Inventors.

Mr. Goschen, member of Parliament, in a recent speech gave the following:

Mr. Morley distinctly says that we shall have to explain what has been done with the millions already voted. That question we ought to answer, and I believe we can. I will tell this meeting and the public one of the reasons why it is always being said that "the millions" have been misspent. The experts, the admirals and the generals, always desire, and naturally desire, to have supplied the last perfected weapon or ship that the ingenuity of the inventor can devise—but invention outstrips manufacture. While we are manufacturing a ship or a weapon that three years ago was the best of its kind, some new invention renders it what, by an abuse of the word, is termed "obsolete," and it is represented that all the money spent on it has been wasted. Thus it is said that our troops are not properly armed. They have certainly not got the newest magazine rifles, because it is only a few months since the experts agreed what was the best type to be adopted; and if we had manufactured magazine rifles one or two years ago, we should now be denounced as having armed our troops with the worst weapon in Europe. (Laughter, and "Hear, hear.")

Similarly the "obsolete" ship of to-day is the perfect ship of three years ago. The obsolete weapon of to-day is the dream of perfection of the experts three years ago. You will therefore see how prudently it is necessary to proceed under such circumstances. We must build more ships, but before they are completed two or three years hence, they will be described as being obsolete as compared with the latest inventions of the time. We sometimes hear of a European convention for disarmament, but if that cannot be attained, it would be a very great gain if there could be a disarmament of inventors. (Laughter.)

If the experts would only agree—but they only agree when it is too late to attempt something which half of them recommended three or four years before. Experts are very hard on politicians sometimes, and especially on the Chancellor of the Exchequer. It is certain that if the inventors were granted a free hand without any restriction, there would be a very considerable waste of public money in regard to ships and guns and arms. Invention outstrips manufacture, and therefore we must always be behindhand, whatever we do, and fail to reach the ideal standard of excellence which is set up.

The Growth of Population in Cities.

The tendency of population in all civilized nations to centralize, and its rate of concentration, has been investigated by Emil Knichling, C.E., of Rochester, N. Y. He finds that the general law of increase is subject to fluctuations due to local causes, but when tabulated in groups of decennial grades in population, a most remarkable uniformity of decrease in the rate per cent for each decennial increase in population is noted.

A study of the statistics of urban population shows that during the past forty years the rate of increase in the population of the principal cities of Europe and America has been much greater than that of the population of the globe. In this period, nearly every large community which possessed fair natural advantages has increased its population from 100 to 200 per cent, while the total increase of inhabitants is estimated at 40 per cent.

In a large portion of Europe, from one half to two thirds of the population is crowded into cities. In the United States, the older States exhibit similar conditions. Leaving out the towns of less than 4,000 inhabitants, the ratio for Massachusetts is 66 per cent, Connecticut and New York 54 per cent, New Jersey 52 per cent, and Pennsylvania 39 per cent constitute the urban population.

The Western States do not come under the investigation from the same standpoint, from the abnormal increase of population by emigration, which somewhat interferes with the uniformity found in the older States.

The following table of the averages for 196 cities of the U. S., showing the maxima and minima rates and the final average, will be found a most interesting study:

When the population is	No. of cities considered in deriving average rate of increase.	Range of rates of annual increase.		Average annual rate of increase in per cent.	
		Maximum per cent.	Minimum per cent.	Average of all the different values.	Probable average value.
10,000	9	30·50	6·50	14·82	—
20,000	15	24·20	4·10	11·17	—
30,000	19	18·00	2·40	8·34	—
40,000	20	15·50	2·60	6·45	—
50,000	20	13·00	2·35	6·05	6·05
	16	—	—	5·90	—
60,000	15	10·40	1·40	5·52	5·60
70,000	13	9·10	3·00	5·57	5·30
80,000	12	8·30	2·10	4·95	5·03
90,000	11	7·95	1·10	4·80	4·85
100,000	10	7 30	2·35	4·93	4·66
110,000	9	8·25	2·80	5·21	4·52
120,000	7	6·40	3·10	4·38	4·40
130,000	5	6·05	3·10	4·37	4·26
140,000	5	5·75	3·07	4·30	4·15
150,000	4	5·65	3·43	4·62	4·04
160,000	4	6·00	3·40	4·51	3·93

In order to make comparisons with the progress of European cities, the following table exhibits the final averages of American, English, and German cities:

Population.	Probable average annual rate of increase in per cent.			
	American cities.	English cities.	French cities.	German cities.
100,000	4·66	3·16	—	3·57
125,000	4·30	2·99	—	3·33
150,000	4·04	2·83	—	3·10
175,000	3·79	2·67	—	2·87
200,000	3·55	2·52	—	2·66
225,000	3·36	2·38	—	2·46
250,000	3·20	2·26	—	2·26
275,000	3·04	2·13	—	2·09
300,000	2·92	2·00	—	1·93
325,000	2·80	1·92	—	—
350,000	2·70	1·84	1·70	—
375,000	—	1·75	—	—
400,000	—	1·68	—	—

Physiology of Shorthand.

A paper on the "Physiology of Shorthand Writing," by Dr. Gowers, excited considerable interest at the recent Shorthand Congress. Shorthand is only a variety of writing, and the paper was therefore mainly occupied with an account of the cerebral physiology of writing. The chief points in the physiology of the brain relating to the act of writing were first described. It was explained that the arm center of the cortex is merely concerned in producing the movements for the written symbols, and that the word processes are arranged in the motor speech center on the left side, as is shown by the fact that disease of this center abolishes the power of writing as well as of speech. Thus in the work of the reporter, as far as is at present known, there is no direct transfer of the nerve processes from the auditory to the arm center; they must go through the motor speech center. The fact that it is the activity of the latter center which excites the arm center and the movements for the written symbols, affords a strong theoretical justification for the phonetic element in shorthand, in which the written symbols are uniform for the same speech processes.

The non-phonetic systems, in so far as they do not adopt the phonetic principle, proceed on a resymbolizing of the ordinary longhand signs. There are two steps to the process, whereas in the phonetic systems the symbols replace the longhand signs, and are placed at once on their permanent footing in direct relation to the speech processes. No doubt, however, the practical difference is less than appears from theoretical considerations, because in all systems the shorthand symbols ultimately stand in very close relation to the word processes, and are produced without any consciousness of intermediate steps. It was pointed out that the term "phonography," applied to the "phonetic shorthand," is not strictly accurate, since it is the speech process, and not the auditory impression, that immediately excites, and is symbolized by, the written sign. It is really "speech writing," not "sound writing." The error is not great, however, because the speech process and the auditory process are in perfect correspondence. The curious fact was mentioned that many persons, perhaps all persons, read by means of the motor speech center, so that if this is destroyed the power of reading is lost, and illiterate persons actually move the lips in reading. This affords another justification for the phonetic principle—*i. e.*, for the uniformity of relation between the written symbols and the motor processes. The paper concluded with some remarks on the muscular mechanism of writing.—*Lancet.*

Spanish Torpedo Boats.

The report on the maneuvers and experiments with first class torpedo boats, carried out by order of the Spanish government last summer, has been published. The programme laid down was a comprehensive one, and occupied seven clear weeks: Launching torpedoes at targets fixed or moving from boats at various speeds, making circles and performing other evolutions, attacks by night and reconnaissances under varied conditions, and, to finish up with, during the sixth and seventh weeks, comparative trials of speed among the torpedo boats. The course was from Carthagena to Alicante, a distance of 68 nautical miles. Six boats only competed, and they arrived in the following order:

	Hs.	Ms.	Speed in knots.	Original speed.	Maker.
Barcelo	3	27	19·7	19·5	Normand.
Halcon	3	30	19·6	23	Yarrow.
Rayo	3	32	19·5	23·6	Thornycroft.
Ariete	3	57	17·2	26·3	"
Ordonez	4	14	16·1	20·2	"
Acebedo	4	20	15·8	20·2	"

Le Yacht declares that this experience in Spain is exactly a duplicate of what happened during similar trials in Russia. The boat built by M. Normand, of Havre, was the only one that maintained the original speed on active service.

It will be seen from the foregoing that trial trip tests as ordinarily conducted give a false idea of the real speed value of the boat.

The Gatling Gun.

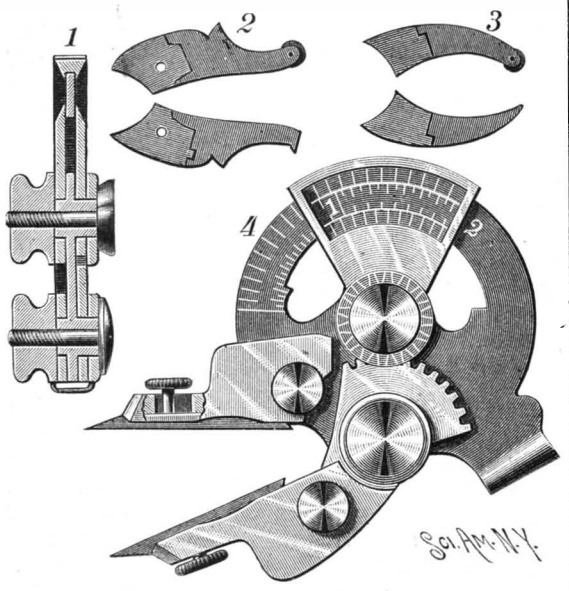
This weapon, the first of quick-firing artillery, has an interesting history. In the New York *Commercial Advertiser* Dr. Gatling tells an instructive story of the development and introduction of his machine gun. The idea of it originated in a conversation Dr. Gatling had in Indianapolis in 1861 with a friend of his, Benjamin Harrison, now President. One of the new guns was shown to General Ripley, then Chief of Army Ordnance, who refused to have anything to do with it, and said the flint lock was the surest and best weapon any way, as his successor in office practically declares the Springfield breech-loader to be better than the magazine guns with which the rest of the world is arming itself. General Butler gave orders for the eleven guns which had been manufactured, and later Mr. Stanton ordered a trial of them. Dr. Gatling says:

"I went to Fortress Monroe and tested them, and made a great success. The young officers at the fort tried to play a trick on me. At their old howitzers they had trained artillerists. To me they assigned three old negroes. I saw through the game, and asked Col. Baylor, who was in command, to give me an hour in which to instruct my men how to use the gun. This he readily assented to, and I began drilling my 'recruits.' They learned very quickly, and in the hour I was ready. The firing was a competitive examination, and with my three old negroes I fired and made about three hits to one on the target to those made by the old guns. Mr. Stanton then gave me an order for $175,000 worth of the guns. Since I have sold a great many in this country and every country almost on earth. England has them, and so have Turkey, Austria, France, Russia, and Italy."

