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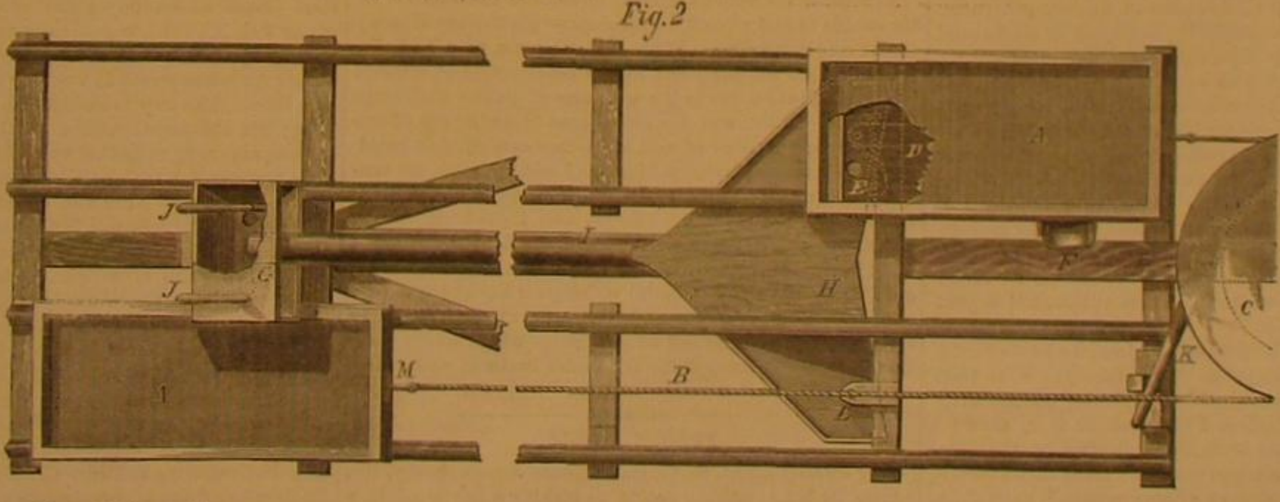
HILL SIDE RAILWAY.

We illustrate in the accompanying engravings a novel form of lowering railway, applicable, as will readily be perceived, to almost any case in which it is required to transport loads down high and precipitous declivities. It consists, briefly, in two self-balancing carriages, provided with reservoirs for the reception of fluid or granulated material (as shot), running upon suitable tracks. Other stationary receptacles are arranged upon the latter so as to supply the carriage reservoirs at suitable times with a quantity of the water or other movable weight, the particular object of which will be explained as we proceed. In Fig. 1, a general perspective view of the entire apparatus is given; in describing the details reference is made to Figs. 2 and 3, which are respectively a representation of the bottom of one of the carriages and a plan view of the tracks and fixed receptacles.

DU BOIS' HILL SIDE OR LOWERING RAILWAY.

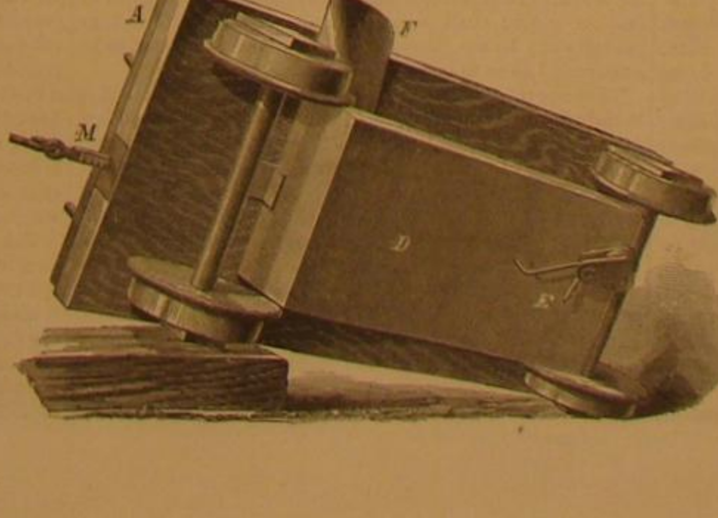
Fig. 2



The cars, A A, are connected together by means of a long rope, B, which passes up and around the grooved wheel, C. The latter corresponds in diameter to the distance between the centers of the tracks, and revolves in a plane parallel to their surface, transversely and longitudinally; in brief, the rope leaves the periphery of the wheel in the same line whatever may be the position of the cars along the length of the rails. The cars, as we have above stated, are self-balancing, that is, the weight of one exactly counterbalances that of the other, and in order to move them it is only necessary that a sufficient force should be exerted to overcome their inertia and the friction of the mechanism. Beneath the platform of each vehicle is arranged a tank, D, Fig. 3, which is provided with an opening and spring valve, at E, and a receiving spout at F. On its lower portion, and between the rails, is a reservoir, G, connecting with a wide receiver, H, by means of a tube, I. The receiver, H, is placed, as shown, near the upper end of the track, and its sides extend out under the rails. The reservoir, G, has in its bottom two spouts and sliding covers or valves, which are actuated by the handles extending above at J.

To understand the operation of the apparatus, let it be supposed that coal, for example, is to be transported from the top of the mountain. The car at the upper end of the track is loaded and started down, its descent being regulated by the brake, K, on the wheel, C. Of course, by the rope, B, the second car is thus drawn upwards. As soon as car No. 1 is at the bottom, car No. 2 reaches the top. Car No. 1 is now unloaded. It is evident, however, that as the coal is removed the weight of car No. 2, which is being filled above, will gradually counterbalance that of car No. 1, and hence begin its downward motion, probably before either filling or emptying is completed. To avoid this, the reservoir, G, is previously filled with water or shot, and one of its bottom spouts, by handle, J, being opened, its contents are allowed to enter the tank beneath the car by the spout, F. This additional weight partially compensates for that of the coal removed, so that the upper car does not overbalance the lower and now empty car until the full load is in a place when there is a slight though sufficient difference in weight in favor of the loaded car, to cause it to start down the decline. Just before the empty carriage, which is of course thus drawn up, reaches the top of the track, an arm on its valve, E, strikes a projection, L, between the rails and underneath the car. The spout which valve, E, when shut, closes is thus thrown open, and consequently the contents of the tank empty into the receiver, H. From the latter the shot or water instantly descend the tube, I, refill the reservoir, G, to be again drawn out, as above described, into the car now at the bottom. The eyes for connecting the rope, B, to the cars, are attached to a rod M passing under the latter, and arranged in connection with a spiral or other spring. By this means the rod being suitably graduated, a balance is formed which indicates the weight of the load upon the car.

Fig. 3



The principle involved in this novel invention is capable of a wide and general application, and from its use a material saving is effected in the cost of handling heavy articles which require to be lowered from one point to another. It may, by suitable modification, be arranged in buildings, the carriages ascending and descending vertically. If fluid be employed in preference to shot, alcohol or other spirits would be substituted in winter to prevent freezing, a proceeding involving very little expense as there is very little waste of the liquid used. In reference to special instances where it is considered that the device may be advantageously employed, the inventor enumerates the following: "In all elevated sand or gravel banks and brickyards; in stone quarries such as are along the Hudson river and Eastern coast; in ice houses, especially such as are situated on Rockland Lake, N. Y.; in cement quarries or mills, as those of the Newark Company, at Ron dout, N. Y.; in coal mines, as exist upon the hills near Pittsburgh; in warehouses on high banks, as are found near Wheeling, Va., and Vicksburgh, Miss., and for moving lumber, as at St. Anthony." It requires but one person to attend to the lowering of the heaviest bodies. The apparatus may also be employed as an elevator, for the ascending platform can be weighted with such articles as it is desired to raise, instead of the usual counterbalancing weight, an advantage which applies to all cases in which the device may be used.

Patented March 18, 1873. For further information address the inventor, Mr. Charles Du Bois, Fishkill-on-the-Hudson, N. Y.

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PATENT PLANING MACHINE LITIGATION.

Among the most memorable litigations that ever took place in this country in connection with patents, were those pertaining to the Woodworth Planing Machine, originally patented by William Woodworth, December 27, 1828, for the term of fourteen years, and twice extended by Congress, for fourteen additional years. The monopoly became so burdensome and oppressive that the legislatures of various States passed resolutions imploring Congress to grant no further extensions, and it finally expired in 1856, after an existence of twenty-eight years.

Woodworth's device was an improvement on Hill's machine, which was defective in that it did not reduce the boards to a uniform thickness. Woodworth arranged the cutting cylinder above the bed; and in connection therewith used yielding pressure rollers to hold the boards in proper position. He thus obtained a new and important result, to wit, the production of planed lumber of uniform thickness. This gave him the almost exclusive monopoly of mechanical planing, from which he or his assignees realized great wealth. Many attempts were made to break down his patent, but they usually failed. A great variety of devices were brought forward, designed to evade the claim of Woodworth to the yielding pressure roller. In some of these the pressure was applied upon the edges of the board by weights; in others by springs upon the face of the board; in others by iron bars resting upon the boards and pressed down by springs. But the courts held that all these devices were infringements, producing substantially the same results as Woodworth's rollers and were therefore not substantial departures from his contrivance.

When the Woodworth monopoly expired, the lumber interests received a great impetus. Manufacturers were freed from the great tax, and the number of planing machines rapidly increased. The dealers little thought that, after the lapse of seventeen years from the expiration of the great original monopoly, an attempt would be made under color of law to saddle another and even greater monopoly upon them. But we are sorry to say that this was the fact.

In 1848 Joseph P. Woodbury applied for a patent for an improvement in planing machines, in which he used a yielding pressure bar instead of Woodworth's yielding pressure roller. Lock Woodworth's roller so that it will not turn, and we have, substantially, Woodbury's pressure bar. Long prior to 1848, the courts had decided that the use of yielding pressure bars were infringements on Woodworth's yielding pressure rollers; and therefore, while Woodbury's patent might have been new and patentable, he could not have used his device, had the patent then been allowed. But the Patent Office decided that there was not sufficient novelty in Woodbury's device to support a patent, and accordingly rejected his claim. The applicant then withdrew his petition, and received back his money. As he could not obtain a patent, everybody who made planing machines had a free right to use his device, and they did so. Woodbury's invention is now to be found employed on almost every planing and molding machine in the land.

In 1870, Woodbury renewed his application for a patent, but was again rejected. The Patent Office decided that its former decisions were correct. In January, 1873, the applicant again renewed his petition, and again the Patent Office decided to sustain its previous decisions and rejected the case. On the 29th of April, 1873, the Patent Office again revived the matter, and decided that all its previous decisions were good for nothing, unreliable, and consisted of a tissue of blunders. So the patent was allowed, and the Woodbury party now flaunt the document in the faces of the lumber planers and molders, demanding payment of a heavy royalty under threat of instant stoppage of their mills.

The lumber merchants and manufacturers throughout the country, are naturally alarmed and indignant to find themselves overwhelmed, as it were, by this decision of a floundering Patent Office, by which a merciless grab is now attempted upon their earnings, and they have combined for a common defense by legal means. They believe the patent to have been wrongfully granted, and will fight it in the courts to the bitter end. The union comprises all of the most enterprising lumber manufacturers in the country, and they are preparing for their defense in the most systematic style. The most prominent legal talent has been employed. The stakes on both sides are immense.

The dealers have agreed, in case Woodbury's claims are sustained by the courts, that they will remove his device from their machines and substitute another, unless he modifies his demand, which is one cent royalty on every hundred feet of lumber or molding of any sort, and which, if paid by all dealers will, it is estimated, amount to the sum of one million dollars per annum. Whether Woodbury's claims will be sustained in the courts is of course uncertain. Some new judicial view of such cases may be announced, or evidence adduced that will nullify the patent. But otherwise, we should expect that the patent would be sustained, because in other cases, heretofore published by us, the courts have, under similiar circumstances, invariably sustained the patentee. It may be justly alleged in his behalf that, if he were really the original and first discoverer of this device, the Patent Office committed a serious error in depriving him, for so many weary years, of the rightful fruits of his invention. That the device is one of great public importance, and therefore worthy of a patent, is proven by the remarkable fact that it is used on about every planing machine in the world.

While this is true, it is nevertheless equally certain that the tax which the patentee requires, and which he may at any time increase, will be for many years to come a grievous burden upon the public.

THE PANIC OVER.

The temporary nature of the financial crisis is proved by the fact that, during the short period intervening since our last issue, the excitement has nearly all subsided, and a better feeling of confidence is rapidly becoming restored in monetary circles. Although, as we have already observed, it seems hardly possible for the usual fall business transactions not to feel in some degree the after effects of so close a stringency of the money market, still we do not consider that any serious or extended injury to trade resulting therefrom need be at all apprehended. An example of its merely passing interference is well illustrated in the case of one of the oldest and largest dry goods firms in this city, which, although suspending one day, were enabled to resume payments on the next.

As regards the manufacturing interests of the country, we are unable to find ground for the sinister predictions of many of our contemporaries. With the exception of a probable check to rapid advancement in the construction of some of the new railroads, due to the weakness of public confidence in their securities, and the consequent throwing out of employment of a number of men heretofore employed in building or in manufacturing rolling stock and supplies, we cannot perceive any diminution in the prosecution of our great industries. Factories, founderies, and indeed all similar establishments, so far as we can learn, are flourishing, and a brisk business seems to be the general rule. Moderation, good management, and hopeful waiting for the storm to pass over have been the means of averting or, at most, confining to a few the evil results of a disaster which might have made itself felt throughout the entire business community of the country.

PUDDLE WALLS.

Our correspondent, S. W. G., of Elsah, Jersey county, Ill., writes for information relative to making a fish pond in a valley by constructing a dam across from one side to the other. The essential idea in a dam is its capacity for holding water. To this end it must be of sufficient substance, so that its weight shall secure it from being overturned or pushed away by the pressure of the water. It must also be constructed so as to be watertight.

To secure this last requirement the most effective method is to include within the dam a puddle wall. The correct method of puddling, so simple in itself, is not always practiced. The popular ideas in regard to this important part of the work are erroneous. By many persons it is supposed that the best material for the purpose is clay. This is an error. Pure clay is, in some respects, the worst. Again, it is supposed that the work must be compacted by a rammer. Ramming is not effective in compacting it. There are still other erroneous notions entertained on the subject, but we will perhaps best expose the objectionable methods by simply stating the correct one. If the puddle is to extend across a valley, commence by removing from the surface, where the wall is to stand, all rubbish, brush, grass, roots and other perishable material, as well as all surface soil down to the solid natural gravel or ground. In doing this, excavate a trench equal in width to the thickness of the wall. Make the bottom of the trench level across the bottom of the valley, and extend it into and up each side hill in level benches or steps, so that at all points the wall shall have under it a level surface to stand upon.

Next, the material. This should be a gravelly loam, taken from a bank where alternate layers of gravel and loam, or clay, are found. Screen from it by a rake all stones larger than an egg. Spread it to an even depth of four inches in the lowest trench. Sprinkle water over the whole surface by a hose or buckets until the material is soaking wet, when another layer of dry material four inches deep is to be spread over the first one. A convenient method of regulating the depth is by setting up at frequent intervals stakes projecting eight inches above the bottom of the trench with notches cut four inches from the top. In placing the first layer, the workman is guided by the notches. The second layer is to be carefully graded to the top of the stakes. Now place a plank, equal in length to the width of the trench, across it near one end. Standing at one end of this plank with a shovel, hold it upright, the back from you. In this position push the shovel to the bottom of the trench by aid of the foot on top of the blade, and then push the handle horizontally from you with force. Withdrawing the shovel, move along the plank the width of the shovel; and placing its point in a line with the position it before held, again press it to the bottom of the trench and horizontally from you. Continue this operation until you have moved along the entire length of the plank. In doing this, you have formed a wedge-shaped opening across the trench. In returning along the plank, slice off, in the same manner, about an inch in thickness from the edge of the opening nearest you, pushing it compactly upon the material previously packed. Continue this process, cutting slice after slice, until the edge of the plank is reached. Turning the plank over gives room for more work. Follow this operation until the whole of the material is cut and compacted. In making these cuttings, the water which was put upon the lower layer of four inches is squeezed up through the whole of the upper layer, and the whole thickness of material is rendered of the consistency of putty. The next morning the puddle will be found sufficiently hard to walk upon freely. Then repeat the entire process of spreading the two separate layers of four inches each, watering the first layer and cutting and compacting as before. By this method, double layer upon double layer is to be laid until the top of the wall is reached. Some parts of the operation may appear unimportant and thus be neglected, but many who have so thought and acted have found to their sorrow, after the completion of the work, the necessity of adhering strictly to what experience has shown, in some of our largest engineering works, to be the true method of making puddle walls.

The thickness of a wall should be in proportion to its hight and length. For small ponds, a wall four feet broad at top and gradually widened downwards at a rate of one and one half inches per foot of hight on each side, or three inches on both sides, will be of ample strength. The puddle wall must be covered from the air on all sides by the filling and stone work used to form the dam.

THE FIRELESS LOCOMOTIVE.

The locomotive engine, run by steam generated from hot water forced into it from a stationary boiler previous to the start (described on pages 290 of our Vol. XXV. and 118 of our Vol. XXVII.), is gradually fulfilling the anticipations of its projectors, and promises to lead us to a practical substitute for horse power in working city railroads and suburban lines. The improvements, however, leave much to be done; but the imperfections of the present machine are such as are easily remedied by a skillful constructor.

On October 3, a trial of a fireless locomotive took place between East New York and Canarsie. The dimensions of the engine are as follows: Boiler, 10 feet long by 46 inches diameter; two cylinders, 8 inches diameter by 12 inches stroke; two pairs of wheels, 30 inches diameter, coupled; ordinary slide valves, working without expansion, the engine being provided with double eccentrics and links for reversing. The exhaust is blown into two condensers, one for each engine, fitted with 36 five eighth inch tubes for promoting condensation, and air pumps for creating partial vacuum. For the engine, such as it was, apologies were made by Mr. G. L. Laughland, the President of the Fireless Engine Company, and Mr. C. H. Haswell, the Consulting Engineer, and due allowance was made by the visitors for its many obvious imperfections. Its performances were as follows: It left East New York at 2.52 P.M., with the steam gage at 180 pounds, and ran the 3¾ miles to Canarsie (down grades) in 12m. 45s. At the end of the trip, the gage showed 108 pounds. During a 9 minutes stoppage, it fell to 104 pounds, and the run back (up grades), in 17 minutes, reduced it to 45 pounds. No fire was used on the locomotive, the entire trip having been made by the steam rising from the hot water with which the locomotive was charged at the start. It drew one car with 120 passengers. The net weight of the engine was 4 tuns 3 cwt.; the car itself was estimated to weigh 7¼ tuns empty, and with its load 12¼ tuns.

The experiment was a successful demonstration of the possibility of running a locomotive by the proposed means; but the poor construction of this particular machine renders it necessary to defer any calculations as to the economy of the device. We understand from Mr. Schieffler, of the Grant Locomotive Works, Paterson, N. J., that an engine to be worked on this plan is to be designed and constructed at that establishment.

THE ART OF INVENTING.

Many persons suppose that the capability of inventing is wholly a natural gift, but such is not the case. It is just as much an acquired art as any other profession. In order to insure success as an inventor, it is necessary for the student to go through a school of inventive studies and to confine his productions to a particular class. If a mechanical inventor he must understand mechanical movements and powers, as well as metals and timber and how to work them. He must study the relation between causes and results, he must acquire a knowledge of drafting, and must learn what has been accomplished in his particular line.

It is true that some wonderful inventions have been made by persons entirely unacquainted with the particular branch in which they were working, but such instances are rare. The more extended the knowledge which the artisan possesses, the more likely is he to make a valuable improvement. But constant and unceasing study is entirely unnecessary; in fact it tires out the mind, which, like the fatigued body, must have rest before it can successfully pursue its laborious journey. If, therefore, the mind becomes weary and confused, it is better to drop the subject for a time and take it up again.

Nearly twenty years ago, in the city of Boston, a friend of ours, still living, invited us to accompany him to see a model of an invention. We went with him, and a very enthusiastic young man showed us a beautifully made model, mostly of finished brass, of a ship with a revolving mast geared into the paddle wheels in order to propel his ship against the wind. He said that he took the idea from a feed mill, run by wind, near Charlestown bridge. "But," said our friend, "that feed mill is on *terra firma;* but where will your ship be going when afloat? With the wind blowing against the revolving sails, you will have to cast anchor in order to keep it from blowing backwards." He had never studied cause and effect; and he told us that he had spent six months and nearly $2,000 in trying to accomplish an impossibility. Years of precious time and thousands of dollars are annually lost in a similar manner. Many hundreds of men have labored at models and expected to make fortunes by running an overshot or breast wheel in a dead pond by causing it to pump up its own water, and by similar impossibilities.

The educated inventor will never run into such wild cat schemes. But as he becomes more and more acquainted with the arts and sciences, he will find that every step forward must be directed to a practical result; and at last, when his life's work is done, he will see that all he has gathered will be only a drop from the ocean of Science, which lies still spread before mankind for other minds than his to continue to explore.

