SCIENTIFIC AMERICAN

[Entered at the Post Office of New York, N. Y., as Second Class Matter.]

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

Vol. L.—No. 17. [NEW SERIES.] NEW YORK, APRIL 26, 1884. [$3.20 per Annum. [POSTAGE PREPAID.]

THE BRIDGE OVER CATSKILL CREEK.

The accompanying engraving represents one of the most picturesquely located bridges on the New York, West Shore, and Buffalo Railway; it spans Catskill Creek, a small stream flowing from the mountains and emptying into the Hudson River.

The bridge consists of eight double deck spans, six of which measure 167 feet each from center to center of end piers, are 26 feet deep, center to center of chords, 20 feet wide, center to center of trusses, 13 feet, center to center of tracks; the two end panels are 16 feet 10 inches, and the eight intermediate panels are each 16 feet 8 inches. There is one span of 103 feet 6 inches between centers of end piers, and 20 feet 11 inches deep; each of the six panels measures 17 feet 3 inches. The remaining span is 97 feet 6 inches long and 20 feet 11 inches deep; the end panels are 17 feet 3 inches; and the four intermediate ones each 15 feet 9 inches. The actual weight of the six 167-foot spans is 2,340,000 pounds, or 390,000 pounds per span; the next span weighs 180,000 pounds, and the third 173,500 pounds; the total weight of the eight spans being 2,693,500 pounds.

The bridge is proportioned to carry (1) the weight of iron in the structure; (2) a floor weighing 400 pounds per lineal foot of track, consisting of rails, ties, and guards only; and (3) a moving load for each track, consisting of two "consolidation" engines coupled, each weighing 80 tons, followed by a train weighing 2,240 pounds per running foot. The maximum strains due to all positions of this live load, and of the dead load, are taken to proportion all the parts of the structure.

To provide for wind strains and vibrations the top lateral bracing is proportioned to resist a lateral force of 450 pounds per foot of span; 300 pounds of this being treated as a moving load. The bottom lateral bracing is proportioned to resist a lateral force of 150 pounds per foot. Variations in temperature to the extent of 150 degrees are provided for.

The bridge was built by Clarke, Reeves & Co., Phœnixville (Pa.) Bridge Works.

Preparation of Collodion Cotton.

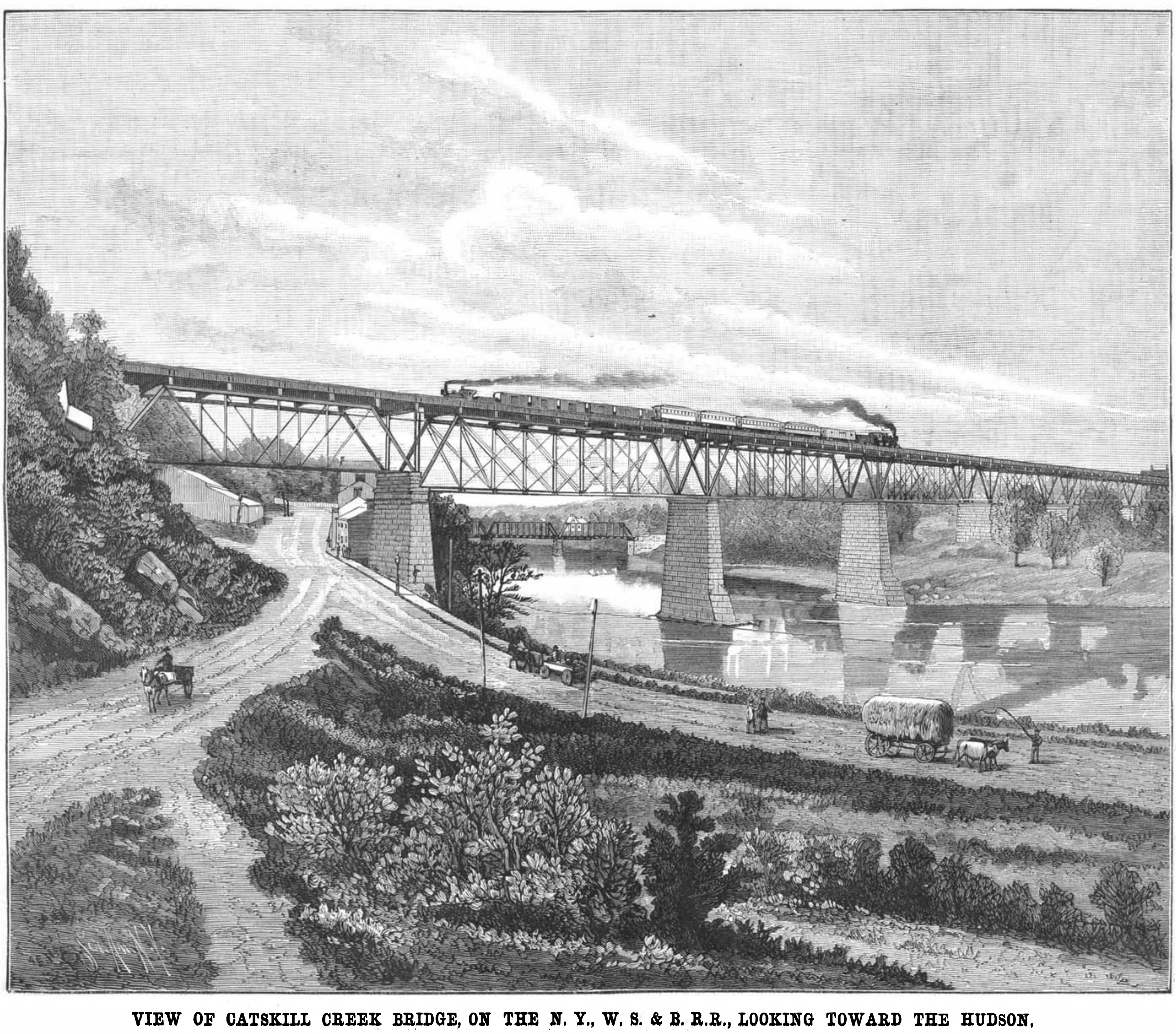
In the preparation of pyroxylene for making collodion, F. A. Katschursky recommends the following process: Three parts of chemically pure sulphuric acid, specific gravity 1·84, are mixed with one part of distilled water and poured (slowly) into three parts of fuming nitric acid, specific gravity 1·48. When the mixture is cold he introduces one part of the purest cotton, from which all traces of grease have been removed. The method of introducing the cotton is peculiar, in that it is twisted loosely around the end of a glass rod, and left in the acids *three days.* The effect of the acid is at first to harden the cotton; when it begins to lose this quality it is taken out of the acid, carefully dried, and washed in water acidified with fuming nitric acid, afterward with distilled water. It is advisable not to put more than 35 grammes (1¼ oz.) of cotton in one vessel, as the heat is so great with larger quantities that it may take fire.

According to *Rundschau*, still better results are obtained by the following: Two parts of purified cotton are wound about a glass rod and dipped into a mixture of twenty-seven parts of sulphuric acid, specific gravity 1·49, with 13 parts of purified nitric acid, specific gravity 1·40. It is left there 1½ hours, then taken out and dried, washed in acidified water, and afterward in distilled water.—*Polytechnisches Notizblatt.*

Professor Hughes on Magnetism.

In his recent paper to the Royal Society, Professor Hughes dealt with the discovery he has made of the presence, in the interior of a magnet, of waves of opposite magnetic polarity, which balance each other when there is neutrality. In a magnet the polarity at the poles is of one name across the bar, but when the iron is neutral the poles run N S N S . . . . across the bar. He also deduces the practical result that very thin magnets have greater residual magnetism than thick ones; thick ones have more magnetic inertia, and take longer to magnetize. Bundles of wires are better than solid cores, because they take a higher degree of magnetization, owing to surface exposure; and this is not proportionately counteracted by their higher residual magnetism.

Professor Hughes is also of opinion that all matter, and even ether, has inherent magnetic polarity and a saturation point. The curve of saturation for the atmosphere is the same in character as that of iron.



VIEW OF CATSKILL CREEK BRIDGE, ON THE N. Y., W. S. & B. R.R., LOOKING TOWARD THE HUDSON.

Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, NEW YORK.

O. D. MUNN. A. E. BEACH.

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NEW YORK, SATURDAY, APRIL 26, 1884.

REMOVAL.

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(Illustrated articles are marked with an asterisk.)

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THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 484,

For the Week ending April 26, 1884.

Price 10 cents. For sale by all newsdealers

SEPARATION OF OIL FROM IRON CHIPS.

After good lubricating oil has once been used, coming in contact with the metals and the oxygen of the atmosphere, it has changed its character so much that it is not proper for use as a lubricant, except in the "running through" for lathe and similar work, in cutting screw threads and lubricating for lathe tools. It cannot be returned to the shafts or to the permanent lubricating cups, and do good service. But this once used oil has its second and third use when separated from its surroundings. Oily chips from the lathe, the milling machine, the screw cutting machine, can be cleaned of their load of oil and the oil be returned for use, unchanged except for its semi-oxidation; the contact of iron or of brass will not, of itself, affect the oil. The exposure in driblets and drops encourages the oxygen of the atmosphere to combine with the carbon of the oil and so change its quality as to prevent its economic use as a lubricant for permanent employment, while it does not impair its value for temporary purposes. For these purposes it does not matter that the oil has partially returned to its base as an acid; its use in running through a screw machine or a lathe is so short that no injury can result. But if once used and exposed oil is fed to shafts and to engine cylinders, the acid from the oxygenized oil will surely make trouble. The proper method of feeding lubricating oil is that of an atmospherically closed reservoir, types of which are largely in use.

But to save oil waste the centrifugal machine is largely in use, and its adaptations are being extended to comprehend the oily debris of many various manufactures. A recent examination of this contrivance, at an establishment that works steel, iron, and brass with oil in streams, shows that the centrifugal machine saves the oil so completely that the resultant turning and drilling chips may be handled without serious soiling of the hands, and the filtered oil appears to be almost as limpid as before using. This appearance is, however, deceptive, for the oil contains chemically, if not suspended mechanically, a large amount of the oxides of iron, steel, brass, and bronze, with which it had been intimately associated, rendering it unfit for purely lubricating purposes. But the method of the centrifugal machine is a reasonable and useful one.

PROGRESS IN IRON FOUNDING.

The art of producing iron from its ores, and of remelting the iron to forms, has always been of an experimental character, owing to the lack of certainty as to its component parts and their proportions. Irons themselves differ in composition so greatly that it is one of the most exactive of arts to produce an unvarying grade for certain and demanded purposes; and the ores vary so much in the same mines that those coming under the same generic, and even specific, terms are not always analogous. As an instance, the Black Band ore mined at Mineral Ridge, Trumbull County, Ohio, is of one character when found under the sixth coal level, and of an entirely different character when appearing as an outcrop near the surface, where it is scarcely better than "kidney" ore or the ordinary "shell" ore, both of them too much oxidized to be of much value in the mechanic arts, except as makeweights. In fine castings, especially those of light weight, there is wasted usually about 700 pounds out of a ton of castings in "sprews," "gutes," and "cullings." This "back stock," or scrap, must be carried over from the first to possibly the fourth day, and be worked in only when the nature of the floor or bench permits it. And even under the circumstances most favorable, these leavings accumulate, to the annoyance of the foundryman and the injury of his customers. It is evident that the intelligent selection of irons and fuels, and especially the determination of the character of ores by analysis or experiment, ought to reduce the present uncertainty of product and insure a result in accordance with the foundryman's design.

This has been the endeavor of a competent mechanic, Mr. J. B. Renshaw, of Hartford, Conn., who has made a study of ores, their fluxes, the resultant iron, and the after-castings his business for several years. At length he has succeeded in putting the work of the foundry on a basis that removes it altogether from the line of speculation and experiment, and relegates it to one of the exact arts. His results from his studies are accepted in practice by a large number of manufacturers who make their own castings, and also by the managers of a number of blast furnaces, who reduce iron ores for castings and for the puddling furnace. One of these latter says that he is producing the best iron in the world from formulæ laid down by this investigator, and that he can sell all he makes, at the works, at satisfactory prices far beyond those of ordinary pig. He says his iron is readily taken, delivered in New England, at $30 per ton, to be used for light castings in combination with cheaper irons, and carrying a large amount of back stock. In this instance, the iron, which is of a very freely flowing nature, and is especially adapted to fine castings, as "bench hardware" and "builders' hardware," is made from 66⅔ per cent of Black Band ore and 33⅓ per cent of the Arnold ore from the Adirondacks, on the western shore of Lake Champlain. This mixture makes, also, iron for the puddler equal to the ores that produce the famous Lowmoor.

Further experiments and analyses have proved that the Black Band (two-thirds) and the Lake Superior hematite (one-third) make a superior neutral iron, possessing great strength with remarkable softness and fluidity. A neutral iron thus produced will reproduce in the castings the very qualities desired. In some respects the Black Band ore is remarkable. It is found in layered masses, as though deposited by water, the layers of iron being sandwiched by alternate layers of coal, so that the ore, when heated, is self-coking. In some instances these alternate layers are so thin that they measure only one-eighth of an inch each in thickness. Where they are thicker, the coal or slaty lignite appears to break into the mass. When melted alone this ore gives a tough result, almost like puddlers' screenings.

These results are only a portion of the outcome of several years of experiments and investigations; the most important parts are those which determine for the practical foundryman the sorts of iron he should use to produce his desired result, and the proportion of the different irons. These data have been determined by trials and experiments in the laboratory, the blast furnace, and the cupola, by chemical analyses, and by microscopic examinations; and that it is possible to determine, before a melting is made, just what iron shall be used, and the quality of the coke for melting, has been rendered certain.

Two other aids complete the means for insuring a certain result that shall be unvarying. One is the use of a centrifugal gate to be used in pouring, by which all the scum and lighter portions of the fluid iron are removed in the act of pouring. The other is the use of test bars—thin castings in the form of the blade of a draughtsman's square—a piece two inches broad, one-eighth of an inch thick, and two feet long, with a hole of from three-quarters of an inch to one inch diameter at one end. Each of these bars is poured from every melting, and it bears on it the date of the pouring. Thus the fluidity of the iron is proved, if it passes from a gate at one end and passes completely around the holes. Bits may be broken off for file tests and other experiments, while the preserved slips are proofs of the quality of the castings for that day, thus being evidence in case of dispute or doubt, and a guiding reference for the future.

What will Burst a Gun?

Perhaps the illustrations given as answers to this question in the SCIENTIFIC AMERICAN of March 22, 1884, are not comprehensive enough. For the safety of amateur sportsmen other instances of gun barrel bursting should be cited.

In bravado a young man placed the muzzle of his fowling piece under the water, and fired the charge. The result was the bursting of the barrel near the breech and the mutilation of his hand. Another placed and held the muzzle of his piece square against a piece of plate window glass, and fired the charge—powder and a bullet. The glass was shattered, so was the gun barrel. Another instance was that of an experimenter who had heard that a candle could be fired from the barrel of a gun through an inch board. He drove a candle into the muzzle of the gun, fired, and the explosion split the barrel almost its entire length, and did not even drive the candle from the muzzle. Still another burst of a gun barrel was caused by the use of wet grass for a wad, well rammed down over a charge of shot. But perhaps one of the most singular exhibitions in this line was a Colt's navy revolver, which some years ago was sent to the factory in Hartford, Conn. This was before the adaptation of these pistols to the metallic cartridges, and it is probable that in loading with open powder and ball only a small amount of powder got into the chamber, and the bullet was not propelled with sufficient force to drive it from the muzzle; at least the bullet did not go out, but lodged. As the shooter did not know whether the bullet escaped or not, he kept on firing until the barrel burst or bulged, and when it was sawed in two longitudinally there were found fourteen bullets wedged one into the other, and so much "upset" by the hammering of the successive explosions of the powder charges that some of them were not less than one inch diameter, being flattened disks instead of conical bullets.

Compressibility of Liquids.

From a paper recently presented to the Academy of Sciences of Berlin, by Mr. Quincke, it appears that the compressibility of liquids, which is generally considered to be practically *nil*, may be shown under pressures of even less than one additional atmosphere. Mr. Quincke experimented with liquids contained in glass bulbs, with a capillary tube attached to them vertically; the bulbs were placed in the chamber of an air pump, and the decrease of volume resulting from increased pressure was observed, which method promised more exact indications than the opposite one of watching the expansion under diminished pressure. Water carefully freed from air by continuous boiling was compressed by 49 millionths of its original volume under a total pressure of two atmospheres. The following figures express the compressions of some liquids resulting from one millimeter additional pressure, also in millionths of the respective volumes: Glycerine, 0·03; olive oil, 0·07; alcohol, 0·12. The observations, which extended over a large number of liquids, agreed well with one another of former, but not such extensive, researches by M. Grassi. Within the limits of pressure of one additional atmosphere, the compression remains proportional to the pressure. The experiments further confirm the theory that a certain relation exists between compression and the coefficient of refraction, but as yet they are not decisive enough, whether one or the other of the various ratios, which have been based upon theoretical calculations, is correct.

SAVING BY CO-OPERATION.

An intelligent Englishman lately gave, in conversation, some facts in regard to the working of the co operative system in several towns in Lancashire and Yorkshire, which seem to sustain the claim to the advantages of the system. In some of the woolen and cotton factories the majority of the employes are stockholders, the shares being only one pound. The internal economy practiced in these mills would surprise some of our manufacturers; the subject of waste making and waste saving being carried to its utmost practicable limits; and this without the enforcement of arbitrary rules, but by the willing and common consent of all the operatives. The quality of the goods produced is excellent, selling readily even on a generally dull market. These co-operative associations can easily obtain money, whenever it is needed, on two and a half per cent. But their influence on the operatives is fully as remarkable as is their financial success. Habits of economy have taken the place of the periodical (weekly) extravagance, the shillings before wasted at the "public" going into the fund to increase the stock holding of the operative. The most significant evidence of the combined moral and financial benefits of this system to the operatives and all concerned is the abolition of the "blue Monday." These co-operative establishments run six days in the week with a full complement of hands. The custom of Monday loafing to sleep off the effects of the Sunday debauch is fast passing away, in fact, has passed away in the co-operative mills; the operatives put in full time and also save their shillings.

Steam Heating.

The advantages of steam heating are set forth by Prof. W. P. Trowbridge in the *North American Review* as follows:

1. The almost absolute freedom from risk of fire when the boiler is outside of the walls of the building to be heated, and the comparative immunity under all circumstances.

2. When the mode of heating is the indirect system, with box coils or heaters in the basement, a most thorough ventilation may be secured, and it is in fact concomitant with the heating.

3. Whatever may be the distance of the rooms from the source of heat, a simple steam pipe of small diameter conveys the heat. From the indirect heaters underneath the apartments to be heated, a vertical flue to each apartment places the flow of the low heated currents of air under the absolute control of the occupants of the apartment. Uniformity of temperature, with certainty of control, may be thus secured.

4. Proper hygrometric conditions of the air are better attained. As this system supplies large volumes of air heated only slightly above the external temperature, there is but little change in the relative degree of moisture of the air as it passes through the apparatus.

5. No injurious gases can pass from the furnace into the air flues.

6. When the method of heating is by direct radiation in the rooms, the advantages of steadiness and control of temperature, sufficient moisture and good ventilation, are not always secured; but this is rather the fault of design, since all these requirements are quite within the reach of ordinary contrivances.

7. One of the conspicuous advantages of steam heating is that the most extensive buildings, whole blocks, and even large districts of a city, may be heated from one source, the steam at the same time furnishing power where needed for ventilation or other purposes, and being immediately available also for extinguishing fires, either directly or through force pumps.

Steel for Military Purposes.