THE following is given as Bill Nye's obituary of Mr. Weeks: "Mr. Weeks was a self-made man, and even in his most prosperous days would not allow finger bowls in his house. His education was mostly in the line of the business he had adopted, and though he did not know that evolution was a gradual change from an indefinite and incoherent heterogeneity to a definite and coherent homogeneity, through constant differentiations and integrations, a flat wheel would wake him out of a sound sleep before it had made two revolutions."

IMPROVED CALIPERS AND DIVIDERS.

The illustration herewith represents an improved measuring and drawing instrument specially adapted for mechanics, and to be used as inside and outside calipers, dividers, etc. It has been patented by Mr. Thomas Green, of No. 651 Christie Street, East Davenport, Iowa. Fig. 4 is a face view and Fig. 1 a transverse section of the instrument. The central plate has a hub, on which is mounted to turn the indicator, fitting over



GREEN'S CALIPERS AND DIVIDERS.

the sides of the plate and on to the hub on each side of the plate, the indicator being held in place by a bolt passing through the center of the hub. A nut screws on the bolt against the other arm of the indicator, and by adjusting the nut the indicator is permitted to turn freely on the hub, or is fastened in any desired position. The indicator has slots on both sides, near its outer edge, arranged segmentally and directly over the outer edge of a segmental part of the central plate, and both the inner and outer edges of these slots, on both sides of the indicator, are formed with graduations, indicating over graduations formed on the inner and outer edges of the segmental part of the central plate. The graduations may be of two systems, on each face, one system indicating by the English and the other by the metric system, making a combination of readings on both sides of the instrument. Around its axis the indicator has gear teeth, which mesh into a segmental gear wheel turning on a bolt secured in the plate, this segmental gear wheel having an arm adapted to carry a pointer arm, as shown in Fig. 4, or one of the inside or outside caliper arms shown respectively in Figs. 2 and 3. The other arm of the dividers and calipers is adapted to be secured to the fixed plate by a bolt, and in order to hold the arm in place there is a notch in the plate, into which fits a corresponding lug formed on the arm. The dividers and inside and outside calipers are adapted to be adjustably fitted into the arms, respectively, according to the use to be made of the instrument, one of the inside and one of the outside caliper arms being provided with a friction wheel at its point. To open or close the divider or caliper points, the operator takes hold of the central plate and moves the indicator, whereby the points are moved toward or from each other, the graduations on the scales indicating the exact measurement in inches or centimeters, etc.

An Electric Light Cake.

The sequel to the celebration of Mr. Edison's 42d birthday recently occurred, when, according to the *Electrical Review*, the servants employed in his house and outbuildings, not to be outdone by the employes of the laboratory, presented him a birthday cake of immense size and novel construction. It was about 2 feet in diameter and 12 inches high. It bore the inscription: "Thomas A. Edison, 1889," in colored greenish-white frostwork, and around its edges were 42 tiny incandescent electric lights, supplied from a battery placed in a cavity in the center of the cake.

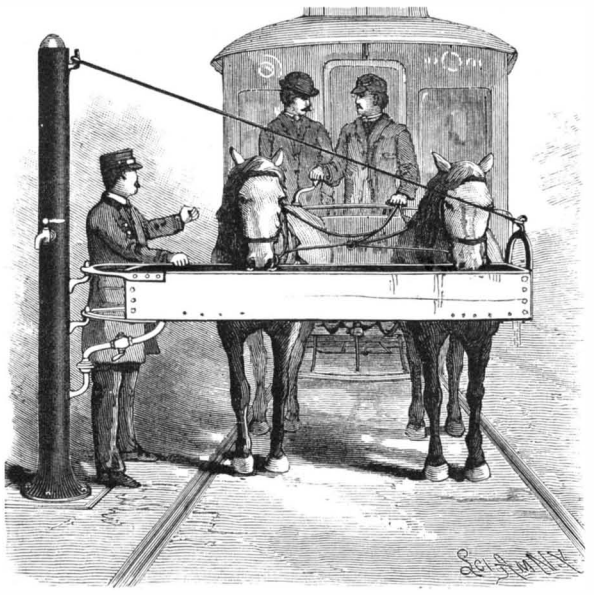
THE NEW SPANISH SHIP OF WAR PELAYO.

This magnificent vessel was launched at Toulon, France, in 1887, having been built by the Societe des Forges et Chantiers de la Mediterranée. Our engraving is from a photograph of the ship. She is approximately, 350 ft. in length; beam, 67½ ft.; depth, 41½ ft.; draught, 25 ft.; displacement, 9,902 tons. She has two screws, driven by four compound engines; also forty-two auxiliary engines used for various purposes, from the working of small fresh water pumps up to those for operating the hydraulic pumps that work the gun towers.

Her armament consists of two 49 ton 10 inch guns, longitudinal axis, mounted in barbette in two turrets; two 12 inch guns, 49 tons each; two 10½ inch 33 ton guns, in barbette in two lateral towers; one 6 inch bow gun; twelve 4½ inch guns in battery, steel breech-loaders, system of G. Hontoria. This ship is one of the most powerful vessels afloat.—*Ilustracion Espanola.*

AN IMPROVED WATERING TROUGH.

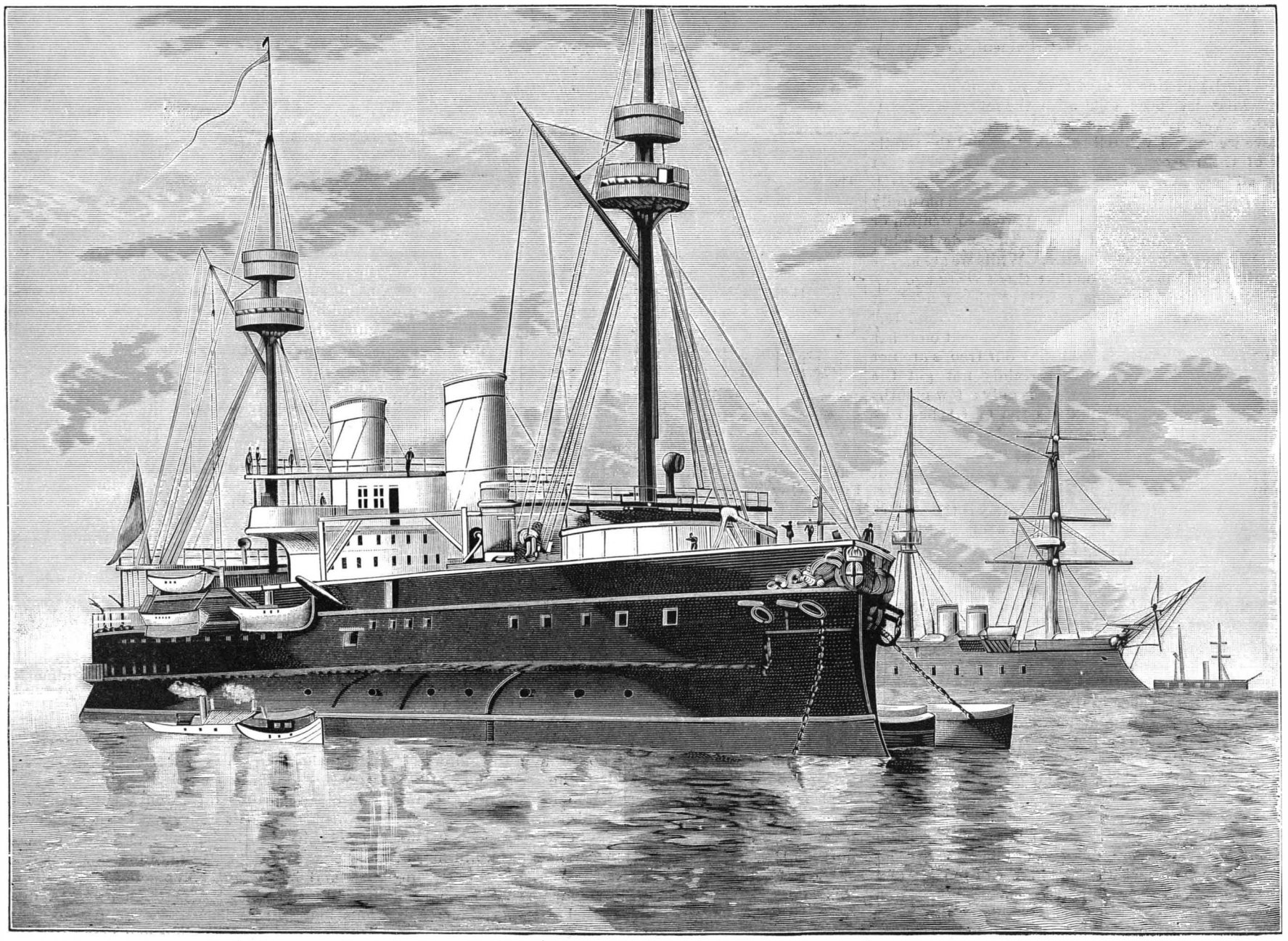
The accompanying illustration represents a swinging watering trough particularly adapted for street railways. It has been patented by Mr. George W. Langdon, of Clinton, Mass. The trough is hinged at one end to a hollow standard adjacent to the track, a water supply pipe rising in the standard and extending through a side opening above the trough, the outer end of the pipe being provided with a cock, through which



LANGDON'S WATERING TROUGH.

the trough may be supplied with water. A discharge pipe is also arranged inside of the standard, extending outward through an opening beneath the water trough, where it is connected, by means of a swivel joint, with a pipe opening in the under side of the trough, the latter pipe having a cock by which the water may be drawn off from the trough.

THE death is announced of the Rev. J. G. Wood, F.L.S., the well known naturalist. The wonders and the beauties of nature found in him an enthusiastic and intelligent exponent. No one, perhaps, in the present age was more diligent and successful, by his writings and lectures, in fostering, especially in the minds of the young, the love of the study of living things. Mr. Wood was the son of a surgeon at one time lecturer on chemistry at the Middlesex Hospital.



THE NEW SPANISH SHIP OF WAR PELAYO.

THE METROPOLITAN TELEPHONE CO.'S NEW CENTRAL STATION AND GREAT SWITCHBOARD.

(*Continued from first page.*)

ing for the house cables leading upward, and by the connection boxes all is placed in correct circuit. The wires are all India-rubber coated.