MANUFACTURE OF ARTIFICIAL BUTTER IN NEW YORK.

We have had occasion in former numbers of our paper to describe the new processes of making butter from substances other than milk. It is to France that we are indebted for the practical inauguration of this new industry, which has now been transplanted to this country and is in full operation in this city. We devote a considerable space in the present number to the illustration of the devices and method of working, as practiced here, in which our readers, we have no doubt, will be much interested. Similar factories will be established in other cities and the manufacture promises to become extensive.

SCIENTIFIC AND PRACTICAL INFORMATION.

CARBOLIC ACID.

Carbolic acid is now so generally employed as a disinfecting agent that a *resumé* of the various forms in which it is made, in the largest establishment carrying on its manufacture in England (Calvert's), may prove of interest. 1. Solid carbolic acid of three different qualities, the point of solidification of which varies from 81° to 108° Fah. 2. Liquid acid of two different qualities, constituted almost entirely of cresylic acid. According to Mr. Calvert, the disinfecting properties of the latter substance are the same as those of carbolic acid. 3. Soaps in which the proportion of carbolic acid varies from 5 to 20 per cent, according to the uses to which they are to be applied. 4. Disinfecting powder, composed of silex and 15 per cent cresylic acid. The silex is obtained from alum factories, where kaolin is treated with sulphuric acid. The disinfecting acids become thoroughly incorporated with it, forming a dry and pulverulent substance.

THE PASSAGE OF GASES THROUGH VEGETABLE COLLOIDAL MEMBRANE.

The experiments of M. Barthélemy lead to the conclusion that the natural colloidal surfaces of vegetables have, for carbonic acid, an admissive power which is from thirteen to fifteen times more considerable than that for nitrogen, and from six to seven times greater than that for oxygen. These experiments, proving the dialysis of carbonic acid through the cuticle of leaves, are of the same nature as the investigations of Dutrochet on membranes and aqueous solutions to determine the endosmose by the cellules. In a word, cuticular respiration appears sufficiently proved by the presence of this membrane on all the organs.

THE FAIR OF THE AMERICAN INSTITUTE.

There have been some alterations in the awards to be given by the American Institute during the present exhibition which, it seems, will enable the judges to discriminate more closely as to the relative merits of articles entered for competition. Last year, the grand medal, a distinction requiring originality and an extraordinary degree of excellence and utility in the invention for which it might be given, and the medal of special award, for the best of a class, general excellence, etc., constituted the list; now, however, another medal has been added, so that the three, respectively of gold, silver, and bronze, with of course the inferior honor of a favorable report, will render the task of thus signifying the value of a device one of much greater simplicity. It is frequently the case that committees feel that an article deserves distinction and yet not so high an honor as another device of far greater utility, while neither may merit the highest award; and similarly, when there are several inventions all of one class and yet each possessing important peculiarities, it is equally difficult, with but a single award to bestow, to determine to which exhibitor it justly belongs. In such instances, the matter is usually compromised by recommending the granting of the same distinction to a number, with the obvious result of causing general dissatisfaction on the part of those who consider their devices merit some special honor, and engendering the ill feeling and dissensions caused by each individual claiming to have received the highest award. Another medal, though it may not entirely obviate this trouble, will perhaps render it an easier matter to stamp at once the best of a class, and yet grant to others of the same category a fair distinction, thus at least raising the standard and enhancing the value of the premiums.

Since our last visit, we note many additions to the display, but, with that tardiness which now seems to be the rule, many intending exhibitors have not yet appeared or, having entered, have not got their articles in proper shape. The fair has now been open nearly a month, and it seems to us high time that its contents should be finally arranged.

The collection of

MACHINISTS' TOOLS

presents some specimens of excellent workmanship and several novel improvements worthy of mention. Among others, we notice a planer from Messrs. Hewes & Phillips, which has a worm wheel outside of the table connecting with the latter by a rack and pinion. A lathe by the same firm has a novel arrangement of back gearing which renders its construction of much more compact form. Van Haagen & Co., exhibit a friction planer which operates excellently and without any perceptible noise. Underneath the table and in the direction of its length is arranged a rack with teeth running longitudinally; into this mesh the projections on a friction wheel of the usual form, somewhat similar to the variety employed on ordinary friction hoisters. Connecting with the pinion is a shaft communicating with bevel friction gearing and a clutch outside, by means of which the motion of the table is changed. It might be supposed at first sight that the gearing under the table would slip under a heavy strain, but it seems that such is by no means the case. A rotary shaper, displayed by the above firm merits mention as a new machine capable of a large number of uses particularly in boring, planing, and keyway cutting, etc. An attachment to this, and in fact to any machine having either revolving or stationary spindles, is a new expansion boring tool, which consists of a slotted hub in which is screwed a shank for attachment to the spindle, and in the cavity in which is pivoted the end of an arm. The inner extremity of the latter is a worm wheel, the worm acting in which passes through the hub and is turned from outside. When the worm rotates, the arm is set to any desired angle, and there are arrangements for firmly holding it in place. Its outer extremity carries the boring tool.

There are several

ROCK DRILLS

on exhibition, but the Ingersoll is, just at present, the only one in actual operation. This machine has a novel improvement for holding the drill bar, which forms an automatic connection. Three tapered gibs, half round so as to fit the bar, are arranged to fit over and enclose its upper end. The collar drops over the gibs, thus wedging them against the bar firmly, grasping and retaining the same and allowing work to immediately commence at the next down stroke.

STONE PULVERIZING

is an operation of some interest carried on by the Zetetic Pulverizer. This machine consists of a stout winged wheel revolving at high speed in a heavy vertical circular box. Stone in moderate sized lumps is fed in through a hopper, and by centrifugal force dashed around within the box, emerging into an enclosed room in a state of almost impalpable dust.

White, Clark & Co. exhibit a means of elevating water to any hight by a combination of their centrifugal pumps. Two small machines are used, one mounted horizontally on a vertical tube, and another similarly arranged at a distance above the former on a prolongation of the same pipe. The shaft passes straight down through the latter. The lower pump draws water through the lower part of the tube, and its discharge is led by a bent pipe to the upper portion, to be acted upon by the pump above. The two portions of the pipe are separated by a stuffing box, through which the shaft passes. Burden's

VACUUM PUMP

is exhibited in several different sizes, and from its odd form and appearance attracts considerable attention. Each machine consists of a number of iron vessels in the shape of bell glasses, a description of one of which will answer for all. The mouth of the receptacle, which is placed in a trough, is closed by a grating, above which is a large valve lifting inwards. Steam enters from above, on the valve being lifted, and filling the vessel condenses, thus drawing in first a small stream of water from a valve about midway up the side, which promotes further condensation. The vacuum formed finally lifts the large lower valve, and the vessel fills completely. Then two other escape valves, opening outward near the bottom, open, and the water is accelerated in the discharge by the steam entering as before.

Ryder's grate bar is an invention of novelty, and consists in every alternate bar of the grate being made corrugated on top, and movable, in a longitudinal direction, by means of mechanism connecting with a handle outside. It is claimed that the fires can be thus kept clean with great facility and little trouble. The device, we understand, is to be practically tested under one of the boilers.

A novel feeding mechanism for sewing machines is exhibited in the main hall, by means of which almost any kind of ornamental stitching used for belts, harness, shoes, etc., can be admirably made. As displayed, it is simply a cam attached to the shaft of the feed wheel, so that the latter is carried sidewise at various times so as to produce a certain pattern by moving the cloth under the needle. A different cam is required for each variety of stitch. Near this machine is an

APPARATUS FOR SEWING ON BUTTONS,

which, if it could only be arranged for every purpose, would be an inestimable boon to the unmarried male population of the country. The present device is adapted for shoe buttons—small round affairs with projecting eyes—and uses the ordinary button just as it is supplied to the trade. The thread leads under the work, and the needle comes down through the eyes of the buttons, which slide down one at a time from a small inclined trough. A barb at the end of the needle catches the thread, carries it up through the leather, and makes any number of chain stitches, changing from eye to outside. As soon as the button is firmly fastened, a loop of the thread, which projects through on the upper side of the leather, is slipped over it. The next button can be secured at any distance from the first, the thread leading along the under side of the material.

R. M. Hoe & Co. exhibit a remarkably fine assortment of saws, besides knives for cutting rubber and cork. The Meriden Britannia Company also deserve a word of praise for an exceptionally good display of silver ware in novel and beautiful designs.

Sir Edwin Landseer.

Sir Edwin Landseer, the celebrated English painter, is dead. It is hardly necessary for us to particularize the works which have rendered his name famous, as no modern paintings are more generally familiar. As a delineator of animal life, Landseer had no superior; and although critics complain that he marred the effect of his pictures by semi-humanizing his brutes, still it may with truth be asserted that such an appeal to a popular taste served in the main to highten the admiration of the world for his efforts, even while a more austere judgment condemned and lamented it as mere vagary of humor.

Springing from a family of artists, Landseer began his labors at a very early age, and exhibited his pictures in public when he had reached but fourteen years. Of late, however, his powers became impaired, and for many years past nothing has left his easel worthy of the great reputation which he had achieved. As a sculptor, a branch of art in which he was induced to try his skill almost by popular acclamation, he produced but one important work, namely, the couchant lions on the Nelson monument, in Trafalgar Square, London, which, however, it is generally admitted, afford no particular evidence of his genius or ability.

His chief forte lay in the representation of horses, dogs and game, of all of which he was unaffectedly fond, and painted with a wonderful fidelity to nature. Most of his works have been engraved, and copies are sold in most of our picture stores. Landseer was born in 1802 and was knighted in recognition of his merits in 1850.

Joseph L. Hewes.

We notice, with much regret, the death of Mr. Joseph L. Hewes, a prominent manufacturer and inventor, resident in Newark, N. J. Left an orphan at fifteen, Mr. Hewes was taken under the guardianship of Seth Boyden, who, after giving him the benefit of an excellent education, entered him as an apprentice in his shops. From this period the subject of our sketch evinced great aptitude for invention, as well as no small mechanical skill, and, after several years of labor for others, in 1846 started in the business of manufacturing machinists' tools and engines in York. At the beginning of the war, Mr. Hewes rendered very valuable assistance in improving and remodeling arms, and it is stated that, through his timely aid, the first eight thousand of New Jersey volunteers were at once equipped for service. He had seven new inventions put in operation last year, and it is believed that the strain upon his energies in making some new machinery at the Industrial Exposition produced his fatal illness.

A JUST AWARD.—The self-acting lubricating devices of Messrs. Nathan & Dreyfus, of No. 108 Liberty street in this city, are, we notice, among the exhibits from the United States to which the highest prize, under the rules of competition, was awarded at the Vienna Exposition. This is a well merited recognition of valuable inventions which have excellently withstood the test of experience.

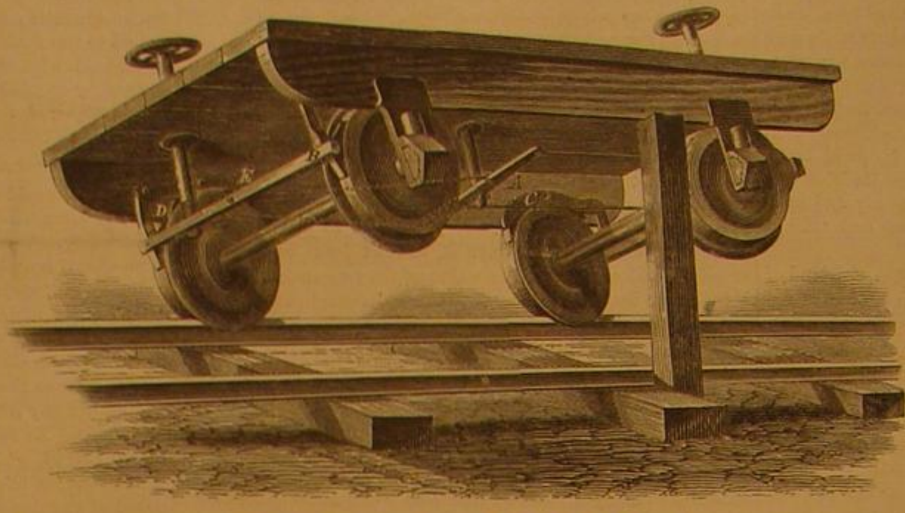
PROGRESS OF THE HOOSAC TUNNEL DURING SEPTEMBER, 1873.—Headings advanced westward, 184 feet; eastward, 132. Total during month, 316 feet. Whole length opened, westward, 14,577 feet; eastward, 9,902 feet. Aggregate opened to October 1, 24,479 feet. Length remaining to be opened, 552 feet. The whole length of the tunnel, is 25,031 feet.

IMPROVED CAR BRAKE.

The invention herewith illustrated consists of a brake so constructed and attached to a railway car as to exert a much greater pressure upon the wheel than is ordinarily obtained. This result is claimed to be effected by a system of levers and auxiliary brakes, causing the rotary motion of the wheel itself to contribute to the pressure upon its periphery.

The shafts of the brake wheels are connected by suitable means with a pivoted lever arranged under the car at A, and the latter, in turn, communicates with the brakes, B. These are arranged on an arm which is pivoted to a horizontal lever, C, which is also pivoted at its center to the framework of the platform, and carries two brakes, D and E. If the car wheels revolve from right to left, their peripheries, acting upon brakes, B, pressed closely against them, tend to draw such brakes downward, thereby tilting the lever, C, and causing one of the pieces thereon, in this case D, to bind firmly against the wheels. If, however, the latter turn in the opposite direction, the brakes, B, are somewhat lifted, depressing the lever, C, so as to cause the piece, E, to act as an auxiliary brake. It is claimed that, by this means, the power of the brake is doubled; and in cases where steam is employed, it will give the same power with one half the strain upon the braking apparatus.

For further particulars address the inventor, Mr. George W. Crowe, 125 West 5th street, Cincinnati, Ohio.



CROWE'S IMPROVED CAR BRAKE.

IMPROVED ANIMAL TRAP.

The invention illustrated herewith is a device for catching and destroying mice, rats, squirrels, and other small animals.

The trap is actuated by clockwork, and once wound up is self-setting. When sprung, a sharp toothed bar is rapidly rotated, striking the animal, killing it, and throwing it out of the box.

The case is made with an opening of a size proportionate to the hight of the animal to be trapped. The vertical shaft, A, is connected with a coiled spring and toothed wheel, part of the latter being shown at B. When the shaft is turned by the key, it coils up the spring without revolving wheel B: but when the spring is allowed to unwind, the said wheel is rapidly rotated. This motion by the cog teeth is transmitted to a similar wheel, C, the shaft of which extends above the case and terminates in a notched disk, D. Just beneath the wheel, C, and at E, is the toothed bar for destroying the animal.

F is a horizontal shaft, having at its forward end an upwardly projecting arm, G, which is caught and held perpendicular by the spring catch, H. At the middle of the same shaft is an arm, I, which passes down through a slot in the case, in such a position that a stop on the wheel, C, may take against it, and the motion of mechanism be thus arrested. At the inner end of shaft, F, is a cam or arm, J, which is so arranged in connection with a projection, K (dotted lines), on the wheel, that said projection strikes it, thus turning the shaft, F, thereby raising the arm, G, so as to be again caught by the spring, H, and also lowering the arm, I, so that the wheel may be arrested, as already explained.

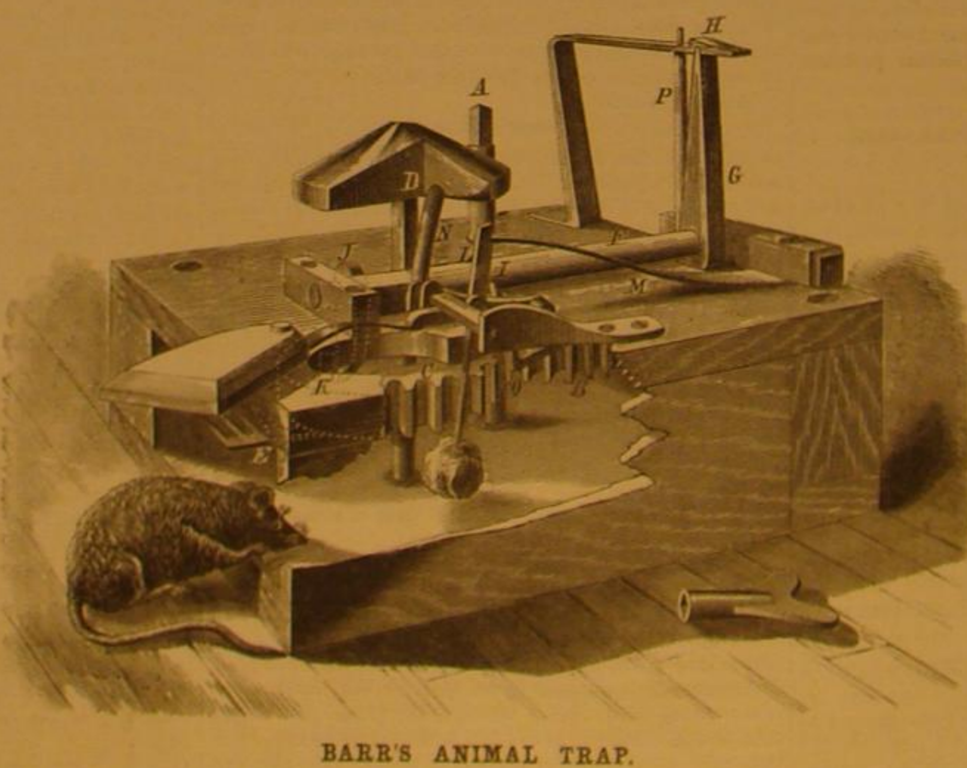
The shank of the bait hook, which is so placed that the animal cannot pass through the case without coming within the sweep of bar, E, passes up through a slot and connects with a flattened rock shaft which rests, as shown, upon the horizontal arm of the bent lever, L, the latter being pivoted at its angle to the top of the case. The vertical arm of the lever has a notch into which is caught the extremity of a spring, M, when the trap is set. Beneath the end of this spring is a bent lever, N, also pivoted at its angle, and having a vertical arm, to accommodate which the notch is made in the disk, D. There is still another bent lever, O, only a part of which is seen, as it extends under the top of the case. This has a projection directly under the end of the spring, M, and connects with the perpendicular rod, P, so that when pushed down by the spring, M, it raises the catch, H, clear of the arm, G, and allows the shaft, K, to turn.

The illustration represents the trap as set. When the bait hook is agitated it turns the rock shaft so that the edge bears down the horizontal part of the lever, L, clearing the spring, M, from the notch. The spring, of course, comes down with some force on the projecting upper end of the lever, O, thereby, as above described, releasing the arm, G, of the shaft, F. This releases the wheel, C, allowing it to be rotated by the wheel, B, acted upon by the coiled spring. By this means the toothed bar, M, is revolved with considerable force, killing the animal and tossing it clear of the box.

The disk, D, of course revolving with the wheel, C, the side of its notch strikes against the vertical arm of the lever, N, thereby raising the other arm, now directly under the spring, M, so as to elevate the end of the latter once more into the notch on the lever, L, and, at the same time, allows the lever, O, to be withdrawn from the catch, H, by a small spring. As the wheel, C, revolves the projection, K, strikes the cam, J, which throws the arm, G, into the catch, H, and lowers the arm, I, to catch and stop the wheel. At the same time the outer end of the lever, N, rises into the notch on disk, D, and its inner end drops away from the spring, M, so that the trap is thus reset.

The device is quite ingenious and very sudden in operation. We should imagine that it would speedily clear a cellar or other infested locality of troublesome vermin.

Patented through the Scientific American Patent Agency, November 12, 1872. For further particulars regarding sale of rights, etc., address the inventor, Mr. George Barr, Clatskanie, Columbia county, Oregon.



BARR'S ANIMAL TRAP.

Action of Platinum and Palladium on the Hydrocarbons.

The recent experiments of M. Coquillon on the above subject take as a point of departure the fact that a platinum wire, rolled in spiral form and heated to redness, remains incandescent in presence of vapors of alcohol or ether, and forms different products of which the principal are aldehyde and acetic acid. All mono atomic alcohols, as well as their ethers, act in analogous manner, and produce, in this incomplete combustion, aldehyde and the acid corresponding to the alcohol; while all the hydrocarbons, volatile oils, aniline etc., participate in this property and maintain the incandescence of the platinum spiral. The fixed oils and sulphureted essences, such as the essence of garlic or mustard, are without this effect.

Palladium has this property of remaining incandescent in hydrocarbureted vapors in even a greater degree than platinum; and with toluol, it similarly produces hydride of benzoyl. When it is plunged in an incandescent state into proto-carbureted hydrogen, it continues in the same condition without requiring to be brought to redness by the battery. With bicarbureted hydrogen, while the platinum wire gives frequent explosions, palladium causes none. It extinguishes itself when the gaseous mixture is no longer suitable. Another curious peculiarity is that its surface becomes rough and wrinkled, and the spirals break, after a few days' experimenting. The weight is also sensibly diminished.