The manufacture of steel and its application to military purposes was the subject of a lecture lately given at the R. A. Institution, Woolwich, by Captain G. Mackinlay, R. A.

The manufacture and progress of mild steel having been alluded to, a few words were said about the tests required by the Government from the manufacturers; the limits allowed being rather narrow and difficult to attain, especially when large ingots are provided, where the qualities of the upper and lower parts must of necessity differ considerably. During the last few months, however, the limits of temperature allowed for tempering in oil have been much widened. For gun steel, a comparatively low tenacity but considerable elongation before fracture is demanded, as safety is essential; it used to be said, until about fifteen months ago, when the system of wrought iron coils was given up, that though steel was strong, it could not be trusted. "Nous avons changé tout cela," and guns are now made altogether of steel. Every effort is made to insure safety, and the advances lately made in steel render this quite possible, though with the heaviest ordnance, for which very large masses of steel are forged, the greatest skill and care are needed.

With heavy gun carriages, cast steel is now largely employed as well as steel plate; for some purposes, however, as for instance for the trail eye of a field gun carriage, which is subjected to considerable vibration and jar, wrought iron is still preferred. Steel has been a good deal used in experimental armor piercing shells, but their high velocities and the increased hardness of armor have imposed strains upon them which they have not yet satisfactorily withstood, though more progress might doubtless be made, if money were granted for experiments on a large scale. It appears that considerable progress has been made on the Continent in this direction.

Tubular steel is now used for a variety of purposes, *e. g.*, for shells of large capacity, for parts of torpedoes, electric contact mines, rocket cases, axle trees, etc.

Compound armor is composed of about one-third of steel of a harder quality than that used for guns (about 0·8 per cent of carbon), as by its hardness it is intended to break up a shell on striking, while the toughness of the wrought iron, of which the rest of the plate is made, tends to hold the mass together and to prevent cracking.

Although Great Britain produces a great deal more steel than any other nation of the world, it seems that some French and German works can make ingots of greater weight than any produced in England, and the plant of some continental works is on a larger scale than any English; for instance, the 100 ton hammer of Le Creusot is larger than any English one; as the successful forging of large masses of steel necessary for very heavy guns appears to need very powerful plants, this point seems to be worth considering, from a military point of view.

A short discussion then ensued, when Captain Orde Browne drew attention to a 9 inch shell of Sir J. Whitworth's which had penetrated 18 inches of wrought iron, at an experiment last year for the Brazilian Government, when Mr. Whinfield stated that no similar projectiles had yet been made for that foreign power.

The departments of the Royal Arsenal and Royal Small Arms Factory, Enfield, exhibited a variety of steel articles; the only other manufactory represented being the Royal Gun Factory, which sent a gun hoop and a complete set of test pieces for a gun tube.

Small pieces of compound armor plates were sent by the only English manufacturers, Messrs. Cammell & Co., and Sir J. Browne & Co.; Sir J. Whitworth exhibited a fine long 9 inch shell, whose performance is already recorded. The Landore-Siemens Steel Company showed mild steel bars tied into complicated knots. The Steel Company of Scotland, test pieces used for shipbuilding purposes. Messrs. Hadfield & Co., a large number of fine castings which had borne rough usage by bending without being broken. The dephosphorizing process was illustrated by two samples of steel rails from Messrs. Bolckow, Vaughan & Co., and also by specimens made in various places and sent by Mr. P. Gilchrist. The ingenious tubular shells with drawn out heads and folded in bases of Mr. Delward attracted a good deal of attention, and Mr. Welsh (Royal Gun Factory) showed some beautiful specimens of nearly pure iron which had been melted in small crucibles. Diagrams, etc., were kindly lent by the School of Mines, South Kensington Museum.

The Origin of Ore.

The following extracts are from a lecture by Prof. John A. Church, delivered to the pupils of the public schools in Tombstone, Arizona:

No one has ever seen ore in process of formation, but something has been learned of its formation, and I will try and tell you how it is deposited in Tombstone. In the human frame there is a circulation of blood passing from the heart through the system and back to the heart. In plants there is a circulation of the sap; the earth has its circulation—water comes to it, passes through it, and rises again to its surface in the form of springs. The first thing to be observed is the rainfall passing into the rocks. Rain penetrates more than twenty miles into the crust of the earth; it dissolves substances—ore as well as sugar. When we wish to extract the silver, we add salt and bluestone; every substance can be dissolved in the water, even the quartz; limestone is readily dissolved. Rain water in passing through the earth takes up minerals—lime, iron, potash, etc.—which are deposited in the interior of the earth, and then return again in the form of springs. The rainfall is pure, but the springs are not pure, for they have taken up these mineral substances. Air also circulates in the earth; it takes up oxygen and nitrogen. When these combine with a solid rock, the rock is said to be hydrated. This air is passed upward through the rocks as the water passes downward. These form springs.

In addition to water and gas, the earth has a circulation of solids; sea waves beat on the rocks and wear them away —where those particles are coarse, we have pebbles; where smaller, we have coarse sand; smaller yet, mud, portions of limestone. Sea beaches are found in the mines of Tombstone.

When these particles are first worn off they are borne away—the finest particles borne far away, and called shale. In the mines of Tombstone are found limestone, quartz, and shale; which proves that where we now stand, on the hills of Tombstone, it was once deep water.

This history of a rocky sea cliff is the history of a whole world. The world was originally composed of gas, much heated and then cooled, like the volcanoes of the present day, where the top goes to the bottom and the bottom comes to the top.

No one has ever seen the original earth. It cooled gradually from a gas to a solid. In this way the chemist tries to obtain pure water: He takes water as pure as he can find it, heats it, then cools the steam and repeats the process until he gets a pure water. In this way quicksilver is purified, and camphor gum. So, a gas will condense into a solid, and a solid may be heated until it becomes a gas.

This earth was once a gas, heated and then cooled, until it became a solid. It is by these circulations of water and air that the ores are collected together and found in one place. If we were to see the original earth, unacted upon by the circulations which I have attempted to explain to you, we should find the quantity of metals in rock very, very small.

At Comstock Lode, Nevada, are found volcanic rocks which contain 55 per cent silver, and gold 45 per cent. So in the eruptive rocks of Leadville, Colorado, the proportions of gold and silver have been found to be similar. The geologists have been able to show how many tons of rock must have been dissolved to give this per cent of precious metal. The waters found holes, or crevices, where they could deposit the metals they had taken up, all of which are not deposited 3,300 feet or one mile below the surface of the earth, so that mining for these metals will not be carried any farther than one mile below the earth's surface, though the water penetrates 20 miles into the earth; the deeper the water goes the more the pressure, and when you increase the pressure you must increase the power of solution; releasing the pressure also releases the metals; the waters passing through the rock are forced now slowly, now more rapidly, and when such waters reach the crevices there is much less speed of the waters, and the metals are deposited there. In regard to the deposition of ores, scientists show us that the rocks have been acted upon again and again by water, and in this way the ore is collected. It is difficult to distinguish the age of the rocks, but they have shown where the first concentration of the metals in the oldest rocks known gave a yield of only one-half cent to the ton. The part of the circulation which collects metals is called the function of the circulation.

No one knows why the precious metals are deposited in veins or in beds; but one thing can be shown—that where these ores are found there are eruptive rocks. In the western part of our country this is especially true.

Where not only shales but dikes are found, where melted rock has been forced to the surface, but by the action of water has been carried beneath the surface, which shows eruptive forces at work, so it is in the hills of Tombstone—forces as simple as the ordinary forces that work in every housekeeper's kitchen or chemist's laboratory.—*Republican.*

Georges Leschot, Inventor of the Diamond Drill.

Georges Auguste Leschot, who died at Paris on the 4th of February at the age of eighty-four years, was a very remarkable man. It is to him that we owe the plan of employing the black Brazilian diamonds, or "carbonados," for piercing rocks, an invention which has proved of immense value. Leschot was the son of a skillful mechanician, Jean Frederic Leschot by name, whose automata, singing birds, artificial limbs, and so on were the admiration of the celebrated Vaucanson. He also effected great improvements in the manufacture of watches by mechanical means, in connection with the Geneva house of Vacheron and Constantine, receiving in 1845 a prize from the French Academy of Sciences in recognition of his services. In 1861, the black, amorphous, but very hard diamonds of Brazil, known as "carbonados," came to Europe, and Leschot's son, being then engaged in Italian railway work for the house of Vitali, Picard, et Cie., knowing the idea of his father that diamonds might be used instead of steel tools to cut rocks (an idea which had occurred to him in examining the fine striations cut in some specimens of ancient red porphyry), communicated with his father on the subject, and the result was that Leschot devised the diamond perforator, which has been in use ever since, especially in England, Germany, and America.

Illuminating Gas from Fermenting Manure.

M. Gayon has demonstrated to the Paris Academie des Sciences the possibility of obtaining illuminating gas in considerable quantity from the fermentation of cow and horse droppings. This material is subject to fermentations of different orders, accordingly as it is kept in a close receptacle or allowed free access of air. In the latter case its temperature rises rapidly, and there is a great evolution of carbonic acid; while in the former the temperature remains fairly constant, and there is an active production of carbureted hydrogen mixed with carbonic acid. The evolution of carbureted hydrogen is ascribed to the agency of organisms infinitely small, but differing in kind from those found in aerated manure. These have been isolated, and have been observed to occasion the evolution of the same gases from pure cellulose. The carbureted hydrogen disengaged from fresh manure kept in a close box, one meter square, has been collected by M. Gayon and burnt before a scientific society at Bordeaux. The volume of carbureted hydrogen given off by 1 cubic meter of fresh horse droppings is about 100 liters, or 3·53 cubic feet, per twenty-four hours. M. Pasteur suggests that as this method of preserving manure in close storage retains ammonia, it is possible that in certain circumstances it might be utilized for the purpose of supplying a useful heating and lighting gas without injury to the value of the fertilizer.

COTTON-SEED hulls are being substituted for cotton waste for packing journal boxes of railway cars, and are said to effect a saving of fully one-half the cost and to answer a good purpose.

A NEW FIRE ESCAPE.

The blocks, B, are formed with projections to rest against the side of the building, and in their upper ends have eyes to which are secured chains or ropes attached to hook bolts fastened to the upper part of the window casing or to the floor or wall within the building. Over a roller, A, journaled in these blocks passes an endless belt made long enough to reach to the ground, and strengthened by chains, G, along its edges. The belt and chains are made in sections; the adjacent ends of the belt can be connected by lacing, and the ends of the chains by snap hooks, so that a longer or shorter belt can be formed. The chains pass over chain rollers to prevent the belt from slipping and to allow the descent to be regulated by brakes. To the belt are attached pockets of sufficient size to readily allow people to get in and out of them.

The blocks, B, are slotted, and within the slots are brake wheels, which are secured to the roller shaft and around each of which passes a strap. The end parts of the straps cross each other above the wheel, and are joined to the ends of levers that cross each other at the pivot, L.

The levers work freely in the upper part of the slot. The outer end of a lever of each pair will project into the window, so that it can be reached by people within the room, and the rate of descent controlled. To the outer end of the other lever is fastened a cord which extends down along the endless belt in order that the people in the pockets can regulate their descent. In order to keep the lower part of the endless belt away from the building, it can be passed around a second roller secured to the ground by stakes. When the fire escape is not in use, the belt can be wound around the roller and kept in a box beneath the window.

Our engraving plainly shows the construction and operation of this useful device.

This invention has been patented by Mr. Samuel Norris, of Halifax, Nova Scotia.

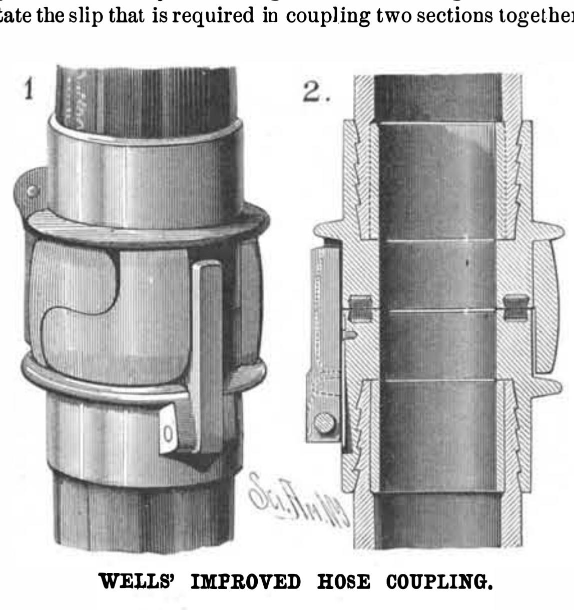
Preparation of Crystallized Aluminum Chloride.

It is an easy matter to prepare a solution of aluminum chloride by dissolving the moist and freshly precipitated hydrate of alumina in hydrochloric acid. Upon attempting to expel the water by evaporation, however, at a certain point it loses its chlorine, which unites with the hydrogen of the water and leaves only alumina (oxide) behind.

According to Gladysz, of Marseilles, the solution can be made to crystallize by evaporating it to 25° or 30° B., and then continuing the concentration in a closed vessel, where the pressure of the atmosphere has been reduced to 500 or 550 millimeters (about 20 or 22 inches of mercury). Here the solution can be evaporated to dryness, or the crystals be separated from the mother liquor in a centrifugal machine. If a concentrated solution of aluminum chloride is saturated with hydrochloric acid (gas?), the pure salt will crystallize out, while ferric chloride and other impurities remain in the mother liquor.—*Neueste Erfahrungen.*

IMPROVED HOSE COUPLING.

A collar or piece of tubing is attached to the end of each hose, and to the outer surface of each collar, upon opposite sides, are secured two hook prongs which project beyond the end of the collar. The hook prongs are all of the same shape, so that their edges will fit very closely against each other. The lower edges of the prongs are formed with a compound curve, so that when locked together they cannot come easily apart. The end of the hose is held between a metal ring and the collar. Each collar is provided with an annular groove in its end edge, into which a metal ring is inserted on which a packing ring of rubber or leather is placed. The object of using the metallic ring is to facilitate the slip that is required in coupling two sections together;



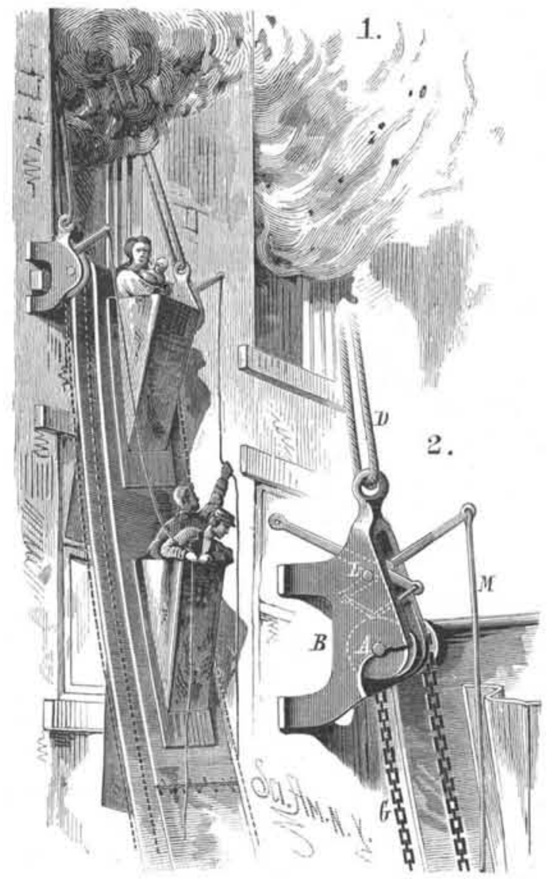
WELLS' IMPROVED HOSE COUPLING.

without these rings this would not easily occur. To prevent all possibility of the sections becoming loosened when once connected, a short bar is pivoted between lugs formed upon the collar in such a position that it will rest in front of the hooked prong when the sections are united. A spring acting upon the rear end of the bar holds it against the joint. This construction makes a joint that is readily operated and that cannot become disconnected accidentally.

Further particulars may be obtained from the inventor, Mr. Thomas E. Wells, of Sandy Hill, N. Y.

Paper Impervious to Grease or Water.

In *Burgoyne's Monthly of Pharmacy* we find the following method described for rendering paper impervious to grease or water. Parchment paper is plunged into a warm solution of concentrated gelatine, to which has been added 2½

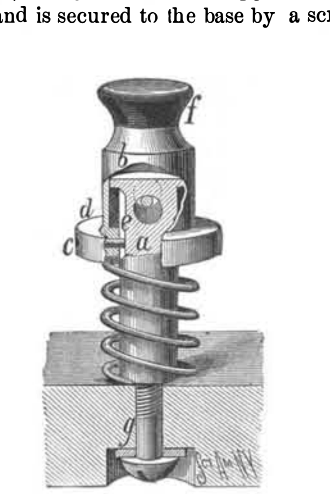


NORRIS' FIRE ESCAPE.

to 3 per cent of glycerine, and allowed to dry. The resulting paper is impervious to grease. If desired to make a paper waterproof, the same parchment paper is taken, dipped in bisulphide of carbon containing 1 per cent of linseed oil and 4 per cent of caoutchouc.—*Les Mondes.*

BINDING POST FOR ELECTRIC CONDUCTORS.

The standard, *a*, is provided at its upper end with an annular flange, and is secured to the base by a screw, *g*, with



GOODBODY'S BINDING POST FOR ELECTRIC CONDUCTORS.

which the conducting wire is connected. On the standard is a loosely held cap, *b*, which is pressed upward by a spiral spring, and which is furnished with a head, *f*, of insulating material. The cap is prevented from turning by a pin, *c*, passing through the flange on its lower end, and entering a longitudinal groove, *e*, in the standard. The flange on the top of the standard prevents the spring from raising the cap too far. Through two holes placed diametrically opposite in the cap and through a hole in the standard (the holes being brought in line by pressing the cap down) is passed a pin secured to the conductor.

The upward pressure of the spring insures the pin being held firmly. The post is especially designed for use in medical batteries and also for ordinary electrical purposes. The insulated top enables the physician or electrician to change the current with great facility while treating the patient, and without diverting the current in any way from the patient.

This invention has been patented by Mr. A. G. Goodbody, of Louisville, Ky.

Steam Launches for the Arctic Regions.

The two launches for the Greely expedition are whale boat shaped and are built very strongly of oak frames, double cedar planking and copper fastened throughout, with a Herreshoff condensing engine and improved safety boiler. They are 28 feet in length, 7 feet 8 inches beam, and have a draught of 3½ feet. The shaft is fitted with a knuckle joint, so that the wheel can be hoisted out of water in case of ice or when sail is used. They are also fitted with three keels, which will act as sled runners when being hauled over the ice.

To Prevent Air Bubbles in Cast Iron.

It frequently happens, says the *Polytechnisches Notizblatt*, that in working castings porous places are found beneath the surface, which render the casting useless. On examining the cavity closely, a little smooth and hard bullet will be found within it. Simple air bubbles can be produced as foam is in melting the metal; but these little bullets indicate that little particles of the metal have been broken or thrown off, and this could only happen while pouring it into the mould. The mould generally consists of a double box (flask) filled with sand. In pouring in the metal from above, it spurts when it comes in contact with the bottom, just like any other liquid; that is, little particles break off, and forming pellets or balls harden in the air. This cooled and solidified iron floats on the surface of the melted iron, and the air that it carries with it forms bubbles, which also harden on the surface, as it is very thin, and hence these bullets and bubbles frequently collect in nests, which are either on the surface or in the corners, and are not melted again by the rest of the fused metal.

The metal that falls perpendicularly frequently tears loose single particles of sand from the mould, and this sand floating on the metal forms cavities wherever it rests, and doubly spoils the casting.