Entering the switchboard room, they are distributed on the cross connecting board along the walls, thence communicating with the mass of wires that run along the back of the switchboard proper. The board stands about eight feet in height upon a slightly elevated platform. Its total length is 258 feet, and it is divided into forty-three sections, each six feet long. The general view of the switchboard (Fig. 4) shows about a third of its length.

Silk-covered wires, cotton wrapped, are used for the board, disposed in cables or bunches, each containing forty-five wires, representing a total of 3000 miles. A view is given (Fig. 3) of the rear of the switchboard showing the groups of cables and also the induction coil boxes and counterpoise weights of the operators' transmitters.

The switchboard, which was erected by the Western Electric Mfg. Co., of this city and Chicago, is of the multiple type. It is presumption to set a limit to invention, but the multiple switchboard seems to have nearly reached perfection. At a recent telephone convention in this country it was described as the nearest approach to a perfect system. Its extensive adoption in this and other countries certainly speaks well for its merits. The connections are so arranged that any operator without leaving her place can connect with any subscriber. The converse is not the case. Only a limited number of subscribers can communicate with a given operator. Thus, as the board is now being worked, each operator can be called up by fifty to seventy-five subscribers. But without leaving her place the one operator can put any one of these in communication with any of the 2,500 subscribers now on the board.

Although only this number are now connected, the board is wired for 6,000, with capacity of extension to 10,000 subscribers. It is divided into 43 sections, each section in six divisions. To each division 1,000 subscribers are connected, in groups of 100. Thus each section has connected with it 6,000 subscribers' wires. For each wire a little hole in the front of the board is seen, and back of this is what is called a spring jack. This originally consisted of a pillar about 1½ inches long and as thick as a lead pencil; a simpler mechanical construction has now been adopted. It carries an insulated stud against which an insulated spring presses. In each section there is one spring jack, and there are altogether on the upper face of the board 43 for each subscriber distributed all around the room. Each 6,000 connections are contained within 6 feet of length of board, and this is repeated 43 times. *These connections are for subscribers who are to be called up only.* But the same number have to be provided for in the role of callers. All along the front of the board for its entire length, and near the edge of the projecting shelf or keyboard, is a single row of 6,000 holes beneath which are corresponding spring jacks. This row is 258 feet long; 150 of the spring jacks occupy the lineal space of one section. Back of these holes are annunciators, or drop shutters, one for each connection. The subscribers connect through the annunciator with these spring jacks. For 50 to 75 of these "calling-up" connections there is one operator. Arranged in rows parallel with the front of the board there are a number of connecting plugs attached to flexible conductors. For each pair of plugs and cords there are two buttons and an annunciator, or drop shutter. A microphone hangs in front of each operator, and a receiver is held by a spring support against the ear. A hand switch for each calling subscriber is also contained upon the keyboard (Fig. 2). The general operation of making a connection is as follows:

The calling subscriber rings his bell. This produces no corresponding sound in the exchange. It merely causes a shutter to drop, disclosing his number to one of the operators. She at once closes the shutter, inserts a plug in the caller's spring jack, and pulls down the cam lever switch, thus bringing her telephone into shunt circuit with the caller's line, and asks, "What number?" The caller responds, giving, it may be, any of the 6,000, assuming the entire board to be in operation. The other plug of the pair is inserted in the proper spring jack in the upper face of the board, if the subscriber's line is not "busy;" the cam key is thrown up, and one of the buttons is depressed. This rings the bell of the subscriber who is asked for, and the two are now in communication. When through, the subscribers ring their bells. This operates the annunciator belonging to the pair of cords and plugs that is in use for their connection. At one time it may be one pair, and a second time it may be a different pair that is used. The annunciator shutter is seen to drop, the plugs are pulled out, the shutter closed, and all again is in *statu quo*. Before making the connection with the subscriber called for, the operator touches the spring jack frame with the plug. If a click is produced in the operator's telephone, it means that the subscriber is already in connection, or is "busy." If no sound is heard, the line is free.

This use of independent plugs and cords is a recent improvement. For a section of 150 calling-up spring jacks there were formerly 150 pairs of plugs and cords. Now there are only 48, and any pair that is free can be used. For each pair of cords there are a pair of buttons, one for the calling subscriber's bell, the other for the answering subscriber's bell, a cam lever listening key that enables the operator to answer the subscribers, and finally a clearing-out annunciator. In practical work, the operators can be arranged as closely as desired around the board, provided a transmitter and receiver is furnished for each. Thus an operator may be subject to fifty callers or less. But she must be prepared to put this fifty into connection with any of the 6,000 or more on the board.

The wire of a single subscriber may now be traced. It enters the cellar of the building and is carried up to the switchboard and all along its back for its entire length. At each section it is cut, and the ends are connected to its own upper division spring jack, one to the spring and the other to the stud. This is repeated forty-three times. These give the connections for being "called up." Besides these, one connection is made with the proper answering spring jack on the lower row, and thence through the annunciator to earth. Leaving out of consideration the induction coils as unnecessary to the comprehension of the board, the other end of the line may be regarded as grounded at the subscriber's end. Thus the circuit includes the general outdoor and indoor lines, and a line the length of the switchboard with the forty-three upper spring jacks, a single lower spring jack, and a "calling-up" annunciator, also in circuit and eventually grounded.

This circuit is insulated from the frames or front collars of the spring jacks. With these frames, that are nearly flush with the front of the board, a second wire is connected, that for each subscriber simply runs from spring jack to spring jack, for the forty-three main connections all around the switchboard. When a spring jack is plugged, the spring is forced away from the stud so as to break the circuit, and is brought into connection with the plug, and through it and its flexible connecting wire with the other plug and second subscriber, and thus with the ground. But the plugs also connect with the frames of the spring jacks, so that the forty-three frames are all in circuit. The second wire comes here into use. If one of the forty-three spring jacks is plugged, then, the frames of all being connected, if an operator touches any of them with a plug, the click heard in her telephone pronounces the line busy. Unless one of the spring jacks is plugged, there will be no click. This wire, called the testing wire, performs no other function whatever. But it is possible that the entire system may be placed on metallic circuit. Then this second wire will be utilized as a metallic return. At present there are about fifty metallic circuits in use on the board. The connections in front of the board, showing the back and front plugs and flexible connections and counterweights, are shown in the diagram (Fig. 6).

In Fig. 4, a general view of the front of the board is given; in Fig. 2, the arrangement of spring jack apertures in groups of 100 is shown. It is evident that the operator can very quickly find any desired number of the 6,000. The upper part of the board is unoccupied. When this portion is filled, the capacity of the board will be nearly doubled. It now, as has been stated, is wired for 6,000 subscribers.

The subscriber's bell is rung by depressing a button. This turns on a current from a dynamo driven by an electric motor. At night a current is taken directly from the storage batteries, and by means of a pole changer is made to vary in direction so as to ring any bell it is connected with.

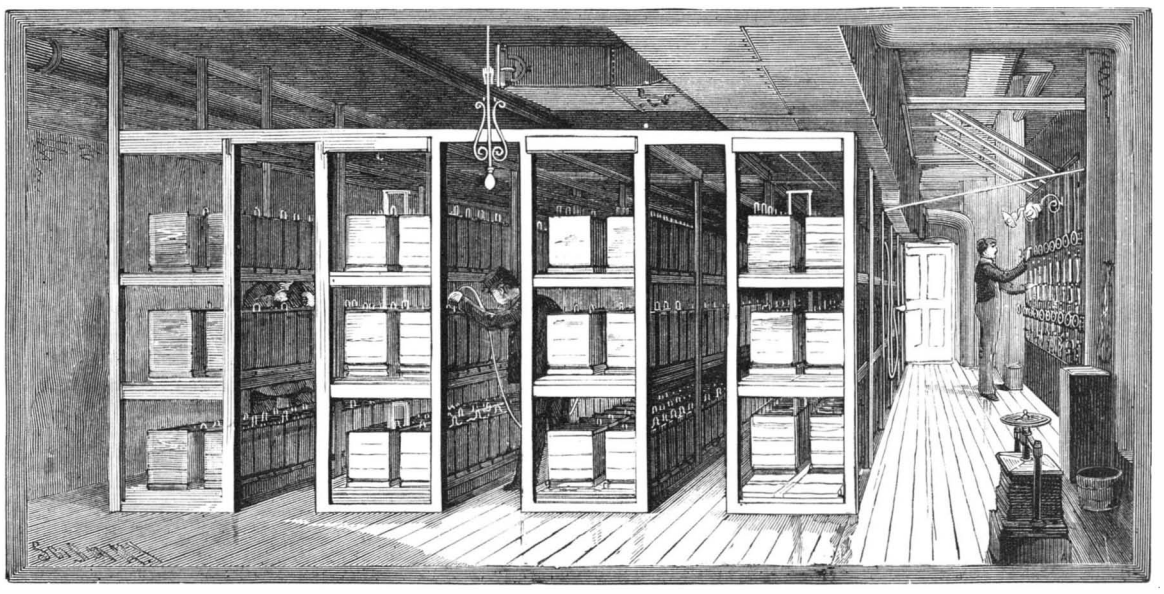


Fig. 5.—STORAGE BATTERY PLANT, SWITCHES, AMPERE METERS AND SWITCHES.

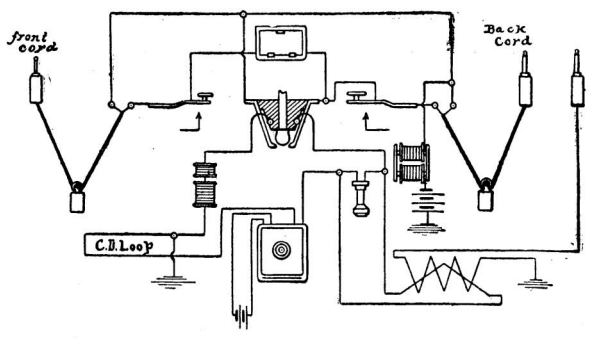


Fig. 6.—KEYBOARD CONNECTIONS.