Chloride of Iron Obtained by Dialysis.

It is now many years since the late Professor Graham discovered that when a solution contained both crystalizable and uncrystalizable, or colloid, substances, the former would pass much more rapidly through an animal membrane that the latter. For performing this experiment, a hoop of hard rubber has a piece of parchment paper stretched over it, and the apparatus, which resembles a sieve, is allowed to float upon the surface of water. The mixed solution is poured into the apparatus, and in a few days the greater part of the crystalizable body will be found in the water, while the uncrystalizable one will remain on the membrane. Professor Graham gave to this process of separation the name of "dialysis," and to the apparatus that of "dialyzer," which names have been generally adopted in all languages.

Since the discovery of dialysis, it has found many uses. It has been used with great advantage in analytical chemistry, for separating crystaloid and colloid bodies, especially organic ones. Its greatest value has been in analyzing the contents of the stomach, when it is desired to show that poison has been taken. The presence of a poison in the slimy contents of the stomach would otherwise be difficult to prove. Recently it has, also, been employed in the arts, and Dr. Reimann describes in his *Färberzeitung* its use in the dye house for preparing iron salts: From mixed solutions of salts and gum, the salts can be separated while the gum remains behind. But not only so; when a salt alone is placed in the dialyzer, the crystalizable portion of the salt, which is usually the acid, passes through the membrane first, the base remaining on the dialyzer. Now there are a series of salts which require a proportionally large quantity of acid to keep them in solution. Notable among these are the sesquioxides, especially that of iron. The very acid salt of iron is extensively employed in dyeing silk as an iron mordant for heavy black. An iron mordant which is very acid and which generally contains an excess of nitric acid, as well as some nitrous acid, acts destructively upon the fiber, so that very heavily weighted black silk loses a greater part of its strength, and sometimes can be pulled apart. To avoid this disadvantage, the iron may be used in the form of dialyzed oxide of iron. In preparing such a solution, oxide of iron dissolved in muriatic acid (perchloride of iron) is placed in a dialyzer. After some time it will be found that the acid is mostly gone off, while a solution of the oxide of iron remains in the dialyser. Such a solution gives up its oxide of iron very readily to the immersed fiber, which is thoroughly mordanted, while it cannot be attacked, since there is no acid, at least no excess of it, present. Such a solution is far more active than the ordinary iron mordant, because the iron in it has a great tendency to deposit itself upon the fiber, while that in the acid mordant, being held by the acid, shows less of this tendency. It seems, too, from what has been learned, that the mordanting of fibers in a solution of salt is really a phenomenon of dialysis. The fibers may be regarded as a conglomerate of membranes, and hence it is natural that the silk, for instance, should take out the iron from a solution of its salt, and allow the acid to disseminate itself through the bath. This tendency of the fiber to take up the iron is assisted by previous dialysis of the solution.

For technical purposes, especially for weighting silk, it is necessary to take away all the acid from the oxide solution. Here it is sufficient to obtain a solution containing but little acid and an excess of oxide of iron.

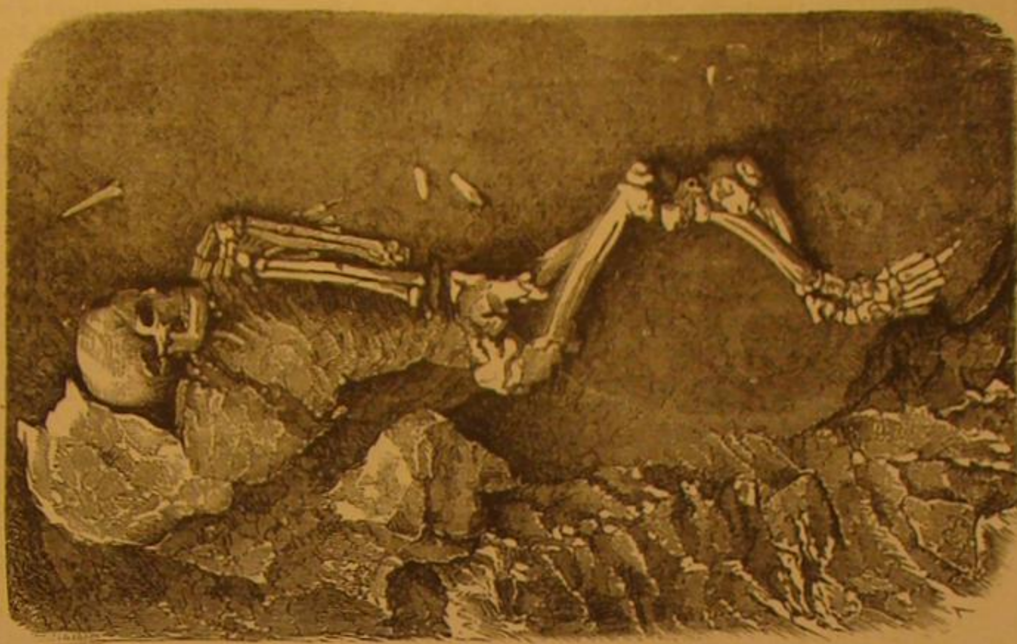
Fr. Oltmanns, an apothecary in Hanover, has for years prepared dialyzed oxide of iron for medical purposes, and recently has also made it for use in dyeing. The dialyzed oxide of iron made by him contains 6 to 7 per cent of pure sesquioxide of iron in solution; a quantity which, because of the ease with which it acts on the fiber, is more than sufficient for most purposes. For weighting silk, and for many similar purposes in the dye house, especially for all cases where it is desirable to load the fiber heavily with the oxide of iron in mordanting, without attacking it, dialysed iron is invaluable.

THE building of dikes at the mouth of the Seine has been the means of causing high water to appear at Havre 36 minutes sooner during the spring and 14 minutes during the neap tides.

THE FOSSIL MAN OF MENTONE.

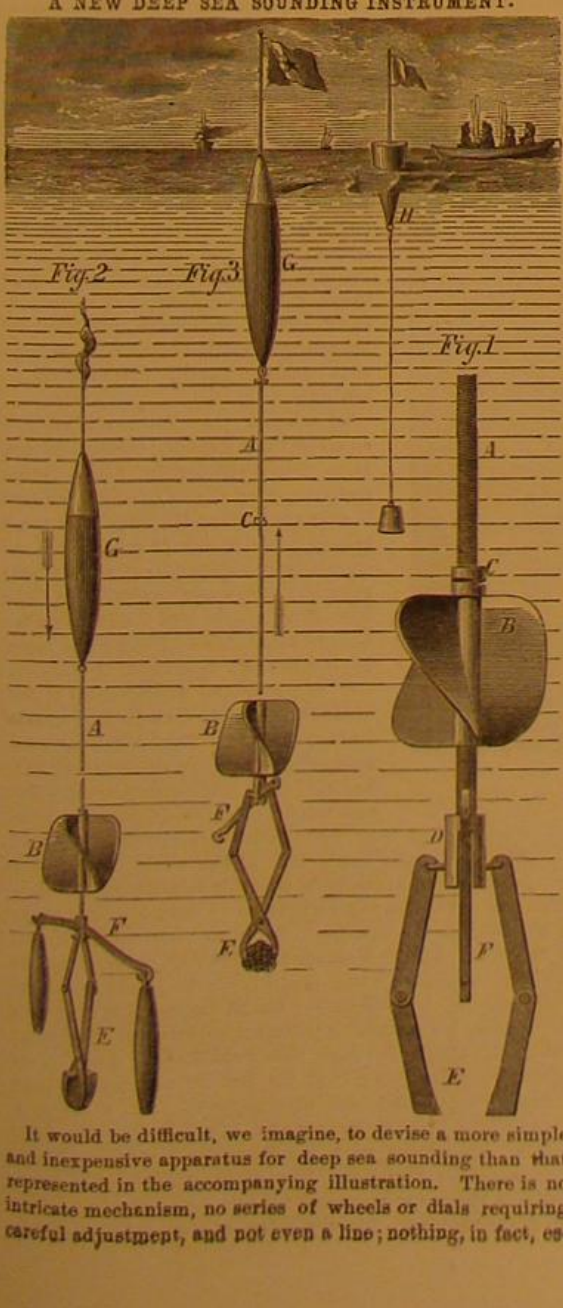
The discovery of a human skeleton in one of the grottoes of Mentone, a village on the south coast of France, near Nice, has produced for some time past no small excitement in the scientific world. The cave in which it reposed is hollowed in the garumnian limestone immediately below the nummulitic tertiary deposit so well developed in the vicinity. Some large imbedded rocks, probably post-eocene, gave rise to the natural excavation.

It appears, from the recent investigations of M. Rivière, that, at the upper portions of the caverns examined, remains of instruments and tools were found, belonging to the prehistoric epoch which immediately preceded, in the west of Europe, the appearance of metals. Below the surface, beds abound, remains of human industry indicating a civilization even more primitive than the antiquity assigned them by the superposed masses. In this locality was discovered, at a depth of 21 feet, the famous human skeleton depicted in our engraving. The earth was evidently in virgin condition, and hence the remains clearly belonged to the geological and palæontological age of its surrounding deposit. While, however, the fauna discovered in connection with the human relics indicate a very ancient palæontological epoch, the bone and stone instruments, and especially the necklace found on the skeleton, seem to point to a more recent period. The presence of cave bears and hyenas, the *rhinoceros tichorinus*, and *bos primogenius*, evidently relate to the most ancient quarternary epoch, the age of the bear; while, on the other hand, the abundance of remains of deer of various species and of small hight (chamois especially), the fact of the multiplicity of bone tools, needles, chisels, and a *baton* of command, together with the peculiar necklace which closely resembles that found on the fossil man of Cra-Magno, lead to the conclusion that the series of objects belongs to an age posterior to that of the bear, namely, to that of the reindeer. It is believed, however, says Dr. Garrigou, in *La Nature*, that the original owner of the skeleton existed during the latter age, and was buried in a cave formerly inhabited by men of the preceding epoch.



THE FOSSIL MAN OF MENTONE.

A NEW DEEP SEA SOUNDING INSTRUMENT.



It would be difficult, we imagine, to devise a more simple and inexpensive apparatus for deep sea sounding than that represented in the accompanying illustration. There is no intricate mechanism, no series of wheels or dials requiring careful adjustment, and not even a line; nothing, in fact, essentially more than a piece of metal wire, screw-threaded from end to end, and a fan working thereon rotated by the motion of the machine. The screw is cut to a certain pitch, so that the descent of the apparatus must be through a fathom of water to cause the fan to make one revolution. The further the instrument travels down, the higher the fan will climb up the rod. As soon as bottom is reached, and the machine begins its ascent, the fan (of course acted upon in a different direction) runs down the screw, but a messenger on the latter, pushed up by the fan, remains at and indicates the highest limit attained. It is only then necessary to pick up the apparatus when it comes to the surface and observe the distance that the messenger has been carried up, and the depth in fathoms is infallibly told.

Compared with the intricate systems for sounding carried by such vessels as the Challenger, and in other marine exploring expeditions, the present device is a marvel of simplicity and cheapness. It can be made on board, with the tools ordinarily found in the engineer's department of a steamer, or, at most, with one special instrument for cutting the screw thread upon the wire. The remainder of the apparatus is a block of wood or other light material for a lifting buoy, the grapplers which bring up specimens of the bottom, and a watch buoy. By noting the time of descent, together with the bearing and distance of the watch buoy from the point at which the machine rises to the surface, the bearing will show the difference of direction between surface and submarine currents, and the distance, the velocity. Thus, in the single instrument, is afforded a means of determining depth, character of bottom, and set and rapidity of currents.

The credit of this very ingenious invention is due to Captain Truman Hotchkiss, of Stratford, Conn., a gentleman of large maritime experience, to whom we are indebted for the substance of the detailed description which follows.

From Fig. 1 the particulars of the device will be understood. A is the screw threaded rod, made of brass or steel, and B is the fan, boxed and tapped to travel thereon. C is the messenger, traveling on the screw and fitting the upper end of the fan by a coupling so as to be moved by the fan only up the screw. At D is a socket screwed to the lower end of the rod, A, which carries the grapnel, E, the latter hanging to the bent end of a bolt which passes through the socket. This bolt also serves as a pivot for an unevenly balanced lever, F, Fig. 2, which passes through a slot at right angles to the plane of the grapnel. The upper end of rod, A, hooks in an eye on the bottom of the lifting buoy, G. H is the watch buoy, provided with anchor and flag.

Fig. 2 shows the machine descending and also the mode of adjusting it. It will be observed that the arms of the lever, F, differ considerably in size, and that they are provided with hooked ends, the curve on the arm on the right turning downward, and that on the left arm in the opposite direction. By this means the two weights represented are supported, one weight, the heavier, extending down to about the level of the bottom of the grapnel. The latter of course remains closed, as is evident from its form. The fan and messenger are then carried down to the bottom of the rod; and thus adjusted, the machine is let go, the watch buoy being previously carried to the place of descent. The time is then noted and a careful watch kept for the return of the apparatus. In descending, the rotating fan climbs up the screw, carrying the messenger with it; and the weights, overcoming the lifting power of the buoy, continue dragging the machine down until bottom is reached. At that moment the lower weight is lifted from its hook and drops clear, the smaller weight overbalances the lever and also falls off, and the jaws of the grapnel, opening against the resisting soil, grab a portion of the bottom. The lifting buoy now easily carries up the apparatus freed from the weights; and soon reaching the surface (Fig. 3), is easily recognized by the flag which it carries, blowing out clear.

The machine is then recovered, and the position of the messenger noted, as already described. As there are thirty-eight turns of the screw thread per inch of rod, it is only necessary to measure the distance in inches between the messenger and socket, D (*minus* the length of the fan), and to multiply the result by thirty-eight, when the depth in fathoms is at once known.

The machine may be made of any desired size; and in cases where the grapnel is likely to catch in seaweed or other obstruction, the power of the lifting buoy can be easily increased to tear away the hold.

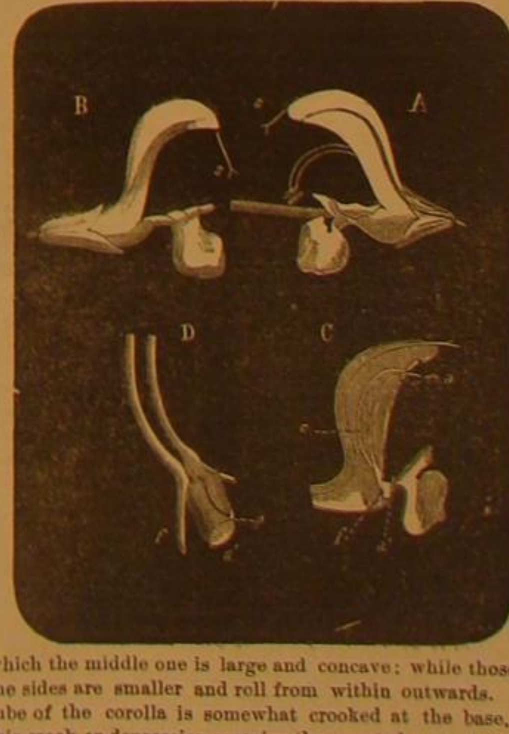
THE FECUNDATION OF FLOWERS BY INSECTS.

Among the numerous discoveries with which vegetable physiology has of late been enriched, none is more interesting or more curious than the part taken by insects in the development of flowers. The fact seems hardly credible, moreover, that, after all the theories which have been invented to explain the passage of the pollen to the stigma of the same flower (to explain which even the intervention of water, which is highly destructible to the pollen of terrestrial plants has been mentioned as possible), in the majority of cases the floral organs are so disposed as to absolutely prevent this contact, and that the pollen needs to be deposited on the stigma of a sister flower or even on a blossom belonging to a separate stalk.

Generally, when the pollen of a flower, through some means, accomplishes its self-fecundation, the result is a deleterious action upon the stigma, and the plant remains barren, as, for example, in many species of the genus *oncidium*. The aquatic plants, of which the pollen is transported by water, are few in number, while the pollen and stigma exhibit a peculiar disposition. With others (*coniferæ*, *gramineæ*), in some cases the wind carries the pollen, but the flowers are insignificant, destitute of nectar and of odor, and their pollen is in such great abundance that it has given rise to a fable, in certain countries, of a rain of sulphur.

Our attention, at present, however, will be directed to the flowers the pollen of which is carried by insects involuntarily from one blossom to another. Such flowers seem to appeal to the insect to enter their open leaves by exhibiting the brightest colors, and most beautiful and varied forms, besides secreting quantities of the nectar upon which their visitor subsists. Nothing can be more wonderful than the thousands of different shapes of corolla, of stamens, and of pistils; and yet all are arranged so as not only to cover the insect, in spite of himself, with pollen, but, at the same time, to separate completely the pollen and stigma of the same flower. Often the mechanical disposition of the various parts of the blossom and their play at the moment of the entrance of the intruder is extremely complicated, as Darwin has demonstrated in the case of many of the *orchidaceæ*; but there are other flowers of which the construction is easily understood and which are equally ingenious and surprising. One of the simplest is the sage (*salvia pratensis*) a very common plant of the *labiatæ*, or mint family, characterized by the existence of two stamens instead of four, portions of the flowers of which our illustration (extracted from the pages of *La Nature*) represents.

The corolla, A B, is deeply divided into two lips; the upper, which corresponds to two divisions of the corolla, turns backward in the form of an arch, and incloses the style and the anthers. The lower lip is divided into three lobes, of



which the middle one is large and concave; while those on the sides are smaller and roll from within outwards. The tube of the corolla is somewhat crooked at the base, and this crook or depression contains the secreted nectar. Of the peculiar form of the stamens, a clear idea will be gained from Figs. C and D. In C the corolla has been cut longitudinally so as to leave the stamens intact. In Fig. D, a portion of the stamens is shown separately. The anthers have a long connective astride the filaments. The latter are very short, and are inserted in the sides of the tube of the corolla, *f*, in Fig. C and D. One anther, *a*, is developed regularly; the other, *a'*, is transformed into a flattened appendix, nearly rectangular, slightly curved, and convex outside. These two organs are so placed together as to form a kind of spoon, which very exactly closes the tube of the corolla. They even adhere quite strongly by their anterior points. The connective, which is almost unapparent on the inferior side, is elongated on the upper portion into a delicate arched filament which carries at its extremity the only pollen-enclosing cell of the anther.

If it be attempted to push a needle or bit of stick into the tube of the corolla, the little spoon, *a'*, will just be enconntered. By a light effort, the connectives are turned around the filaments, when the fertile anthers, concealed under the superior lip, project themselves forward and deposit their pollen upon the intruding instrument. On withdrawing the latter, the elasticity of the filaments carries the anthers back under the upper lip. Up to the time when the pollen is ripe, the style, which is also concealed at the bottom of the upper lip, does not arrive at complete development and the bi fidal stigma, *s*, hardly extends beyond the corolla, Fig. A. In the advanced flower, deprived of its pollen, the style elongates downwards and carries the stigma at the level of the entrance of the tube (see *s*, Fig. B).

It is now easy to follow the action of the flower, when a bee, for instance, visits it. The insect alights upon the lower lip of the corolla, and, to reach the hidden nectar, tries to penetrate the tube. But this it cannot do without, as already shown, pushing before it the short branches of the two levers formed by the connectives. At the same time the arched upper parts advance and embrace the body of the bee, applying the open anthers to its abdomen so that the insect emerges covered with the fine pollen. As long as it seeks the nectar of flowers of the same age as that just left and of which the styles are still very short, the stigmas can receive but little pollen; but when the bee attempts to enter an older blossom than B, the elongated stigma grazes along its back, rubs off the pollen, and thus becomes fecundated. Since the pollen of the *salvia* is deposited on the back of the insect, it is evident that little can be given to a flower of another species the construction of which requires the placing of the substance upon the head or trunk. While whatever may be the flowers which the bee visits before entering another *salvia*, the pollen with which it is charged is not rubbed off or wasted as it remains intact until a proper blossom is entered.

UP THE AMAZONS.

No. 2.

VOLUME OF THE GREAT RIVER AND ITS TRIBUTARIES.

The Amazons is the most voluminous of rivers. At the narrows of Obydos, six hundred miles from the sea, half a million cubic feet of water pass any given point every second. Born in Lake Lauricocha, among the Andes of Peru, the main trunk runs northerly for five hundred miles in a continuous series of rapids; and then, from the frontier of Ecuador, it flows easterly, twenty-five hundred miles across the great equatorial plain of the continent. The average current of the Great River in its passage through Brazil is three miles an hour. At Tabotinga, two thousand miles from its mouth, the width is a mile and a half, with a depth of eleven fathoms; at the entrance of the Madeira, it is three miles wide, and below Santaren, it is ten. The tributaries are in keeping with this colossal trunk. In fact, the Amazons is a great river system, rather than one river. It has twelve affluents over a thousand miles long, the largest, the Madeira, equaling the Arkansas, entering the Amazons nine hundred miles from its mouth.