According to the *Techniker*, all this can be avoided if the funnel or pouring-in hole is arranged at an angle of 30° to 45°, and in such a manner that the metal shall enter the mould from beneath if possible. With such a pouring-in place the metal will enter the mould without spurting, and if care is taken to furnish a suitable escape for the air it will fill out the form beautifully. The only disadvantage of this arrangement is that it would require a larger flask, and for most patterns even this can be avoided by skill in placing the pattern and funnel.

Glass Manufacturing in Europe.

Each of the various countries on the Continent where glass is manufactured produces an article peculiar to itself and unlike its neighbors; and one of the specialties of Austrian glass making is the manufacture of various fabrics for ladies' wear from spun glass. The glass is spun into threads, like ordinary silk or cotton, and woven into different colored fabrics, sometimes entirely of glass, and sometimes with a warp of silk or cotton. Collars, neckties, cords and tassels, fringes, pin cushions, feathers, belts, etc., are all made of this material. At the Paris Exposition in 1878 a bonnet made entirely of spun glass, with feather and ribbons, lined with silk, was shown, as well as cloaks and other articles of wear. This spun glass is also used for watch chains, brushes, etc. Glass flowers are also made to a considerable extent, but it is difficult for these to compete with those made from china.

NEW RECLINING CHAIR.

The side bars of the back are pivoted to the outside of the arms—thus making a wide and comfortable back—and below the arms they are bent inwardly and extended downwardly inside of the legs. The lower ends of the bars are connected by rods to the foot rest frame that is pivoted to the arms near their front ends. The seat frame is pivoted to the foot rest frame and also to the side bars of the back. This makes a contrivance of parallel bar connections between the foot rest and back, allowing the person occupying the chair to swing the back to suit his pleasure by simply moving his body backward or forward. One end of a flat bar, having its surfaces serrated so as to prevent it from slipping on the

DEPPEN'S NEW RECLINING CHAIR.

bars, is placed under the lower cross bar of the back and over a front cross bar, by which the weight of one or both of the legs will hold the seat and back when set; the removal of the weight will relieve the back so that it can be shifted. This bar can be readily adjusted lengthwise so as to bring the rest to any desired position, and can also be adjusted laterally. Our engraving shows a side elevation and a perspective view of this comfortable and durable chair.

This invention has been patented by Mr. Isaac Deppen, of Scranton, Pa.

Observations on Hardening.

Too many of the so-called steel articles sold in the market are either made from steel incapable of being hardened, or are not hardened at all. Good cast steel can be hardened and tempered so as to receive and retain an edge. This is not required of table cutlery generally—only of the carving knife—but it is required of the hand saw and the buck saw, of the spade and the manure fork, of the scissors and the pocket knife. Saw blades (so far as the writer has tried them) are not hardened; they will not retain "set" nor hold edge. They are gummed, as they come from the rolls and the slitting machine, with no pretense at hardening or tempering. But they are stamped "cast steel," and that probably satisfies the public; but there are mechanics who would pay something extra to get good hardened and tempered saw blades, even at a much higher cost than that of the soft plates, the teeth of which can be bent by thumb and finger, and the set of which is removed by sawing through an inch thick spruce board.

A spade is only an enlarged chisel; it should be capable of retaining an edge sufficient to cut through tough turf and dead grass. But most of the "cast steel" spades in the market can be sharpened as readily by drawing the edge cold under the hammer as by the grindstone. The edge never breaks, but batters and bends.

The trouble with almost all the cast steel tools put ready made on the market is, that they have never been hardened. Cast steel unhardened is as soft as wrought iron uncasehardened. A cast steel hammer became so indented on its face by driving nails during one season in jobbing that it had to be reground and polished. Yet the hammer was of steel capable of being hardened, as was proved by its being subsequently hardened and drawn to temper. It is quite possible that the reason why many of these articles prove to be soft is not that the material is not good, but that they have never been hardened. Brightened steel that has not received a hardening may respond in after-heating to several of the tempering colors, and this is probably one reason why common steel articles are not thoroughly hardened.

It is not uncommon to see a forger or temperer heat a piece of cast steel to a very low red—a red that shows only in the shadow—and then brighten and draw the temper to color, when the after-trial proved that the steel had never been hardened. Indeed, the dull red that some smiths use for hardening such tools as cold chisels and other low grade tools is that at which a red annealing may take place—the piece being heated to a dull red and plunged into water.

The first requisite in making a cast steel tool into a working tool is to harden it. After its hardness is proved, then it may be tempered to the condition required. There is no intermediate process of properly tempering between absolute hardening and subsequent drawing.

The Lead Bath.

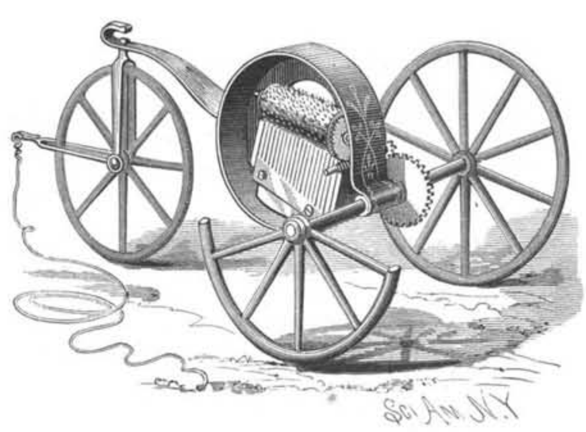
Users of the lead bath for heating for hardening make frequent mistakes in allowing something besides lead to form a portion of the bath, and also in allowing the bath to be kept below its proper temperature. Only pure lead should be used to obtain the full heat for hardening good tool steel. A mixture of lead and tin—a melted mass composed of pewter, type metal, and soft solder—is not a lead bath. The melting and heat holding qualities of metals are not alike. With clean, pure lead, either pig or bar, good cast steel can be heated to its proper intensity to obtain a good hardening, and then be drawn to color in sand or blazed in oil. But the lead must be kept at a limpid fluid heat, hot enough to make its covering of charcoal powder glow, else the steel will not receive sufficient heat to harden.

Anti-Induction Telephone Circuit.

Recent and very satisfactory trials have, we understand, been made by the National Telephone Company on their trunk line between Greenock and Glasgow, of a telephone circuit devised by Mr. Smillie. The telephone instruments at each end are each connected in circuit with a flat circular coil of wire, without a core, and the earth. These coils are confronted by equal and parallel coils of wire, also without cores, and in circuit with the main line wire and a loop line, thus forming a continuous going and coming circuit. The message is induced into the line by these coils, which, not having soft iron cores, exercise little retarding influence on the currents.

MUSICAL WAGON.

Our illustration represents a musical wagon of novel construction recently patented by Mr. Hiram J. D. Miner, of Dunkirk, N. Y. Mounted in any suitable way upon an approved kind of wagon is the case of a musical instrument consisting of a pin barrel and comb, the former being provided with the usual toothed wheel and worm for turning it. But instead of being geared with the train of a driving spring, the worm is geared with the axle of the main wheels of the wagon by a pinion and wheel, so that, when the wagon



MINER'S MUSICAL WAGON.

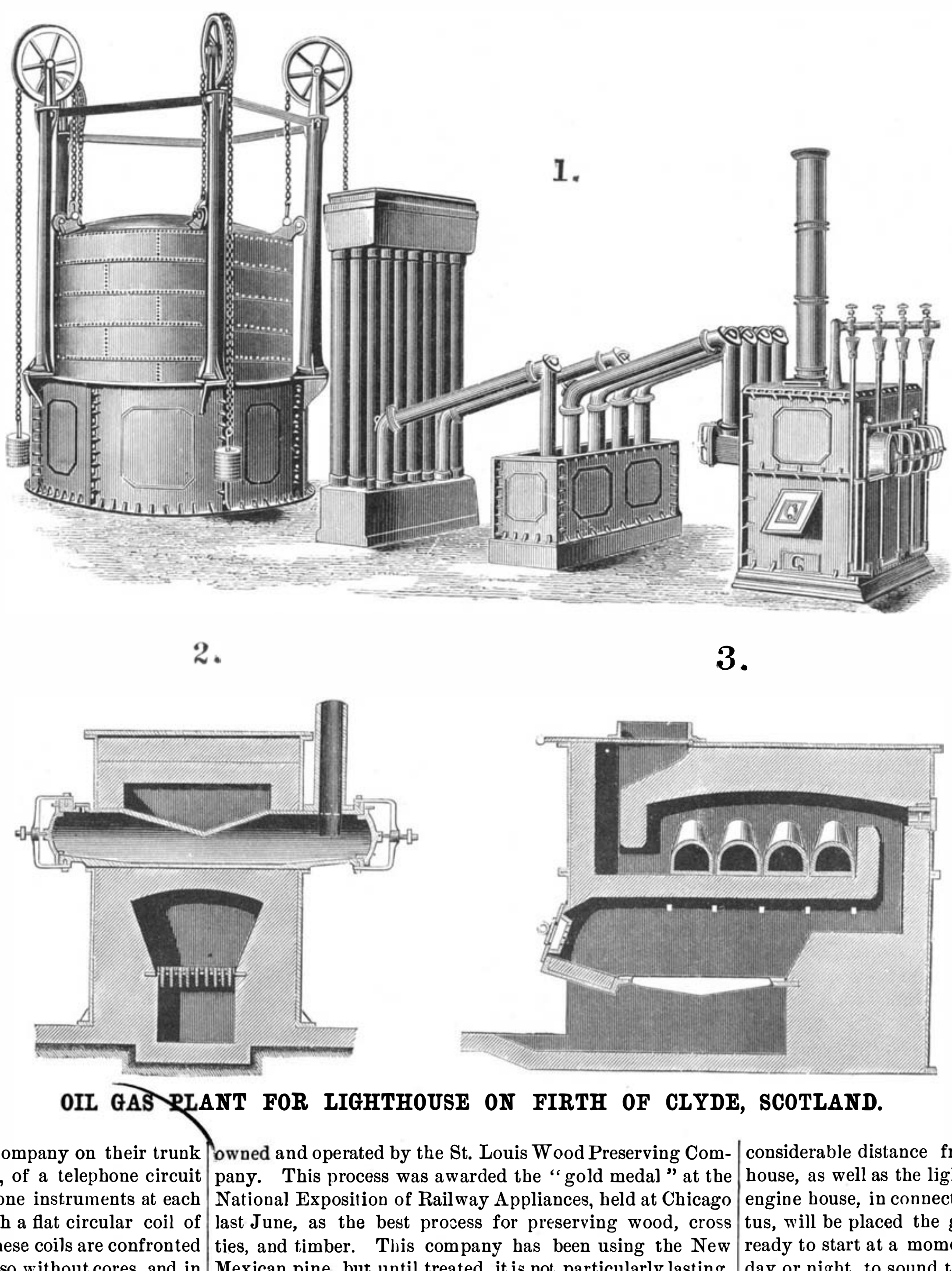
is drawn along, the barrel will be revolved and music made the same as if the barrel were driven in the ordinary way. The driving wheel and pinion can be readily taken off, to substitute others of different proportions, for varying the time of motion to render the music in quick or slow time as may be desired.

Wood Preserving Works at Las Vegas, N. M.

A Las Vegas exchange reports that the Atchison, Topeka & Santa Fe Company have executed a contract for the erection at Las Vegas of very extensive wood preserving works. They are to use the Line-Tonnier chemical process, which is owned and operated by the St. Louis Wood Preserving Company. This process was awarded the "gold medal" at the National Exposition of Railway Appliances, held at Chicago last June, as the best process for preserving wood, cross ties, and timber. This company has been using the New Mexican pine, but until treated, it is not particularly lasting. After being subjected to this chemical process, it is said to be very superior timber. This industry, when generally adopted throughout New Mexico, will prove one of importance.

OIL GAS PLANT FOR AILSA CRAIG LIGHTHOUSE.

A considerable time ago the Commissioners of Northern Lighthouses, on the recommendation of their engineers, Messrs. D. and T. Stephenson, decided to proceed with a scheme of erecting a new lighthouse on Ailsa Craig, an immense rock lying in the channel at the entrance to the Firth of Clyde; and as there was ample space on the islet for the fitting up of gasworks, they arranged to have the great lantern lit by gas. To provide against the obscurity of the light during the dense fogs which hang over the Firth during the winter season, the Commissioners determined also to fit up a large fog horn, to be operated by compressed air, the air being compressed by means of a number of gas engines. The works contemplated being of unusual magnitude, the Commissioners submitted the scheme to the most prominent oil gas engineers throughout the country, and asked for plans and estimates for carrying out the work. After a long delay, during which trials of various kinds of apparatus have been made, the Commissioners have at length definitely adopted the plans furnished by Mr. James Keith, gas engineer, of London, Edinburgh, and Arbroath, whose apparatus has already been used for similar purposes at Langness Point, in the Isle of Man, by the Northern Lighthouse Board. At Langness the oil gas plant was laid down merely to provide gas for a pair of Otto gas engines which operate the foghorn, but at Ailsa Craig the works are on a much larger scale, and provide for the supply of gas to the great lantern in the lighthouse tower, as well as to no less than 8 Otto gas engines of 8 horse power each. The works on Ailsa Craig will comprise a commodious gas house, in which will be erected three of Keith's patent oil gas producers and washers, with four retorts in each producer. There will thus be in all 12 retorts, capable of producing in the aggregate 2,000 cubic feet of gas per hour. The retorts are of simple construction, and are so arranged that the necessary heat can be raised within two to three hours, and the manufacture of gas be thereafter continuously carried on at the rate mentioned during the longest fogs. A short distance from the gashouse will be placed two gas holders, with cast iron water tanks, columns, and mountings of an exceptionally substantial character, to withstand the furious gales to which the rock is exposed. Each gas holder will contain 10,000 cubic feet, the two holders thus providing between them a store of 20,000 cubic feet of rich oil gas. The gas holders are connected to the producers in the gashouse through 12 of Keith's patent oil gas coolers placed outside, the gas produced from the oil being extremely pure; the scrubbing apparatus is of the simplest kind, and no purifiers are required. The material employed for the generation of the gas is a partially refined shale oil, technically known as blue paraffine oil, which has the advantage of being inexplosive, and of being obtainable in any quantity at a very cheap rate, ranging, according to quality, from sixpence to ninepence per gallon. The oil produces a rich 50 candle standard gas, which is reduced, according to a method adopted by Mr. Keith, before it is consumed, by admixture with about half its volume of air by means of a meter mixer, so that the total quantity of stored gas available—of a quality equal to good Scotch standard coal gas—is 30,000 cubic feet. The meter mixer automatically and accurately measures the proper quantity of air, which it thoroughly mixes with the gas, as the gas passes through the meter, and as it is being consumed. This reduction of the quality of the gas admits of the ordinary form of gas burners being used. The cost of the gas consumed on the rock will not exceed 5s. per 1,000 cubic feet, and the gas itself—though undergoing no purification by lime, etc.—will be much purer and brighter than the best Scotch coal gas.



OIL GAS PLANT FOR LIGHTHOUSE ON FIRTH OF CLYDE, SCOTLAND.

The gasworks, says the *Mechanical World and Steam Users' Journal*, will be situated at a considerable distance from the new lighthouse and engine house, as well as the light keepers' dwelling houses. In the engine house, in connection with the fog signaling apparatus, will be placed the gas engines, so that they may be ready to start at a moment's notice at any time during the day or night, to sound the roaring fog horn, should a fog suddenly come on and obscure the light in the lighthouse tower overhead. The engines, as we have mentioned, are eight in number and are each of 8 horse power, the engines selected being of the Otto silent type. In ordinary circumstances, during a fog, four of the gas engines will be kept running at a time, the other four being kept in reserve. The capacity of the gasworks is, however, ample to provide gas for all the engines and for the lighthouse as well; and when four engines are kept running, and the lights in the tower are kept burning, the gas stored in the gas holders would be sufficient to last thirty hours, even if no more gas were made during the interval. In practice, however, the gas holders will always be kept full, whether the engines are wanted or not, the gas produced in the retorts being led into one gas holder, while the other is used to maintain the necessary supply to the engines and to the lantern. It is expected that the works will be in operation this summer. The use of Keith's mineral gasworks at Langness during the past three years has proved the feasibility of employing rich 50 candle gas to drive gas engines, a point on which the gas engine makers expressed considerable doubt at the time Mr. Keith's plant was erected at Langness; but Mr. Keith successfully overcame all the objections, and the whole work has given satisfaction. The advantage gained by employing oil instead of coal for producing the gas is very great in such situations as Ailsa Craig, which is only accessible in fine weather for landing the necessary material. The oil yields three times the volume of gas, with at least twice the illuminating power, as compared with good cannel coal, taking oil and coal weight for weight—that is to say, only one-sixth of the gas producing material is required when oil is used instead of coal. It can also be conveniently landed in barrels and stored, while the process of making the gas is extremely simple, and does not require skilled labor.

Fig. 1 shows in perspective the arrangement of the gas producer, washer, coolers, and gas holders. Figs. 2 and 3 are respectively a transverse section and a longitudinal section of the producer furnace, showing the retorts. The retorts are fitted over a setting of brickwork, which protects them from the direct action of the fire in the furnace below, the flame being carried round the brickwork and over the retort to heat them equally all round. The oil from which the gas is produced is supplied to the retorts through pipes fitted in front, and formed with traps to prevent escape, the pipes being filled from a cistern. The retorts are slightly inclined downward from the front to the center, so that the oil entering by the supply pipes runs in a thin stream toward the middle of the retort, where the heat converts it into gas. The gas as it is generated passes to the other end of the retorts and rises through the ascension pipes, which are connected to the washer. The doors of the retorts are only provided to give access for cleaning purposes, the charge of oil being supplied through the pipes. The furnace is incased in metal plates, which are so arranged that each or all of the retorts can be withdrawn and replaced without taking down the brickwork. The gas produced is a fixed gas of great purity, and very little scrubbing is required. It is simply passed through water in the washer, and then led through a series of tubes which form the cooler, and thence into the holders. Mr. Keith's mineral oil gas apparatus has, we understand, been largely used for a number of years for supplying gas to country mansions.

Magnetism and Electricity.*

BY CHARLES F. CHANDLER, PH.D., PROFESSOR OF CHEMISTRY AND MEDICAL JURISPRUDENCE.

MAGNETISM.

I will say only a word about magnetism. A magnet is either natural or artificial. A natural magnet is a piece of magnetic iron ore or magnetic oxide of iron (Fe_3O_4), also called loadstone, and it occurs in nature. An artificial magnet is one produced by artificial means. Artificial magnets are of two kinds—permanent and temporary. A permanent magnet is a piece of steel that has been magnetized by bringing it in contact with another magnet or piece of loadstone, or by passing a strong current of electricity around it. A temporary magnet is a piece of soft iron which has been made temporarily magnetic by being brought near to a permanent magnet, or by passing a current of electricity through a coil of wire surrounding it. The properties of a magnet are: 1. The power of attracting certain metals—iron, nickel, cobalt, and, to a slight degree, chromium, and a few others. 2. The property of tending to assume a certain position as regards north and south. A magnetic bar or needle, if allowed to hang by its center on a string, or to float free on a piece of wood in water, will assume a position approximating north and south, but not exactly so. 3. The property of polarity—that is to say, a magnet exhibits its peculiar attracting powers chiefly at the extremities. There is a center of attracting power near each end, but not absolutely at the end, and at this point or center the magnetic power is strongest. These two magnetic centers are called the poles of the magnet; the end which points toward the north is called the north pole, and the one pointing toward the south, the south pole of the magnet. When two magnets are brought near each other, the north pole of one will attract the south pole of the other, and repel the north pole. So it has been found to be a law with magnets that "like poles repel, and unlike poles attract each other."