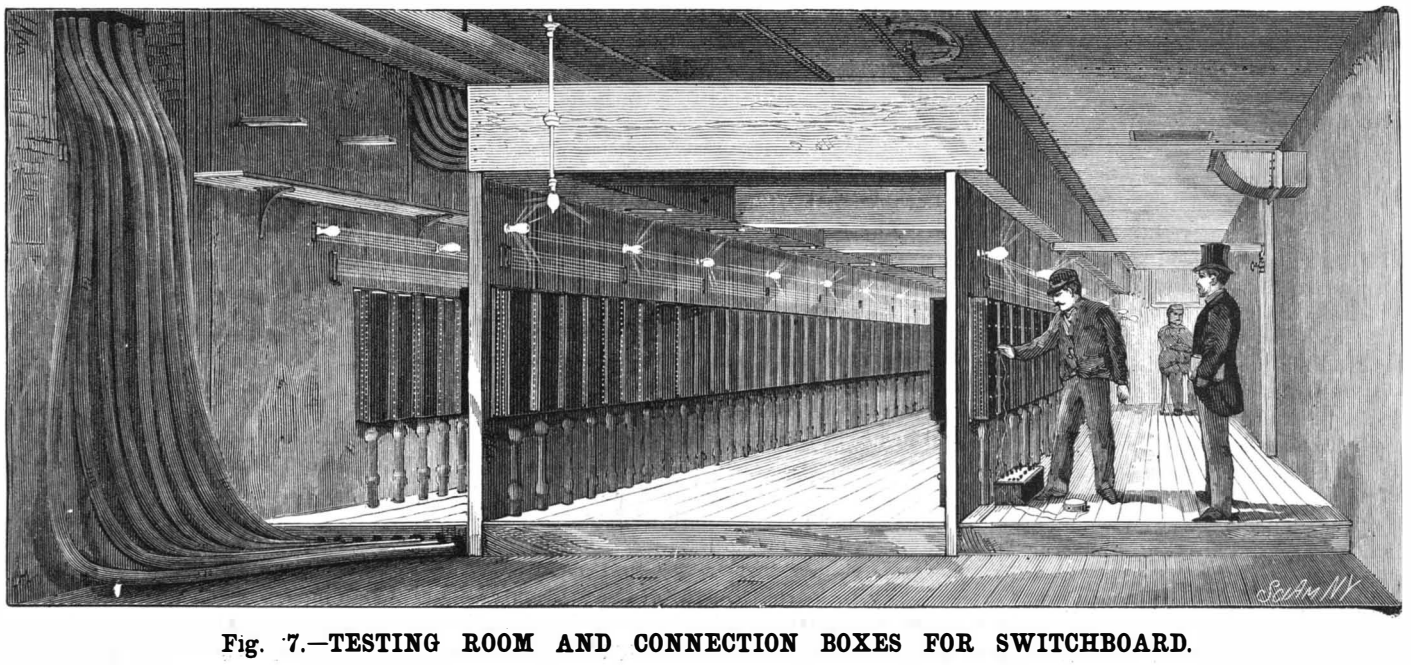


Fig. 7.—TESTING ROOM AND CONNECTION BOXES FOR SWITCHBOARD.

Some idea of the magnitude of the work may be reached from the number of soldered connections. Of these there are 810,000 back of the board. After it was erected and in place, over a year was consumed in making these joints and connecting the wires with the switchboard.

In Fig. 3 a view is given of the rear of the board, showing the general arrangement of cables. The division into sections can here be traced, one section and part of another occupying the foreground of the cut. At the top the induction coils are seen, which form part of the operator's talking and listening apparatus. Hanging from pulleys the counterweights can be seen which support the weight of the swinging transmitting microphones.

On the floor of the room are three desks with spring jack connections, telephones, etc. At each of these sits a monitor, who can connect at will with any of the operators or with her group of subscribers, so as to hear all communications between operators and subscribers. Thus he watches their work, receives from them any notices of faults, and can be asked by the operators for information. The three monitors can also communicate with each other.

Lightning arresters are placed in each circuit back of the board. They are seen in Fig. 4 on the left hand side, arranged in rows against the wall. They consist of a thin strip of easily fusible metal held within a protecting tube. This foil will be melted by the lightning before it can do any injury. Very few are thus destroyed, and they can be instantly replaced by new ones.

Starting with front of the keyboard, the following is the succession of keys, etc. (See Fig. 2.) Nearest its front edge is the row of buttons for ringing the calling-up subscriber's bell; second, a row of cam lever switches for the operator's listening connection; third, one set of plugs and flexible connections. There are 48 of each of these in one section. Fourth comes the row of 6,000 answering spring jacks, with, fifth, a correspondingly numbered set of 6,000 calling-up annunciators, 150 to a section. Sixth comes the row of clearing-out annunciators, one for each pair of plugs, or 48 to a section; and seventh, the second set of plugs, completing the pair. This completes the contents of the keyboard. Back of it rises the main board, with its quarter million spring jacks, 6,000 in a section. The general arrange ment may be seen in the diagram of keyboard connections already referred to.

In the rear of the cellar is the lighting plant for supplying current for nearly eight hundred lamps contained in the building, as well as for ringing subscribers' bells. It comprises two Edison and two Electro-Dynamic Co.'s dynamos, driven by Buckeye engines. The generators are so arranged that they work in connection with a storage battery, charging it and also supplying lamps with current. At night the battery is relied on for lighting. It comprises 580 cells (Fig. 5) arranged in ten series, giving an output of 300 amperes at about 125 volts potential.

The cells are continually tested with the hydrometer to determine when they are exhausted and when charged, the acid being kept within the limits of 1,160 and 1,200 specific gravity. The voltage of a single cell is never allowed to fall below 1·9. The plant is provided with ammeters and all appliances of the most advanced order.

In a subsequent issue the subject of underground distribution of electric currents for light, telephonic and telegraphic communication, power, etc., will be treated in detail, with full illustrations. The subject of local connections with the through lines and the means of making connections with them will be included, thus fully explaining the solution of underground transmission of electric energy.

The Future of Iron.

This product, which, from the immense extent of its uses, and its applications to the true necessities of mankind, would seem properly stable in its very nature, has during the last two decades suffered much from violent fluctuations. At present the iron trade is reported to be in rather a depressed condition, which would be worse except for a combination among the manufacturers which keeps the production down sufficiently to maintain prices on a paying basis. All over the country mills are starting into action and shutting down, a species of restlessness characterizing the outlook. But an increased market is looked for during the next three months, and after the lessons of the past an improvement that lasts even for that length of time will not be without good effects. The government by its recent operations in ship and ordnance construction has done something to help matters, and probably the same assistance will be rendered during the next four years.

Dowling, not Darling.

An article in our last issue referring to a paper read before the New York State Homeopathic Medical Society on heart disease was erroneously credited to Professor Darling. The types should have read Professor J. W. Dowling, M.D., of the New York Homeopathic Medical College.

The World's Industries.

The report from the consuls of the United States from different parts of the world for the month of January, 1889, is just issued, and from its pages we cull some valuable statistics and useful information on a variety of subjects upon which, we think, the reader will be interested.

THE PHILIPPINE ISLANDS.

The principal islands are divided into twenty-seven provinces, thirteen of which are on the Isle of Luzon; four on the Isle of Negros; three on Panay; and four on Mindanao. Each of these islands has its governor, and each province and district has its "gobernadorcillo," or sub-governor. The principal cities and shipping ports, and the only ones that do any foreign trade, are Manila, on the Isle of Luzon; Iloilo, on Panay; and Cebu, on the island of that name.

According to Alexander R. Webb, stationed at Manila, Spanish is the official language, and is, practically, the only language spoken. Those American business men who desire to extend their trade to this particular part of the world should understand at the outset that a knowledge of Spanish is indispensable, and that they will greatly advance their interests here if they conduct their correspondence in that language, unless it is addressed to the one American or five or six English houses; and even in those all the employes speak Spanish. Mr. Webb mentions at great length the resources of the Philippine Islands, of which the city of Manila is the principal shipping port. Mr. Webb thinks American goods cannot compete in price with Germany, England, and Switzerland in manufactured products of the fancy sort known here as "notions," but that paper bags are much needed, and that tin ware, and all sorts of cooking utensils, wooden ware, sewing machines, canned goods, agricultural implements, would meet with good sale.

Paper bags and good wrapping paper and twine, such as one sees in the stores of America, are unknown here. You make a purchase at a grocery store, and if the article in in a tin can or box, you are expected to take it as it is without a wrapper; if it is something that requires a wrapper, you will get it rolled up in an old Spanish newspaper or a scanty piece of Chinese paper, something like the inside wrapper of a bunch of fire crackers, which will tear upon the slightest provocation. It is rolled, but you get no string tied around it, and must take the chance of spilling your purchase before you reach your destination. Speaking of the horses, Mr. Webb says they are very small, and he does not understand how they keep alive under the brutal treatment they receive and heat of the climate. They are thrashed up and down the streets from early morn until far into the night, hauling passengers hither and thither, probably only half fed, and yet apparently healthy and vigorous at all times. Some of them look a little discouraged, but the majority are in good condition. They are never used, however, for hauling freight or other heavy loads; that sort of work is left to the Chinese coolies and "carabaos" or water buffaloes. The latter animal is about the size and shape of a half grown ox, with a hide like an elephant's, and a pair of great curved horns about 6 inches in diameter at the base, and from 2½ to 3 feet long. These beasts are hitched singly to small, low, two-wheeled drays and haul enormous loads at a most aggravatingly slow pace.

DECORTICATING AND CLEANING RAMIE.

The prizes offered by the French government for the machines best adapted to the decortication of ramie, which were awarded last autumn, did not prove as satisfactory as was hoped, in view of the efforts made and the number of premiums offered. According to Consul Charles P. Williams' report, there were nineteen entries of machines for decortication and ten different processes for treatment of the fiber on the list of exhibits. Three decorticating machines only took part in the competition. The principle upon which the two French machines worked was similar to that of the two Berthet machines, the reversion of the stalks in the former being accomplished by hand, while in the latter it is automatically done.

The machine termed "Landsheer," which took the first prize of 600 francs, and the "Armand," to which was awarded 400 francs, both claimed to do their work in stalks both green and dry. The former machine costs from 1,500 to 2,000 francs, the latter about 1,500 francs.

The third machine, to which was awarded a recognition in the way of a nominal prize of 200 francs, was presented by the American Fiber Company, of New York. It is simply just to say that a machine had been hastily prepared to exhibit the system adopted by the company in decorticating the ramie, while insufficient time prevented the completion of details which would render it capable of successfully competing in the quality and quantity of its work with machines which had been studied and improved upon for a long time. The principle exemplified by this machine is that of splitting the stalk in two pieces, and as the ribbon is stripped from each piece the stalk is broken into short lengths and dropped. The ribbon is continuous, and the waste much less than by any other process. With some alterations and adjustments, which apparently are easily attainable, this machine would become very popular. The machine can be simplified and bids fair to carry off the prize at the French International Exhibition next year. The machine did its work better on the green than the dry stalks.