Besides these and a host of minor tributaries, there is a wonderful network of natural canals alongside of the main river and joining the tributaries, called *igarapés*, *paranás*, and *furos*. These bypaths are of immense advantage for intercommunication. They are characteristic of the country, and are so numerous that Amazonia is truly a cluster of islands. Atlogether, this vast inland fresh water sea drains a territory of two million square miles, reaching from the Andes to the Atlantic and throwing out its arms to the Orinoco and Paraguay. On the Lower Amazons, the annual rise reaches its maximum about the middle of June, and its minimum in December, the difference of level being about fifty feet.

MOUTH OF THE AMAZONS

EXTENT OF NAVIGATION.

No other river runs in so deep a channel to so great a distance. No other river can furnish over six thousand miles of continuous navigation for large vessels. For two thousand miles from its mouth, the main stream has not less than seven fathoms of water; and not a fall interrupts navigation for twenty-five hundred miles. The Pongo de Manneriche is the western limit to navigation on the Amazons proper. While the current is ever east, there is a constant trade wind westward, so that navigation up or down has always something in its favor. In August and September, a strong breeze sweeps up the lower part of the main trunk, so that schooners often go from Pará to Obydos in ten days, or one third of the ordinary time.

As to the tributaries: the first in order, the Tocantins, could furnish a natural highway to the rich province of Minas Geraes, were it not for rapids one hundred and fifty miles from its mouth. This interruption will some day be circumvented by a railroad. Above the falls, a steamer can go six hundred miles. The Xingú is navigable nearly one hundred miles. From Santarem, steamers ascend the broad Tapajós about sixty leagues, to the rapids of Itaitúba; and passing these, traders go by canal to Diamantino and Cuyabá on the confines of Paraguay. From Itaitúba, there is communication *viá* Manes with the Madeira. Near Obydos enters the Trombétas, navigable one hundred miles. And just beyond Serpa, the great Madeira pours its flood of waters. This majestic tributary is about two thousand miles long, one branch rising near Lake Titicaca, a second starting within fifteen miles of the source of the Paraguay, and a third washing down the gold and diamonds of the Sierras. It has a three mile current, and at its mouth is two miles wide and sixty-six feet deep. It is navigable to San Antonio, a distance variously estimated from five to seven hundred miles. Here begins a series of rapids, nineteen in number, having a total fall of thirty-eight fathoms; above which a steamer can ascend to Santa Cruz, in the heart of Bolivia. Colonel Church, who sounded the Marmoré for six hundred miles above the rapids in October (the dry season), found nowhere in midchannel less than fifteen feet of water, an average current of two miles an hour, and a width varying from six to twelve hundred feet. A railway around the formidable rapids which separate Bolivia from the Lower Madeira is now in process of construction by the Madeira and Marmoré Railroad Company. The track extends from San Antonio to Guajarámirim, a distance of one hundred and eighty miles, and by the terms of the contract the road is to be finished in April in 1874. This is one of the most important enterprizes on foot; but great difficulties have been encountered, as the scarcity of laborers, the attacks of Indians, and the prevalence of epidemics. The company, however, in spite of all obstacles, declare that this great connecting link must and shall be built. As soon as completed, the National Bolivian Navigation Company will be ready to put a fleet of steamers and barges on the Marmoré and Guaporé. Both Brazil and Bolivia are interested in this railway, and have conceded to the company over one million acres of territory along the line. The affluents of the Madeira water a region as large as the basin of the Nile and nearly as rich. The valley of the Beni above is famous for its gold, Peruvian bark, coffee, and cacao, which now have to climb the mountains of La Paz and cross to the Pacific.

One hundred miles west of the Madeira enters the Rio Negro, which is navigable to San Gabriel; but at present steamers go only to Santa Isabel, or five hundred and forty-six miles. It is a deep though sluggish river, the depth at Manáos at high water being forty-four fathoms. Steamers, therefore, do not usually cast anchor, but fasten to buoys. The Rio Branco branch can also be navigated by small steamers for sixty leagues. Above the rapids of San Gabriel, the Negro is connected by the Cassiquian with the Orinoco; and hence the commerce of this part of the river is naturally in the hands of Venezuelans.

Next in order is the Purús, one of the most promising tributaries of the Amazons. Recently opened to the world by the daring Chandless, this hitherto mysterious river, possessed by the untameable Chunchos, has suddenly become one of the most attractive and valuable streams in the world. Rising in the richest part of the Andes and entering the Amazons only forty-five leagues above the city of Manáos, it is navigable for steamers, the greater part of the year, for over twelve hundred miles. At the distance of eight hundred miles from its mouth, the depth is never less than twelve feet. It is nearly, if not fully, equal to the Madeira in size, but is exceedingly winding in its course. Parallel to the Purús is the almost equally important Juruá. It is navigable, for steamers drawing three or four feet of water, for fifteen hundred miles. Like the Purús, it is a very crooked river, and has a two and a half mile current. Five hundred miles from its mouth, it has a depth of two fathoms at low water.

The Jutahi and Japurá are first class tributaries; the latter is navigable for ten days by steamer, when falls are reached where there is a lofty table-topped mountain. The Icá has no rapids and is navigable into New Granada. It is a healthy river, and is of considerable commercial value. The Jávari is navigable for an unknown distance, and is called the "Golden Dream of the Peruvians," who think it is the eastern outlet of their country. The Napo could be ascended by a flat bottom steamer five hundred miles; it is the natural highway eastward for Ecuador. The noble Ucayáli has been navigated by a steamer of five hundred tuns for six hundred miles in the dry season; and a small steamer has ascended over seven hundred miles, or within two hundred miles from ancient Cuzco, and three hundred from Lima. There is twenty feet of water at Sarayacu. The Ucayáli will undoubtedly connect Lima with the Amazons. Finally, the Huallága has an average depth of three fathoms for a hundred miles; but canoe navigation begins at Tingo Maria, one hundred and twenty miles from Huánaco. Such are the vast capabilities of this gigantic river, fitly called the Mediterranean of the New World.

THE NATURAL WEALTH

of the country is in proportion. No spot on the globe contains so much vegetable matter as the Valley of the Amazons. Within it we may draw a circle of eleven hundred miles in diameter which shall include an evergreen, unbroken forest of grand and beautiful and valuable trees, in endless variety. In truth, it is this very excessive exuberance which offers the chief obstacle to settlement. We know next to nothing of the interior; but the margins of the main trunk and especially of the tributaries abound with precious woods, drugs, dye stuffs, edible fruits, and other useful products. Among the most important of these for exportation are: Moira, pinima, moira piránga, moira coatiára, itaúba, palo di sangre, massarandúba, sapucáya, jacaranda, cedar, and cumarú; salsaparilla, vanilla, cupaiba; cinchóna and guaraná; cacao, coffee, tonka beans, nuts, farina, tapioca, cotton, rice, tobacco, and sugar; rubber, piassába, pita, and copal, and a host of others unknown to commerce.

SAILING CRAFT AND STEAMERS.

The present traffic in the riches of this inexhaustible region is far behind the world's expectations; but it has wonderfully increased since the introduction of steamers in 1853. It is impossible to ascertain the number of sailing vessels on the river; but the variety is extraordinary, for the Indian is a carpenter and shipwright by intuition. Thus we see: First, the *canoe* proper, or "dug out." Second, the *montaría*, a small boat made of five planks, or a canoe increased by two narrow boards for the sides and small triangular pieces for stem and stern. The paddle serves for both steering and propelling. Third, the *montaria-possante*, a large montaria with oars. Fourth, the *igarité*, a large canoe or montaria with two masts, rudder, keel, and palm leaf awning or cabin near the stern. Fifth, the *galiota*, an igarité with wooden covering. Sixth, the *cobérta*, a large galiota with one or two wooden cabins. Seventh, the *cigilêngas*, a large igarité, short and broad, flat bottom with keel fore and aft, first made at Viges. Eighth, the *batelao*, a barge with square sails but no deck, to carry cattle; sometimes propelled by long oars. Ninth, the *barco*, a batelao with deck. Tenth, The *escuna* or schooner.

Of steamer there are now thirty-five afloat on the Amazons, varying in tunnage from seventeen to eight hundred and sixty-four. The aggregate tunnage is over ten thousand. Twenty of these belong to three companies, which receive a large subsidy from the Government and have a total capital of $3,600,000. The oldest and most powerful line ("*Companhia de Navagaçao a vapor de Amazonas*") is owned in London, but is under the management of the distinguished and energetic Sr. Pimeuta Bueno, of Pará. This company is endeavoring to swallow up the other two having just purchased the Paraense line and nearly completed negotiations for the Fluvial, and thus monopolize the carrying trade on the river. Officially made free to the world in 1867, the navigation of the Amazons is virtually restricted to the Brazilian flag. Foreign vessels may go up the main river as far as Manaos; up the Tapajos to Santarem; and up the Madeira to Borba. On the Maranon the Peruvian government has two large steamers, doing monthly service, besides several small ones for the tributaries; and an English firm at Iquitos has recently inaugurated a private line between that point and Pará. Goods for Peru pass Pará free of duty. Two regular steamers leave Pará for Manaos and intermediate points, on the 2d and 18th of each month, and a monthly steamer plies between Manaos and Loreto, on the Brazilian frontier, connecting with the Peruvian Morona for Yurimaguas on the Huallága. The other steamers run from Pará and Manaos to numerous villages along the main river and the tributaries. The navigation of these tributaries, but ust commenced, is most important, for they are the real sources of the characteristic products of the country; the region bordering the main trunk yields scarcely anything. On the Tocantins a steamer goes once a month to Cametá; once a month (during high water) to Baiao and to the first falls. Almost the only trade on this river is in Brazil nuts. The Xingu has one occasional steamer going just above Souzil for rubber, of which the annual product is five or six thousand arrobas. The Tapajos has a monthly steamer as far as Itaituba (175 miles) leaving Santarem the 28th, and bringing down rubber, salsaparilla, tobacco, farina, cacao, coffee, copaiba, pepper, nuts, pirarucú, pitch, hides, lumber and limestone. The annual amount of the Topajos cacao is is 100,000 arrobas, rubber the same, pirarucú 50,000 arrobas, salsaparilla 1,000 arrobas, nuts 40,000 bushels, hides 20,000. A steamer leaves Manaos for San Antonio, on the Madeira, the 27th of each month, and oftener when there is a cargo.

PRESENT AND PROSPECTIVE COMMERCE.

At present the trade on this chief tributary is inconsiderable, its value, in 1872, amounting to only $279,312. The exports consist of rubber (about 25,000 arrobas), hides, tallow, quina, copaiba, cacao, nuts, fish, tobacco (of superior quality for pipes), and salsaparilla. But the moment the railway around the falls is finished, a magnificent country will roll its wealth down the Madeira. Above the falls are the cities of Exaltocion, Trinidad, Santa Cruz, Oruro, Cochabamba and La Paz; there is the Bene valley, famous for its gold, silver, tin, copper, lead and mercury mines; and from the banks of the Marmorá will be exported, as soon as an outlet can be made, cinchona bark, rubber, coffee, cacao, salsaparilla, tobacco, farina, cotton, llama and alpaca wool, cattle and hides. At present, cattle can be bought there at $7 a head; cinchona, $45 a qúintal; cacao, $1.50 an arroba; sugar, $1 an arroba.

On the Rio Negro a steamer makes six trips a year as far as Santa Isabel (546 miles) for piassába and salsaparilla. The value of the trade on this tributary, in 1872, was $62,586; it is now on the increase. The rich cacao and coffee, once raised in this region, is no longer cultivated; and no one can be found to cut the celebrated moira pinima—the most beautiful wood in the world. Not a stick can be found for sale in the city of Manaos; while everybody confesses that there is an abundance of it up the Negro, especially on its branch, the Branco, near the boundary line of Guiana. A regular monthly steamer (and often an extra one) goes up the Purús, one thousand miles to Hyutanahau, bringing down rubber, copaiba, salsaparilla, nuts, turtle oil and fish. The commerce on this river is rapidly increasing. Its value in 1872 was $627,602. There are more inhabitants along the banks of the Purús than on any other tributary.* There is a monthly steamer, likewise, on the Juruá, ascending to Marary (five hundred miles), and the trade is similar to that on the Purús. The Peruvian steamers, plying between Lonto and Yurimagnos, takes up dry goods and hardware in exchange for Moyabamba hats and salsaparilla. Her rate down stream is eighteen miles an hour and from ten to twelve up, while the Brazilian steamers descend at the rate of twelve or fifteen miles an hour, but make only eight up stream.

Such is this great fluvial highway, as thus far developed. Unless checked by blind legislation, the commerce of the Amazons, leavened by Anglo-Saxon capital and Anglo-Saxon enterprise, is destined to assume proportions commensurate with the magnitude of the river. JAMES ORTON.

*The latest intelligence contradicts the report of Mr. Piper's massacre, and announces that he has found gold in abundance.

NOTE ON AN ELECTRO-DYNAMIC EXPERIMENT.

BY MM. GASTON PLANTE AND ALF. MAUDET-BREGUET.

In charging a secondary couple of leaden plates with the magneto-electric machine of Gramme, we have observed a phenomenon which affords quite a curious example of the reciprocal transformation of mechanical power into electricity, and of electricity into mechanical power.

The machine of Gramme possessing, as is well known, the remarkable property of furnishing currents influenced in the same direction, the secondary couple is charged by the aid of this machine as if under the influence of a voltaic pile, and enables us to obtain, at the end of a few moments, by a successive chemical action accumulated upon a large surface, temporary effects of an intensity superior to those which the machine produces in a continuous manner. It is easy to verify this, either by the incandescence of a thread of platinum, or by any other physical action. But if, instead of thus discharging the secondary couple, it is left in communication with the machine, and if we cease to make it revolve, if we even stop it entirely, by opposing a sufficient resistance, it will immediately be observed to put itself in motion again under the influence of the secondary couple which it has just charged, not in a contrary direction, but in the same direction as the motion with which it was animated, while charging the secondary couple.

The velocity is less, it is true, than that which is given to it in order to develope electricity, but it is still sufficiently great, and the rotation may be prolonged two or three minutes, that is, during the time employed by the secondary couple to discharge itself. The dynamo electric machine operates in this case as an electro-magnetic motive power, and the secondary couple gives back to it, under the same form, the power which it has stored up. Electricity serves only, as it were, as the intermediate machinery in this communication and restoration of motion.

If we measure the forces called into play, we can plainly ascertain that this restoration is not complete on account of the loss inevitable in every transformation. But as the measure of the product of the secondary couple, effected by one of us in a previous experiment conducted after another method, has demonstrated that this couple was a good receiver of the electric force, it is probable that one would find here, all the circumstances being the same, only a trifling waste in the transformation.

The direction of the rotatory motion communicated to the machine by the discharge of the secondary couple is, we have said, the same as that in which the machine was turned in charging the couple. Now if the machine in turning in a certain direction has charged this couple, it is difficult to conceive, at first view, that under the influence of the discharge of the couple it turns still in the same direction; for it must then tend to recharge the secondary couple, so that the latter would be discharged and charged at the same time.

Nothing seems more paradoxical. Nevertheless the fact is easily proved, and is very simply explained in the following manner: If we consider in the first place the direction of the current furnished by the machine, that of the current given back by the secondary couple (which is the reverse of the preceding), and if we take into account the actions resulting, we confess that, according to the laws of induction and of electro-dynamics, the rotating ought indeed to act in the direction indicated by experience. If we observe, on the other hand, that the secondary couple, once charged, has a temporary intensity superior to that of the machine, that is, that it can furnish in a given time, by means of the accumulation which takes place, a quantity of electricity superior to that which the machine would produce during the same time, we understand that it could overcome or surmount the feebler intensity which the machine tends to develope by its rotation even under the influence of the discharge of the secondary couple.

The motion then takes place by virtue of a difference of intensity between the current furnished by the secondary couple and that which the machine would tend to develope by the simple fact of its rotation. Thus is explained, according to us, this apparent paradox of electro-dynamics. We will add that the experiment can be easily repeated, with the smallest as with the largest models of Gramme's machine.

On the Manufacture of Ether.

O. Süffenguth states that the best method of making large quantities of ether is by the continuous process. A retort, containing a mixture of nine parts sulphuric acid of 66° B. and five parts 90 per cent alcohol, is heated to 284° Fah. and alcohol allowed to flow in continuously to keep the mixture at a constant level. Heretofore a direct fire has been applied under the copper or iron retort; but owing to the inflammability and volatility of the ether, this is evidently dangerous; and moreover, the direct fire soon destroys the retort, or at least dissolves the leaden lining. This is now entirely avoided by the use of superheated, high pressure steam for heating the retort. Even though this method is rather more expensive, it prevents igniting and exploding the ether vapor, which quite compensates for the cost. Another advantage is the ease with which a constant temperature is maintained by regulating the pressure, so that the operation is no longer dependent upon the care and experience of the workmen.

Various materials have been used for the retort or still; sometimes copper alone, sometimes copper lined with lead, and also iron lined with lead. Experience has proved that the last named is not only the cheapest but will last the longest. If the operation is carefully conducted, 66 per cent of ether of a specific gravity of 0·730 will be obtained. Half a pound of sulphuric acid makes 100 pounds of ether, and the apparatus is so constructed that it can be refilled without interrupting the operation. Great attention to the regulation of the temperature and to the flowing in of the alcohol are the principal conditions for obtaining a large yield.

The crude ether thus obtained is freed from the acid dissolved in it and washed, after which it is rectified in a suitable apparatus. Attempts have been made to rectify it in the process of its manufacture, by conducting the ether vapor into a vessel with double walls, the space between the walls being filled with water at a temperature of 35° C. (95° Fah.) Here the water and alcohol are condensed, whil the ether passes up into a second vessel filled with pieces of quick lime of the size of a man's fist, which take up the sulphurous acid. It is now warmed and enters from beneath into a cylinder holding a leaden basket of dried wood charcoal, or alternate layers of charcoal and pieces of coke soaked in a solution of soda and well dried. From here it is conducted through a cooler into the receiver. This continuous rectification is more difficult and requires greater attention on the part of the workmen than where the purification is a separate operation, first on account of the continual regulation of the temperature in the different parts of the apparatus, and secondly because the lime sometimes stops up the tube or is carried off in the vapor. The operation never goes on regularly nor is the product always pure. It seems to be better, in practice, to keep separate the two operations of making and of purifying the ether.

Bees as Architects.

Now we exercise a patient observation on Nature, analyzing, investigating, calculating, and combining our facts, and say coolly with Professor Haughton, "bees construct the largest amount of cell with the smallest amount of material;" or with Quatrefages, "their instinct is certainly the most developed of all living creatures with the exception of ants." "The hexagons and rhomboids of bee architecture show the proper proportions, between the length and breadth of the cell, which will save most wax, as is found by the closest mathematical investigation," says another great authority. Man is obliged to use all sorts of engines for measurement—angles, rules, plumb lines—to produce his buildings, and guide his hand; the bee executes her work immediately from her mind, without instruments or tools of any kind. "She has successfully solved a problem in higher mathematics, which the discovery of the differential calculus, a century and a half ago, alone enables us to solves at all without the greatest difficulty." "The inclination of the planes of the cell is always just, so that, if the surfaces on which she works are unequal, still the axis running through its inequalities is in the true direction, and the junction of the two axes forms the angle 60° as accurately as if there were none." The manner in which she adapts her work to the requirements of the moment and the place is marvelous. A center comb burdened with honey was seen by Huber and others to have broken away from its place, and to be leaning against the next so as to prevent the passage of the bees. As it was October, and the bees could get no fresh material, they immediately gnawed away wax from the older structure, with which they made two horizontal bridges to keep the comb in its place, and then fastened it above and at the sides, with all sorts of irregular pillars, joists, and buttresses; after which they removed so much of the lower cells and honey, which blocked the way, as to leave the necessary thoroughfares to different parts of the hive, showing design, sagacity, and resource. Huber mentions how they will find out a mistake in their work, and remedy it. Certain pieces of wood had been fastened by him inside a glass hive, to receive the foundation of combs. These had been placed too close to allow of the customary passages. The bees at first built on, not perceiving the defect, but soon changed their lines so as to give the proper distance, though they were obliged to curve the combs out of all usual form. Huber then tried the experiment another way. He glazed the floor as well as the roof of the hive. The bees cannot make their work adhere to glass, and they began to built horizontally from side to side; he interposed other plates of glass in different directions, and they curved their combs into the strangest shapes, in order to make them reach the wooden supports. He says that this proceeding denoted more than instinct, as glass was not a substance against which bees could be warned by Nature, and that they changed the direction of the work before reaching the glass, at the distance precisely suitable for making the necessary turns—enlarging the cells on the outer side greatly, and on the inner side diminishing them proportionately. As different insects were working on the different sides, there must have been some means of communicating the proportion to be observed; while the bottom being common to both sets of cells, the difficulty of thus regularly varying their dimensions must have been great indeed. The diameter of the cells also varies according to the grubs to be bred in them. Those for males have the same six sides, with three lozenges at bottom, as those for workers, and the angles are the same; but the diameter of the first is 3½ lines—that for the workers only 2⅖. When changing from one size, to another, they will make several rows of cells intermediate in size, gradually increasing or diminishing, as required. When there is a great abundance of honey, they will increase both the diameter and the depth of their cells, which are found sometimes as much as an inch and a half in depth.—*Good Words.*

Enameled Iron.