With regard to the direction the magnetic needle takes when allowed to move freely, it does not point directly north and south, but it assumes a position pointing a little to the east or to the west of north and south, depending upon the locality at which the observation is made. This is because the magnetic poles in different parts of the earth do not correspond exactly with the geographical poles, and the difference between them varies with the location at which the observation is made. This is why nautical almanacs are made to tell mariners the amount of variation from the true north and south made by the compass-needle in different parts of the world. This deviation of the compass-needle from the true north and south is called the "declination" of the needle. The term "declination" is very liable to be confounded with that of "inclination." When a bar of steel is hung by a thread at its center, it assumes an exactly horizontal position; but if this bar of steel is now magnetized, it will assume a direction pointing north and south, but it will no longer hang exactly horizontal except at the equator of the earth.

At all points north of the equator the north pole of the bar will dip downward, and the farther north you get the greater will be the dip, while at all points south of the equator the south pole of the bar will dip downward; and the degree to which the needle dips from the absolutely horizontal direction is called its "inclination." This is because the two magnetic poles of the earth do not correspond to the two geographical poles, but they appear to lie nearer the center of the earth. To overcome this tendency of the magnetic needle to dip at a varying angle according to the distance north or south of the equator, the needle of the mariner's compass is made by uniting two magnetic bars laid parallel, with the north pole of one adjacent to the south pole of the other, so that they lie with their opposite poles end to end. Such a needle is said to be "static." At a point on the surface of the earth corresponding with latitude 70° N. and longitude 96° 43' W. the north magnetic pole seems to be located, and at this place the dipping needle assumes a vertical direction. The south magnetic pole is apparently located at latitude 75° 5' S. and longitude 154° E.

The production of magnetism by induction is a curious phenomenon. If a permanent magnet is brought near a handful of iron nails it will attract them to it, and as soon as a nail becomes attached to the magnet it becomes a magnet itself and attracts another nail, which in turn becomes a magnet and attracts another, and so on, the magnetic power of each new nail attracted becoming constantly less than that of the preceding one. It is not even necessary that the nail should absolutely touch the magnet in order to assume this magnetic power, for it will be transmitted through short spaces from one to the other. This power which a body acquires by being brought near a magnet is called "magnetic induction." An important fact in this connection is that when a coil of iron wire is made to surround a permanent magnet it becomes magnetic itself by induction, and is capable of inducing magnetism in another bar of iron surrounded by it. This principle is made practical use of in the construction of the telephone and magnetic telegraph.

ELECTRICITY.

We now come to the subject of electricity. This is a peculiar agent, capable of producing certain astonishing results. There are different forms of electricity and different ways of generating it. The different forms are statical electricity, dynamical electricity, and magnetical electricity, or magnetism. It may be generated by means of friction, percussion, heat, chemical action, cleavage, and by magnets. The effects of electricity in its different forms are manifested as attraction, repulsion, light, heat, violent commotions, and chemical decomposition.

To excite electricity we must always do something, and the first way of producing it, discovered in the earlier ages, was by rubbing amber, and so the term electricity was derived from the Greek word ἤλεκτρον, signifying amber. It was afterward found that certain other substances when rubbed assumed electrical properties, and would attract or repel other materials. This electricity produced by rubbing or friction is called statical electricity. This is a form of electricity that can be held for a considerable length of time, and hence it has received the name of stationary or statical electricity. This is the only form of electricity that we can store up and keep for a time. What is known now as the storage battery does not really store up electricity, but only energy, which can be transformed into electricity at will. So much for statical electricity.

We have a totally different kind of electricity, called dynamical electricity, or electricity in motion. This is a form of electricity that circulates only in a conductor or along a wire, and it cannot be held. It was first discovered by Galvani in experimenting on frogs' legs, and hence it is often called galvanic electricity. It is now ordinarily produced by means of galvanic batteries and dynamo machines. The third form of electricity we have already referred to incidentally as that which is induced by means of magnets, and it is therefore called magnetic electricity, or magnetism.

According to the generally accepted theory, there are two so-called electrical fluids, and these two are commingled in equal proportions in all bodies; and hence all the processes for getting electricity must result in pulling these two electrical fluids apart, and in taking a portion of one away from a body. These two fluids are called one positive and the other negative electricity. It is found that when two bodies are electrified with the same kind of electricity, as both with positive, or both with negative, they repel each other; but when the two bodies are charged with opposite kinds of electricity, as one with positive and the other with negative, or when one body is charged with either kind while the other is left in its normal condition, then the two bodies attract each other. Hence we derive the law which states that "bodies charged with like forms of electricity repel, and those with unlike attract." The gold-leaf and pith-ball electroscopes are constructed on this principle.

When a piece of sealing wax is rubbed it manifests electrical properties for some time, but certain other substances, like metals, for instance, after being rubbed in the same manner, show no electrical properties, and this is because the electricity easily gets away from them. Thus we find that while certain substances remain electrified for some time others do not, and hence these bodies are named conductors and non-conductors. But these terms are not absolute, but only comparative. The metals, carbon, gypsum, and acids are called good conductors, while amber, glass, sulphur, and silk are poor conductors. If we want to insulate electricity and keep it from running off into surrounding objects, we surround the object containing it with a poor conductor. Thus, the glass insulators on telegraph poles prevent the electricity from leaving the wires and running off into the ground, and the non-conducting materials placed around the wires of the Atlantic cable so protect it that a small charge of electricity will carry a message from here to Europe.

Great difficulty is experienced in experimenting with statical electricity, because it so easily gets away. All substances are conductors to a greater or less degree, including the dust in the air and the moisture in the atmosphere. Perfect insolation and a warm, dry air are, therefore, favorable conditions for holding statical electricity. The reason it was not used earlier for practical purposes was because it was so difficult to manage. The electricity which is produced on glass by friction is called vitreous or positive, while that produced in the same manner on shellac or sealing wax is called resinous or negative electricity.

Franklin had a theory that there was but one electrical fluid, and that all substances in the natural state had an equal amount of it, but a body charged with an excess of this fluid was said to be in a positive state, and one in which there was a deficiency was said to be in the negative state.

But this theory has now given place to the two-fluid one, which maintains that all bodies are charged with an equal amount of the two electrical fluids called positive and negative, but when a body is electrified these two fluids are separated so that one remains in excess of the other. There is always a passage of the electrical fluid in two directions along a conductor, but, when the direction of the current is spoken of, it is the direction of the positive current that is always meant. Statical electricity can also be produced by pressure, as when certain crystals are firmly pressed together; by cleavage, as when two layers of mica are split apart; and by heat as well as by friction. It may also be produced by torsion. It is found that the charge of electricity, if collected in a spherical body, is on the outside, and not within the body; and if it is not a spherical body, the electricity collects chiefly at the part most nearly pointed. This kind of electricity is transferred in three different ways: 1. By conduction from one body to another in contact with it; 2, by convection, where gas or the air in contact with an electrical body takes away some of its electricity; 3, by discharge, where a highly electrified body suddenly loses a portion of its charge.

ELECTRICAL MACHINES.

Machines for producing statical electricity are usually based on the friction method. The old-fashioned machine consisted of a circular glass plate which was rotated between two cushions, and the electricity thus produced was taken off and carried to a metallic cylinder, called the prime conductor, by means of metal points. Silk and glass as insulators prevented the electricity from running off into neighboring objects. More recently machines have been constructed on the principle of induction, as illustrated in the electrophorus. These are known as the Holtz machines.

The condensation of electricity is illustrated in the Leyden jar. This is a sort of bottle, lined up to a short distance from its top, both inside and outside, by tin foil, and in the stopper is a brass knob which is connected with the tin foil on the inside of the jar by a chain. When the knob is charged with positive electricity from a machine, it collects on the tin foil inside the jar, while a corresponding amount of negative electricity collects on the outside of the jar. By this means a large amount of electricity may be collected and held by the jar until discharged, by making connection between the tin foil on the inside and that on the outside of the jar. The electricity is held, not on the tin foil, but on the surface of the glass. This is proved by means of a jar that can be taken to pieces after being charged—although the two pieces of metal which lined the inside and outside are now brought in contact, yet when the whole is put together again the charge is found to remain, and it is discharged by connecting the knob with the metal lining of the outside. All that these metal linings accomplish here is to make a large conducting surface over the whole of the glass upon which the electricity collects.

The discharge of electricity from such a jar, or a battery of several of them connected, produces a variety of results. The spark will pass through a thin plate of glass or a card and make a hole in them by disrupting them; or, in passing through points of metal, it heats them to a high temperature and vaporizes them, so that we get luminous effects from them. Electricity is estimated to travel at the rate of two hundred and eighty-eight thousand miles in a second.

* A review lecture delivered at the College of Physicians and Surgeons, New York.

Franklin first showed that lightning was simply a discharge of electricity from the clouds to the earth, and it occurred to him that, as points condense electricity and draw it away and discharge it quietly, lightning rods might be made on this principle that would prevent the disruptive effects of a discharge of lightning, and so be a protection to buildings on which they were placed. Such lightning rods are really a protection when properly made. A perfect one should be large enough to carry the charge of electricity, should have no break in it, should terminate at the top by numerous points, and connect at the bottom with the ground below the water line, and there be surrounded by fragments of iron buried in moist earth. It is well, also, to have it connected with the metallic water and gas pipes running through the house.

DYNAMICAL ELECTRICITY.

Now, a few words in regard to dynamical electricity. Galvani discovered, in experimenting on frogs, that when two pieces of metal, like copper and zinc, were placed in contact with the frog's leg and their ends connected, a movement of the leg would take place. This discovery gave rise to considerable discussion and experimentation, and, as a result, Volta developed the voltaic pile, which at first consisted of alternate layers of zinc, wet paper, and copper, piled one on top of the other in varying numbers. It was found that, when the top layer was connected with the bottom one by means of wires, a current of electricity was set up. It became understood then that the electricity was produced by the chemical action of the water in the paper on the zinc, and so more active solvent fluids came to be used instead of water, and cloth was substituted for the paper. It was found that the zinc was the positive element here and the copper the negative, and it is usual to find in all batteries that the metal acted upon is positive, and the one not acted upon is negative. There is now, practically, only one metal used for the positive element, and that is zinc, for it is the cheapest and the best.

THE GALVANIC BATTERY.

A galvanic battery is simply a combination by which we produce this chemical action, and zinc is the metal acted upon. The principle of the galvanic battery is this: If we immerse two pieces of metal, like copper and zinc, in a liquid like sulphuric acid contained in a glass vessel, and then connect the two metals by pieces of wire, a current of electricity is set up, because the liquid is decomposed by the zinc, and the H_2SO_4 is split up into SO_4 and H_2, and the H_2 is set free while the SO_4 unites with the zinc and forms Zn_2SO_4. The H set free tends to collect upon the surface of the negative element, and in this way the copper finally becomes "polarized" by the hydrogen. The positive element, the zinc, always drives the positive electricity through the fluid toward the negative element, the copper. The wires which conduct the currents from one element to the other are called electrodes, and the one coming from the zinc is the negative electrode, and the one from the copper is the positive electrode. While zinc is universally used for one element, the second element in the battery may be composed of different kinds of metals, according to convenience.

A difficulty in using zinc as the positive element was soon found in the fact that little local currents were set up between it and the impurities contained in it, and this caused an unnecessary waste of the zinc. So it became customary to amalgamate the zinc in order to prevent this local action of the fluid upon it. The next improvement made was to prevent the little bubbles of hydrogen from collecting on the surface of the copper, thus keeping the liquid from coming in contact with it in all parts—that is, to prevent the "polarization" of the copper. For this purpose certain substances came to be used to absorb the hydrogen. The first of these substances was the sulphate of copper as used in the Daniell's battery. This consisted of a copper vessel containing a porous cylinder in which was suspended a rod of zinc. Dilute sulphuric acid was contained in this cylinder, and in the copper vessel outside of the cylinder was placed a solution of the sulphate of copper. In this battery the hydrogen set free decomposes the sulphate of copper, forming with it sulphuric acid, and sets free copper which collects on the copper element.

Grove's battery consists of a glass vessel containing a porous cup surrounded on the outside by a coil of amalgamated zinc, and on the inside is suspended a rod of platinum instead of copper. The vessel outside of the porous cup is filled with dilute sulphuric acid, and inside with strong nitric acid. The nitric acid absorbs the hydrogen set free by the sulphuric acid and zinc. In the bichromate battery the bichromate of potash dissolved in sulphuric acid is used to absorb the hydrogen, and chromic acid is formed. So the three substances in use for absorbing the hydrogen in different kinds of batteries are sulphate of copper, nitric acid, and bichromate of potash. Bunsen suggested the use of gas carbon to take the place of the copper, or the negative element, because of its cheapness. So the Bunsen battery consists of a cylinder of carbon immersed in a vessel containing nitric acid, and within this cylinder is a porous cell containing sulphuric acid, in which a rod of zinc is suspended. To avoid using the porous cups, the force of gravity has been brought into play in the construction of the so-called "gravity battery." This consists of a glass vessel with plates of copper at its bottom, and upon this crystals of sulphate of copper are scattered, while over all is poured pure water, in the upper portion of which is suspended a plate of zinc. A very little sulphuric acid is added to start the battery, and then its action will keep up. Gravity here keeps the two liquids apart—the solution of sulphate of copper at the bottom, and the dilute solution of sulphuric acid at the top. This battery produces a constant current, and will run for a very long time. The Leclanche battery consists of a porous cup containing sal ammoniac in which is suspended a rod of zinc, and this cup is surrounded by the oxide of manganese as a depolarizer, immersed in which is the carbon. This battery is used when a current of electricity is desired for a very short time at once, as in striking burglar alarms, signal bells, etc. In the dipping battery a plate of zinc is suspended between two plates of carbon, and, when in use, these are let down into a solution of bichromate of potash dissolved in an excess of sulphuric acid. This fluid is called the electropoion. The galvanic battery is now being replaced for many purposes by dynamo-electric machines.

THE ELECTRIC LIGHT.

If a strong current of electricity is sent along a good conductor, it passes very easily; but, if passed along a poor conductor, it makes it hot. This is the principle upon which is based the incandescent electric light. A current sent over a fine thread of carbon heats it to a white heat, and thus produces a brilliant light. The same principle holds in the arc light, where the air acts as the poor conductor. Here two pointed sticks of carbon are placed in contact until a current is started through them, and then they are gradually separated for a short distance, when the resistance offered by the air to the passage of the electricity from one point to the other heats them to incandescence, and small particles of carbon in a state of combustion are broken off and carried through the air, thus causing an arc of light between the carbon points. The incandescent electric light and the arc light form two systems of electric lighting.

A current of electricity passed through certain substances will decompose them, and this process is called electrolysis. If it is desired to plate any object with a metal, that metal should be hung upon the positive pole of a battery, and the object upon the negative pole, and then, when an electrical current is passed through them, the metal on the positive pole will be decomposed, and a layer of it will be deposited over the surface of the object hanging on the negative pole. This process is known as galvanoplasty.

The most convenient method of measuring a current of electricity is by means of a rotating needle, around which the current is passed; and this is called a galvanometer.

THE ELECTRIC TELEGRAPH.

The electric telegraph is based upon the production of temporary magnets by passing a current of electricity through a coil of wire surrounding a bar of soft iron. All systems of electro-telegraphing involve a battery, a wire, a piece of soft iron surrounded by a coil of wire, a key or current breaker, and a sounder or indicator. Morse devised an alphabet, the letters of which were made up by various combinations of dots and dashes, which were scratched upon a strip of paper by the indicator. But telegraph operators soon found that they did not need to see these letters on the paper, for the ear quickly became educated to detect the letters by sound alone; so the paper was discarded, and now they hear, instead of see, the dots and dashes.

THE TELEPHONE.

It is found that, if by any means you change the strength of the magnetism in a permanent magnet, you will at the same time change the strength of a current of electricity passing through a coil of wire surrounding the magnet, and it is upon this principle that all the modern telephones are constructed. If in front of such a magnet a thin sheet of iron is fastened, and if the plate of iron is then approached a little nearer to the end of the magnet, the magnetic center is brought a little nearer to the extremity of the magnet, and hence the magnetic power at this point is increased; at the same time a similar increase is induced in the current of electricity passing through the coil of wire surrounding the extremity of this magnet; and now, if in the same circuit of wire there is a second similarly arranged apparatus, the increased strength of the current passing through the coil surrounding the second magnet will induce an increase in its magnetic power, and hence the second plate of iron will be attracted closer to the end of the magnet. In the same way a slight withdrawal of the first plate from the end of the first magnet would cause a weakening of the magnetism in the second, and cause its iron plate to spring backward again. So, in speaking in front of the first plate, at every vibration of the air produced by the voice the plate vibrates in harmony, and a precisely identical sort of vibration is produced in the plate of the apparatus at the other end of the wire, and these vibrations can be heard as the sound of a voice. This is all there is to the Bell telephone, and it is the principle on which all telephones are constructed.—*N. Y. Medical Journal.*

Canadian Indian Medicines.

The Marquis of Lorne, in his lecture at the Society of Arts on "Canada and its Products," speaks of some of the cures effected by Canadian Indian squaws and medicine men. Although many of their medicines are known to medical men, and in spite of the *hocus pocus*, or incantations, practiced in their application, he believes that there are many herbs which would well repay the examination, and possibly lead to the discovery of valuable remedies.

Civil Service for Conductors.

"Suppose a passenger having a ticket dies on my train, would it be proper to lift it?"

"What—the train?"

"No; the ticket."

"A full first-class ticket is required for a corpse," is the answer.

"Yes; but then it travels in the baggage car. The circumstances in the case I state are unusual. What must I do?"

"You have no authority to touch anything on the body. The coroner is the proper person to take up the ticket and deliver it to the company," explained the instructor, clearly.

Fifteen men sat at desks in a rear wing of the vast building of the Pennsylvania Railroad on Fourth Street every day last week undergoing the usual inquisition which determines their capabilities. The above and many similar dialogues occurred during the week's examination, and so far from appearing humorous or ridiculous to the preceptors, such inquiries were encouraged.

"Almost anything is liable to happen on a train," explained one of the tutors to a *Times* reporter on Saturday. "A thorough knowledge of the rights of the company and the passenger is essential. In the case you overheard, the responsibilities of the company undergo a complete change by the sudden death of a passenger from natural causes. You can see that a conductor may be called on, in an emergency, to decide some very important and knotty questions."

Beginning this morning, fifteen more applicants, coming chiefly from the ranks of brakemen and gatemen, will be examined for prospective conductorships. Six applications are already filed for next week. The method pursued in the week's examination is varied somewhat from time to time, but takes this general shape: The candidate is first asked to write a letter. Then he is tested as to his knowledge of mathematics. A statement more or less intricate, and involving numerous whole and half-fare tickets and rebate coupons, is read to him. He is told to render an account. The time consumed in making up his statement is noted to a fraction of a minute. At other times a statement is required of the miles traveled by passengers on a mythical train that makes lightning trips to all parts of the main and leased lines. The candidate is then lectured for two days, generally Tuesday and Wednesday. All the kinds of tickets are described. The rights of passengers and of the corporation are defined; local, first-class, thousand-mile, commutation, school, limited excursion, workmen's, and stock-shippers' tickets are carefully described. Samples of the various tickets are shown the candidates, and some of the interpretations put on the language of the ticket by the nascent conductors are novel, interesting, and often startling. Not much time is wasted over free passes, for the company incurs no responsibility for a passenger traveling on tickets of that kind. About this point, a budding conductor asked several days ago: "Suppose a man goes to Pittsburg on a return pass and dies there, will his pass be good to bring the body back?" The answer was in the negative, though circumstances might secure a waiver of the company's rights.