It was impossible to determine the amount of work which either of these machines could accomplish, as the stock of ramie was badly assorted and in poor condition. Enough could be gathered from this exhibition to confirm the belief that the difficulties are great, if not insuperable, in decorticating the ramie in the dry state. The character of the decortication was made evident in the subsequent processes of spinning and combing by the quantity of waste.

The effort required to separate the ribbon from the wood in the dry state is far greater than in the green state, when the bark peels readily, assisted by the gummy substance surrounding the stalk, which in the dry state acts like a cement.

When the attempt to separate the fiber from the woody pith is attempted in the dry state, even if none of the fiber should adhere to the wood, the force required to separate it is necessarily so great that the continuity of the fiber is less perfect and the waste more considerable when subjected to the subsequent processes necessary to utilize it.

THE SOUTH AMERICAN REPUBLICS.

Increasing interest centers in the Spanish South American colonies, not only by our people, but by other commercial and manufacturing nations, who are on the alert for a market where they can exchange their wares for the products of other countries.

Venezuela, Colombia, Ecuador, Peru, and Bolivia are among the most prominent states toward which enterprising merchants from other countries are turning their attention and establishing trade.

Alexander R. Jones, consul at Barranquilla, Colombia, says: The commerce of Colombia is with England, France, Germany, and the United States.

The principal exports are coffee, cotton, hides, bark, balsam, tobacco, ivory, nuts, and cotton seed; and of the mines, he says Colombia is without doubt rich in mineral resources. The mountainous part of the interior abounds in gold and silver, and in some parts iron is found in considerable quantities, while on the coast, in the region of Santa Marta, copper exists. The working of the iron mines has not proved a success, while the copper has not been attempted. An American mining engineer has lately reported petroleum in very considerable quantities to exist in Tubara, twelve miles from Barranquilla, and within the limits of this consular district. But the principal mines are of gold and silver. Until a few years ago, these mines were almost entirely in the hands of the English. But recently there has been an influx of American enterprise, capital, and machinery. It is too early yet to say what will be the outcome of this, but with better communication and facilities for getting the heavy machinery into place, there seems to be no reason why mines will not be worked to advantage.

Agricultural pursuits are in a most primitive state. In fact, agriculture, as understood in the United States, may be said not to exist. No machinery is in use, and the native disdains even the use of the ax, preferring yet the old and more laborious instrument, the machete. The machete is a half-knife, half-scythe instrument, greatly resembling the American corn knife. It will be many years before the improvements which make the drudgery of agriculture easy are adopted in Colombia.

Manufactures in Colombia may almost be said not to be worth naming. With the exception of common soap, there is nothing manufactured which begins to cover the demand, unless it be the wretched rum of the country. In every manufacturing enterprise of importance which has found a footing in Colombia, it has been necessary to depend wholly upon the importation of foreign skilled labor. The average Colombian brain is absolutely devoid of the genius of invention, if not, indeed, of the very power of imitation.

[CHEMICAL NEWS.]

Indian Ink.

I find that a color apparently identical to Indian ink can be produced by the action of sulphuric acid on camphor.

An excess of camphor should remain some twenty-four hours in strong sulphuric acid; it then results in a gelatinous mass of a slightly reddish color. This, when heated, effervesces, gives off fumes of sulphurous acid, and turns intensely black. By evaporation the superfluous sulphuric acid and camphor (for there remains an excess of both, the weakened acid not acting on the camphor) can be driven off. The remainder when applied to paper as a paint appears, to my unartistic eye, to be Indian ink.

When dissolved in water, it remains an indefinite time without precipitating. It appears to be dissolved, not held in suspension. B. PIFFARD.

Metallurgic Notes.

Aluminum Irons.—A notable event of the past year was the publication of an important paper by Mr. Keep, of Detroit, giving the results of a careful series of experiments upon the influence of additions of aluminum to cast irons, with special reference to the improvement of inferior irons by such additions, so as to adapt them to foundry uses. The results of these investigations appear to establish the fact that small additions of aluminum (in the form of ferro-aluminum) up to one per cent exert a distinctly favorable influence on cast iron, permitting the production of soft and faultless castings from irons heretofore regarded as altogether unfit for foundry use. Some question has been raised as to whether the results noted by Mr. Keep should not be attributed, at least in part, to the silicon in the aluminum alloy he employed; but the preponderance of evidence appears to be in favor of the view that the influence of small additions of aluminum to cast iron is no less marked and favorable than it is known to be in the case of wrought iron. The interest excited by the announcement of these results is shown by the fact that a considerable demand has lately sprung up for ferro-aluminum for foundry use. Should Mr. Keep's results be verified in practice, they will prove of the highest importance to foundrymen.

It is worthy of notice, in connection with the unusual share of attention that has of late been given to the subject of the cheap production of aluminum, that the general sentiment among metallurgists respecting the practical value of this metal has undergone a considerable modification. Sober second thought, now that the day of cheap aluminum appears to be drawing nigh, has dispelled many of the extravagant notions that formerly were entertained, even by men of science, respecting the possible utilities of this elusive metal. The more carefully its properties are studied, the more probable does it appear that it will always hold a subordinate place in the arts, and that its greatest utility will be derived from its alloys, which, with diminishing cost of production, will come into very general use in the arts of construction.

Manganese Steel.—The effect of the presence of manganese in steel has been made the subject of careful study, and it is believed that the constructive arts will shortly be the gainers by the possession of a metal possessing altogether new and highly valuable properties. The most interesting results have been obtained with steel containing as much as ten to fourteen per cent of manganese. It has been found with this material that, notwithstanding its considerable toughness when cast in the ordinary way, an extraordinary gain in strength is obtained by methods which, in the case of ordinary steel, would cause brittleness, water cracking, and other defects. The process is termed "water toughening," and consists in heating the article under treatment to about 1,800° to 2,000° Fah., and then plunging it into cold water. The nearer the above temperatures are approached, and the colder the water, the tougher will be the material. After water toughening, notwithstanding their hardness and stiffness, it was found that test specimens could be bent double, cold, almost in the same way as a piece of the mildest forged steel, thus proving that the new alloy combined the apparently contradictory qualities of hardness and toughness. It is believed that manganese steel treated by this toughening process will be found especially well adapted for railway car wheels, car couplings, and similar uses.—*Jour. Franklin Institute.*

Refilling of Old Coal Mines.

An ingenious artifice that has lately been successfully put in practice at Shenandoah by the Reading Company, at the Kohinoor colliery, for refilling the excavations from which coal has been taken out, is worthy of mention, since it is desirable that it should be imitated elsewhere throughout the coal regions where similar conditions prevail. The method is both simple and effective, and prevents the caving in of the earth above, and the consequent loss of valuable property, which has not been infrequent in the mining towns of the anthracite region. Besides, the valuable pillars of pure coal, which for many years it was customary to leave in the mines to prevent falling in of the roof, can now be taken out without fear. A coal dirt conveyer, consisting of a series of semicircular chutes, similar to those used in discharging coal from carts into cellars, and an endless chain with scrapers attached, automatically conveys the fine refuse from the coal breakers to an elevation, from whence it is discharged into a second chute. As the coal dirt falls on this, water, pumped from the mines, mixes with it and carries the stuff, in a semi-liquid state, back through a jig or puddling hole into the bowels of the earth, from whence the coal has been removed. The coal dirt settles to the bottom of the breasts and packs closely, and the water seeks an outlet below, to be again pumped out to repeat its duty. The cost of this puddling the refuse matter back into the mines, about three to four cents per cubic yard, is very small compared with the value of the pillars of marketable coal of which the mines may be safely "robbed," and the security obtained for dwellings and railroad property on the surface, above the mines. Already more than two acres beneath the city of Shenandoah, from which the coal had been mined, have been again solidly refilled with the coal dirt which used to be piled mountains high around the town.—*Jour. Franklin Institute.*

PHOTOGRAPHIC NOTES.

Plates for Development with Plain Water.—Mr. Leo Backelandt, a well known Belgian chemist, has just issued plates covered on the back with salts fit for the development of the image. It suffices to immerse the plate in ordinary water, and this immersion dissolves the reducing salts, and the image is developed. It is a very ingenious idea. We have just made a successful trial of these plates, and we think that they will be appreciated by amateurs desirous of dispensing with the trouble of preparing developing solutions beforehand. The fixing agent, ready powdered, is also inclosed in the box containing the plates; so that we have at once the sensitive film, the developer, and the fixing salt all to hand in the solid form. If the thing is really as good as it appears to be at first sight, what facility is offered for photographing on a journey in the country, etc.! We think that by the help of papers impregnated with developing salts the same result may be obtained, and then this method will be applicable to plates, papers, and pellicles of all makes.—*Leon Vidal, in Photo. News.*

Rapid Hydroquinone Developers.—A point of great importance is stated by Captain Himly, and his statement concurs with what has reached us from other quarters, namely, that the addition of a small quantity of caustic alkali to either the carbonate of potash or soda developers confers more brilliancy and more detail upon the negative, advantages independent of that for which it was added—its great accelerating influence. This is a very curious and unexpected result, the general effect of an accelerated developer when using pyro and ferrous oxalate not being in favor of additional brilliancy, at all events.

As to the use of meta-bisulphite of potash, Captain Himly finds that, when used in too great proportion, it retards development considerably, but is notably more powerful as a preservative in the solution than sulphite of soda alone. When color of the image is important, however, it is not desirable to omit the sulphite of soda, or even to reduce the amount of it, when meta-bisulphite of potash is used, as the former salt has such a beneficial effect upon the color of the deposit.

As the result of Captain Himly's researches, he recommends the following developer, here put into English measures:

HYDROQUINONE AND CAUSTIC SODA DEVELOPER.

Solution A.

Hydroquinone	40 grains.
Meta-bisulphite of potash	16 "
Water	2¼ ounces.

Solution B.

Caustic soda	1 ounce.
Water	8 ounces.

To 5 ounces of water, ½ ounce of each the above solutions is added. This developer is recommended as very good for negatives, but not for positives upon bromide of silver emulsion paper, as the tone is very unequal, and for the most part of a reddish color.

HYDROQUINONE AND POTASH DEVELOPER.

Solution A.

Hydroquinone	40 grains.
Meta-bisulphite of potash	16 "
Water	2¼ ounces.

Solution B.

Carbonate of potash	1 ounce.
Sulphite of soda	½ "
Water	10 ounces.