M. Peligot has made a report, to the Society for the Encouragement of Industry, on the enameled wrought and cast iron work introduced by M. Paris about twenty-five years ago, and for which the Society have awarded him two medals. According to the report in question, the enamel used is a true transparent glass which allows the color of the iron to show through, very tenacious, having the same power of dilatation as iron, and capable of resisting powerful acids. The ordinary white enameled ware of Paris generally contains lead, and often in large proportions, and is liable to be attacked by even very weak acids. M. Paris' ware has been employed for many purposes: cast iron vases for gardens decorated in imitation of old Rouen ware have been exposed to all weathers without suffering any injury; a chimney in enameled plate iron was set up at the Mazas prison in 1849; the doors of the gold assay furnace in the laboratory of the Paris mint are of the same, and have borne the effect of nitrous vapors since 1850; in 1866 this enameled iron was selected for street names and house number plates, in several districts of Paris, and the report states that, while other manufacturers make enameled ware of the same appearance as that of M. Paris, the latter has shown its superiority in resisting the effects of time.

Specimens of new applications, lately introduced by M. Paris, were presented to the Society, and included chairs, tables, and stools for gardens, enameled on sheet iron and mounted on castings; and stands for dishes, decanters, etc., made in imitation of ancient earthenware, but presenting the superior advantage of bearing heat well.

ACTION OF NITRIC ACID ON CHROMATE OF LEAD.—On treating chromate of lead with about double its weight of nitric acid, a solution of chromic acid is obtained, according to M. E. Duvillier, containing but two per cent of oxide of lead. It is considered that the nitric acid decomposes the chromate of lead into chromic acid and nitrate of lead, which precipitates itself on boiling in presence of the excess of nitric acid employed.

MANUFACTURE OF ARTIFICIAL BUTTER IN NEW YORK.

Milk is a mechanical mixture of butter, casein, and water, the latter holding in solution sugar of milk, or lactin, and several salts. The butter is held suspended in the milk by the caseous or cheesy matter, and the whey, with which it is intimately blended. Milk is thus a true emulsion, resulting from a mixture of these three ingredients, and owes its opacity and white color to the diffusion through it of the butyraceous oil. The particles of butter in milk consist of very minute globules $\frac{1}{5500}$ inch in diameter, suspended in the surrounding serous fluid.

Fig. 1.

MANUFACTURE OF ARTIFICIAL BUTTER.—THE HASHING MACHINE.

When milk is allowed to stand for some time, the lighter particles of butter rise to the surface, constituting, with a certain quantity of the other ingredients, cream, leaving the casein, from which cheese is made, and the whey below. All the particles of butter, however, are not eliminated by this means. Still the remainder is by no means rich in oily matter, as the poverty of skim milk plainly shows.

When the cream is agitated for some time, or churned, the semi-solid particles of fat aggregate, and we have a mass of butter. The remaining fluid, termed buttermilk, contains casein and lactin, or sugar of milk, in solution. This sugar very soon decomposes, forming lactic acid (from *lac*—Latin for milk), which gives to buttermilk its sour taste.

In the manufacture of cheese the casein (Latin, *caseum*, cheese) of course is the principal ingredient. The casein is coagulated by an acid, usually obtained from the stomach of a young calf, and called rennet. The curd thus obtained is pressed, and, after a variety of manipulations, becomes cheese.

Butter is a rather complex organic compound, consisting chiefly of olein, margarin, and stearin. The olein is the largest and most important constituent, and one most familiar to our eyes, in the shape, more or less pure, of the fixed oils, of which olive oil is a good example, as it contains seventy-five per cent of olein.

The three substances named exist in all natural fats, from which chemists have long been enabled to produce butters which, owing to bad odors and flavors, have never been suited to human wants.

M. Mouriez, of France, was the first to solve the difficulty, and some six years ago gave to the world an excellent method of making good butter from hard beef fats, known as beef suet. This process will be found in the Science Record for 1873.

The process, with modifications by M. Paraf, has latterly been introduced in this country, and is now in successful practical operation in this city, on a large scale, at the establishment of the Oleo-Margarine Manufacturing Company, in 56th street, near Third avenue, where one or two tuns of the new butter are now daily turned out, and find a ready market.

The article to which we refer does not differ materially in composition from ordinary butter, olein (and that of a very pure character) being the principal ingredient, no casein being present, which is the primary cause of rancidity in butter. The olein from which this artificial butter is prepared is obtained from beef suet.

The general process of manufacturing artificial butter is as follows: The suet is first washed thoroughly, for two hours, in water, to remove all superfluous animal matter, and is then, by means of a "hashing machine," shown in our illustration (Fig. 1), ground thoroughly, and pressed through a fine sieve or plate of iron pierced with fine holes, which forms one side of the machine. The machine consists of a series of sharp blades set on an axis like the thread of a screw. These are contained in a closely fitting chamber or cylinder placed horizontally. The cylinder is divided into two portions, hinged together on one side, and capable of being securely fastened or bolted on the other, when the machine is in operation. The upper half can be readily thrown back, should the machine become clogged or when it becomes necessary to cleanse it. The shaft on which the knives are fixed extends through one end of the cylinder, and is geared in the ordinary way, by means of a belt and pulley, to the shaft of the engine transmitting the power.

A large iron trough lined with porcelain is supported above the cylinder with its revolving knives. This trough or feeder has an aperture in one corner, which fits over a corresponding hole in the upper part of the cylinder, through which the suet is fed to the machine. When the machine is in operation, the suet is not only effectually hashed in the cylinder, but forced by the screw thread set knives through fine holes bored in the opposite end of the cylinder. The machine we saw in operation was capable, it was stated, of hashing 1,000 pounds of suet in an hour. The fat comes out of the hasher in the form of a jelly considerably whiter than when put in, owing to its finely divided state, and the uniform distribution of olein through it.

The material is now in a proper condition for the second operation, which has for its object the separation of the fluid olein, and the solid margarin and stearin from the animal

Fig. 3.

MANUFACTURE OF ARTIFICIAL BUTTER.—FILLING THE BAGS FOR THE PRESS.

tissues which enveloped them. For this purpose it is put into a number of steam vats, shown in the illustration (Fig. 2). These vats are of the ordinary wooden description, with steam pipes entering the bottom, the steam being admitted or cut off at pleasure by stop cocks. Here the fat is raised nearly to the temperature of boiling water, the steaming being continued for two hours. The heat causes a separation of the olein and stearin from the animal matter, the former rising to the top, while the latter sinks to the bottom. The material is well stirred during the time the heat is continued, and when the process is completed the oil is drawn off while still hot, and then allowed to cool slowly in

Fig. 2.

MANUFACTURE OF ARTIFICIAL BUTTER IN NEW YORK.—THE STEAMING VATS.

tanks placed below the steam vats. About 90 per cent of a mixture of olein, margarin, and stearin are thus obtained from a given weight of suet, the remainder (10 per cent) being, of course, the tissue and muscular and fiberous parts of the material.

The real fat being thus separated from the superfluous animal matter, the next step is the separation of the fluid olein from the solid margarin and stearin. One of the lower tanks, seen beneath the steam vats in the large illustration (Fig. 2), containing the mixed fluid and solid parts of the fat, is moved to a small table in another part of the room. On the table are small tin molds, six or eight inches long, four or five wide, and two or three deep, each containing a small cotton bag, with sufficient margin of cloth to form a double lap from each side. Here may be seen the operation of bag filling (Fig. 3).

The partly crystalized and lumpy fat is ladled into these molds until full, when the laps of cloth from each side are turned over upon the top, and the material inclosed. The bags contain about two pounds each, and after using once are carefully washed to avoid any taint or rancidity which might injuriously affect the butter. Our sense of smell being acute in some directions, we applied one of the bags to the nostrils. It was clean and sweet. This, though apparently a small matter, the proprietors of the establishment have not overlooked. The floor, indeed, and all the articles in use gave evidence of care and cleanliness, which is next to godliness.

When the bags are full they are put between sheets of galvanized iron and placed in the oil press (Fig. 4), which is a combination of the toggle joint with a closely cut thread screw, as shown in the engraving. The pressure is gradually applied to the contained fat, and there presently issues from the pores of the cotton a fine yellow oil, which drips into a receiving trough at the bottom of the press, and is afterwards dipped or ladled into ordinary galvanized iron milk cans.

It is this oil, olein, containing in solution more or less margarin and stearin, from which the butter is now to be churned, as we shall presently describe. This expressed oil has neither taste nor smell, and is a very pure article of olein. The residuum left in the bags is solid stearin, which, the proprietors informed us, is worth two or three cents per pound more than the ordinary stearic acid, and is used chiefly for candle-making.

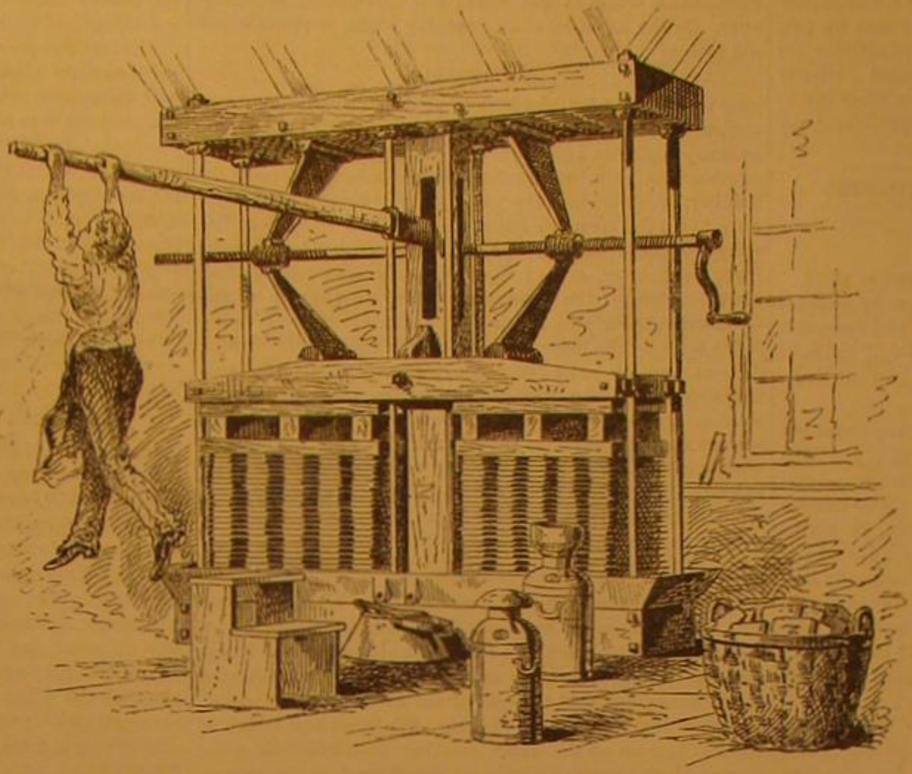
We now come to the last operations connected with the manufacture of the artificial butter, to wit, the churning (Fig. 5), which is the same as the ordinary churning of cream. The churns have revolving paddles, and the oil on being placed in the churns is mixed with one fifth of its weight of sour milk. The churning operation is continued for twenty minutes, when the compound has assumed the semi-solid condition of soft butter, which a slight diminution of temperature renders firm. The churns are worked in a cool chamber, rendered so by means of a reservoir of ice suspended overhead. The butter is now colored yellow by admixture of a little vegetable annatto, which is harmless, and after being salted is worked like ordinary butter on a working table, with a presser, as shown in the illustration (Fig. 6). The churning of the oil with the sour milk increases its weight from the absorption of water, so that three pounds of oil will make four pounds of butter. From one hundred pounds of suet, seventy pounds of butter are produced, twenty pounds of stearin, and ten pounds of scraps. The change from the liquid to the semi-solid condition is due probably to some molecular change or oxidation of the oil during the process of churning.

We tasted some of the butter thus made and prepared for the market. With the exception of a slight granular consistency, we could perceive no difference between it and good ordinary firkin butter. This peculiarity, it is stated, disappears after keeping for some length of time.

The butter made in this way can be afforded much cheaper than the ordinary article, but it must not be supposed that the cow's occupation is forever gone. Suet is an article the supply of which is limited, and it is only in large cities, or localities where beef cattle are largely slaughtered, that it will prove profitable to engage in the manufacture of this artificial butter. The company expect, we were told, to enlarge their works to the capacity of some twelve tuns of butter per day. This is only about one tenth the quantity daily consumed in the city of New York.

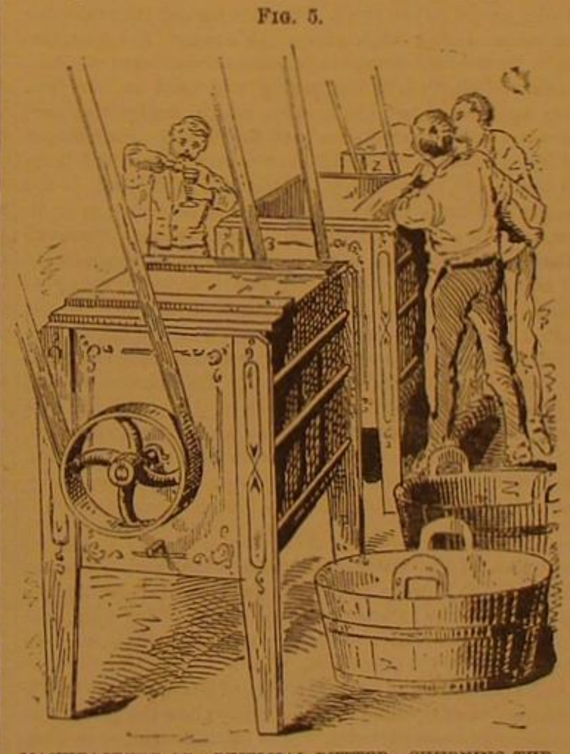
The butter made can be transported to and will keep in warm climates, owing, as before stated, to the absence of the readily putrescible compounds existing in ordinary butter. Shipments have already been made to South America; and as regards home consumption, it is said that hotels in this city, and even a fashionable club, are customers of the company for this artificial butter.

FIG. 4.



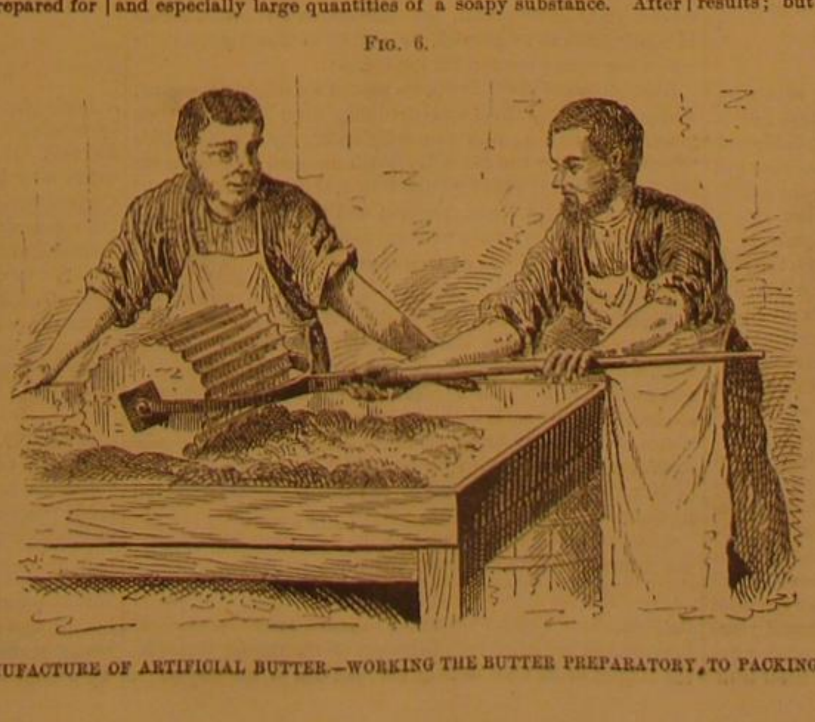
MANUFACTURE OF ARTIFICIAL BUTTER.—EXPRESSING THE OLEIN.

FIG. 5.



MANUFACTURE OF ARTIFICIAL BUTTER.—CHURNING THE OLEIN WITH MILK.

FIG. 6.



MANUFACTURE OF ARTIFICIAL BUTTER.—WORKING THE BUTTER PREPARATORY TO PACKING.

Preparation of Pure Chlorophyll.

"The plant used in my experiments," says F. A. Harsten, "was the ivy (*hedra helix*) which possesses two advantages; first, that it can be obtained at all seasons of the year; second, that it is very rich in chlorophyll. Beside this, the chlorophyll of this plant is not easily decomposed by such agents as light or alkalies. The leaves are chopped up fine and mixed with alcohol of 55° to a *magma*, which is pressed out after standing 12 hours. The object of this is to prepare the leaves for the action of the benzole. The alcohol extracts the water from the leaves and also the bitter principle (*hederin*) and especially large quantities of a soapy substance. After the alcohol has been removed by pressing, the leaves are mixed with benzole, and let stand for 24 hours, in which time the benzole extracts the chlorophyll. The benzole is now pressed and distilled off. The residue remaining in the retort is of a fatty nature and dark brown color. Three hundred grains of leaves furnish about 8 grains of residue which contains fat, chlorophyll, and a yellow coloring substance. This residue is boiled for 10 minutes with soda (80 grains of extract to 10 grains soda and 150 grains water). When cold it is filtered through 4 or 5 thicknesses of paper, and a dark green alkaline fluid obtained, while the insoluble fatty soap and the yellow coloring matter remain in the filter. From the green solution the chlorophyll soap and soluble fatty soaps are separated by common salt, or nitrate of soda, and the soaps washed with solutions of the same salts. After the soap is freed from alkali, it is dissolved in water and sulphate of copper added. In this way a beautifully colored powder is obtained, which contains chlorophyll oxide of copper and a copper soap. It is washed rapidly to remove all the sulphate of copper, and then dried. The dry powder is boiled with absolute alcohol and then washed with ether and benzole. These solvents remove all the copper soap and some of the chlorophyll compound. The chlorophyll oxide of copper which remains is suspended in alcohol and decomposed by a current of sulphuretted hydrogen. By exposure to the air, the alcohol evaporates, leaving the chlorophyll in the form of fine brittle grains of a dark green color, almost black. It is insoluble in water, but dissolves in alcohol and hydrochloric acid with a very beautiful green color. This green color differs, however, from the green of the leaves, since the latter is modified by the yellow coloring matter.

I have the following grounds for considering the chlorophyll free from fats: 1. It was dry and brittle; 2. On heating it, no smell of acrolein was produced; 3. It is easily soluble in alcohol and hydrochloric acid.

I have also prepared compounds of chlorophyll with lead and silver, but neither can be employed for preparing pure chlorophyll. The chlorophyll oxide of silver blackened easily in the light. The lead soap could not be removed so readily from the chlorophyll lead compound, by the use of absolute alcohol, ether and benzole, as the copper soap."

New Plan for Obtaining a Powerful Light.

Herr Edelmann, of Munich, has devised a very simple and satisfactory mode of obtaining a powerful light, well suited for photographic purposes, if the materials employed be judiciously selected. He has found that the oxyhydrogen flame produced from common coal gas and oxygen at ordinary pressure produces an intense light, of any desired color if, by means of it, we burn a mixture of picrate of ammonia with a suitable metallic salt.

To this end a hollow cone of hard gas carbon—similar to that used in electric lamps—is prepared of the following dimensions: Hight, one and three quarter inches; diameter, one inch, tapering to three quarters of an inch, and pierced by a tube tapering in the same direction from half to one quarter of an inch. This conical carbon tube is placed, narrow end down, upon an upright oxyhydrogen jet, the compound nozzle of which fits into the narrow end of the inverted cone of carbon. The oxyhydrogen jet is the usual kind of double tube, the coal gas issuing round the oxygen nozzle; and when the gases are ignited, they burn through the center of the cone, which then resembles a small carbon furnace one and a half inches in depth.

The number of these cones to be made corresponds with the number of intensely bright colored flames required. When the gases burn in the ordinary way, scarcely any light results; but in order to produce the desired effects, we spread over the inner surface of a cone, with a spatula, a paste made by rubbing together in a mortar picrate of ammonia, the metallic salt desired, and alcohol. The cones are then allowed to dry at ordinary temperature, and placed over the double tube when light is required. To produce the flame, the oxygen tube, which should be movable in a vertical direction, is raised as high as possible, the coal gas lighted, and the oxygen then turned on. By moving the oxygen tube slowly downwards, and regulating the gas supplies, the point at which the greatest brilliancy is produced can be readily ascertained. The light obtained is very intense and steady while it lasts.