By Thursday the applicant is expected to know every station on the main line, the points at which branch roads deflect, the crossings where connections are to be made, and the names of all the leased roads in New Jersey and Pennsylvania. The rest of the week is devoted to questioning and drilling him in the details of his daily work.

Finally, on Saturday a tabulated statement is made of the candidate's grade. The successful men are rated first, second, or third class. All ranking below the latter grade are dropped. Men of the first or second classes are appointed to main line trains; those of the third class are only placed in charge of trains on branch lines. When the applicant has been unfortunate in his early education and is naturally intelligent, he is urged to try again, and is allowed a year or more to prepare for his re-examination.—*Philadelphia Times.*

Hydrogen by Electrolysis.

Of all possible methods for the production of hydrogen that of the decomposition of acidulated water by dynamo-electric machines would appear, on the face of it, to be the most extravagant. Yet the question has often been put to the editor of *La Nature*; and in a recent issue the process is explained, and its practicability denied once for all. Supposing a perfect dynamo—that is to say, a machine capable of converting all the work of a motor into electrical energy; and also a perfect voltameter, having no resistance and using all the current in producing electrolysis of the water. Under these theoretically perfect conditions, a horse power developed by a steam engine will in an hour decompose exactly 166 grammes of water, and set at liberty 18·5 grammes of hydrogen, measuring 296 liters, or 7·27 cubic feet. Supposing that practically the chemical action really utilized by the voltameter represents 70 per cent of the total energy, it follows that a horse power can only produce 13 grammes, or 146 liters, of hydrogen per hour. The production of a cubic meter of hydrogen per hour would therefore require the total energy of about 7 horse power. Thus the production of 1,000 cubic feet of pure hydrogen by this method would be effected by the expenditure of nearly 200 horse power for an hour; and the probable cost of the process may be left to the reader's imagination.

Streets on Tops of Houses.

To convey what I mean, says Dr. B. W. Richardson, let us move to the best constructed, as well as the most beautiful street of this metropolis, if not of the world—Regent Street—in the part called the Quadrant. That is laid out for such a design as if it had been prepared for the experiment. All the houses are of the same height, and the height throughout is just right for a city like ours. It is sufficient to be handsome and commodious without being overwhelming, and without excluding the light from the streets. The roofs of Regent Street, at this part, are flat in comparison with other roofs. They are utilized here and there by photographers' studios, which, although temporary structures, stand firmly and well, in ready communication with the houses on which they are placed. The studio, where it exists, seems naturally to form and become a part of the house. When we glance along the line of roofs, as on a level terrace, the idea of reconstruction of all roofs, and of the readaptation of them, becomes most distinct and suggestive. The width of most London houses averages, as near as I can estimate, about 25 feet from front to rear. Here, then, is good space for a terrace for foot passage. Imagine along two lines of long streets a terrace of this kind, with handsome railing on each side, and perfectly level floor surface of wood; and, at intervals, light bridges spanning from one terrace to another, and you have an upper-day London which might almost relieve all the pressure from foot traffic in the streets below. Each house would have its own exit, or door, at the upper as well as at the lower parts; and, at convenient spaces, each terrace would be accessible from the street, as the Holborn Viaduct is at the present time.

It suggests, at first, a revolution of ideas to conceive such a change. It suggests much out of which a humorist can for a moment make capital. I know all this very well. But there is, in point of fact, nothing more in it than in the first idea of making a tunnel under the streets or under a river. When the suggestion is looked at bit by bit, without prejudice, it offers more of sanitary advantage for the purification of the atmosphere, the protection of property, the comfort of the people in transit, the lodging of the people, the exercise of the young, and the beautifying of the whole city, than could be entertained on a mere general statement of the proposition.

In the first place, for every house in connection with an upper terrace, there would be the most perfect through and through ventilation of air. The staircase would no longer be a closed cupola for holding and storing all the emanations from the basement upward.

In the second place, the fact of having terraces on the upper surface of London would lead to immediate arrangements for the purification of the air from smoke. So soon as the roofage was accessible as a terrace, the plan which Mr. (now Sir) Spencer Wells projected for the removal of smoke from every house, by laying down horizontal conducting tubes with central exits and smoke consuming furnaces, would be easily practicable, presuming always that some smokeless fire be not invented, or that coal gas does not become the fuel of the people. These terraces would then be the healthiest parts of London; charged with flowers and trailing evergreens; they would be the empyrean gardens of the great city.

The terraces, with their light intercommunicating cross bridges in the long thoroughfares, would be more than pleasant foot ways and shady lanes for the foot travelers or travelers in light, noiseless vehicles, like tricycles; they would be most useful for other purposes. Along them the electric lines would pass and enter the houses direct; and from them the letter carriers would most easily deliver their letters.

These terraces, while relieving the traffic in the streets below, would remove all necessity for the fire engine, and would make London practically safe from fire. From them water would be supplied readily, a trained police for this upper London being ready at every moment to go down and extinguish fire in every domicile, carrying his hose with him, or plying it from above.

I think that no one who reflects will fail to see that all these changes would be advancements of great value for the health of a city like ours. They are, however, not the chiefest advantages. If any one will take the trouble to go observingly through the busy parts of London, where there are long miles of roadway—along Whitechapel and Mile End, for example—he will see the most jagged, hideous lines of roofage. Here a row of houses two stories high; there a row of three or four stories; then a single house five or six stories; and so on, over and over again, like a set of bad teeth. If the plan here suggested were carried out, all this would be rectified. A street like Regent Street expanded into a straight line would extend from the Marble Arch to the City, and from the City to the extreme East End. The line of terrace pitched at five stories would necessitate the building up to the same level of all the houses in that line, by which at least one-fourth more housage would be supplied, with arrangements for giving comfortable and healthy homes, beyond what now exist, to a fourth of the present population. The suspension cross bridges would not be without their compound service. They would be bearers of electric lines along their side ways, and would probably soon be utilized as centers from which electric beacons would be suspended to light the streets beneath.

Imagine the metropolis turned into a fairy land by this adventure of science into the domain of art, and art reciprocating the idea with all her rich resources, and we see in our mind's eye what our children, when we are all of us gone, may really see, and, perhaps, thank us for proposing for their benefit.

Objections will be made about mechanical and architectural difficulties. I heard them all made when the Holborn Viaduct was projected; I saw them all melt way as Colonel Haywood's practical mind came into work, and his unthanked skill and industry and responsibility and genius carried all before him.

CARYATID IN MAUSOLEUM OF CHAACMOL, YUCATAN (FRONT).

It will be objected that flat roofed houses are not weather tight. In the year 1825 the then Parisian Asphalte Company roofed two houses with asphalt in Hinde Street, Manchester Square. I lived in one of those houses for twenty-eight years, and a better roof I never knew; but for the London smoke, it would have been made into a garden. Men working upon it, walking over it, communicated no sound whatever into the rooms immediately below.

It will be objected that houses will not bear the weight of superimposed suspended terraces for foot walks. If they will not, they ought. In no direction would the sanitary improvement for the purification of a great city be more useful, as a side improvement, than in so reconstructing defective houses as to make them capable of bearing an equalized weight, which, carried by many, would, as we know from the bearing of ice, be comparatively light and practicable.

Of the many plans which have been suggested for giving space to crowded cities, such as terraces in the streets opposite to first floor windows, and tunnels subterranean, none seem to me to be half so practical, half so likely to secure the purification of atmosphere, as this, which I have now for the first time, after some years' hesitation, ventured to sketch out, not as expecting ever to see such a project realized in my own time, but foreseeing as even a necessity and practicability in the times to come.

Restoration of Faded Photographs.

It is only to immerse the yellowed print in a dilute solution of bichloride of mercury until all the yellowness disappears. It is then well washed in water to remove the mercurial salt. If the print be a mounted one, it is by no means necessary to unmount it previously to treatment. All that is required in this case is to keep it in intimate contact for a time with blotting paper charged with the bichloride; indeed, this is the plan originally suggested by Mr. Barnes. By the bichloride treatment no lost detail is actually restored, as some have imagined. It is simply that the sickly yellow color which, as it were, buried the delicate half-tints, or what remains of them, is removed, and thus renders the picture bright and clear. Pictures which have been treated with the mercury always possess a much warmer tone than they did originally, as the purple or black tones give way to a reddish brown or reddish purple—more or less bright according, probably, as gold or sulphur had been the principal toning agent. Here a question very naturally arises with regard to the future permanence of pictures which have been thus "restored," seeing that negatives intensified with mercury or transparencies toned with it are so prone to change. In answer to this we may mention that they appear to be permanent—at least that is our experience with some that have been done for many years. There appears to be no further loss of detail, and the whites retain their purity. Indeed, since undergoing the treatment with mercury, no alteration is yet perceptible.—*Br. Jour. of Photo.*

DR. LE PLONGEON'S LATEST AND MOST IMPORTANT DISCOVERIES AMONG THE RUINED CITIES OF YUCATAN.

(*Continued from page* 240.)

THE MAYA PEOPLE.

We have been among the ruins since September 20, continuing our studies of the grand though now crumbling edifices of the ancient and highly civilized Maya people.

With abundant reason the Spanish soldiers and priests were amazed at the magnificent white stone houses which they saw on their arrival at Yucatan, in the fifteenth century. They little thought to find such edifices among people whom they regarded as savages, but who, in fact, were most civil, and so warlike and determined that they resisted the invaders for twenty years. True it is that at that time the inhabitants of the peninsula were a degenerate people, owing to the admixture of races which resulted from the invasion of nations inferior to the Mayas. Nevertheless, Spanish writers who had every opportunity for knowing tell us that the Europeans found the country thickly populated by most polite people, who enjoyed and appreciated the refinements of life; people who had current coin, though not metallic; who had just laws and upright judges; who considered it an unpardonable offense to lie; who were so honest that no document was needed to make a contract binding, nor doors to keep intruders from their houses, which, according to the historians, were commodious and tasteful, though not luxurious as we consider things to-day. Their wise men were learned; the Spanish father burned their books without knowing what they contained. In their foolish estimation they had a right to destroy that written knowledge because the authors did not believe in their particular divinity! How narrow is human intellect where theology is concerned!

The Maya artisans were clever, the laborers industrious. As for that virtue *which covereth a multitude of sins*, in every city there was an asylum for the aged, crippled, and infirm, policemen being employed to look for them, and conduct them to the desired shelter. The strong and healthy worked together in community, sharing equally the result of their labor.

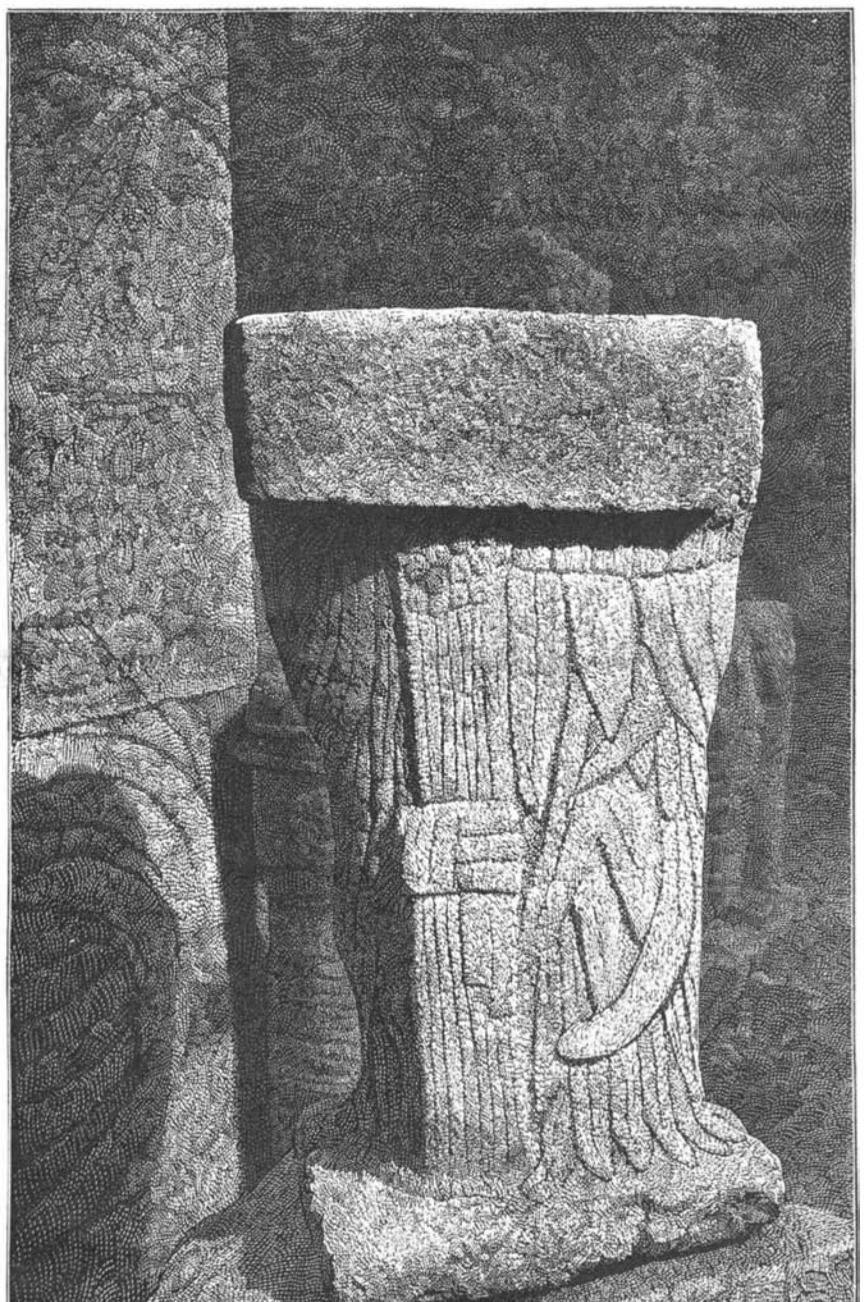
Regarding their amusements, Father Cogolludo, who has written a most interesting work on Yucatan, tells us that they were clever actors, remarkably witty, and very sarcastic, often telling hard truths to their superiors, and in such language that no one could accuse them of having done so—at times converging their whole meaning in a single word. But it is to the historian Herrera that that we are indebted for a description of some of their pastimes. They had large gymnasiums, where the people congregated to be amused by athletes and agile gymnasts—the aborigines of the present time climb and stand in very dangerous places without fear or hesitation. In one game a ball was to be received on the hip, and by a peculiar movement made to rebound from it without being touched by the hand. He who succeeded in thus casting it from him, causing it to pass through a certain stone ring, had a right to seize the cloak of any one present. On such occasion there was a general scamper that gave rise to much fun, but no one cared to forfeit his mantle and ransom it afterward. This garment was called *tilma*, and was simply a square cloth tied with ribbons by two corners on one shoulder; some were very costly, beautifully woven like damask. Even yet, the Indians when at work secure their shirts by tying the sleeves on one shoulder; and the *tilma* is still used by certain Maya tribes.

The gymnasium at Chichen consists of two long walls, forty feet high, and thick enough for two large carriages to roll on abreast. About the middle of each wall, projecting from near the top, was a stone ring; one is yet in place, the other fallen, and eight strong men with difficulty raise it from the ground. Entwined rattlesnakes are sculptured on its sides, with crowns on their heads. One of the uses of these rings was no doubt the game described by Herrera.

At the north end of the gymnasium there is a structure that may very well have been a box from which the royal family witnessed the games. The front half of the roof was supported on round stone pillars, still in place, with figures of warriors and other designs sculptured on them. The back wall and sides of this box are covered with bass-reliefs that do great credit to the dead and forgotten artists. They represent human figures in various dresses and attitudes, and landscape. There is one face with Semitic features and full beard. There is not the least doubt that a bearded race dwelt here, for many bearded men are carved in stone, and nearly all seem to be in the act of worshiping.

On the south end of the east wall of the gymnasium a monument was built to the memory of a certain individual, and it seems that no time, labor, or expense was spared in beautifying it. The most patient laborers, cunning artificers, and clever artists taxed brain and body at that work. This is apparent even yet, though for the last thousand years at least it has been abandoned, and, what is worse, purposely damaged, first by invaders, and then by foolish iconoclasts.

The engravings which we present this week are enlarged views of the caryatides described in the last issue, and enable the reader to form a very perfect idea of the peculiar headdress and the other details of the costume which were not discernible in the comprehensive views of the interior of the chamber of monument of Chaacmol shown last week. The rear of the caryatid is also very curious.



CARYATID IN MAUSOLEUM OF CHAACMOL, YUCATAN (BACK)

Bodily Location of Human Happiness.

Dr. B. W. Richardson, in *The Asclepiad*, treating of felicity as a sanitary research, observes: "The center of the emotion of felicity is not in the brain. The center is in the vital nervous system, in the great ganglia of the sympathetic, lying not in the cerebro-spinal cavities, but in the cavities of the body itself, near the stomach and in the heart. We know where the glow which indicates felicity is felt, and our poets have ever described it with perfect truthfulness as in the breast. It comes as a fire kindling there. No living being ever felt happy in the head; everybody who has felt felicity has felt it as from within the body. We know, again, where the depression of misery is located; our physicians of all time have defined that, and have named the disease of misery from its local seat. The man who is miserable is a hypochondriac; his affection is seated under the lower ribs. No man ever felt misery in the head. Every man who has felt misery knows that it springs from the body, speaks of it as an exhaustion, a sinking there. He is broken-hearted; he is failing at the center of life; he is bent down because of the central failure, and his own shoulders, too heavy to be borne, feel as if oppressed by an added weight or burden, under which he bends as though all the cares of the world were upon him to bear him down."

Commenting on this the *Lancet* says that, in other words, felicity is a physical result of a brisk and healthily full circulation of blood through the vessels supplying the ganglia of the great sympathetic system of nerves; and whatever quickens and at the same time frees the flow of blood in these vessels particularly, engenders the feeling we call happiness. This is the fact, and we believe it explains the action of many articles of food and medicine and medical appliances. It, moreover, explains and confirms the truth of the maxim which we have so often recommended for general adoption: "Be briskly, not languidly, joyous if you would be well." This is the converse of the doctrine that happiness is an affair of the heart and stomach. A comfortable, as contrasted with an austere, mode of life is the most natural, and therefore the healthiest and the best. We sometimes wonder why those who live by rule, and tremble as they live, laboring to eat and drink precisely what is "good for them," and nothing else, are so weakly and miserable. The cause of failure is that such persons are over-careful; life is a burden to them. They have no "go" in their mode of existence. One-half of the "dyspeptics" we see, and whose sufferings we are asked to relieve, would be *well* if they were only *happy*. Everything in life and nature acts and reacts in a circle. Be happy, and your sympathetic ganglia will have the blood coursing through them with the bound of health; and this quickening of the pulse, if it be produced by "good cheer," whether at the table or on the mountain side, will, in its turn, produce happiness. Felicity is the outcome of a physical state, and that state is itself enhanced by the sort of cheerfulness which often consists in being happy in spite of circumstances.

A Queer Character.

The *Drugman* relates the following curious account of one Mangin, a celebrated black lead pencil maker who recently died in Paris. He drove every day, in an open carriage, attended by a servant, to his stands, either by the column of the Place Vendome or on the Place de la Bourse. His servant handed him a case, from which he took large portraits of himself and medals with descriptions of his pencils, which he hung on either side of him. He then replaced his round hat with a magnificent burnished helmet, mounted with brilliant plumes. For his overcoat he donned a costly velvet tunic with gold fringes. He then drew a pair of polished steel gauntlets upon his hands, covered his breast with a brilliant cuirass, and placed a richly mounted sword at his side. His servant then put on a velvet robe and helmet, and struck up a tune on an organ mounted in gold. To the crowds gathered around he then exclaimed: "I am Mangin, the great charlatan of France. Years ago I hired a modest shop in the Rue Rivoli, but could not sell pencils enough to pay my rent. Now, attracted by my sweeping crest, my waving plumes, my din and glitter, I sell millions of pencils." This was true, the writer adds. His pencils were the very best.