For development, ten parts of A and from fifty to seventy-five parts of B are added to from fifty to twenty-five parts of water, according as it may be desired to produce a soft or a powerful negative. As accelerator, six minims of the one in eight solution of caustic soda above mentioned is to be added. The addition is stated to have also a favorable influence upon the color of the deposit. This developer is also recommended as very suitable for positives.

HYDROQUINONE AND SODA DEVELOPER.

Solution A.

Hydroquinone	40 grains.
Meta-bisulphite of potash	20 "
Water	2¼ ounces.

Solution B.

Carbonate of soda	1 ounce.
Sulphite of soda	½ "
Water	10 ounces.

For development, to ten parts of A from fifty to seventy-five parts of B are added, and fifty or twenty-five parts of water, as with the potash developer.

This developer also works noticeably better when six minims of the one in eight solution of caustic soda as accelerator is added. The developer works exceedingly well, both for negatives and for positives upon bromide of silver emulsion; and is especially good for the latter purpose, the tone being very even. It is recommended, before washing, to immerse the print for a short time in a dilute acetic acid solution, which discharges any yellow color that may have appeared upon the paper. The use of a bromide as a restrainer is unnecessary, this function being sufficiently fulfilled by the meta-bisulphite of potash.

In the table of comparative results given by Captain Himly, caustic potash shows a less favorable action than caustic soda, and the latter is therefore recommended. On other accounts—less cost and greater freedom from impurity—soda is also to be preferred.

The carbonate of soda required is not the powder sold under that name, and known also as sesqui-carbonate and bicarbonate, but the crystals. Washing soda, if moderately pure, generally answers perfectly. The precaution of using for the hydroquinone solution either distilled water or water that has been boiled and allowed to cool, must be observed, as well as that of thoroughly dissolving the sulphite—when sulphite of soda is used—before the addition of the hydroquinone. Sulphite of soda must be in good condition—must not have effloresced.

Development by hydroquinone has been making way by leaps and bounds. The present modification—that which removes the one most serious objection hitherto raised to its use (slowness of action)—appears at the same time to confer additional good qualities to the negative itself, and seems likely to bring the method into a much more extended application than it has hitherto enjoyed.—*Photo. News.*

Time Servers.

How many men there are, holding good, paying positions as journeymen, who are really of no value unless kept constantly under the eye of the foreman or their employer! They are simply time servers, who take no interest in the business they represent beyond the actual time necessary to count them a day's work. They work when closely watched because they are obliged to, not from any motive of honor or interest in the business.

What can be expected of such workmen but that they will shirk their work and idle their time at every opportunity?

If you cannot give your employer your full time for which he pays, and take some interest in his business, you had better leave him at once. To this he is entitled, and has a right to expect it of you.

If your mind is not upon your work, you cannot expect to accomplish it with any degree of satisfaction to your employer or credit to yourself.

In going about from one shop to another it is a very easy matter to pick out the time servers. Upon the slightest pretext they drop their work to talk or look about, and are always ready to get out of the door the moment the clock strikes six, and their example is very rapidly followed by the apprentice or younger workmen. They have to be constantly watched, and this fact, being known to the firm, is not long in having its results.

Employers are more generally knowing to the habits and qualities of the men they employ than the men often realize, and they invariably know who are the time servers among them, so that when there comes a convenient opportunity or a lull in business, these are the first to be discharged.

It pays to be faithful and to do your best at all times, and more especially when your employer is not watching. If you must idle away time, do it when he is about, but don't dishonor yourself or betray his confidence by taking advantage of his absence.

This is one of the worst features of our American system. It is an example which is set by the older men, and which is readily adopted by apprentices, and it is the exception rather than the rule that we find a young man who is sufficiently interested in his own welfare and his employer's as well to give his full time and attention to his work. Those who do this are sure of success, and it is from among such that have risen those men whose names are written upon the pages of history as having made their mark in the world, and left behind not only pleasant recollections, but a shining example that is worthy of a careful imitation.—*The Practical Mechanic.*

Peach Stone Fuel.

It has been demonstrated in Vaca Valley that peach stones will make as good a fire for household purposes as the best kind of coal in the market, says the Vallejo (Cal.) *Chronicle.* The fruit growers, instead of as heretofore throwing the pits away, dispose of the stones at the present time at the rate of $6 a ton. A sack of the stones will weigh about 80 pounds and will last as long as an equal number of pounds of coal, and give a greater intensity of heat. At many of the orchards in the valley may be seen great stacks of peach and apricot stones which will eventually find their way to San Francisco and other places to be sold for fuel. The apricot stones do not burn as readily as the peach, and will not command as good a price. The fruit raisers will undoubtedly be pleased to learn that they now have another source of revenue open to them. A large number of peaches are dried during the summer season for shipment. As soon as the owners find that they have a market for the stones, a greater number of pounds will be dried than heretofore.

RECENTLY PATENTED INVENTIONS.

Engineering.

VALVE GEAR.—Edwin Garst, Dayton, Ohio. Combined with a rotary cam is a longitudinally sliding valve-operating frame, and a transversely sliding frame thereon embracing a cam, with other novel features, the valve being simple and durable in construction, using steam expansively, and automatic in its operation.

BOILER.—George F. Spencer, Thompson, Pa. This invention provides a boiler designed to be economical in fuel, and in which provision is made for the settlement of all waste in the base of the boiler, thereby preventing incrustation of the tubes, the object being also to increase the area of the heating surface, and provide for the rapid circulation of the water and steam.

Railway Appliances.

AIR BRAKE.—Joseph S. Lapish, American Fork, Utah Ter. Combined with two auxiliary reservoirs on each car, connected by a pipe, is an operating pipe connected with the reservoirs, a valve, and a coupling connected by a rod with the valve, with other novel features, the pipes being connected in the usual way with the main reservoir on the locomotive.

CAR STOVES.—Robert H Gilmour and Fortunatus G. Kellogg, Huntington, Ind This invention covers an apparatus to be located in each car and connected with the engine and the stove in the car, so that the engineer can extinguish at will the fire in the stoves on a train by causing water or chemicals to be discharged into the stoves.

Agricultural.

SULKY PLOW.—John H. Zinn, Gettysburg, Pa. The plow frame has slotted cross pieces to which the beams are adjustably secured, that they may be raised and lowered as required, and the plows or shovels have a socket connection with the beam, also adjustable according to the work to be done, while the driver's seat is so arranged that it may be moved either forward or backward on the frame.

Mechanical.

FRICTION CLUTCH.—Daniel T. Denton, Soudan, Minn. This invention covers a construction in which the clutch wheel is pivotally connected by toggle links with a collar secured on the main shaft, with other novel features, the clutch being especially adapted to hoisting machinery, in which a powerful friction and large bearing surface are required.

COTTON PRESS.—August Schkade, Giddings, Texas. This invention covers a tramper attachment for cotton presses which may be readily applied to any press, and is designed to be operated by steam, the attachment being simple and durable, and the invention covering various novel features of construction and combinations of parts.

CONVERTING MOTION.—Edward Burke, Le Mars, Iowa, This is a mechanism for converting reciprocating motion into rotary motion, or the reverse, employing a rectilinearly reciprocating rod, a shaft with rigid crank arm, a small traveling gear wheel mounted on the outer end of the crank and having a crank connecting with the rectilinearly moving rod, a stationary concentric gear being connected with the traveling gear wheel.

Miscellaneous.

SAD IRON.—Julius J. Czepull, Charleston, S. C. This is a self-heating sad iron which has a hollow body connected by pipes, and so constructed that when the reservoirs are once filled with gasoline, and the gases issuing from the burner are ignited, the sad iron will be continually heated for about six hours before the reservoirs need to be refilled with gasoline.

BOTTLE STOPPER.—William P. Crary, New York City. In this stopper the cork is covered with cloth or other tissue, which is tied above the cork, and extends above the binding cord to furnish a grasp or handle for withdrawing the cork from the bottle, this covering being also adapted to be tied down over the neck of the bottle to protect the cork and neck.

WATCH CASE PENDANT.—Frank G. Faxon, Mount Morris, N. Y. This invention covers a construction of a pendant set in which the watch bow will retain the winding and setting stem within the pendant when in its normal position, but which will release the stem-holding springs when the bow is in a particular position.

BRICK TRUCK.—James C. Steele, Statesville, S. C. This is a wheeled truck, with a pair of rests or lifting arms arranged between the wheels and near the ground, with lifting mechanism for both the front and rear ends of the arms to raise and lower them in level position, the arms being designed to be pushed under a platform carrying a load of bricks.

VEHICLE BRAKE.—John Fraser, Simcoe, Ontario, Canada. This invention covers novel details and combinations of parts in a brake designed to be simple and durable, and which will not only lock the wheels when the vehicle is descending a hill, but which will also lock the wheels should the vehicle be stopped in ascending a hill.

LETTER SHEET AND ENVELOPE.—Henry A. Ditzell, Romulus, N. Y. This is a sheet with gummed projecting portions adapted to make a combined letter sheet and envelope, and also having a projection adapted to bear the return address on the front of the envelope.

WARM AIR INHALER.—Louis Weigert, Berlin, Germany. This invention relates to an apparatus for supplying heated air of a suitable temperature for inhalation by persons suffering from diseases of the throat or lungs, the apparatus having a chamber heated by a burner, with outlets for the escape of the products of combustion, and an outer chamber to heat air by contact with the central chamber.

FLYING MACHINE.—Reuben J. Spalding, Rosita, Cal. This machine consists of a jacket adapted to the body of the aeronaut, right and left wings and a tail held to the jacket, and a balloon from which the aeronaut is suspended by connections to the jacket and to straps or bands encircling his legs.

PAPER BOX.—Emil L. Meyer, Brooklyn, N. Y. This invention covers a blank of novel form and a box set up from such blank, which will be strong and inexpensive, and which may be mailed or shipped cheaply in flat or unfolded condition, and will keep its shape when set up, without the use of glue or other adhesive at the joints.

TRUNK.—Henry W. Rountree, Richmond, Va. This improvement is designed to give access to the body of the trunk without the necessity of lifting the tray out, the arrangement being such that the tray may be slid back on a horizontal line into the hinged lid or top when open without lifting the tray off its supporting strips.

EYEGLASS POLISHER.—Edward E. Thorpe, New York City. This polisher consists of an outer backing or body of flexible material and an inner sheet of polishing material, the latter being connected to the backing or body, the polisher being preferably made in a form convenient to fold and carry in the pocket.

CASH CARRIER.—Nelson Weeks, Jr., Long Island City, N. Y. This invention is designed to so improve cash carrier apparatus as to effect the complete independence of the several sales stations, conveying the cash pockets to and from each station by a single carriage without the interference with or dependence on the cash pockets of the other stations.