If a white light be desired, sulphide of antimony or magnesium filings can be mixed with the picrate of ammonia; but if it be desired to use the light for showing on the screen metallic spectra, the chlorides of sodium yellow, thallium green, iridium blue, and calcium are most suitable; while Herr Edelmann finds that the chlorates or nitrates of strontium red, barium pale green, and copper deep green, afford the most satisfactory results. For photographic purposes the antimony would be most suitable, but it should be mixed with the picrate of ammonia with caution.

This plan of obtaining a powerful metallic light is specially recommended for illustrating some of the phenomena of spectrum analysis. At present it is usual to employ the electric light for the purpose of projecting spectra on a screen in order to exhibit them to a large audience. The cost and inconvenience of the electric light is, however, so great as to debar many from trying to exhibit these beautiful experiments. Edelmann now proposes the above plan for producing intensely brilliant metallic flames as a substitute for electric method, and states that he has succeeded perfectly in projecting the spectra on a considerable scale when using the very simple and inexpensive source of light above described.—*British Journal of Photography.*

LETTER FROM UNITED STATES COMMISSIONER PROFESSOR R. H. THURSTON.

NUMBER 11.

Brussels, September, 1873.

Leaving Berlin immediately after breakfast by express train, after a ride of four hours across a level and frequently sterile country, which is remarkably devoid of interest, we arrived at the pleasant and quaint old German town of

HANOVER.

Here we dined, and then spent two hours strolling about the principal streets and the noble park, and calling at the celebrated polytechnic school, of which our venerable and distinguished friend, Dr. Karmarsch, is the head. The curious architecture of the older buildings of the town, in which wooden framing with brick filling produce an odd and not unpleasing effect, contrast remarkably with the pretty cottages and fine modern residences which have been built in brick and stucco near the railroad station. Hanover is well known as the capital of the late kingdom of the same name, but is not less widely known as the birthplace of Herschel and the home of Leibnitz.

Resuming our journey toward Cologne, we were entertained by the conversation of an intelligent young Turk, whose place of residence was Constantinople, but who had left his home and his harem to see the great exhibition and to travel in Europe. We were pleased to learn that the women of his country are, at last, offered some opportunities of acquiring knowledge. There are twenty-four advanced schools for young women, in his native city, which are fully attended, the students being from fifteen to eighteen years of age. The seclusion of females is, however, quite as carefully looked to as ever, and our fellow traveller was greatly shocked and surprised by our accounts of the progress and of the aspirations of the strong-minded of the sex in the United States.

Crossing the Rhine on a fine specimen of a very bad kind of iron bridge, the lattice girder, the traveller finds himself in

COLOGNE,

or *Cöln*, as the Germans call the city. It is a curious old town, with exceedingly narrow and labyrinthine streets; but it contains almost nothing to attract the stranger, with the important exception of its great cathedral. This famous structure is well worthy of the reputation it has acquired, notwithstanding the fact that that it is still far from completion, although commenced six centuries ago. Its immense size and its symmetry of form, and the beauties of its architecture, make it probably the finest specimen of the gothic style in existence. The length of the building is something over 500 feet, its breadth 231, and the hight of the principal towers, when finished, will be 532 feet. The ridge of the roof is 250 feet above the pavement, the nave rises 165 feet, and the aisles 80 feet. No description can do justice to this magnificent and colossal pile; and only repeated visits and comparison with surrounding objects enable the traveller to obtain a just idea of its immensity. The gracefulness and the richness of gothic architecture are nowhere in the world, probably, more fully illustrated than in the cathedral of Cologne. The work of completion is now progressing rapidly, but the building has been so long in course of erection that the repairing of the decaying stonework of the earlier must accompany the labor of completing the later construction. The excursion up

THE RHINE

is always anticipated by the traveller in Europe with a degree of interest which is perhaps unequaled by that felt in any other part of his journeyings. And he is probably seldom disappointed. Our little party certainly was not, and the long sail from Cologne to Mayence, occupying the whole day, was one of extraordinary pleasure, while the return next day over the same route was hardly less enjoyable.

There is probably no point on the Rhine at which the natural beauties of the scenery exceed those of our own noble Hudson where it breaks through the Highlands at West Point; no part of the Rhine can equal in its picturesque and wild beauty those northwestern examples of fine river scenery, the Dalles of the St. Louis or of the St. Croix, and nowhere on the Rhine can be found any one spot of as great historical interest as many that might be named in Great Britain; yet it may well be asserted that in no other part of the world can the intelligent traveller and the appreciative observer of Nature find such a combination of these attractions, in one uninterrupted series, as upon this splendid German river, between Cologne and Mayence. Magnificent scenery of ever changing but never intermitted beauty, picturesque old ruins of castles, around which cluster the most interesting and important reminiscences of a thousand years of German history, and each of which is founded upon some promontory or craggy mountain side which itself is often the subject of an old and romantic tradition, or of some still more improbable but none the less interesting fairy tale, in which sprite or gnome or nymph lures an unfortunate victim to destruction or leads him to unimaginable bliss, are seen at every turn. Leaving Cologne, and passing Bonn, the noted *Sieben Gebirge* (seven mountains) rise into view, their rugged sides and ruined castles awakening in the traveller a sensation of mingled admiration, surprise, and interest which is not again lost until he reaches Mayence. On the one side, at an imposing hight, is the splendid old ruin of

DRACHENFELS,

near which Siegfried, the hero of that noble but sanguinary ancient German poem, the *Niebelungenlied*, killed the dragon so many centuries ago. On the other side is Rolandseck, another fine ruin, which has been rendered famous by Schiller, who here lays the plot of his "Knight of Gottenburg." In the river we notice the island in which was immured the beautiful girl who had supposed her long absent lover lost forever, one of the thousands who fell fighting the barbarians of the East; and above, on the top of the overhanging precipice which forms the river bank, is the castle built by the lover after his return from a long imprisonment, and where he spent the remainder of his life, looking down upon the roof which sheltered his lost bride. Farther on, the high rock *Erpelerlei* raises its basalt crest seven hundred feet above the river; and from top to bottom, wherever earth will lie and wherever terraces can be made to sustain them, it is clothed with a mantle of green vines laden with the wine-producing grape.

We pass the old city of

COBLENTZ

and, opposite, the immense fortification of Ehrenbreitstein with its four hundred guns and its immense range of outlying works. It is stated that this almost impregnable stronghold has sufficient storage capacity to provision 8,000 men for ten years, and that the cost of the fortification amounted to nearly ten millions of dollars. We pass the bridge of boats and go on up the river, meeting with beautiful gems of scenery and romantic ruins at every bend of the stream. We pass the extensive ruins of Rhinefels, and the beautiful remains of Rhinestein, the homes of the booty-loving and law-defying old robbers who, in ancient times, took toll of all who passed on the river. We pass around the projecting rock where, sitting high above the stream, the beautiful *Lurlei*, by her entrancing songs, draws the unfortunate fishermen resistingly into the raging whirlpool at her feet. Then we pass the two old castles, which, confronting each other, are called the "Mouse" and the "Cat." Near Bingen we see an island in the middle of the stream on which is an old tower, and, overlooking it from the river bank, is the equally old castle of Ehrenfels. Here, according to tradition, the rich and avaricious old Bishop Hatto (of Southey's ballad) stored his grain in the tower, and lived in comfort in his castle, while the people, far and near, were dying of famine. Holding his grain in expectation of a rich harvest of gold when the highest attainable price should induce him to sell, the miserly wretch finally removed, for safety, to the tower where he could better watch his treasure, as well as defend himself against the attack of the maddened people. He was there destroyed by an army of starving rats, which gathered from all directions to feast upon his stores, and to visit upon the wicked proprietor a righteous judgment. We pass

JOHANNISBERG,

the source of the finest of Rhenish wine, and, steaming along through a more level and less beautiful country, we gaze with intense interest upon the scenes which were, centuries ago, so attractive to Charlemagne, and which were so often visited by his successors.

At Mayence we find another bridge of boats, and we watch the operation of opening and closing, to allow the passage of vessels, with some curiosity. The rapidity and ease with which a section is dropped down with the current and swung out of the way is as remarkable as is the difficulty and the slowness with which it is hauled back into its place. Near the bridge are several *schiffmühle*, grinding away very busily, and, about them, are several small boats, either bringing grain to be ground, or taking to the city the flour which has been prepared for the market.

Some distance lower down, we passed a dredging machine, anchored in midchannel and dredging most effectively, its machinery driven, like the *schiffmühle*, by great paddle wheels turned by the current. With unusual reluctance we left this beautiful valley of the Rhine, the most fruitful of all regions of poetry and romance, and pursued our journey westward. A few hours were spent at

AIX-LA-CHAPELLE,

an interesting old town in which we found another of the the great German technical schools. With a splendid building, erected by private contributions of public spirited citizens, a fine corps of instructors, and a small but well selected and increasing stock of apparatus, and more than full of students, this school is doing its share of the important work which is so rapidly bringing continental nations into successful competition with Great Britain, in industrial pursuits. The current expenses of the institution are defrayed by the State.

Another moderately long ride by rail brought us across the frontier, and we made our next stop at

LIEGE,

Belgium, near which busy and pleasant city is the town of Seraing and the great establishment of the *Société Cockerill*, the largest of its kind in Belgium and one of the largest in the world. It was this Cockerill company which exhibited the immense blast furnace blowing engine, which, with their locomotive and marine engines, formed so striking a collection in the machinery hall of the great exhibition. The principal works are situated in the valley of the Meuse, six miles from Liége and upon a great coal formation which constitutes one of the principal deposits of Belgium. The works were founded by Cockerill Brothers, a half century ago, for the purpose of manufacturing steam engines and flax spinning machinery. The first blast furnace was erected in 1826.

The establishment now comprises four collieries, producing annually about 350,000 tuns of excellent bituminous coal, thirty iron mines from which are raised 150,000 tuns of ore per year, five blast furnaces yielding 55,000 tuns of pig iron, four new blast furnaces for the production of Bessemer metal, which are still unfinished, two iron and one copper founderies turning out 5,000 tuns of excellent castings, a rolling mill which turns out 40,000 tuns of rails and other sorts of rolled iron, a large steel works containing ten Bessemer converters and producing 17,000 tuns of steel per annum, a forge which has an annual production of 1,500 tuns, large machine shops employing 1,500 workmen, a bridge and boiler shop in which are built 6,000 tuns of boilers and bridges annually and, beside all this, the company has, at Antwerp, a large shipbuilding yard.

THE SERAING ESTABLISHMENT

covers an area of 200 acres, and employs 9,000 workmen. On the place are over 250 steam engines, having a collective power of 8,000 horses. Two millions of dollars are paid annually in wages, 350,000 tuns of coal are consumed, and the annual receipts from sales amount to five or six millions of dollars. This immense establishment has grown up from the small beginnings of John Cockerill and mainly through his energy and business capacity. The great engineer is now deceased, and the works are carried on by the "Société John Cockerill" among whom, it is said, is no less a personage than the King of the Belgians. The coal raised from the shafts within the works is of fine quality, and cokes well. The coking is done partly in ordinary ovens, and partly in Appold kilns, which are said to work finely. The coke is hard, clean, and bright, and seems capable of sustaining a burden nearly equal to that borne by the celebrated English Durham and Newcastle coke.

Pig iron for ordinary purposes is made, of very good quality, from ores of the neighborhood, but ores are imported from Spain and from England for Bessemer pig. Molding sand, fire brick, and fire clay are obtained from the neighborhood, and thus the principal part of the raw materials used in the works is obtained from deposits close at hand.

The castings made in the founderies are unusually smooth and clean. The work turned out in the machine and boiler shops is exceedingly creditable. An important feature of the practice here is the use of steel for nearly all moving parts of machinery. It has displaced iron almost entirely in forged work, and, to some extent, it is substituted for iron in even cast pieces. This introduction of steel has taken place here more than at any other place which we have ever visited, and the general success here met with may be taken as an indication of one of the directions in which improvement is going forward. The new steel plant will be expected to produce one hundred and fifty tuns per day of Bessemer metal. The riveting in the boiler and bridge work is, wherever possible, steam riveted. The work, in all departments, seems invariably well done, and is finding a market in all parts of Europe, and, to some extent, even in Great Britain and the United States.

The workmen are paid about three fourths as much here as in Great Britain. Molders receive about seventy-five cents per day, puddlers a dollar to a dollar and a half, pattern makers seventy-five cents, machinists from seventy-five cents to a dollar, riveters seventy cents, and foremen in the several shops from one to two dollars. A day's work is twelve hours, nominally; actually it is sometimes less and not infrequently more. A few women are still employed in the lighter kinds of labor.

The workmen of Belgium are probably more nearly equal in skill to the English mechanics with whom they compete than are those of any other European country.

R. H. T.

Solidification of Nitrous Oxide.

According to Wills, nitrous oxide may be easily solidified by causing a rapid current of air to pass through the liquified gas. Differing in this respect from carbonic acid, nitrous oxide may be kept liquid for some time in open vessels. Carbonic acid solidifies, as soon as it escapes from its containing reservoir, because the tension of the vapor of the solidified acid, even at the moment of its formation, is considerably superior to atmospheric pressure; while liquid nitrous oxide attains —133° Fah. and solidifies at —146°, so that the tension of its vapor is weaker than one atmosphere. The density of the liquid protoxide at 32° Fah. is equal to 0·9004; its coefficient of dilation is very considerable. It is insoluble in water.

A Correction.—In our article on "Specific Heat," on page 208, current volume, the expression (lines 45 and 46) "Specific heat at temperature 39° 1° (T)—1(C)," should read: "Specific heat at temperature 39° 1°—1; specific heat at temperature T—C."

In Saginaw county, Mich., a poor man named Relf, while boring a well, is reported to have been greatly frightened by the upward flow of gas, the escape of which shook the earth, produced a noise like thunder, and, when fired, shot up a flame fifty feet high.

Recovery of Silver from Cyanide Baths.

Dr. Graeger states that there are many methods of accomplishing this object; but none have been so easily carried out or have obtained enough of the silver as to be satisfactory. The process recently described by Ney, in which the silver was precipitated as a chloride by the addition of muriatic acid, had both these faults. The silver was not all precipitated, the subsequent treatment of the precipitate was not a simple one; and beside, the operation was attended with a strong evolution of prussic acid, which is extremely unpleasant to many persons, not to say dangerous to life.

"By accident," says Dr. Graeger, "I discovered a method of obtaining all the silver in a very simple and easy manner, and one that may be operated by persons who are not chemists. It is based upon an observation made by myself that cyanide of silver is perfectly reduced to metallic silver by grape sugar, provided the solution contains no free alkaline cyanides (cyanide of potassium or of sodium). The cyanide of potassium present is destroyed by adding a suitable quantity of a solution of green vitriol, which converts it into ferrocyanide of potassium. Then grape sugar will reduce the silver in the alkaline solution. In carrying out this method, the silver bath, which has become useless, is allowed to settle, and is then decanted into a large iron kettle, where it is warmed, and protosulphate of iron slowly added until a slight precipitate (oxide of iron) is formed, which does not disappear on stirring. It is next heated to boiling and made strongly alkaline by adding caustic soda or potash, if necessary; and a solution of grape sugar is then added gradually until the liquid acquires a brownish yellow color. The heat is now to be removed and the precipitate allowed to settle, after which the clear solution is removed by means of a siphon, and the sediment, consisting of metalic silver and oxide of iron, is thrown on a filter, washed, dried and ignited. This residue is then treated with nitric acid, which dissolves all the silver and but little of the oxide of iron. The very last trace of silver in the bath is thus separated and dissolved in nitric acid. To test this process, the following experiment was made: 0·85 gramme nitrate of silver was dissolved in 5 cubic inches distilled water, and chloride of sodium, sulphate of copper, sulphate of zinc, caustic soda and carbonate of soda added, together with enough cyanide of potassium to produce a perfectly clear solution. One third part of this solution was treated with a suitable quantity of sulphate of iron, heated to boiling, and the glucose added. The precipitate obtained, when treated as above and tested volumetrically with chloride of sodium solution, showed 0·238 grammes of nitrate of silver; this taken three times = 0·814 grammes instead of 0·85 gramme taken, or 84 per cent. A second experiment gave 94·5 per cent. These results are very favorable, especially when we consider that we were dealing with a solution containing only 4 parts of silver in 10,000 of water. It is a striking phenomenon that not a trace of the copper, which was purposely added to test this point, was reduced by the grape sugar."—*Polytechnisches Notizblatt.*

Recent American and Foreign Patents.

Improved Sheet Metal Roofing.

Edward C. Hegeler and Frederic W. Matthiessen, La Salle, Ill.—This invention consists in the employment of fine corrugations of the metallic sheets used in the construction of roofs, and for similar purposes, and the arrangement of the corrugations in the direction crosswise to the pitch of the roof, also crosswise to the length direction of the gutters, eaves troughs, etc. This fine corrugation may be made one eighth of an inch deep by half an inch in width, or in other proportions. It can be very fine and still allow by its curvings the expansion and contraction of the metallic sheet in the direction crosswise to the corrugation, and thus allow of the bending of the sheets transversely to the corrugation sufficiently to permit the use of the various modes of uniting the sheets of roofing now practiced.

Improved Mode of Attaching Journals to Feed Rollers.

George M. Amsden, South Boston, Mass.—This invention consists in making shafts with ends flaring conically outward, around which the rollers are cast. Screws and nuts on the shaft just beside the rollers draw the journals tight into the holes of the former in case they become loose through any cause.

Improved Doubletree Equalizer.

Wm. Martin, Clarence, Iowa.—This invention relates to double trees that are usually pivoted to the tongue of a vehicle or the end of a plow beam to allow a certain amount of vibratory movement. It consists in remedying the objectionable looseness on the beam or tongue and the want of a proper limitation of the motion of the said doubletree by extending rearwardly the place of the center bolt, and placing in front a friction device which holds the doubletree steady until a greater force is applied at one end than the other, and which, at the same time, regulates the extent of its motion.

Improved Bridge.

Benjamin F. Davis, Hearne, Texas.—This invention consists in a novel method of constructing the arches and chords of truss bridges by successive layers of planks nailed together, and at the extremities of banded and braced wedges.

Improved Adding Machine.

Solomon Pool, Chapel Hill, N. C.—This invention consists in the use of concentric circles with partitions between them, turning upon a revolving plate, around a common center; the circles divided into two or more sections, and the sections into ten spaces each, and so arranged that when an inner circle is turned ten spaces, it turns the next outer circle one space, by means of a drop catch falling through a graded opening in the partition between them, from the outer circumference of the inner circle, and catching teeth arranged on the inner circumference of the circle. The teeth are so graded as to allow the drop, working loosely when down in the opening of the partition, to slide over them when the outer circle is turned backward.

Improved Car Coupling.

Wm. H. Waddell, Lyttleton Waddell and John A. Lutz, Churchville, Va.—This invention consists in a spring-pressed lever in rear of drawhead, provided on one end with a foot piece by which the other end may be removed from over the link hook and allow it to rise; in a treadle and a grapple hook to hold the lever; in a grapple hook bar and trigger, so contrived that the latter lifts the former and allows a spring-pressed lever to turn back and lock the link hook; and finally in the combination of the essential parts so as to form an improved car coupling.

Improved Fruit and Egg Carrier.

Courtenay J. Simmons, Kansas City, Mo.—The invention consists in an egg or fruit carrier made of a series of rows of cardboard pentagonal cells, having their bottoms held thereto by a U-shaped clamp and fitted in obtuse angled recesses on the inside of the end pieces of frame.

Improved Porter's Box.

Isaac Barman, Portland, Oregon.—This invention consists in a box for the use of porters in stores, warehouses and similar establishments, the object of which is to provide a convenient place for the tools and materials used by them in their work. It has apartments, a receptacle for nails, stencils stencil brush, ink, etc., conveniently and compactly arranged.

Improved Steering Apparatus.

William E. Thomas, Queenstown, Md.—This invention relates to means by which rudders may be worked in steering ships, vessels, or boats, and consists in combining with the rudder a sprocket wheel, chain and reversely threaded screws rotating in opposite directions, also in connecting sliding the pinions with screws.

Improved Lemon Squeezer.

Edward M. Sammis, Babylon, N. Y.—This invention has for its object to furnish an improved lemon squeezer, so constructed that a whole lemon may be put into it and the juice expressed without its being necessary to first cut the said lemon, and which will prevent the juice from squirting out over the operator. The invention consists in the knife secured in the cavity of a lemon squeezer; in the arrangement of the knife in the cavity of a lemon squeezer in an inclined position; in the slit or notch formed in the knob or projection, and in side flanges which overlap the side edges and thus prevent the juice from squirting out.

Improved Lamp.