Simple Method for Determining the Value of Wheat Flour.

The nutritive value of wheat flour depends upon the amount of gluten, sugar, starch, and phosphate of lime that it contains. The superiority of this breadstuff over all others is due to the large quantity of gluten and phosphate of lime that it contains as compared with other kinds of grain.

The *Germano-Austrian Millers' Journal* (No. 37) gives the following *approximate* method of estimating the above named constituents of wheat flour, which can be easily performed by any one:

1. THE GLUTEN.

One hundred grammes of flour (or 1,000 grains may be taken if preferred, and the same relative proportions maintained throughout the analysis) are mixed with water to a dough, let lie for an hour, and then kneaded, fresh water being added until all the starch is washed out. The residue is gluten, and may be laid aside on some thick blotting paper, but all the wash water must be kept.

2. THE STARCH.

The various portions of water used in washing out the starch are united and set aside in a large vessel where the starch can settle. When this has taken place and the supernatant liquid is clear, the latter is poured off and the precipitate placed upon a weighed (tared) filter, which is placed in a funnel. All the starch must be washed out of the vessel and brought upon the filter.

3. ALBUMEN, GUM, AND PHOSPHATES.

The clear liquid that was poured off, as well as that which runs through the filter, is evaporated to a certain degree (how far is not stated, probably to one-fourth of its original quantity), then filtered through a weighed filter. The residue that remains on the filter is the albumen. The filtrate is evaporated still further, until it forms a thick sirup, when it is mixed with ten times its weight of alcohol, and filtered; the residue is washed with alcohol on the filter. This residue consists of phosphate of lime and gum. The two substances can be separated by dissolving in water, filtering, and evaporating; for the latter is soluble in water, while the former is not.

4. SUGAR.

By evaporating or distilling off the alcohol from the solution the sugar is obtained, and can be collected on a filter as above.

5. WEIGHINGS AND CALCULATIONS.

The substances above separated are dried at a moderate heat (212° Fahr.), and weighed. The weight of the albumen can be added to that of the gluten, since it is a kind of gluten, and has nearly the same nutritive value. Having taken 100 parts of flour, by weight, the weight of each constituent in grammes will at once represent the percentage. (If 1,000 grains were taken, divide the weight in grains by 10 for the per cent.) In each case the filter must be dried at the same temperature (about 212° Fahr.), and carefully weighed beforehand, for if it is subsequently heated to a higher temperature it will lose moisture and weight.

The quantity of gluten will be found to vary according as the flour is fresh or old, for old gluten retains less water. There is also less gluten in flour from hard grain, and less in freshly mixed dough than in that which has stood for a few hours, and also less after long washing with large quantities of water, which will make a gluten 10 to 20 per cent lighter.

To avoid gross errors in estimating gluten, the *Pharmaceutische Zeitung* recommends making a dough from 50 grammes of flour with 20 or 25 grammes of water, which is divided in two parts at the end of twenty-five minutes. In one half the gluten is estimated at once, while the other is left an hour longer before the gluten is separated. As soon as the water runs off clear it is pressed firmly with the hand and weighed, then washed for five minutes longer, pressed, and weighed again. As both weighings are made with each half we have four different results, the average of which may be taken as approximately correct.

[The only method of estimating gluten with great accuracy consists in determining the percentage of nitrogen in the flour by combustion with soda lime or copper oxide. Both require skill and experience with costly appliances. Even here the albumen is reckoned in with the gluten, but does no harm. An extensive series of wheat analyses have been made by the Department of Agriculture, estimating gluten in this way.—ED.]

THE British *Medical Journal* says: "We often hear a great deal about the dampness of our climate as a cause of disease, of the respiratory organs especially, but the death rate and the amount of rain fall do not appear to stand in any definite relationship, whereas a spell of cold weather produces an immediate and notable effect."

A Disease from Reeds.

A curious affection has been occasionally met with in certain parts of France, especially in Provence, among reed workers, chiefly those who manipulate the stems of Arundo donax. A case at Frontignan (Herault) has lately been very carefully studied by M. Baltus, of Lille. A man, aged forty-seven, and his son, aged seventeen, had been at work for several hours loading a cart with reeds, which had been cut a year before, and kept in a damp trench. Both were seized with painful irritation of the nose, eyes, and throat, followed by erythematous swelling in the same parts, which extended to the hands, trunk, and genital organs. A number of acuminated pustules appeared on the red swollen areas, the conjunctivæ were injected, the eyes streaming, and there was a slight cough. The next day four other persons —three adults and a child—who had come in contact with the reeds deposited at the farm, presented the same symptoms, although in slighter degree.

Moreover, four cats and three dogs which had frequented the same reeds presented red painful crusts about the nostrils. In every case the disease ran a mild course, and disappeared in a few days, under the influence of wet compresses. An examination of the reeds showed that they were covered with a mould consisting of the spores and mycelium of a fungus—Sporotrichum dermatodes—which had developed under the influence of the prolonged exposure to moisture. The spores had been shaken off as dust during the manipulation of the reeds, and had irritated the exposed parts of the skin on which they had lodged. Although usually trifling, the malady may sometimes assume a severe form, lasting nearly a fortnight, and has been known to cause the death of an old man seventy-one years of age. It may apparently be prevented by the simple expedient of washing the reeds before their manipulation.—*Lancet.*

New Slate Mines.

An important discovery of slate was made a short time ago at a spot about one mile from L'Anse, Mich., which report now says is proving of immense magnitude. The following is given in a press dispatch: "A depth of 25 feet has been reached, which shows a deposit of excellent billiard and roofing slate. The vein dips toward the southeast to a distance of 300 feet in width as far as the test pits have been made, then runs west, crossing the Marquette, Houghton & Ontonagon Railroad to an indefinite distance. The outcroppings on the sections show the slate to be within three feet from the surface. The facilities for shipping are excellent. With the railroad to the left of it 200 feet, and the Keewenaw Bay one mile in front of it, the markets of Chicago, Buffalo, and other leading ports can be reached with a cost of 50 to 60 cents a square. The discovery is looked upon with great interest, and will be one of the leading industries of the Upper Peninsula. Stripping and test pitting and other work to improve the property is under progress. The slate is equal to that which has been selected for covering the new Board of Trade Building in Chicago."

American Wheat Exports.

According to the statistics of the British Board of Trade, the United States supplied four years ago 75 per cent of all the wheat and flour imports into Great Britain; in 1881 this import decreased to 69, in 1882 to 55, and in 1883 to 46 per cent; in other words, the import of 93,000,000 bushels in 1881 diminished to 74,000,000 bushels in 1883. The decrease is not due to a reduced consumption, for the total import has increased from 136,000,000 bushels in 1881 to 160,000,000 bushels in 1883.

While we thus see a constant diminution in Great Britain's imports from the United States, we find an increase from other countries, especially Russia and India. Russian grain shipments to England have, for instance, increased from 8,000,000 bushels in 1881 to 27,000,000 bushels in 1883, and the import from India, which consisted of 15,000,000 bushels in 1881, has risen to 23,000,000 bushels in 1883.

In addition to this, Australia produced in 1883 not less than 32,000,000 bushels of wheat, of which a large part was taken to England and sold at prices refused by American speculators.

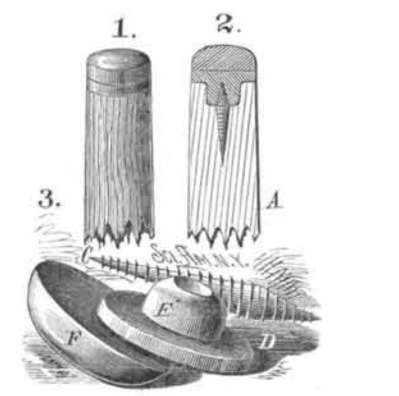
BUTTER PACKAGE.

The accompanying engraving illustrates an invention, recently patented by Mr. J. P. Sinclair, of Mottville, N. Y., which provides an air tight package for holding small quantities of butter. The package is composed of two similar parts made with flanges, so as to form lips which hold the rubber packing in place when the jars are put together. The flanges are beveled to form enlarged portions on opposite sides—as clearly shown in the perspective view, Fig. 1—thereby permitting the jars to be drawn tightly together upon the packing by the buttons. The flanges are under cut in order to furnish a secure hold for the notches in the buttons. This construction prevents the buttons slipping off or in any way injuring the flanges, and insures an hermetical seal.

After the jars have been filled with butter they are placed together, the packing rings having been put between their edges, and the buttons are moved to the thick portions of the flanges. Air being excluded from the interior, the butter will keep fresh and sweet for a great length of time. One-half the contents of a package can be removed, moulded ready for the table, as shown in Fig. 4, without disturbing the other half. Fig. 2 shows the packing ring and clamping buttons, and Fig. 3 is a front view of one jar.

BILLIARD CUE TIP.

A screw, C, which is tapered toward both ends—one taper being about one-third the length of the other—is screwed into the end of the cue in the middle of a cavity having a concave bottom, the short taper projecting from the base of the cavity. One side of the butt piece, E, is furnished with a neck fitting in the cavity in the cue and into which the short taper is screwed, thereby holding the piece securely on the end of the cue. The tip, F, is then glued on the



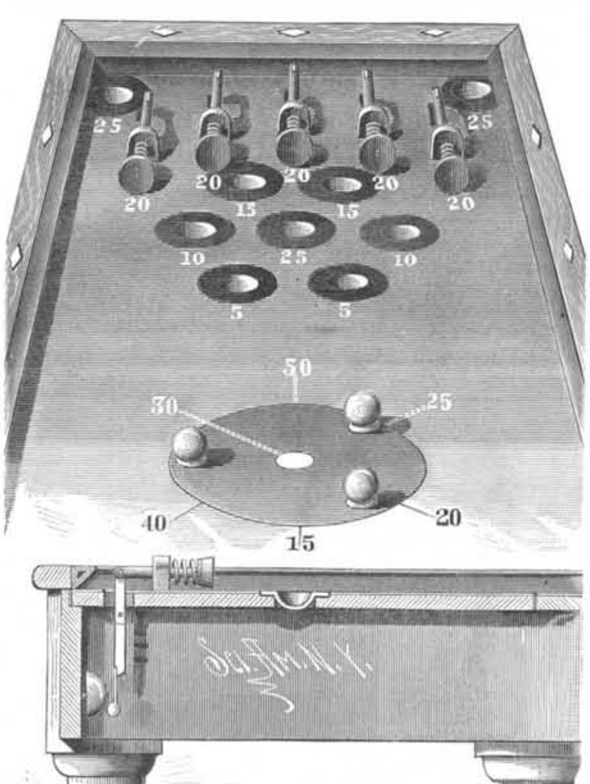
THOMAS & CORES' BILLIARD CUE TIP.

front surface of the butt piece. As the bottom of the cavity is made concave, the leather, in shrinking, forces itself against the screw, binds firmly, and cannot become detached. The tip can be adjusted very readily and accurately, and in such a manner that it cannot be knocked off.

This invention has been patented by Messrs. W. H. Thomas and C. B. Core, whose address is P. O. Box 696, Peoria, Ill.

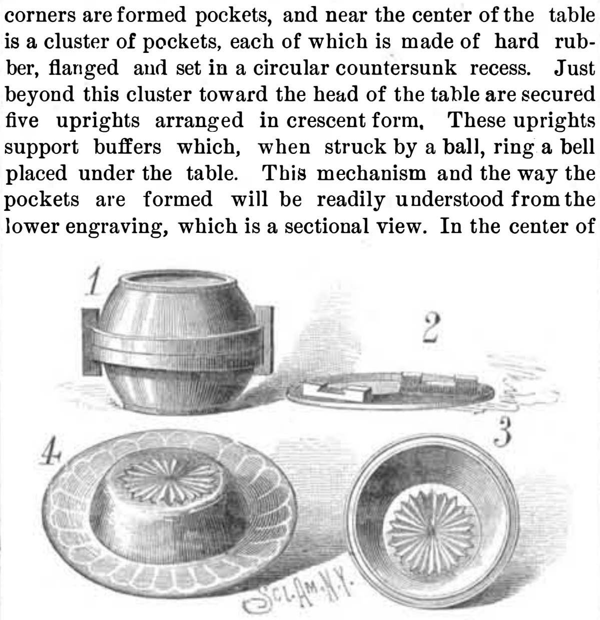
NEW GAME TABLE.

The table is rectangular in form, covered with baize, and cushioned at the edges like a billiard table. Near the upper



DE FOY'S NEW GAME TABLE.

corners are formed pockets, and near the center of the table is a cluster of pockets, each of which is made of hard rubber, flanged and set in a circular countersunk recess. Just beyond this cluster toward the head of the table are secured five uprights arranged in crescent form. These uprights support buffers which, when struck by a ball, ring a bell placed under the table. This mechanism and the way the pockets are formed will be readily understood from the lower engraving, which is a sectional view. In the center of



SINCLAIR'S BUTTER PACKAGE.

the table is pivoted a wheel provided with three pegs placed equal distances apart. In the middle of the wheel is a spot from which leads a radial index line, and around the wheel, upon the baize, are marked six radial lines as shown. The lines, pockets, and buffers are numbered as shown in the cut.

The game, which the inventor, Mr. Frank R. De Foy, of Dannemora, N. Y., calls "Apollo," is played with one red, four white, and four black balls, by two or four persons. The red ball is placed on the spot on the wheel. The first player shoots a ball, with a cue, at one of the pegs, so as to revolve the wheel and start the red ball off. If this ball goes in any of the pockets in the cluster, it counts for double the number marked upon it; and if the index line of the wheel stops in line with one of the marks in the table, it counts the number indicated. Subsequent shots are made at the balls on the table, and if they strike the red and another ball, it counts five. Any of the balls entering the cluster pockets or striking the buffers count what they are marked, but if the player sends his own ball into one of the corner pockets it counts twenty-five for his opponent. Unless the player hits his partner's ball with his own, he cannot count. If the player touches his partner's ball, then touches the red, it counts fifteen. The game is two hundred points.

California Dried Fruits.

Geo. W. Meade & Company, of San Francisco, give the following *resume* of the above California products for the year 1883:

Raisins, 20 pound boxes	125.000	boxes.
Sun dried apples	800.000	pounds.
" peaches	500,000	"
" pears	75,000	"
" apricots	300,000	"
" nectarines	20,000	"
" figs	60,000	"
Evaporated apples	250,000	"
" apricots	90,000	"
French prunes	250,000	"
Dried grapes	150,000	"
Pitted plums	100,000	"
Comb honey	125,000	"
Extracted honey	835,000	"
Almonds	700,000	"
Walnuts	500,000	"

Acidity of Beer.

It is frequently asserted that the acidification of beer is due to the development of acetic acid, and therefore writers have frequently called this change acetification; but when beer is submitted to careful chemical analysis, it is surprising to find how small a quantity of acetic acid is to be found in even that which is very sour. The fact is that very little acetic acid is formed in beer, the acid which gives the taste of sourness being mostly lactic acid. Acetic acid is only formed by the oxidation of alcohol, brought about by the intervention of a peculiar ferment called *Mycoderma aceti,* while lactic acid is formed by the simple molecular change of any of the carbohydrates of the sugar type, and does not even require the presence of any oxygen. Lactic acid may be easily distinguished from acetic acid by its property of not being volatile. If the total acidity of a sample be first determined, and then a portion of the same beer be evaporated to dryness, and the acidity of the residue be determined, this will give the amount of lactic acid, and this, deducted from the total acidity, will give the amount of acetic acid.

Resolutions of the Legislature of the State of New York.

On the 11th inst., in the Assembly of New York, the subject of the proposed objectionable changes in the patent laws came up for discussion, in the course of which Gen. Husted, from Westchester County, made a very able speech in defense of the rights of inventors and in support of patent property. The following excellent resolutions were passed almost without a dissenting voice:

RESOLUTIONS OF THE NEW YORK ASSEMBLY.

Whereas, The incentive and rewards given to inventors by the Constitution of the United States and the laws of Congress passed thereunder have done more, perhaps, than any one cause to advance our whole country to the front rank in wealth, resources, and industries among all nations in the world; and. *Whereas,* any material change in those laws would, in the opinion of this House, seriously retard our material progress as a people,

Therefore, be it resolved, etc., That our Senators and Representatives in the United States Congress are respectfully requested to oppose the passage of any bill which would have the effect to discourage inventions, by impairing the value of patented property or of imposing any conditions on the owners of such property in prosecuting and maintaining their rights to the full value of their said property which are not equally applicable under the laws of Congress to the rights of all property, and the remedies provided to protect the same, for all citizens of our entire country.

Resolved, That this House heartily approves of such amendments to existing patent laws as shall provide speedy and full punishment for all persons who appropriate the patented property of others without authority of law, and manufacture and sell the same to innocent purchasers and users thereof, to the great annoyance in some cases of the user, and to the great injury of the rightful owner of such property in all cases.

Resolved, That a copy of these resolutions be forwarded, etc., etc.

It is to be hoped that the Legislatures of all the other States in the Union will pass similar resolutions without delay. A little earnest effort on the part of the friends of progress and industry in each State where the Legislature is in session will secure the adoption of suitable resolutions likely to have much influence with Senators in Congress.

Memorials before Congress.

Large numbers of petitions and memorials are being sent to Congress, praying that no changes adverse to inventors may be made in the patent laws. Here is a specimen of one day's delivery by Senator Hawley:

Mr. Hawley presented the following memorials, remonstrating against the repeal or hostile modification of the present patent laws, which were referred to the Committee on Patents:

A memorial of Simpson, Hall, Miller & Co., and 7 others, manufacturers and inventors, of Wallingford Conn.;

A memorial of Isaac Cole and 4 others, of New York city;

A memorial of Professor Alexander C. Twining, C.E., of New Haven, Conn.;

A memorial of R. Wallace & Sons' Manufacturing Company, of Wallingford, Conn.;

A memorial of the Whiting Manufacturing Company, of New York;

A memorial of J. H. Bullard and 18 other manufacturers and inventors of Springfield, Mass.;

A memorial of D. W. Wesson and 15 other manufacturers and inventors of Springfield, Mass.; and

A memorial of the Billings & Spencer Company and 9 other manufacturers and inventors of Hartford, Conn.

Resolutions of the New York Board of Trade and Transportation.

At the regular monthly meeting of the New York Board of Trade and Transportation, held in this city April 9, 1884, the President, Mr. Ambrose Snow, in the chair, Mr. A. B. Miller, of the Executive Committee, addressed the board touching the several bills before Congress which propose changes hostile to the patent laws of the country. In conclusion, Mr. Miller offered the following preamble and resolutions:

Whereas, The rapid development, growth, and wonderful prosperity of the United States is largely attributable to the inventive genius and skill of our people, which—under the stimulus of the protection afforded by existing patent laws—have, by the creation of labor-saving machinery, rendered it possible to not only compete successfully with the cheaper manual labor of Europe in almost every branch of agriculture, manufactures, mining, transportation, etc., but also to bring under profitable cultivation thousands of square miles of territory which would otherwise have remained a wilderness; and

Whereas, Bills have been introduced in Congress for the purpose of limiting the existence of a patent to five instead of seventeen years, as now, and in other ways to destroy or injure the value of patents; and

Whereas, It is well known that but a small number of the many patents that are issued ever become valuable to the inventor or owner, and that in those cases where successful it has rarely happened that any suitable pecuniary reward has been received until after the expiration of five years, as at least that time is generally consumed in perfecting the manufacture of the patented article and bringing it into public use; therefore

Resolved, That this board views the proposed legislation in regard to patents with the gravest apprehension, as being designed to not only do a serious and irreparable injury to all owners of existing patents, but by withholding the hope of just reward as the result of a successful and useful achievement in invention, the genius of our people will be throttled, the rapid progress and prosperity of our country will be checked, and agricultural, commercial, and all other industrial interests of our nation will suffer.