SHIPPING RECEIPTS.—Daniel K. Howe, Portland, Oregon. This invention provides a safe and convenient receptacle for a large number of receipts or papers, without the necessity of binding them between covers, and where also duplicate receipts or stubs may be safely and conveniently kept prior to filing them away.

TAG HOLDER AND TAG.—Martin L. Fogel, Superior, Neb This is adapted to be readily attached to and detached from packages of goods to be marked without injury to the goods, to remain securely upon the package until the package is consumed, while the tag holder can be used over and over again until worn out.

Business and Personal.

The charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

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.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(538) A. W. P. K. asks for (1) method of cutting glass by means of fire. A. File a notch in the glass and touch with a red hot iron. This may be repeated until a crack is started. A drop of water may be placed on the spot to start it, if it fails to appear. Then by moving a hot iron a little in advance, the crack can be led in any desired direction. 2. Recipe for making an invisible chemical substance which makes a snapping noise when stepped upon. A. Mix 2 parts chlorate of potash and 1 part red phosphorus with a little gum water, and apply drops of it to paper. It is very dangerous to work with. 3. Candle power and voltage of a 4 quart Bunsen battery. A. Such a cell will give nearly 2 volts and 10 watts, equivalent to two or three candle powers. 4. How many 4 quart Bunsen cells are required in operating a 2 gallon nickel plating solution? A. One or two cells.

(539) W. H. C. writes: 1. What is the difference between an electrical and a steam horse power? A. There is no difference, properly speaking. One horse power second of mechanical energy converted without loss into electrical energy would generate 746 volt-coulombs. The rate of one mechanical horse power is 33,000 foot pounds per minute; the rate of one electrical horse power is 746 volt-amperes. But as in the conversion there is inevitably a loss, ten per cent may safely be subtracted from the electrical H. P. to get a practical figure. 2. How many storage batteries would it take, of 300 ampere hours and 2 volts, to run a motor of four electrical horse power? A. If we assume a discharge rate of 30 amperes, then 50 cells would be needed. 3. About what would be the cost of storage batteries of the above capacity? A. For prices address any reliable firm of electrical supply dealers.

(540) R. H. B. writes: In SUPPLEMENT, No. 633, p. 10110, you describe Prof. Low's incandescent gas burner. Would you please inform us through your columns what is the incandescent cone made of, and how is it made? Please tell us of some cheap composition that will stand incandescence for five or six hundred hours, over a Bunsen burner. A. The composition of the cones of incandescent burners is secret. Zirconia forms a prominent constituent. Platinum wire is sometimes used. A mixture of zirconia and magnesia or lime would answer, but it is doubtful if it would last 600 hours.

(541) G. W. R. writes: Will you inform me what effect about 2,000° Fah. will have on graphite in its powdered state, also whether it is considered a good non-conductor of heat? A. The heat mentioned will have no effect on graphite. It is a conductor of heat if compressed, but only a poor one; if in loose powder, it is a still worse conductor.

(542) J. R. B. asks in what manner the alternating current differs from other currents in electricity. A. As its name denotes, it changes its direction continually, sometimes many hundred times a second.

(543) H. D. W. writes: In Greensburg, Pa., is located a house which often is the scene of peculiar electrical phenomena. Everything therein in the way of metal becomes charged with electricity, such as gas fixtures, door knobs, etc., and even the occupants in passing each other in rooms or halls who touch hands can experience a shock. In turning on a gas light the shock is often very pronounced. The house is located in the natural gas region, which is burned in fireplaces and ranges, but is not used for illuminating, and there are no electric wires attached to the house at any point. One or two other houses in the same place have been charged with electricity, but not to such an extent as the one under consideration, and the disturbance can be noticed only on clear days. Can you throw any light on this subject? Will you please, if it can be done, explain why this electricity is in the house and where it comes from? A. The air of the house and the materials composing it, we presume, are very dry, so that the friction of a person's shoes upon the carpet is enough to excite electricity.

(544) H. C. writes: I am making a small electric motor. The magnet is made of ten pieces of Russia iron, each 13½ in. long, 2 in. wide, and about 1-40 of an inch thick, bent in the form of a circle about 4½ in. in diameter. The armature is a gray iron casting for an H armature, 2 in. long, 1½ in. diameter, with a groove 1 in. × ⅜ in. for the wire. I should like to run the motor with three Crowdus Universal batteries, each having an advertised E. M. F. of 2·5 volts, an internal resistance of 0·4 ohm, and a current through its own resistance of 5 amperes. 1. Please tell me how much and what size wire I should put on each magnet pole and armature to obtain best results with my battery? A. Your results will be very inferior on account of the material and construction of your armature. It should be built up of sheet iron punchings with shellacked tissue paper between them. Wind field and magnet with No. 20 wire, using altogether 200 feet. 2. How much power should you think the motor ought to give? A. The motor will not give over 1-100 H. P.

(545) H. P. writes: I would like to ask you how to make a battery to run a small or toy motor. I have a jar 6 in. × 8 in. Is there any way of constructing it to run the motor? Or is there any battery that will run a small motor for months without recharging the same? If so, how are they made? A. For battery see SCIENTIFIC AMERICAN, December 17, 1887, and for a battery plate made from electric light carbons see SCIENTIFIC AMERICAN, October 27, 1888. A large gravity battery is most constant for long periods. See SUPPLEMENT, Nos. 157, 158, and 159, for description of all prominent batteries.

(546) M. L. asks the relative loss by friction on a common steel shaft running in: 1. Ice boxes (theoretically)? A. The friction of steel on ice journals has no record. On runners it is very low, probably not exceeding one per cent of the load. 2. Steel boxes? A. Steel shaft in steel boxes, continuous lubrication, 3 to 3½ per cent. 3. Babbitt metal boxes? A. Steel shaft in Babbitt, 4 to 4½ per cent. 4. Brass boxes? A. Steel shaft in brass, 4 to 5 per cent. 5. Graphite boxes? A. Steel shaft in graphite boxes dry, 5 to 6 per cent of the load. The friction of journals varies very much with the quality and kind of lubricants.

(547) F. S.—You will find the red mulberry tree growing in Central Park, on the Bloomingdale road (this side of the Asylum), on Hoboken Heights, N. J., and at Glen Cove, L. I.; and the white mulberry you will find rather common in cultivation about the city, and in Astoria, Hoboken, etc. As regards distribution, the red mulberry (our native species) is found in rich woods from New England to Illinois and southward.

(548) F. H. S. writes: I have a steam fruit evaporator, which is a horizontal shaft of the following dimensions: Length 46 feet 8 inches, height 7 feet, width 4 feet. The heat is obtained by five horizontal coils of 1 inch steam pipes. Horizontally the pipes are 4 inches apart, and vertically 12 inches apart. One end of the shaft is raised 4 inches to give drainage to the pipes. The drying is done on eleven rows of gal-

vanized wire sieves distributed between the coils of steam pipes. Air for drying is admitted at the bottom of this shaft along the floor by slide doors. And to carry off the moist air I now use natural draught, by a wooden stack, 4 feet square and 20 feet high; at one-third of the distance from each end of the shaft, two more moist air draughts, each 4 feet square, connect with the 20 foot high stack from the top of the center of the shaft or evaporator. When I run this evaporator up to its full capacity, it puffs up and sweats the fruit with only 150° of heat. If I should put an exhaust fan in the center of the moist air stack, would it stop this sweating and cooking process of the fruit that I am now troubled with? If it would, what kind and size of fan would it require to give the best results for this sized evaporator? A. It appears from your description that the ventilation of the evaporator is not equally distributed, or is weak at the ends. This should be tested by thermometers at points out of the direct current of air through the evaporator, to ascertain inequality of temperature, and if found, should be regulated by increasing the number of vents and lessening the size. The wire sieves should not be too close to the steam pipes, as the strong radiant heat would cook the fruit, when a thermometer hung up in the moving air would only indicate 150°. If you had only one row of steam pipe with the fruit above it, or in other words, spread the plant over a larger area with less height, the cumulative heat of air circulating through 5 rows of coils would be avoided. We apprehend (although you failed to state it) that the trouble is on the upper shelves at points of least circulation. A common fan blower of 2 feet diameter, blowing the air into a chamber under and along the bottom of the evaporator, with perforations to equally distribute the air, might prevent cooking in the hot parts, but would make the lower tier too cool for effective service. The most effective driers for fruit have all the heat below, so that air of the same temperature pervades the whole chamber. This arrangement is largely used in New York and other places for drying fruit.

(549) H. L. asks: 1. Would it cost any more to run the dynamo after it was set up and ready to run than it would cost to run oil lamps for the same amount of light? A. Oil lamps are more economical than incandescent electric lights. 2. In what SUPPLEMENT can I find it described in full? A. SUPPLEMENT, No. 600. 3. How are the magnet arms secured to the base and top, and of what kind of iron are all the castings made? A. This information is given in the SUPPLEMENT referred to. 4. What do you mean by the polar extremities? A. The extremities in which the magnetic poles are developed. 5. Would not copper bars do instead of the bronze bars of the commutator? A. Yes. 6. Where can I get copper or bronze? A. Consult our advertising columns. 7. Can I melt copper or bronze in a blacksmith's forge, and in what? A. You can melt it in a Hessian crucible. Heat the crucible and its contents gradually at first. 8. How can I mould the metal for the commutator cylinder. A. Use ordinary moulding sand. 9. Would it not do as well to solder the ends of the armature wire to the commutator cylinder as to screw them? A. Solder is apt to fail in such a place. 10. With what size wire shall I wrap the armature and magnet of a twelve-light machine, made on the same principle as the eight-light machine? A. Wrap the armature with No. 18 wire. Apply four extra layers of wire to the magnet, and increase the speed.

(550) A. V. asks: Would you be so kind as to let me know how many layers and how many turns in each layer of No. 10 copper wire will bring a magnet to its maximum point, the core of which is soft iron, being 1¼ inches in diameter, 10 inches long, being in circuit with 250 16-candle power lamps connected in multiple arc, from a dynamo having 72 volts? A. We presume that your lamps are 70 volt; if so, their resistance is very slight, and you cannot afford to introduce more than a fraction of such resistance in series with them. Thus No. 4 wire would introduce a resistance of about one-tenth ohm, or nearly one-third that of your lamps, reducing their illuminating power seriously. Your proper method is to use heavy wire, and if necessary increase the size of the core, and as a last resource use lamps of lower voltage.