John C. Wharton, Nashville, Tenn.—This invention consists in the construction of a lamp in such manner as to interpose a body of water, or other incombustible fluid, between a small quantity of oil in contact with the wick and the main body of oil contained in a separate reservoir; also so as to supply the flame automatically with oil from said reservoir through the water to the wick: also, in certain cases, when a more complicated but safer lamp is desired, to isolate the oil contained in a suitable reservoir from all contact with any atmosphere whatever, thus preventing the possibility of ignition within the lamp.

Improved Combined Chair and Secretary.

George C. Taylor, Thibodeaux, La.—The object of this invention is to furnish a convenient piece of furniture for family or business use, which combines the advantages of an arm chair, secretary, writing table, drawers, etc., if used by a business man or invalid, with those of a work receptacle, scrap bag, needle and thread repository, etc., if used by a lady. The whole is portable, and may be easily moved to any desired place. The invention consists mainly in combining an arm chair with a case or secretary having movable pigeon hole arrangement, drawers, and folding leaves, with drawers under the seat of the chair, and casters on one side under the secretary to be lifted by the arms of the chair and rolled about.

Improved Coal Breaker.

Rufus A. Wilder, Cressona, Pa.—This invention consists in casting teeth on both sides of the rack plate composing the cylindrical breaker, so that the plate, when the teeth on one side are worn, can be reversed and used on the other side.

Improved Harvester Reel.

Charles F. Goddard, St. Ansgar, Iowa.—This invention has for its object to furnish an improved harvester reel, which shall be so constructed that the driver may conveniently adjust the reel bars, so as to bring leaning grain upon the platform. The invention consists in the reel shaft, made in two parts, provided with grooved and recessed flanged collars at their inner ends. The reel shaft is made in two parts, having flanged collars formed upon their inner or adjacent ends, the flanges of which are securely belted to each other. In the adjacent faces of the flanges are the reel arms which are bent inward at right angles, so as to enter a small disk placed in a cavity formed to receive it in the central parts of the flanged collars, which cavity is made larger than the disk, so that the said disk may be moved longitudinally in a recess with relation to the shaft. The inner part of the shaft is made hollow to receive a rod which passes through it, and to the inner end of which is attached the grooved disk. With the outer end of the rod is connected one end of a lever. The other end of the lever extends back into such a position that the driver can readily operate it with his foot to adjust the reel bars.

Collecting Dust in the Manufacture of White Lead.

Micaiah Tolle, St. Louis, Mo.—The object of this invention is to utilize the lead dust which escapes in white lead factories after having passed through the separator in which the corroded lead has been separated from the uncorroded lead, so that a considerable saving be accomplished, and the health of the workmen be protected against the deleterious influences of the lead dust. The invention consists, principally, in the combination of an elevator with a casing or spout, through which the uncorroded lead is conducted on the elevator, which is submerged in a tank of water, so that the lead dust carried down from the separator is retained therein, and the uncorroded lead carried up by the elevator.

Combing and Mixing Tampico and Bristles.

George Willett, Burlington, assignor to Enoch B. Whiting, St. Albans, Vt.—This invention consists of movable endless chain holders, to which the tampico and bristles are carried by endless belt carriers and so presented to said holders that they project about half their length or more from the side as they are carried slowly along past a comb, so arranged and operated that it combs out the projecting portions thus subjected to it. The invention also consists of a combination, in one machine, of two of these movable holders and combs with endless carrier belts so arranged that they take the partly combed stock from the first holders and comb, and reverse and transfer it to the second holders, so that the uncombed portion is presented to the second comb to be completed by it. The stock is laid on the endless carrier belts a little in advance of the holders, and spread and mixed as evenly as possible, so that it combs together. It may be run through the machine several times till the mixing and combing are satisfactory.

Improved Clothes Reel.

Dennis L. Huff, Bay City, Mich.—This invention relates to the horizontal revolving reels used for hanging clothes to dry; and it consists of an arrangement of the rods or braces upon the upper side of the arms to reinforce and protect the spider in which the inner ends of the arms are secured.

Improved Rotary Engine.

Francis J. Hollenweger, New Rochelle, assignor to himself, Joseph Martin, and Charles F. Spaulding, of New York city.—This invention relates to two steam chambers and a rotary piston arranged between them, having similar spiral cavities in their adjacent faces. The chambers are provided with passages for the induction and eduction of the steam, and with passages for conducting the steam from the inlet to the outlet, passing successively through the cavities, so as to retain the steam and cause it to act by expansion upon the piston, causing said piston to make several revolutions before said steam reaches the outlet. The steam, acting upon both sides of the piston, balances it and limits its friction. The chambers are provided with bolts to enable them to be accurately adjusted to faces of the piston, and with grooves for containing water of condensation for lubricating said faces and packing them steam tight.

Improved Combined Water Cooler and Filter.

William J. English, Providence, R. I.—This invention consists of a double cased filter with a dead air space between; also of a partition in the inner case, dividing it into two compartments—one for the ice and the water to be filtered, and the other for the filtered water, with a filter in the bottom of the former compartment, arranged in three divisions, through which the water passes successively, the first and last containing gravel, and the middle one charcoal. The filter is also arranged with a sloping top, against which the filtering substances pack by granulation, so that the water must pass through them.

Improved Machine for Sorting Potatoes.

David M. King, Garrettsville, O.—This invention relates to means whereby potatoes may be simultaneously screened and sorted; and consists in two inclined endless screens, the fine one arranged with its upper end projecting and sifting out only the dirt, while the latter is coarse and sifts out all the unmerchantable potatoes. It also consists in using cords and weights to operate with hooks in holding the bags.

Improved Letter Envelope.

John D. McAnulty, No. 177 South Ninth, corner of Fourth street, Brooklyn, E. D., N. Y.—This invention consists of a lock formed in the flaps of a paper envelope by a T shaped slit in one, and a dovetail-shaped tongue in the other, so contrived that by folding the tongue, inserting it in the slit, and then unfolding it, a practicable lock is formed, which, when sealed, cannot be opened without mutilating the envelope to such extent as to clearly show that it has been opened. An engraving of this device was published on page 390, volume 28 of the SCIENTIFIC AMERICAN.

Improved Machine for Making Window Sash.

James Travers, Roslyn, N. Y.—This invention is a device for facilitating the manufacture of window sashes; and consists in a guide for governing the position of the stiles and meeting rails of the sashes in sawing the dovetails and mortises for putting them together.

Combined Chest Protector and Shirt Bosom Support.

John A. Aston and Charles C. McMurphy, Leavenworth, Kan.—The object of this invention is to supply to the public a chest protector made of some stiff material, so that the same may serve also as a support to the shirt front, and not only keep the chest warm and comfortable but prevent also the ungainly folds and wrinkles of the shirt front. This invention consists of a piece of stiff pasteboard or other material covered by linen, flannel, or similar fabric, and suspended around the neck or otherwise applied to the chest.

Improved Tyre Tightener.

Milo E. Jacobs, Winnebago, Ill.—The object of this invention is to provide a device for tightening tyres, when cold, around the wheel without removing them, so that the same are fully protected and strengthened when in use. It consists of the tyre with two ends, so constructed that they are recessed to pass beside each other, and rest with face plates toward the fellies, to be tightened by means of a screw bolt passing through them.

Improved Manufacture of Dies for Punching.

Robert J. Mullin, Providence, R. I., assignor to himself and Michael R. Hanley, of same place.—The object of this invention is to improve the die used for the cold punching of nuts, washers, jewelry, etc., so that they are more durable, require less steel, and offer a greater punching surface. The present difficulty lies in welding the steel and iron parts of the dies together so that the face does not break off in hardening, or when working with it. The invention, which is intended to overcome this trouble, consists in welding the steel into the iron base, flush at the top and extending to within a short distance from the bottom, so that there is a greater depth of steel and greater strength, as the iron part surrounds the steel core.

Improved Machine for Dressing Wood Rails.

Horatio G. Angle, Chicago, Ill.—This invention consists of a small truck on ordinary wheels, and have lateral guide wheels adapted to run along the wood rails or stringers after they have been laid. Vertical and horizontal rotary planing tools are arranged in advance of the front wheels to plane the upper and inner surfaces of the stringers as the truck is moved along. The planing is gaged by the wheels of the truck, and the planing tools are operated by belts and pulleys in the ordinary way, driven by steam or by any power. The depth of the cutting on the upper surface is regulated by a vertical adjustment of the frame on the front track axle, and the adjustment of the vertical cutters for turning curves and the like is effected by a lateral adjustment of the frame at the rear relatively to the axle and wheels

Improved Eaves Trough Hanger.

Thomas F. Palm, Toledo, O.—This invention consists in one continuous wire, passing around and over the eaves trough, and which is provided with loops and fastened ends.

Improved Grinding Mill.

Ephraim H. Austin, Scott's Hill, Tenn.—This invention pertains to improvements in grist mills of the ordinary kind, having special reference to the means of feeding the grain to the spiral passages in the eye of the runner, and the means of connecting the water wheel, shaft and spindle of the runner.

Improved Turbine Water Wheel.

Angus A. Herriman, Greensborough, N. C.—The object of this invention is to so improve the gates and chutes of a water wheel that an unbroken sheet of water is admitted to strike the wheel without any space for expansion or break of the water, whether the gate be fully or partially open, so that thereby the greatest attainable percentage of power with a partially drawn gate is obtained. The invention consists in the arrangement of flexible wings or guide plates in connection with a circular sliding gate and the chutes.

Improved Windmill.

Ovett B. Knapp, Brandon, Wis.—This invention relates to that class of pumping windmills in which an oscillating regulator vane with automatic apparatus for working it so as to take the wind or not, and another to turn the wheel which has non-adjustable vanes edgewise to the wind for stopping it, are used; and it consists in having the oscillating regulator vane arranged below the shaft on which it is suspended and around which it oscillates, whereby it is made more sensitive to the effect of the wind, and is controlled better than when pivoted at the middle or above it.

Improved Sled Brake.

Peter Cable, Elizabeth, Ill.—This invention consists in the arrangement of a toggle lever having a rule joint and projecting arm or brace for attachment of the operating rod, whereby a dog pivoted to the runner may be caused to take into the snow, and is held in that position without continuance of the force necessary to apply at the outset.

Improved Corpse Cooler.

John Hoffman, Toledo, Ohio.—The object of this invention is to furnish, for the use of undertakers and others, an improved cooling and ventilating casket, through which a constant current of fresh cold air is supplied which carries off all gases of decomposition, conveying the same to the chimney, window, or other place, so that dead bodies may not only be preserved a greater length of time without difficulty, but also without causing annoyance by foul and putrid odors. The invention consists of a casket connected with ventilating pipes or tubes, and a cooler which sends a current of fresh air through apertures of the casket, the cooler forming at the same time one of the supports for the casket.

Inventions Patented in England by Americans.

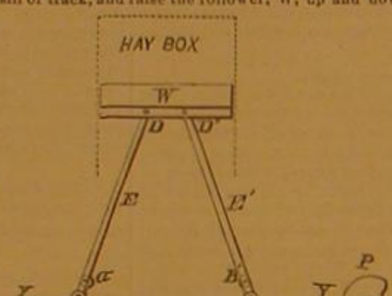
[Compiled from the Commissioners of Patents' Journal.]
From September 9 to September 18, 1873, inclusive.

AUTOMATIC VALVE.—G. L. Kitson *et al.*, Philadelphia, Pa.
BLAST FURNACE.—B. Ray, Hudson, N. Y., *et al.*
BRACKET.—J. B. Morrison, Brooklyn, N. Y.
BRAKE.—E. P. Jones (of Shell Mound, Miss.), London, England.
BRIDGE.—J. B. Eads, St. Louis, Mo.
BRIDGE.—J. B. Eads, St. Louis, Mo.
CLOCK CASE, ETC.—C. W. Roberts, Chicago, Ill.
COTTON SCUTCHING, ETC.—A. T. Atherton, Lowell, Mass., *et al.*
DIAMOND CUTTING MACHINE.—I. Hermann, New York city.
ENGINE VALVE.—W. J. Stevens, New York city, *et al.*
FEED WATER INDICATOR.—A. S. Goodrich *et al.*, New York city.
HECKLING MACHINE, ETC.—J. Rinek, Easton, Pa.
MAKING FERTILIZER, ETC.—J. J. Storer, Boston, Mass.
PAPER BAG.—E. J. Howlett *et al.*, Philadelphia, Pa.
PUDDLING PROCESS AND FURNACE.—W. Sellers, Philadelphia, Pa., *et al.*
RUBBER TUBING, ETC.—C. Righter, New York city.
SCREW PRESS.—G. P. Boomer (of Syracuse, N. Y.), London, England.
SCREW VALVE.—P. Corrigan, New York city.
STEAM BOILER AND CONDENSER.—B. T. Babbitt, New York city.
TELEGRAPH PAPER, ETC.—T. A. Edison, Newark, N. J.
TOY.—T. Alexander, Washington, D.C.
TRANSMITTING MOTION, ETC.—T. A. Weston, Ridgewood, N. J.
TRAVELING SIDEWALK.—A. Speer, Passaic, N. J.
WINDMILL.—A. P. Brown, New York city.
VENTILATING AND PUMPING.—G. W. Richardson, New York city.
WASHING MACHINE.—T. Bell, Catskill, New York.
WEIGHING SCALES.—S. Harris, Philadelphia, Pa.

Business and Personal.

Notes & Queries

C. C. says: I have a hay press which works in the following manner: E and E' are levers with track wheels at the lower end, C and C', which roll on X Y as a sill or track, and raise the follower, W, up and down



in the hay box. A chain is fastened to a pin in the side of the track, H, then passes over a pulley at B, thence over a pulley at A, thence over a second pulley at B, thence over a second pulley at A, thence to the power, P. A power of 1,600 lbs. is pulling on the chain at P; what will be the pressure on W, when the levers are 3 feet farther apart at the bottom than at the top? The levers are 8 feet 8 inches long. What power is gained by the 4 pulleys when one end of chain is fixed as above? [Problems involving the principle of this machine have been solved in our paper on several previous occasions. But as this is rather an ingenious combination, perhaps some of our readers may like to work it out.—Eds.]

E. C. M. proposes the following problem: A hemisphere has its base fixed in a horizontal position, and a body, under the influence of gravity, moves down the convex side of it from the highest point. How far from the base will the body be when it leaves the surface of the hemisphere? [This is a very interesting problem, which we throw open to competition among our readers, as we judge it will be more profitable for them to answer the question themselves, than to read our solution. It will be necessary to assume some force acting which will impel the body down the surface of the hemisphere with a given velocity, as it is evident that, if the body were balanced at the highest point, it would remain at rest.—Eds.]

W. J. asks: Is there any kind of gas that will cause iron to rust, or to form a hard coating on it in 12 or 24 hours?

W. J. B. asks: How can I prepare umber from the crude earth?

W. asks: How is silk numbered? Woolen yarn is in runs of 1,600 yards to the pound, that is, 10 runs yarn is 10 times 1,600 yards to the pound: cotton is in hanks of 840 yards to the pound, so that No. 100 cotton is 100 times 840 yards to the pound.

Z. Y. asks: Will some one please explain the best way to make a wagon wheel?

G. C. McC. asks: How can I enamel bricks so that they will not take in water from the outside of the wall?

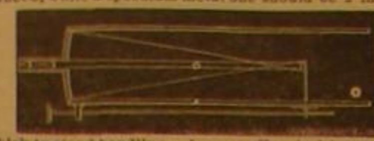
C. M. N. asks: How can I make out the dates on worn coins? I am aware of course of the use of the microscope, but is there not something else?

Answers to Correspondents

E. B. H. will find information for making a microscope on pp. 276 and 298, vol. 27.—F. W. P. can make linseed oil varnish by following the directions on p. 150, vol. 28. The lifting power of balloons is detailed on p. 89, vol. 25.—J. C. W. should consult a local geologist. We do not know the nature of the soil in which the tree was found.—J. P. J. will find directions for making hard rubber on p. 278, vol. 28. Type metal is composed of lead, tin and antimony; it can be readily cast in a plaster of Paris mold.—J. C. G. can make his blackboard by following the directions on p. 299, vol. 28. —G. T. H. will find the explanation of time around the earth on p. 401, vol. 28.—J. H. W. will find that the three formulas are the same, and it matters not which form he uses. Muspratt is undoubtedly correct.

D. asks: What is mildew on textile fabrics? Can it be removed, and how? Answers: 1. Mildew consists of microscopic fungi, the growth of which is produced by moisture and a close atmosphere. 2. A remedy for mildewed linen is as follows: Soap the surface of the articles well and rub into them, while wet, finely powdered chalk.

S. D. E. says: I want to construct a 15 inch reflector in this wise: First, I make a reflector of cast iron, and a grinder to match, and grind the surfaces to a proper curve: then I tin the reflector over, and put a sheet of pure nickel, say one thirty-second of an inch thick, between the shell and grinder, and heat till the tin flows. When cold, I grind till the two meet all over, coat with pitch, and polish. Will this make a good reflector? If so, what should the focal distance be of the above size and how large must the small reflector be? Gregory's plan (see illustration) was to reflect the light back through a hole in the large reflector. Is this plan the best? If not, what is? I want to construct the instrument in the most approved manner. I can easily polish a reflector, but cannot make a refractor. By making the base of cast iron it need not be over ¼ inch thick, if ribbed, while a speculum metal one should be 2 inches



thick to stand handling. Answer: You had better polish the iron, and nickel plate it after you get a good figure. The Newtonian plan is most convenient. The diagonal mirror reflects the cone of rays at right angles to the eyepiece at the side of the telescope tube. Your previous inquiry was answered on page 139 of our current volume.

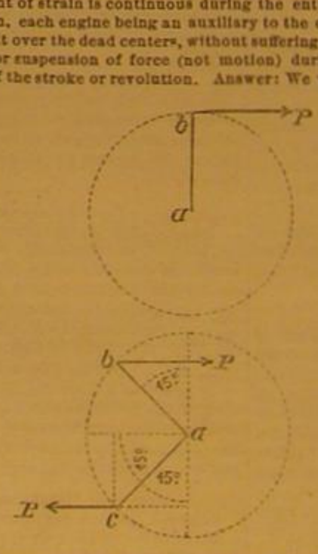
J. W. asks: Is there any liquid which will take blots or writing off paper without spoiling the appearance of the paper? Answer: Try a strong solution of oxalic acid, applied with a camel's hair brush. Heat the solution if possible before using. Oxalic acid is a poison.

G. G. asks: What is a cheap and durable mode of putting gilt or silvered lettering on glass to have it look neat and tasty? Answer: Glass can be gilded or silvered by blending powdered gold or silver leaf with gum water and a little borax and applying the mixture, or painting the letters on the glass by means of a camel's hair pencil. The article is then heated in an oven or furnace to burn the gum and vitrify the borax, which cements the gold or silver to the surface. It is afterwards polished with a burnisher.

J. B. P. asks: How can I increase the draft of my furnace? The boiler has 39 three inch tubes; smoke stack is 24 inches in diameter and 40 feet high. Would an addition of 5, 10 or 15 feet, to hight of stack, help it? Would a blower introduced into smoke stack above the flues be of use? Answer: Apply your blower in the usual way, below the furnace.

W. D. N. says: I am not satisfied by your answer to Y. E. about his engine and shaft. If, as you say, a shaft were just strong enough to transmit 12 horse power, of course the thirteenth horse would be the feather that would break the camel's back. But I claim that twice (approximately) the power may be transmitted without endangering the shaft, provided it be ample to bear the strain of 12 horse power. By referring to the diagram it will be seen that the crank B and connecting

rod D are at a right angle, at which point (if I comprehend you) is the maximum moment of strain. The crank, C, and connecting rod, E, are nearly on the back center, and consequently are exerting no particular force at all. But as soon as that cylinder takes steam, C and E begin to exert a twisting or wringing force upon the shaft A; increasing it until they reach the point occupied by B and D. In the meantime, B and D have been relaxing their force as fast as C and E have increased theirs, and at the same time; therefore it follows that the shaft is not endangered because the force is no greater at any point of stroke, but more power may be transmitted for the reason that this same maximum moment of strain is continuous during the entire revolution, each engine being an auxiliary to the other to assist it over the dead centers, without suffering a relaxation or suspension of force (not motion) during any part of the stroke or revolution. Answer: We will try

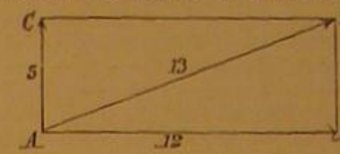


and make our meaning plain, by the aid of the accompanying diagram. In the case of the single engine, exerting a pressure P on a crank a b, supposing, for the sake of simplicity, that all the positions of the connecting rod are parallel, the maximum twisting moment is P×a b. Now add a second crank, at right angles to the first, with same pressure P on the second crank pin and the position of maximum strain, or the point at which the greatest twisting moment is exerted, will be as represented in the sketch, when each crank is 45° from a vertical position. In this case, the twisting moment is $P \times a\,b \times \cos.\ 45^\circ + P \times a\,c \times \sin.\ 45^\circ = P \times a\,b \times 2 \times \sin\ 45^\circ = P \times a\,b \times \sqrt{2} = P \times a\,b \times 1{\cdot}413$. Hence the maximum strain in the second case is 1·413 times as great as in the first.