Resolved, That while this board is not opposed to the reasonable protection of those who without knowledge have purchased and used a patented article and discontinued the use thereof after notice, it is clearly of the opinion that the manufacture and sale of patented articles with the knowledge that the same are patented, unless with the consent of the patentee or his assigns, should be made a penal offense, punishable with either fines or imprisonment, or both, at the option of the court.

Resolved, That it is the judgment of this board that no action should be taken by Congress that in its operation would reduce the term for which patents are now given, or in any way render them less secure or valuable.

The preamble and resolutions were unanimously adopted, and the secretary directed to forward a copy of same to President Arthur and to each member of the United States Senate and House of Representatives.

Resolutions of the Davenport, Iowa, Academy of Sciences.

At a meeting of the Academy of Sciences, of Davenport, Iowa, on the 4th of April, the pending patent legislation was discussed, and the following resolutions adopted, which we take from the *Daily Gazette:*

Whereas, All experience has shown that one of the very important elements in the progress of a nation and the development of its resources is the wise and liberal encouragement of mechanical invention and practical scientific discovery, promoting improvements in manufacturing processes, in means of transportation with greater public safety, and in the establishment of new and important industries; and,

Whereas, Now, while other nations, recognizing the wisdom, justice, and expediency of liberal legislation to protect and encourage invention and research, are fast adopting the course which has so long been in successful operation in the United States, and at a time, too, when increased effort is necessary to keep pace with the progress of the age, numerous bills have been presented in Congress—several of which have already passed the House of Representatives—calculated to impair the rights of inventors in the products of their own industry and research, and to discourage all effort in that direction; therefore,

Resolved, That we respectfully and earnestly request our honorable Representatives and Senators in Congress to use their best endeavors to prevent the repeal of the existing guarantees or the enactment of any laws obstructing the inventor's control of his inventions or the defense of his rights therein, and destroying the value of that which is legitimately his own property, or for shortening the period of the existence of a patent, taking away his prospect of pecuniary compensation for work in the highest degree beneficial to the community, and contributing largely to the prosperity of the nation, and discouraging the exercise of talent and means in that direction.

Resolved, That these resolutions be published in the daily papers, and copies forwarded to the Congressional Senators from Iowa and Representative from this district.

The American Patent Protective Association.

This association is the outgrowth of the convention of inventors that assembled in this city in October, 1883. A very excellent constitution has been adopted, the principal officers are gentlemen of ability, and the corporation is now doing some excellent work in opposing the progress of the hostile patent legislation before Congress. The president of the association is Mr. E. M. Marble, of Washington, D. C., late Commissioner of Patents, J. A. Price, of Scranton, Pa., first vice-president, A. S. Cushman, 83 Cedar Street, New York, corresponding secretary. The association has issued the following statement concerning the obnoxious patent bills:

"The founders of our Government conferred upon Congress as a power to be exercised, that of promoting progress of science and the useful arts, incorporating it into the national Constitution, and indicating the manner of its exercise in such clear and explicit terms as to fix its scope and limitation. That manner is '*by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries.*'

"Annually attempts are made to nullify these plain, concise guarantees of the Constitution, and to render the right insecure, and redress difficult and illusory. In the 45th Congress a bill which was introduced in each branch, prepared by skilled attorneys in the interests of 81 Western railroad corporations, to evade a liability of some millions of dollars, would have impaired the value of every patent in the land. Fortunately, the fixed hour of a closing session prevented concurrent action, and the danger was postponed.

"But it is believed that at no former session have so many varied attempts in the interests of infringers been attempted, including: Bill H. R. 311, introduced by Mr. Calkins, of Indiana; bill H. R. 419, by Mr. Lamb, also of Indiana; bill H. R. 1,956, by Mr. Wood, likewise of Indiana; bill H. R. 1,081, by Mr. Ray, of N. Y., the main features of which were incorporated in Bill H. R. 3,934, reported by the House Committee on Patents, without (so far as we know) prior notice or hearing having been afforded to inventors or those representing the important investments of capital in patents. This bill was not only reported as a substitute for the preceding bills, but also for bill H. R. 1,134 and bill H. R. 1,250, and has actually passed the House of Representatives, by a vote of 114 *ayes to only* 6 *noes, without debate.* Another similar bill, H. R. 3,925, had passed only the day previous under a suspension of the rules. This indicates speed on the part of those pushing the measure, and indifference on the part of the main body of the House. Still another bill, H. R. 3,617, introduced by Mr. Anderson, of Kansas, seeks to limit the term of a patent to five years, and thus not only injures the American inventor in his own land, but prevents his enjoying the fruits of his inventive genius for any longer term in a foreign land. Other bills have been introduced, making a total of twenty bills to modify the patent laws in the early days of a new Congress.

"The manifest purpose of these bills, considered together, is to gradually undermine our patent system; to render patents valueless; to obstruct patentees in obtaining redress, by closing to them our national courts, and turning them over to local courts; to overturn the valuable settled line of decisions which have been pronounced by the soundest judges, and in their stead create uncertainty and diversity; to render poverty an insuperable barrier to obtaining any redress; to convert a victory into a paralyzing discomfiture by making the burden of costs of action fall upon the one who is wronged, and not upon the wrong doer; to render every patent a contest, and every contested patent valueless; and generally to grant immunity to infringers, and to discourage, vex, and impede those who venture to assert their rights before the tribunals. By the provisions of one bill, the inventor may be compelled to have a license against his will, and that too without his consent as to the amount of royalty to be paid for the license. By another provision, though the right to sue is not taken away, yet in the case indicated in the bill no damages or profits can be recovered by a judgment. Individuals and corporations other than manufacturing (*e. g.*, railroad) can purchase in open market, and use with impunity, till actual notice, all kinds of patented articles without paying anything to the one whose brain has provided the convenience; and after notice (unless the patentee recovers over twenty dollars) he is saddled with his own costs, and pays his adversary's attorney fifty dollars.

"Such legislation multiplies infringers, and enables them to set at defiance society's benefactor. It crushes the inventor if he has but little capital. It terrorizes him with hazardous litigation if he has capital, and unless in the case of machinery for manufacturing purposes, depreciates the value of his invention, so that a patent under the broad seal of his government is but a certificate of his folly in paying the official fees.

"Further inaction is perilous to the capitalist as it is to the inventor. There is need of a united, intelligent effort on the part of those who desire a continuance of the benign and wise policy of our fathers, which has placed our industrial prosperity in unrivaled prominence."

Thomas E. Daniels.

The inventor of the widely known Daniels planer died at Fitchburg, Mass., on the 11th inst., at the advanced age of eighty-three years.

Mr. Daniels was born in Fitchburg at the commencement of the present century, and spent a large portion of his life in his native town. He was fond of mechanics and inventions, and was the recipient of sixty-two patents.

The invention with which his name was most extensively associated was the Daniels wood planer, patented in 1836, and which is still in extensive use. The novel feature of the invention, as most of our readers know, was having the cutters revolve at right angles with a perpendicular propelling shaft, while the lumber was carried under the cutters and the surface planed; and for certain purposes, such as planing timber, and producing a true plane surface on lumber, it has never, we believe, been superseded, and the introduction of the Daniels planer has extended to all parts of the world.

Mr. Daniels was much respected by his townspeople, and his loss will be felt by a large circle of relatives and friends.

Trials with the New Dynamite Gun.

The first of the regular series of experiments with the new pneumatic dynamite gun, of which we published an engraving and description in the SCIENTIFIC AMERICAN of April 5, took place a few days since at Fort Hamilton, under the direction of Col. John Hamilton and Lieut. E. L. Zalinski.

The target at which the shots were fired was situated at a distance of 2,100 yards, on the shore at Fort Wadsworth, the gun being placed on the glacis of Fort Hamilton. The first shot fired was one weighing 17 pounds, capable of carrying from 10 to 12 pounds of dynamite. It was loaded with the same weight of sand and lead, instead of dynamite. The pressure used was 485 pounds. The shot went 60 yards to the left and slightly above the target, exactly as Lieut. Zalinski had foretold it would do, owing to the wind. The second shot, with a pressure of 480 pounds, went 10 yards to the left of the target and 15 yards above it, burying itself completely in the hill. The third and last shot, which was sent in a blinding rainstorm, was a line shot, which went 25 yards short of the target and struck the water.

"I am well satisfied with the experiments," said Lieut. Zalinski. "While these dynamite guns can never supersede the ordinary powder guns, they will be a very valuable auxiliary, as they can be used equally advantageously on land or sea. The pressure used to-day—480 and 485 pounds—we shall increase to 2,000 pounds as soon as another engine is supplied. You know that the numerous attempts to throw dynamite with ordinary powder guns have nearly always met with disastrous results."

Wire Tests.

At a recent meeting of the Philosophical Society of Glasgow, Professor Jamieson said he had obtained some specimens of nearly pure aluminum wire from the Aluminum Crown Metal Company, the same being prepared by Webster's process. On analysis, the wire gave 98·39 per cent of aluminum, 1·24 per cent of iron, and 0·37 per cent of silicon, the specific gravity being 2·786. As the wire was only in short lengths, he had been compelled to determine the electrical resistance of the metal by the "fall of potential" method with chemically pure copper wire as well as with a standard B.A. unit; and he had found that the aluminum had 1·96 times the resistance of the copper wire of the same gauge and length, and but little more than half the resistance of pure copper for the same length and weight. The conclusion arrived at, therefore, was that aluminum had by far the least resistance of any known metal for its weight.

In the course of his investigations he had elicited a very curious fact, namely, that the introduction of a very small percentage of aluminum into copper not only raised its tensile strength immensely (the specimens shown having a breaking stress of about 45 tons per square inch), but also enormously increased its resistance. So far as his tests had gone, the specimens shown had a resistance of 25 times that of pure copper. He pointed out the probable uses of such wire, as, for example, in the construction of high resistance coils. Other qualities might be found well adapted for telephone wires, and the purer kinds of aluminum, owing to the great lightness of the metal, could be used for military purposes, in which lightness of baggage was an important desideratum.

ENGINEERING INVENTIONS.

A car truck has been patented by Mr. John R. Fish, of Grand Rapids, Mich. The equalizing bars are so arranged that the frames connecting the journal boxes are entirely relieved of all the weight of the car and load, the bars extending entirely over and resting on the springs of the axle bearings.

An improved means of packing, lubricating, and cooling the pistons of air compressors has been patented by Mr. Charles F. Ruff, of Phœnixville, Pa. The piston has annular grooves to receive water, and works in a cylinder with a larger annular groove in which water circulates, the water in the several grooves making a close joint, and packing, cooling, and lubricating the piston.

A reversing and cut-off gear for engines has been patented by Mr. Andrew F. Johnson, of Stillwater, Minn. This invention covers a special construction and arrangement of parts, so that a direct action is established between the load and the engine valve without the intervention of a centrifugal governor operated by the velocity and requiring a certain period of time for its operation.

A feed water heater has been patented by Messrs. Patrick McGivern and William E. Frye, of Crestline, O. A detachably supported water table is located in the fire box with feed water and delivery pipe connections, the heater being supported by the pipe connections and the side sheets of the furnace, and the pipe connections having outside joints back of the fire box, where they can be connected or disconnected at will.

MECHANICAL INVENTIONS.

A waterproof journal bearing has been patented by Mr. Nicholas W. Godfrey, of Northport, N. Y. The invention covers a novel construction of socket bearing, with lining, flexible packing, and washer, to protect the journals of shafting in excavators and other machinery which requires to be immersed in water, from contact with water or sand.

A flier for spinning machines has been patented by Mr. Leedham Binns, of Paterson, N. J. The object is to overcome the present difficulty of the eye of the flier becoming notched by the wearing of the thread, and this invention provides means for causing the thread to have a lateral traverse along the leg or arm of the flier, so there will not be a single contact point as at present.

A saw mill set works, or improved head block for saw mills, has been patented by Mr. Robert R. Parsons, of Jackson, Miss. The setting shaft is geared with a rack on the under side of the head block, the shaft having its bearings in the block, and there being a spring applied thereto and to the head block, with various special combinations and arrangements of parts.

An improved wrench has been patented by Mr. Dwight M. De Silva, of Corning, N. Y. The jaws are pivoted to a head block, whereon a handle is also pivoted between arms of the jaws, extending back of the pivots, on which cams of the head of the handle act so as to cause the jaws to bite, and to hold with great power, when the handle is turned, on a nut, pipe, or other object.

A thread separator for ring spinning frames has been patented by Mr. Gilman Jaquith, of Maysville, Ky. This invention consists in a continuous construction of separator throughout the whole length of the ring rail, of specially advantageous form, its small columns or supports being arranged back of the center of the ring rail, leaving the front or working side open or clear, so the travelers on the rings are easily reached by the fingers of the operator.

AGRICULTURAL INVENTIONS.

A thrashing machine has been patented by Mr. John A. Beam, of Baden, Ontario, Canada. In combination with specially devised crank shafts and rakes are perforated plates, the rakes having greater throw than the plates, so the machine operates with small power, has increased capacity, and is capable of excellent work.

A hay stacker has been patented by Mr. James B. Matlock, of Huntsville, Mo. The hay is collected with a rake in the ordinary manner, and the loaded rake is drawn to and upon the bars of a frame, where it may be connected with sliding catches, and elevated by drawing upon ropes, and then automatically released upon the stack.

A potato digger has been patented by Mr. Willis Dodge, of Presque Isle, Me. In combination with a draught beam and scoop is a shaker or screen pivotally suspended, and a specially shaped crank shaft having a lower forward extension engaging a grooved cam disk, the scoop passing the potatoes backward over the screen, which is agitated to separate them from the earth.

MISCELLANEOUS INVENTIONS.

A cover for water closet seats has been patented by Mr. Dale O. Cowen, of Batavia, O. This invention provides for seat sheets to fit the apertures in water closet seats, and cover or protect the person from contact with any part thereof.

A spring wagon has been patented by Mr. Thomas P. Yates, of Factoryville, N. Y. This is a novel construction for combining the spring and axle in one device, and so calculated to simplify the construction and improve the operation of spring wagons.

A bag holder has been patented by Mr. Percy Cole, of Pipestone, Minn. This invention is an improvement on a former patent issued to the same patentee, and covers an improved means of holding a bag in connection with a hopper while the bag is being filled.

An improvement in supporting belts for absorptive pads, or a catamenial sack, has been patented by Nannette Amia, of Brooklyn, N. Y. The supporting belt is made of webbing, to which is buckled elastic webbing and elastic hangers, which have loose sliding rings to receive the strings of an absorptive pad.

A pipe stem has been patented by Mr. Jurgen P. Lange, of Butler, N. J. The stem has a spirally grooved core with longitudinal passages and transverse passages, a reservoir for nicotine rising with the smoke, and an aperture which provides for its separation, so as to keep dampness from the bowl.

An improved window and door lock or button has been patented by Mr. Evander B. Newcomb, of Corydon, Iowa. It is simple in construction and no spring is needed, but by it the sashes may be locked when fully closed, or the lower sash supported when raised to its fullest height or only partially raised.

A washing compound has been patented by Annie E. Rhoads, of Baraboo, Wis. It consists of sal soda, saltpeter, and gum camphor, combined in certain proportions, and used in slightly different ways for the varied work of cleaning dirt from clothes, and spots from floors, ceilings, woodwork, carpet, etc.

A street cleaning machine has been patented by Mr. Beekman Van Gaasbeek, of Mount Vernon, N. Y. A truck carries a water tank, a compressed air chamber, and a water and air distributer, pipes from which may be so set as to sweep the dirt to the curbstone or point desired, there being also means for keeping the water and air hot for melting snow and ice.

A measuring device for surveying and other purposes has been patented by Mr. Alfred Atkins, of Wanganui, New Zealand. There is a wire in a series of sections, swivels uniting the sections, tallies, and a chain for connecting the swivel on the inner end with a reel, all furnishing an improved means of measuring in an uneven country.

A sugar dumping wagon has been patented by Messrs. James D. Edwards and Leon F. Haubtman, of New Orleans, La. The invention consists in a wagon box provided at one end with a means for hinging it, and at the opposite end with means for receiving a rope to lift the latter end of the box and thus dump its contents.

A refrigerator for cooling contents of bottles, cans, etc., has been patented by Mr. Bernhard Moebius, of Chihuahua, Mexico. The invention consists in a fibrous bag or covering to be passed over a bottle or other vessel, part of the covering extending into a liquid which is absorbed by the fibers and is evaporated, thereby cooling the contents of the vessel.

A creaming can has been patented by Mr. John A. Kendall, of Hamilton, Mo. The can has at its lower part a closed annular warm water or air chamber, in combination with a surrounding cold water vessel, to keep the lower portion of the milk warmer than that at the top for a period, during which the cream will rise rapidly.

A drum and cymbal clamp has been patented by Mr. Perry W. Fair, of De Kalb, Ind. The clamp device has a seat and stud screw for attaching the cymbal, and a bottom and flange for seating substantially on the hoop of the drum, forming a simple and quickly adjustable device to make a substantial connection of the cymbal to the drum.

A gate opening and closing apparatus has been patented by Mr. Amon W. Chilcott, of Mattoon, Ill. This invention covers a special construction and combination of parts in mechanism for operating sliding gates, and is an improvement on a former patent issued to the same patentee, whereby the operation is made more easy and convenient.

A bosom board has been patented by Mr. Samuel Maxim, of Wayne, Me. The invention covers a special construction and arrangement of the clamping device for holding shirt bosoms while being ironed, in that class of ironing boards which have a projection to go through the neck and a clamping part to hold the bottom of the shirt.

An improvement in tombstones has been patented by Mr. Solomon R. Miller, of Mount Union, Pa. The invention covers a casing for receiving a picture, and adapted to be secured on a tombstone, the casing having a rubber lining which holds the glass covering the picture air and water tight, and there being a washer or packer between the cover and the casing.

An air cooling refrigerator has been patented by Mr. David Sanderson, of Ottawa, Ill. The ice rack has a curved plate or deflector at the under side of its central upper portion, in combination with a hopper-shaped ice bed with a central oblong air passage in its lower convergent portion, so air will be caused to circulate well around the ice, and thus cool the air in a room.

A trimmer for sewing machines has been patented by Mr. Daniel Maus, of Utica, N. Y. It is rotary, with a periphery which is an eccentric curve, or a curve of constantly varying radius, and with saw teeth serrations in the curved cutting edge, so the trimmer is made to cut positively, without causing the wedging action which antagonizes the feed.

An improved hame clip has been patented by Mr. Edward D. Cole, of Macon, Ill. It is so made that by removing a screw the clip may be detached from the hame, and also from the hame tug, so that either may be changed in the harness if desired without destroying the hame clip, and the clip is cheap, practical, and durable.

An improved horse power has been patented by Mr. August Zastrow, of La Harpe, Ill. The invention covers special constructions of belt casing with guide pulleys or idlers journaled to guide the belt clear of frictional contact with the ground, and permit the belt casing to be depressed where the animals pass over it in working the sweep.

A machine for leveling boot and shoe soles has been patented by Mr. Seth D. Tripp, of Lynn, Mass. The machine is made with a shaft connected with the drive shaft by beveled gear wheels, and with a right and a left worm gearing into worm segments carrying the last and presser foot, so the last and presser foot are made to move in unison.