(551) O. T. H. writes: 1. In the SCIENTIFIC AMERICAN SUPPLEMENT, April 14, 1888, No. 641, page 10240, on the 31st line, about how to make a simple electric motor, it reads: "The size of the iron wire of the core is No. 18 American wire gauge," and on the next page, the 7th line from the last, it reads: "Size of wire on armature, Am. W. G. No. 16." Please tell me which one is right? A. Both. No. 18 iron wire is right for the core, and No. 16 is right for the coils of the conductor wound upon the core. 2. What is meant by a disk of vulcanized fiber? A. Vulcanized fiber is an insulating material used largely in electrical work. 3. How much will it cost to run the simple electric motor for eight hours? A. Seventy-five or eighty cents. 4. Which is the easiest way to make a cell of plunging bichromate battery, having one zinc plate 5×7 inches and two carbon plates of the same size? A. Place the zinc plate between two paraffined quarter inch bars of wood. Place the carbon plates outside of the strips, and clamp the carbon plates and the zinc plates together by means of a pair of paraffined bars of wood three-quarters of an inch thick, and extending beyond the edges of the plate.

(552) F. G. W., Denver, writes: On Sunday, February 3, there were three groups of spots on the sun in the form of a triangle. These groups seemed to be composed of minute spots. On Monday afternoon, February 4, we had a violent dust and wind storm. It continued through the night. On Tuesday afternoon, February 5, I observed the sun. The spots had disappeared. With my strongest eye piece, giving a power of 100, I could not detect a trace of the spots. I am almost certain that there was some connection between the storm and the spots. Would a solar cyclone, or something like it, produce such a storm? A. The past season has been a period of minimum sun spots, and any sudden outburst of spots upon the sun at such periods indicates abnormal conditions of activity at the solar surface, which at times heretofore have caused coincident magnetic storms upon the earth. These magnetic storms have been followed by wind storms. It seems to be pretty well established that there is an almost instantaneous coincidence of magnetic effect upon the earth derived from solar disturbance. This may also resolve itself into its electrical equivalent and become observant in corresponding meteorological phenomena.

(553) R. A. W., "Adams Co."—In the SCIENTIFIC AMERICAN SUPPLEMENT, No. 182, and in others you will find many forms of electro-magnets described. In general terms the larger you make the magnet, the greater will be the power. You might try a one inch bar of iron, two feet long, bent into U shape, and wound with 1,000 feet of No. 15 wire. This with from five to fifteen cells of Fuller battery would give an excellent effect.

(554) G. E. T.—White military belts can be made to look as good as new by the following: Dissolve 1 ounce white tallow soap in ¾ pint of warm water and mix well therewith white of one egg and 3 ounces fine Paris white. Wipe in and rub down with a rag. White Castile soap may be used where the white tallow soap cannot be had.

(555) R. S. asks: 1. What size should I make the iron wire armature core of simple motor, March 17, 1887, if the whole armature was to be 5 inches diameter? What size iron wire would I have to use for the core, and how many layers of it would I have to wind? A. Use 12 layers of No. 18 wire. Make the core 3 inches wide. 2. What size wire would I have to use on armature, and how many layers on armature? A. Wind the core with No. 16 wire disposed in 20 coils of six layers each.

(556) J. S. S. writes: 1. I can get almost unlimited gravity battery power (nearly 300 cells), and would like to run a simple electric motor as described by you. How can I do it by this battery? A. If you wish to use all the cells, place 16 in series and as many as you wish in parallel, the more the better. A. Gravity battery, owing to its high resistance, is ill adapted to this work. 2. In the storage battery does the current decompose the water? A. Not unless the current is continued after the battery is fully charged. 3. (*a*) What is the amount of the dangerous alternating current? (*b*) Of the continuous? A. (*a*) 600 to 700 volts. (*b*) About the same.

(557) W. A. R. asks: Can you change the center of gravity of a dish by filling it with water, or in other words, can you make a hollow vessel or dish of such a shape that it will tip over by filling it with water? A. To a pipe inclined at an angle of 45° attach a small base of sufficient weight to support the pipe while empty. Such a vessel when filled with water will tip over.

(558) C. E. B. asks: 1. If five Leclanche cells were to be set up in one common solution without the glass jars, would such a battery be equal in power to one of the usual form of separate jars? A. No; its power will be scarcely more than that of a single cell. 2. How many electric light carbons six inches long should I use to each zinc in a sal-ammoniac battery to get the best results? A. 9 or 10. 3. For electric gas lighting should the zincs and carbons be connected one to the other, or should they be connected separately? A. For a single lamp the zinc of one cell should be connected with the carbon of the next, and so on. For a number of lamps the elements would have to be connected according to the voltage of the lamps. 4. Would such a battery as described above or a Leclanche battery work with a solution of salt (chloride of sodium)? A. You can get a current from a Leclanche battery charged with a solution of common salt, but it is not equal to sal-ammoniac, and it evolves chlorine, which is disagreeable. A Leclanche battery is very quickly polarized in active service, and takes time to recover.

(559) H. D. H. asks: Have ice boats been known ever to make 100 miles an hour, and about what rate of wind would be necessary for that speed under the most favorable circumstances? A. We have no record of so high a speed as 100 miles per hour for an ice boat. A 60 mile gale might produce the speed if the boat could preserve its leeway, or hold up to the wind, which is very doubtful. Probably from 50 to 60 is the highest speed ever attained. See SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 54, 61, 214, and 220, for sailing faster than the wind.

(560) W. F. P. writes: 1. I find the battery described in the SCIENTIFIC AMERICAN for December 17, 1887, soon becomes polarized. Will you kindly inform me through your Notes and Queries how I may remedy this? Is it necessary to amalgamate the zincs often? A. All single-fluid bichromate batteries are unsatisfactory as regards constancy of current. You cannot remedy it. 2. Is there any hand dynamo described in your paper that may be constructed without castings? Is the simple electric motor suited for this purpose? A. The trouble with a dynamo having soft iron laminated magnet cores, such as used in the motor named, is that it is hard to start the current for want of residual magnetism. We advise you to adhere to cast iron cores for small machines.

(561) A. A. writes: With regard to the simple electric motor in the SCIENTIFIC AMERICAN SUPPLEMENT, No. 641, of April 4, 1888, page 10240, will you be kind enough to inform me if a field magnet with the body made of cast iron would be as efficient as one made of strips of Russia iron, such as described in the article? A. The difference is slightly in favor of the Russia iron or wrought iron magnet, but if you use very soft gray cast iron, the difference will not be perceptible.

(562) Motor.—Any device which will keep the bars of the commutator smooth and clean would be worthy of a patent, and could be patented if new.

(563) A. P. asks for the value of coal gas for cooking purposes. Is it to be preferred to coal, and is it more economical than coal? Could you give me the address of a good maker of gas stoves? A. Coal gas for cooking saves the annoyance of ashes and dust, and if properly used, is in many cases not more expensive than coal, as it can be extinguished as soon as the cooking is over. For gas stoves apply to your gas company, or consult our advertising columns.

(564) W. J. H. asks: 1. Will the dynamo described in SCIENTIFIC AMERICAN SUPPLEMENT, No. 600, run lights enough to light a room 20×40×12? A. The dynamo will run eight to twelve 16 candle power lamps—hardly enough for room you mention. 2. What kind of lamps are the best to use with it? A. Use Edison or other incandescent lamp, 60 volt, arranged in parallel. 3. How much power does it require to run the dynamo, and what would be the running expense of the lamp per hour, when run from 4 to 6 hours a day? A. About one horse power. A lamp will last about 400 hours. From these data you can make your own calculations, based on expense of fuel, etc., in your locality.

(565) A. H. asks: 1. What is paraffine wax made from? A. It is made largely from distillation of coal at low temperatures. Ozocerite, a natural mineral, is also an extensive source. 2. At what temperature does it run best (to mould)? A. Different samples melt at different temperatures; such as requires 112° Fah. or more is adapted for casting. When well fused, you can pour it into the moulds. 3. Is oil proper to use? A. No. Generally you will require nothing on the mould. 4. How do you cleanse it? A. Melt it and keep in fusion until impurities either settle or rise to the top, when they can be removed. You can wash it with hot water or filter while hot through flannel. Chemical treatment involves heating with strong acids or alkali, according to the nature of the impurities, followed by washing.

(566) H. S. C.—For description and tests of the modern great guns see SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 230, 256, 450, 510, 583, 600, 617, 615. For the great battles of the world, see Fisher's "Outlines of Universal History," which we can mail for $3.50. We know of no successful attempts at aerial navigation without balloons.

(567) F. V. B. asks how to temper drills to drill surface rocks and bowlders, some of the hardest granite, others more like flint, and what steel is best to make the drills of? A. Use what is called "drill steel" in the hardware trade. Make the cutting edge rather thick, and do not draw the temper. Any blacksmith can forge and harden such drills at the lowest heat without drawing the temper.

(568) H. W. G.—Belts that slip from overwork are benefited by lagging the pulleys. It is true that two cylinder engines at right angles have no dead center without a balance wheel.

Enquiries to be Answered.

The following enquiries have been sent in by some of our subscribers, and doubtless others of our readers will take pleasure in answering them. The *number* of the enquiry should head the reply.

(569) C. P. T. writes: The months of January and March of this year have each two new moons on the first and thirty-first days, while February has none. Can you tell me how long it will be until another such event occurs?

Replies to Enquiries.

The following replies relate to enquiries recently published in SCIENTIFIC AMERICAN, and to the numbers therein given:

(404) H. R.—Water Power, etc.—For estimating the value of a water power, multiply the water flowing in the stream in cubic feet per minute by 62·4 (the weight per cubic foot) and by the fall in feet. Divide this product by 33,000 for the horse power. See SCIENTIFIC AMERICAN SUPPLEMENT, No. 616, on water power. 2. Set posts butt down. 3. Bark on, wet or dry as convenient. 4. Charred posts last 50 per cent longer than uncharred. 5. Winter is the best time to cut posts.

(405) C. A. A.—Roofs.—Water from a galvanized iron roof is not safe. The roof should be painted with iron oxide paint. Galvanized iron pipe is largely used for conveying water, and is considered safe if water is allowed to run constantly. Tin makes the best roof, all things considered. Water is safe to drink from a roof painted with oxide of iron paint.

☞ Books or other publications referred to above can, in most cases, be promptly obtained through the SCIENTIFIC AMERICAN office, Munn & Co., 361 Broadway, New York.

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March 12, 1889,

AND EACH BEARING THAT DATE.

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