An earth scraper has been patented by Messrs. John F. O'Connor and Sterling M. Williams, of Davenport, Iowa. This invention covers a special construction and arrangement of parts for effectively operating a scraper, and for readily causing it to dump itself by the preponderance of weight in a certain portion thereof, or for carrying the load if desired.

An elevator bucket has been patented by Mr. Joseph A. Holmes, of Greenland, N. H. This is an improvement on an invention formerly patented by the same inventor, and provides that the bucket shall be attached to the endless band at or near the center of its length, so that when the buckets are large or heavily laden they will not pull away from the band.

A time lock has been patented by Mr. Moses C. Hawkins, of Edinborough, Pa. The invention consists mainly in what is called an "accident lever" with two pawls, one engaging a ratchet on the going barrel and the other a stationary ratchet the lever having an inclined surface for engaging the time catch when the accident lever is thrown forward by the recoil of the going barrel on the breaking of a spring.

A driving mechanism for sewing and other machines has been patented by Mr. Samuel Maxim, of Wayne, Me. There is a driving ring with a face groove, in which the heads of studs held in pivoted plates fitted in recesses of pivoted drive links bite alternately at opposite sides of the drive ring groove on reverse movements of the treadle, to impart continuous rotary motion.

A cheese press or mould has been patented by Mr. Lewis A. Rites, of Chester, N. Y. The invention covers two correspondingly recessed compressing rollers arranged diagonally to each other in the frame, to facilitate the feeding of the curd and the dropping out of the compressed rolls, there being also a hopper of special form in connection with the recessed compressing rollers.

An improved bell has been patented by Mr. Marcus M. Bowers, of Baltimore, Md. The flare of the bell is made with a series of interrupted straight lines, there is a concave form for the head, and a hammer swell within the inside of the shell, whereby the strength of tone is increased and the bell is less liable to break from shrinkage, tension, or strain of the metal in casting.

An apparatus for painting bobbins has been patented by Mr. Luther C. Baldwin, of Manchester, N. H. This invention is in part the same as that covered by a former patent of the same inventor, where the bobbins have a prolonged travel on an endless moving belt, and there is a novel arrangement of belts whereby the bobbins are carried in a small space, so they are guided, steadied, and rotated while being painted.

A safety catch for elevators has been patented by Messrs. August J. Becker and Joseph B. Young, of Mount Carmel, Pa. Combined with an elevator car is a frame held on the same and supported by springs; the suspension rod of the cage is connected by chains with the frame, so that when the hoisting cable breaks, cams or eccentric disks will be pressed against the guide posts and lock the cage or car in place.

An ash sifter has been patented by Mr. Henry C. Pigueron, of Spring Lake, N. J. On opposite sides of the sieve are lugs with apertures through which a square rod is passed, the rods not turning in the lugs, so the sieve cannot tilt; the coals and cinders cannot pack between the rod and the screen, and the sieve can be emptied more readily than those in which the rod is passed through the sides.

A stencil plate has been patented by Mr. Romeo E. Ghezzi, of New York city. The invention covers a stencil plate provided upon its face with raised brush guides on each side of the perforations to restrict the color during each application to a single perforated character or device, the plate having also blank spaces to afford facility, when shifting the plate, to space or line succeeding impressions, or observe previous stencilings.

A firemen's tower has been patented by Mr. Eugene B. Magnus, of South Norwalk, Conn. This invention consists in a certain combination of ladders and means of connecting them, the whole forming a scaling tower for firemen, which may be set on the ground at a distance from a burning building, whereby convenience is afforded for firemen to stand in different positions, the tower being readily put together and taken apart.

A machine for pulverizing clay has been patented by Mr. Marshall P. Phillips, of Lakeland, La. Two opposite sets of rotary saws are operated in a hopper with an intermediate partition having pins, and a cross partition arranged above the saws, the fineness of the product being regulated by the set and shape of the saw teeth, the distance between the saws, the position of the partitions, and the speed at which the saws are run.

A mail bag has been patented by Messrs. Frederick Michael and Robert Williams, Jr., of Eaton, O. In the edge of each side, at the opening, is a longitudinal pocket, for receiving welts on a sliding cover piece, so the sides of the pouch are drawn together and the pouch closed by passing the cover and welts into the pockets, there being a hasp on the sliding cover adapted to be locked in place by a combined lock and tag holder.

A photographic plate holder and case has been patented by Messrs. Sebastian S. Peckinpugh and George J. White, of Big Rapids, Mich. In combination with a plate holder is a plate or strip with an adjusting screw, so the plate can be adjusted to exert a greater or less pressure against the photographic plate, to press the latter firmly against the front of the plate holder, to facilitate their carrying and transference into the plate holder of the camera without exposure to the light.

A gate hanging and operating apparatus has been patented by Mr. John H. Brafford, of Red Oak, O. Combined with a pivotal hinging rod, the gate has upper and lower hinging brackets and an intermediate arm, the rod passing through brackets and arm, and the arm carrying a pulley or roll, a latch rod, and operating cords, the whole making a simple and substantial gate, easily adjustable when it sags, and readily opened and closed without dismounting from a carriage or vehicle.

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Notes & Queries

HINTS TO CORRESPONDENTS.

No attention will be paid to communications unless accompanied with the full name and address of the writer.

Names and addresses of correspondents will not be given to inquirers.

We renew our request that correspondents, in referring to former answers or articles, will be kind enough to name the date of the paper and the page, or the number of the question.

Correspondents whose inquiries do not appear after a reasonable time should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them.

Persons desiring special information which is purely of a personal character, and not of general interest, should remit from $1 to $5, according to the subject, as we cannot be expected to spend time and labor to obtain such information without remuneration.

Any numbers of the SCIENTIFIC AMERICAN SUPPLEMENT referred to in these columns may be had at the office. Price 10 cents each.

Correspondents sending samples of minerals, etc., for examination, should be careful to distinctly mark or label their specimens so as to avoid error in their identification.

(1) A. V. P. asks the style and size of lens and focus, etc., suitable for a camera obscura for outside sketching. A. A plano convex lens of 2 inches diameter, and 2 feet focus, makes a very convenient proportion of picture for sketching. A sharper defined picture may be made by using two 30-inch focus lenses, 2 inches diameter, in a tube flat sides outward or back to back, 4 inches between the lenses.

(2) P. G. asks: 1. Will a windmill lift surface water through a 1½ inch pipe to a tank 40 feet higher than water level, distant 400 feet? A. A windmill will *force* water the distance and height named, the quantity depending upon the power of the mill. 2. Would it do to carry water for drinking purposes through galvanized pipe? A. Galvanized iron pipe is largely used for conveying water, and is not considered very unhealthy if the water is cold and not allowed to stand in the pipe. Cast iron pipe is better, however.

(3) B. K. F. asks what the mode of printing from engraved or stamped music plates is like. A. Music printing is done in the same way as copper plate printing. The plate is covered with ordinary printing ink by a dapper (plate warm enough to handle easily without blistering the hands); rub off the excess of ink with a rag, then rub the palm of the hand with some whiting and lightly rub over the face of the plate. This requires a little dexterity to wipe in different directions, so as to leave the plate surface bright and the ink in the lines. Then place the dampened paper upon the plate and pass under the roller, which should be blanketed. The press is a rolling platen, with a roller 6 or 8 inches diameter over it and rollers or wheels under it.

(4) G. L. G. asks: What is the pressure per square inch on a steam cylinder 1 foot in height, 8 inches in diameter, when Fahrenheit thermometer shows 420°, and will a brass cylinder same dimensions, a quarter of an inch thick, stand the pressure? If not, how thick necessary? A. 296 pounds above atmosphere. Yes, if perfectly sound, but we would recommend that it be not less than three-eighths of an inch thick, and tested to 450 pounds by hydraulic pressure before submitting it to that pressure of steam, viz., 296 pounds.

(5) O. H. T. asks (1) how to prepare green paint which will stand the heat of steam and not scale off and change color, for painting a steam engine. A. Use a chrome green ground in Japan, and put on in several thin coats, and then coat it over with a good body wearing varnish. 2. Please give the dimensions for making a water tank which will hold four barrels of water. A. Make the tank to hold 16¼ cubic feet, or if round, 2½ feet diameter, 4 feet 2 inches high, or 3 feet diameter, 2 feet 10 inches high. If square, 2½ feet square by 2 feet 8 inches high.

(6) S. S. G. writes: 1. Length and size of bore, weight and shape of ball, weight of powder, and all other conditions being the same, which will throw ball the greater distance—a smooth bore or rifled gun? Does not rifling impede the discharge of the ball, and does it do any other good than to insure greater accuracy to the direction of the shot? A. Smooth bore is best for round bullets. The rifling is necessary for long bullets. 2. What horse power is required to sustain 33,000 pounds immovably without other support? A. Horse power is supposed to be a *moving* power, and is not used in sustaining weight immovably.

(7) L. W. McC. writes: We are running an old fashioned pair of slide valve engines, cylinders 11 inches bore, 36 inches stroke, 70 pounds boiler pressure. We have some controversy on several points. We want not so much a maximum of power (that being ample) as to get say 40 to 70 horse power with a minimum of coal. What size steam and exhaust ports ought they to have? What size steam and exhaust pipes? At what point of stroke ought engine to receive steam to insure economical or harmonious working together? Would we get any very perceptible reduction of fuel, by reducing the driving pulley (which is 9½ feet), enlarging the driven (4 feet), and increasing speed (now 64)? If so, at what speed and pressure of steam would we get the highest economy? Would the saving, if any, be attributable exclusively to increased speed and pressure? Or, would the reduction of driver of itself contribute to the result? One engineer says the economy would be the result only of increased piston speed and pressure, while another says the change in pulleys would also help. Is there any efficiency in ammonia fortior in dissolving or loosening scale on boiler plates and tubes? If so, how used and in what quantities? Would the use of crude petroleum prevent scale? If so, how used, and in what quantities, and is it safe? We use a tubular boiler 60 inches by 16 feet, with 90 three inch tubes, fed from spring water strongly impregnated with lime and (supposed) magnesia, which forms scale rapidly and gives us trouble. The water passes through an old boiler, and is heated with exhaust before being pumped into boiler. Can you tell us how to get rid of this scale and prevent it? We have used various compounds, also soda, tanner's liquor, etc., with only partial and varying results. How many feet of grate surface ought the furnace to have? Distance from grate bars to boiler, from grate bar to bottom of ash pit? What size opening or throat at bridge wall and at back end of the boiler? A. You would not materially economize in fuel by altering the ports or changing the steam or exhaust pipes. 3 inch steam and 3½ inch exhaust pipes are ample for each engine—4 inches main steam. Knowing the point of cut-off of the valve would enable you to decide the best running adjustment of the valve. Cutting off at one-third to one-half the stroke for engines without automatic cut-off is fair practice. The automatic cut-off engines are made to vary from one-tenth to one-half, according to the work. There are other points that are of great importance in the condition of an old engine that require looking after, such as cut faces upon the slide valves, loose piston from wear, the sustaining springs giving out and allowing the piston rings to run loose. The leak of steam at these points is very much overlooked in old engines. Cylinders should be rebored when they are found to be out of shape. An engine that has run ten to fifteen years, especially if of the horizontal kind, needs reboring and new rings. Much of your loss in economy is derived from the use of two cylinders instead of one of equal power. We do not recommend change in the relative size of pulleys or speed. The steam pipe should be well felted, and the top of the boiler covered 2 or 3 inches deep with fine light ashes if now exposed. As you say nothing about the kind of fuel used, we are to suppose that you are using bituminous coal, which requires a peculiar method of firing. For this coal the boiler should be 3 feet above the grate. Grate 5 feet by 5 feet, or 25 square feet, if you are only using about 50 horse power. Your boiler is rated 60 effective horse power. Ash pit should be two feet deep from top of grate; area over bridge wall equal to area of tubes. Always keep a good flue brush on hand, and see that it is used often and thoroughly; for bituminous coal, twice a week. In feeding the coal never cover the whole grate at once with fresh coal, but feed at the front and gradually push the coal back, always keeping the bright fire at the back of the grate. This tends to consume the smoke. As you have tried nearly all of the chemical compounds for scale, we can only recommend you to try some of the mechanical boiler cleaners.

(8) W. T.—The vernal colure for 1884 is 28° 15′ 26″ west from the point of correspondence of the signs of the zodiac and the signs of the constellations, the time of which is supposed to have been fixed as a reckoning point 140 years B.C.; the precession of 50·26″×2,024 years giving the above position for this year—28° 15′ 26″. You will find Norton's Astronomy a sufficient guide in any mathematical calculation that you may require. The Nautical Almanac for this year will give you the exact data.

(9) J. H. D. writes: I have been told that the sun has receded in the equinoctial point of the ecliptic until, though the equinox nominally takes place in Aries (that is, the sign), it really happens in the 30th degree of the constellation Aquarius. Is it so? A. The zodiac is divided into 12 equal parts of 30° each; the division commencing at the vernal equinox, which corresponds with the first point of Aries, following from west to east in the order of the signs. The first point of the sign Aries is the beginning of the reckoning for right ascension and longitude. The signs of the zodiac corresponded with the constellations of the *same name* about 140 years B C., at which time the arrangement of the zodiac and the naming of the constellations was supposed to have been established. Since then the equinoctial and solstitial points have retrograded nearly one sign; so that now the vernal equinox, or first point of the sign Aries, is near the beginning of the constellation Pisces. In consequence of the precession of the equinox the *star maps* have to be corrected from time to time, the older maps not representing the true reckoning in right ascension. Thus from precession alone the equinox has receded in 2,024 years 28° 15′ 26″, or 50·26″ per year.

(10) H. B. G. writes: The distance from the mouth of the Cumberland River to Nashville, Tenn., is 200 miles, with a fall of fifty feet, or 3 inches to 1 mile. Width of the Cumberland River is about 175 yards. Now, in case of the Ohio River being very high, will it affect the flow of the water in the Cumberland River at Nashville? A. A large rise in the Ohio at the mouth of the Cumberland would very sensibly affect the flow at Nashville. We do not know the topography of the stream, and cannot be expected to give an intelligent answer upon the mere data of 200 miles with 50 feet fall, or 3 inches to the mile. The depth and volume of water flowing in the Cumberland has much to do with the amount of back water from a rise in the Ohio. It is also necessary to know the amount of rise in the Ohio in order to estimate the rise at Nashville.

(11) T. L. asks: What is zylonite? What is vulcanized fiber? What is the correct name of the flaceous plant known commonly as "corn geranium"? A. Zylonite is fiber of cotton or linen and sometimes wood pulp combined with camphor by the alcoholic process, and pressed into a homogeneous mass, or only another name for celluloid. Vulcanized fiber is fiber changed by a chemical combination through the aid of heat. The word vulcanized was coined in the rubber trade. Ask your florist about "corn geranium."

(12) C. A. C. asks: Who established the first locomotive works for building railway engines, and when? A. We think Geo. Stephenson, in England; probably Ross Winans established first works in this country.

(13) W. W. E. asks (1) the rule to find what quantity of water will flow through a pipe when you have the size of pipe, length of pipe, and fall given. A. The result is affected by the character of the pipe (material) and bends. Rule given in Haswell's Pocket Book, page 385:

$39{\cdot}27\sqrt{\frac{h\,d^5}{l}}$ = volume of discharge in cubic feet per second, in which h = head in feet, d diameter in feet, and l = length in feet, in this case,

$$39{\cdot}27\times\sqrt{\frac{50\times0{\cdot}166^5}{200}}.$$

2. I would like the rule for finding the pressure, friction, velocity, and quantity of water delivered, when you have all the above points to compute by. A. The pressure is, 0·4335 pound per square inch for each foot of head. In Haswell's Pocket Book you find the rules of hydraulics fully treated, also in Trautwine's Engineer's Pocket Book.

(14) F. W. R. asks how to calculate the pressure of water through an iron stand pipe 20 feet high, 2 inches in diameter, water flowing in at the top and discharging at the bottom through an orifice of a quarter of an inch in diameter. Should the pressure be increased or diminished if the stand pipe were reduced to 10 feet high and diameter increased to 4 inches? A. The pressure is determined by the height or head maintained in the stand pipe; the diameter, or flow into or out of, does not affect the pressure. The pressure is 0·4335 pound per square inch for each foot of height or head of water.

(17) V. B. asks: What is used in graining machines to stain poplar lumber in imitation of Spanish cedar? A. Just exactly the composition of the stain used we cannot say, but quite likely a solution such as can be made by boiling ½ pound madder and 2 ounces logwood chips in a gallon of water and brush well over while hot; when dry go over the whole with pearlash solution, 2 drs. to the quart. If not exactly the shade, it can be modified by altering the proportions of the ingredients.

(21) S. G. J. asks: For what is talc used? Is there more than one grade or quality of it? About what price will it bring in market? A. Talc is used extensively in soap making, and also for dressing sheep skins, leather gloves, etc. The domestic talc is used in the manufacture of paper, replacing terra alba for this purpose. A small amount of talc enters into the composition of some lubricating compounds. The talc imported is considered to be of a superior quality as compared with the domestic. The average spot value is about $12.00 per ton.

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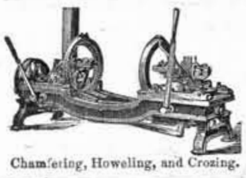

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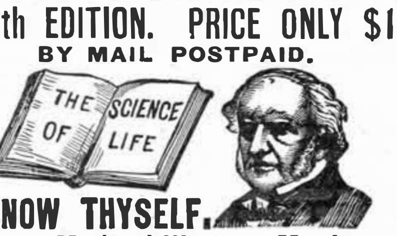

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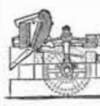

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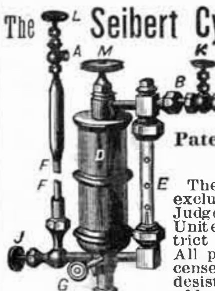

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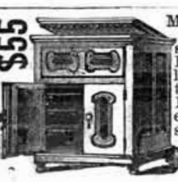

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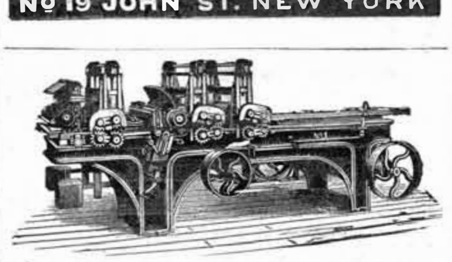

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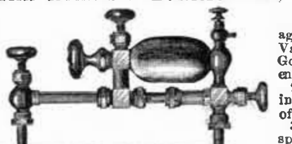

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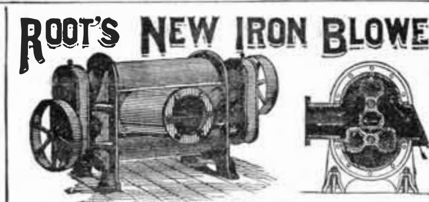

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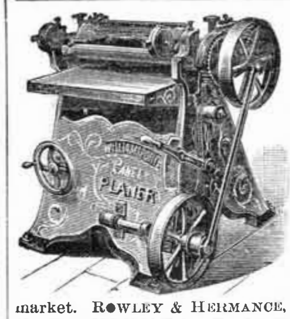

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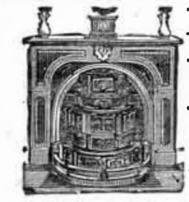

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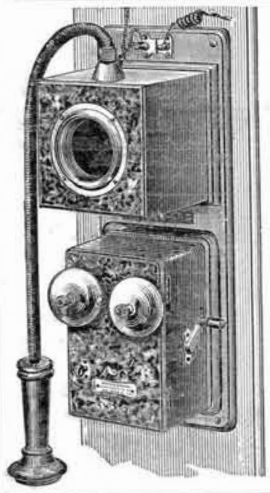

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