C. H. H. says: I am running a 9x14 engine in a saw mill, driving a 60 inch circular saw with a 30 inch top saw. Sometimes the piston rod makes a grating noise in the stuffing box; at others, it runs still. I have partly overcome the trouble by raising the ways. What is the cause? Answer: The trouble may be caused by leaks, for want of oil, or because the engine is out of line. It would be necessary for us to make an inspection, before giving a decided opinion.

J. E. H. asks: 1. What is the philosophy of hardness, that is, what is there about one substance that makes it harder than another? 2. Let iron and steel be the substances: why is it that, by heating iron and plunging it into cold water, it will harden the iron? 3. How many elements will fire take out of wood? 4. Will light pass through common window glass faster or slower than, or in the same time as, through the atmosphere? Answers 1. Hardness is the quality of bodies by which the molecules maintain their relative positions when a force is applied. One substance is harder than another, when it takes more force to disturb the position of its molecules. 2. When a metal is hardened by being tempered, it is supposed that a different arrangement of the molecules takes place. 3. Wood contains water, carbon, oxygen, and from 1 to 5 per cent of ash. When the wood is burned, all the constituents, except the ash, combine with the oxygen of the air. 4. Light passes through glass more slowly than through the air.

E. C. M. says: A force, A B, acts at A in the direction east, while A C acts at same point, A, in the direction north. By the familiar laws of the parallelogram of forces, these two forces, relatively 5 and 12, acting at right angles, produce the resultant 13, which



we are taught in works on mechanics is equivalent to the components 5 and 12. This we can admit in the sense of equal in effect, but as indicating measure of force, 13 is not equivalent to $5+12=17$, evidently. What has become of this force 4, which appears in components and not in the resultant? Answer: It is well known that if we apply a force to produce motion in a given direction, only so much of that force as acts in the required direction tends to produce motion. The rest of the force is, in general, apparently lost; but in reality, it is converted into something else. For instance, suppose that pressure is applied to a pump handle in a direction oblique to its axis; then some of the force either compresses the fibers of the handle, in which case it is converted into heat, or it produces greater pressure on the pivot of the handle, when it appears as friction. Take the case given in your illustration, and suppose that a force of 13 acts obliquely on the pump handle: it may be replaced by two forces, one of 12, at right angles to the axis, tending to produce motion, and another of 5, in the direction of the axis, producing end pressure. Here we have replaced a force of 13 pounds by two forces having a volume of 17 pounds, and it may be asked, how did we obtain the additional four pounds? But the answer to this question is, quite evidently, that we gained pressure by making the force act in a different direction, and that all the apparent gain was counteracted by the fact that part of the increased force acted at right angles to the direction of the motion.

F. L. S. says: A book tells that "the area of a circle is found by multiplying the circumference by half the radius." Elsewhere it says: "It follows, then, that the area of a circle is equal to the square of the radius multiplied by the circumference, or 3·1416." It seems to me there is great difference between the half radius and the square of the radius. There must also be a great difference between the circumference and the ratio between circumference and diameter. The number 3·1416 I take to be the ratio. Can you explain this? Answer: The circumference of any circle is equal to the product of the diameter and the ratio of the circumference to the diameter, which latter is constant for all circles, and is expressed approximately by the number 3·1416. Hence the second rule, as quoted by you, making the circumference of any circle and the number 3·1416 synonymous, is wrongly expressed. The number 3·1416, besides representing the ratio between the circumference and the diameter of any circle, is the circumference of the circle in the particular case in which the diameter is equal to one. You can readily correct the rule, by inserting, after the term "circumference," these words: "of a circle whose diameter is unity."

W. H. Y. says: In your answer to T. O'N., you say: "When transmitting power with a quarter turn belt from one horizontal shaft to another, also horizontal, at right angles to it, guide pulleys are generally employed." Not so if said shafts are directly over one another, or at any reasonable distance, providing the receiving side of pulley be in a line with the delivering side. Answer: The case you mention is a special one, and does not militate with the statement that in general guide pulleys are employed. We are glad, however, that you have called attention to the matter; and it would have been better if we had mentioned the exceptional case in our answer.

S. M. asks: In the case of a cast iron plunger, about 3 inches long and ¾ inch in diameter, having to work perpendicularly, how will it do to have the hole in which it works cast large, and fill in Babbitt metal around the plunger to make it work steadily? Will it work true and run well if not oiled? The plunger is flat on one side of its section. Is there any other composition that would do better? Answer: The device mentioned by our correspondent has been tried with satisfactory results.

E. M. K. says: On page 362 of volume XXVII, C. E. G., tells D. G. N. to use a butterfly valve on his engine. We are running a 25 horse power engine at 75 revolutions, belting on to 52 feet of 2 inch line shafting, and thence to a saw mandrel. When we are sawing wide boards (with a 52 inch saw) the governor does not let steam on quick enough. Why cannot we use a butterfly valve on it, and let our saw run well, instead of slacking down in the log from 12 to 24 inches? We use the same engine to run a grist mill with—4 run of stones, 2 grinding wheat and 2 corn. The saw mill stands still when the grist mill is running. I have been thinking of putting a string on the rod that carries the pea that steadies the governor so as to open the governor quicker. Will it work, and will the butterfly valve work on this engine? The balance wheel weighs about 3,600 or 4,000 lbs. Answer: There are governors in the market with valves that will give full opening. The butterfly valve, arranged as you propose, is often used.

B. W. asks: Will wire rope wear well in suspending clock weights? Answer: We think you will find it very durable.

W. R. A. asks: Would a boiler 5 feet long by 14 inches diameter be large enough to drive an engine inches bore x 4 inches stroke? If not, what size would it require? Would such an engine drive a boat 16 feet long, 3 feet wide and 2 feet deep, and at what rate? Answer: You will find general directions as to boiler proportions in answers to previous correspondents. It is impossible to answer questions of this kind, unless more data are sent.

S. A. T. says: 1. What will make a soft waterproof varnish for muslin, one that will not crack? I have constructed an umbrella with 7½ feet ribs, making a diameter of 15 feet; it is covered with muslin, and I wish to varnish it. 2. Can you give me the recipe for Worcestershire sauce? Answers: For a waterproof varnish, take of India rubber 1½ ozs., bisulphuret of carbon 1 pint; digest in the cold until the solution is complete. Or take linseed oil 1 gallon, dried white copperas and sugar of lead, each 3 ozs., litharge, 8 ozs.; boil with constant agitation until it strings well, then cool slowly and decant the clear portion. If too thick, thin down with quick drying linseed oil. 2. We have never made any chemical examination of this article to determine its composition. Recipes will be found on pp. 249 and 281, vol. 26.

A. J. C. asks: Can water be carried over a hill 50 feet high with a siphon, or can it be raised any higher with a siphon than it can be raised by suction? If a siphon were laid over a hill 50 feet high and filled with a force pump, and the pump removed, would the water run out, or would 33 feet perpendicular hight of water remain in the tube with a vacuum in the tube above, provided the tube was perfectly airtight? Answer: The difference of level between the highest point of the siphon and the level of the water that supplies it must never be more than the hight to which the water will rise, by the pressure of the atmosphere, in a vacuum.

S. M. L. asks: 1. Of what material should I make a pair of rollers for drawing stalks between? The drawing will make considerable friction. Should they be of iron or wood? Would wooden rollers, with a covering of belting or rubber, be preferable to either? 2. The stalks being of unequal size, it is desirable to have the rollers fitted in rubber sockets, so that they will open for large stalks and close on small ones. This would prevent me from having the rollers connected by gear wheels. Would the friction of one roller upon the other be sufficient to draw the stalks through? It is not my object to have the stalks crushed. 3. These rollers being about four feet from the driving power, can I derive the same desirable effects from the rollers by having them driven by a small belt or endless chain as I would by having them driven by gear wheels? 4. Would I derive any benefit by using a fly wheel on the rollers? 5. In preparing a model for the Patent Office, is it necessary that the model be made of the same material that it is designed to construct it of in manufacturing for general use? Or may brass or other soft metals be used instead of iron? Answer: 1. A very common way of effecting this object is by means of cast iron rollers having projecting teeth, which catch the stalks. 2. Rollers which open, driven by gearing, are in use on many clothes wringers. 3. A belt would probably give the best results. 4. We think not, but could not answer certainly without knowing more about the proposed machine. 5. A model for the Patent Office may be made of any convenient material.

N. S. A. asks: Does frost or hoar frost ever form if the mercury stands at any point above 32° Fah.? Answer: Hoar frost is frozen dew, and is never formed at a higher temperature than 32° Fahrenheit. It is true, however, that a thermometer placed in the vicinity might mark a higher temperature, because frost is sometimes formed by rapid evaporation of moisture from the surface of the ground, so that the temperature is lower than that of the surrounding atmosphere. But if some of the frost were collected and placed on the bulb of the thermometer, it would cause the mercury to fall to 32°.

W. W. McC. asks: How are iron, copper, and brass pipes bent for use on locomotive engines, such as for pumps, injectors, sand, heater and blower pipes? Are they bent hot or cold; and if cold, are they filled with anything, such as resin, solder, or lead? Answer: Small copper pipes are generally filled with resin, and bent without being heated. Curves in large copper pipes are formed by hammering the separate pieces before they are brazed together. Small wrought iron pipes can be bent by heating them and applying pressure carefully. They are not generally filled with anything. Large iron pipes of special form are generally made of cast iron, from patterns.

T. W. H. asks for a correct rule for figuring the amount of power from a given number of cubic feet of water, the fall being also given. Answer: Let Q=number of cubic feet of water discharged per minute, h=hight of fall, measured vertically, in feet. P=horse power of the water. $P=(Q\times h\times 62{\cdot}5)\div 33{,}000$, or the horse power of the water is equal to the product of the quantity of water discharged per minute, the hight of the fall, and 62·5, divided by 33,000. Example: What is the power of a water fall, 10 feet high, discharging 50 cubic feet of water per minute? $P=(50\times 10\times 62{\cdot}5)\div 33{,}000=0{\cdot}947$ horse power. All this power cannot be realized by the application of a hydraulic machine, but an amount, varying from 15 to 80 per cent of the whole, will be lost.

C. D. asks: How is iron, such as porcelain kettles, etc., enameled? What are good books on the process? Answer: Iron vessels are enameled by first cleaning with dilute sulphuric acid; the porcelain mixture is then applied in the form of a paste consisting of calcined ground flints, borax and potter's clay; and when this coating has set or become firm, the enamel is sifted over the surface, and then fused in a furnace. For details, consult Tomlinson's "Cyclopædia" and the article on enameling in Brewster's "Edinburgh Cyclopædia."

D. G. H. asks: 1. Is there an easy and thorough method of curing membrane, such as bladder, so that it will be dry, soft, tough, inodorous and durable? 2. I have read in your journal of a new substance, harder than asphaltum, for covering roads. Can you refer me to it? Has any trial been made of it in your city, and with what result? How will it do for cellar floors? 3. What is fuchsin? Answer: 1. There is no easy process. The best method, probably, is that for preparing goldbeater's skin, which is tedious and difficult. 2. "The Coming Pavement" was published on page 16 of our present volume. 3. Fuchsin is a brilliant red color made from coal tar. See page 73 of our volume XXIV.

J. M. asks: 1. Can a wire rope be employed as a belt to run over two pulleys of 16 and 40 inches diameter, respectively, making the 40 inch revolve 50 or 60 times a minute, so as to be trustworthy? 2. How should the pulleys be made? Answers: 1. Yes. 2. Consult a manufacturer.

W. C. A. asks: What gives to Russia leather its peculiar finish and smell, and what kind of skin is used? Does the odor proceed from some article used in the process of tanning or dressing? Why is it not manufactured in other countries as well as in Russia? Answer: Russia leather, known as *juchten*, has long been esteemed for its valuable qualities of resisting moisture and the attacks of insects. Russia was long the only country that produced it, but it has lately been made in Paris. Its odor and peculiar qualities are attributed to the oil of birch bark with which it is impregnated after tanning. In Russia this leather is manufactured from all kinds of skins; but in Paris only sheep and goat skins are used. The method of preparing this article is not very generally known out of the seats of manufacture, but the following details will give an insight into the process: The dried skins are softened by soaking in water for five or six days in summer, ten or twelve in winter, and then well cleansed and deprived of their hair, by steeping in milk of lime. During the steeping the skins are frequently examined; and when the hair and epidermis are detached, they are worked upon the beam with knives. The hair is removed from ox and cow hides by piling them upon one another and thus inducing fermentation. For more delicate skins, bran water baths are sometimes used. The usual steeping and heating, etc., are afterwards given, and then the clean skins are introduced into a vat, holding a fermented menstruum of rye, oatmeal, salt and leaven. These are left here for 48 hours or longer, until raised. The tanning process is then begun by first steeping the skins in an infusion of oak or willow bark, and afterwards they are interstratified in a tan pit with layers of coarse willow bark, and charged with the liquor of the last steep. Fresh bark and solution are substituted for the exhausted material, every fifteen to twenty days, and from three to six such changes are required, according to the thickness of the skins. Very thin skins get but two. After this tanning process, the leather is immersed for a day or two longer in a thin paste of oatmeal, salt and water to remove its rigidity, and then cleaned and allowed to drain. The currying then begins. The moist leather is placed, grain side downwards on a table and treated with a mixture of oil from sea calves and that distilled from birch bark. One part of birch oil and two parts of the other is the standard composition. About 9 ozs. of the mixture are used to each medium sized skin, and it is laid on carefully in a uniform and entire coat. The skins are then stretched upon cords in an open shed and left so till dry.

B. F. W. asks: Is there any way of dissolving gum benzoin so that it will mix with linseed oil? 2. Is there any way to harden the surface of common window glass? If so, how is it done? Answer: Gum benzoin will only dissolve sparingly in linseed oil. Digest the gum in the oil with frequent stirring. 2. There is no method, that we are aware of, of making the surface of window glass any harder than it ordinarily is, yet preserving its transparency.

P. O'B. asks for a formula for preparing adhesive mucilage. Answer: The ordinary mucilage sold at the stationers is far inferior to the old fashioned solution of gum arabic. This mucilage seems to be a solution of dextrin or British gum. Dextrin is formed by the action of dilute boiling acids, or by an infusion of malt at about 160° Fah., on starch. It is also formed when potato starch is exposed to a heat of about 400° Fah. You can make gum dextrin, on the large scale, by observing the following process and proportions: Malt (crushed small) 1 lb., warm water 2 gal., mix, heat the whole to 145° Fah., add potato starch 5 lbs., raise the heat to 160° or 165° Fah., mash for 25 minutes, or until liquid becomes thin and clear. Then instantly run off and raise to boiling point to prevent formation of sugar. After boiling 3 or 4 minutes, filter and evaporate to dryness by steam heat. There are various other processes, but we cannot determine whether you could make a reasonable profit by manufacturing.

J. F. asks: Can a man give power enough to saw cord wood by a cog wheel with 120 cogs on which is a crank, a pinion wheel with 18 cogs, and a balance wheel 60 lbs. in weight, with a wooden wheel 4 feet in diameter for a drive wheel, with a belt attached driving the saw, the pulley on the saw shaft being 7 inches diameter? Answer: Yes; but as there is always a loss from friction, etc., with every connection, he can probably do better with the old fashioned buck saw and horse, if he is sound in the back.

M. L. L. says: When we see a chain of lightning pass from the clouds to the ground, say at a distance of four miles, we feel no jar until we hear the report. What is it that causes the jar and makes the windows rattle? Is it caused by the sound passing through the air, or is it caused by the electricity coming in contact with the earth? Answer: The jar that you speak of is probably due to the disturbance of the air.

E. P. M. asks: What are the inside dimensions of a square box flume, one mile in length, to be placed under ground and capable of carrying from 1,000 to 1,200 or 1,500 inches of water, it being fed from a reservoir giving eight feet head? Will the pressure of water in the reservoir overcome the friction in the pipe so as to give an outlet to the water on a level with the bottom of the reservoir? Answer: You do not furnish enough data to enable us to determine the size of the the box. In our article on "Friction of Water in Pipes," on page 48 of our current volume, you will find information as to loss of head. The box should be set so as to preserve the level or fall.

A. L. R. asks: 1. Does not an inside cylinder locomotive draw a passenger train more steadily than an outside cylinder engine of the same size? If so, is not an inside cylinder engine better as a passenger locomotive? 2. What good book would you recommend on locomotives? Answer: 1. We think not. 2. Weissenborn's work, now in course of publication.

A. M. asks: 1. Can I braze or solder brass to brass? If so, what kind must I use? 2. Is there any book published that will give me an idea about breech-loading rifled cannon and small arms? Answer: 1. Use spelter solder and sal ammoniac. 2. The specifications and drawings issued at the Patent Office are divided into classes, and those of any class are sent for ten cents each. Breech loaders are in class 18. We cannot advise you as to a trade in your locality.

E. T. L. asks: Where a book of recipes is compiled from various sources, and few if any of the recipes, processes, etc., are original, does the copyright of such a book protect it from being published in part by others, or prevent others from copying from it? In other words, what does the copyright cover in such a case, the whole book, the arrangement, or only the title? Answer: Matter which has already been published cannot be protected by copyright. The copyright of such a book as you mention would cover the title and the original matter only.

W. A. B. cannot remove the scale from his boiler. Answer: Send us a specimen of the scale.

W. S. P. asks: 1. If an engine of sixteen horse power be applied to pump atmospheric air into another engine of same dimensions, will the engine No. 2 which is worked by air have the same number of horse power as engine No. 1? 2. If so, what temperature will the air be heated to while undergoing such pressure between the two engines? 3. If the air be exhausted in a large pipe or tunnel, 4 feet in diameter and 100 yards long, open at the end furthest from the exhaust, what would be the temperature in any part of the pipe or tunnel? 4. Will compressed atmospheric air work a concentric rotary engine? Answers: 1. No. 2. You will find a table of temperatures due to pressure on page 155 current volume. 3. This question could not be answered without knowing the size of the compressing cylinder. 4. Yes.

P. J. T. says: What are the proper dimensions of a boat to run with an engine 3¼ x 4 inches? Please state diameter and pitch of screw wheel. 2. What sized boiler is best suited for the same? Answer: 1. Boat from 25 to 30 feet long. Screw from 1½ to 2 feet in diameter, 3 feet pitch. 2. Boiler with about 100 square feet of heating surface.

H. A. F. asks: How can I cure a dog that is troubled with a humor or vermin, I hardly know which? Answer: Your animal is probably suffering from mange. Administer flowers of sulphur internally, and wash externally with carbolic soap.

T. R. F. asks: Can any of the readers of the SCIENTIFIC AMERICAN inform me where anhydrous sulphuric acid (SO_3) and nitric acid (NO_5) can be seen? Answer: We have no doubt that Professor Chandler of the School of Mines, Columbia College, would give our young correspondent an opportunity to see what he wants in the fine laboratory of that institution.

C. E. asks for a description of the vulcanizing process. Answer: A full description of the vulcanizing process would be too lengthy for this place. It consists in combining sulphur or the mineral sulphurets with India rubber. The discovery of the singular action of sulphur on caoutchouc was made by Charles Goodyear, of New York, in 1842. See specifications of patents of Charles Goodyear, 1842, and of Thomas Hancock, England, 1843.

W. F. H. asks: Is cider boiled in an iron kettle injurious to the health? If sweet cider be brought to the boiling point, then skimmed and strained and barreled up tight, will it keep sweet during the summer? Answer: We would not risk boiling cider in an iron kettle, either as regards health or for the purpose of preserving it. Boiling would cause its change to vinegar more quickly than anything else. We will give you a process which has proved successful, but which the trade may consider trade secrets. To 1 barrel of new cider, add ½ part sugar and 2 handfuls of fish sounds to clarify. Let stand 2 weeks in cool place, then rack off into a well washed cask or barrel, and add from 1 to 2 dozen whites of eggs; let stand another two weeks, and then rack off into another barrel. Add finally 2 gallons of whisky, stirring well, then bottle. This cider will keep sweet through the summer.

J. S. asks: Is a safety valve 3 inches in diameter large enough for two boilers 16 feet long, 44 inches in diameter, with four 12 inch flues in each? How do you obtain the proper diameter for a safety valve for any sized boiler? This is my rule; is it correct? From six tenths to eight tenths of a square inch area of valve for each square foot of grate surface. Answer: We expect soon to publish some remarks on the proper proportions of safety valves, giving most of the rules in common use. You will find some rules in back numbers of our paper. Your allowance agrees well with the practice of many engineers.

H. asks: Can you suggest a cheap and quick method of restoring a badly smoked ceiling other than scraping it? Answer: Wash the ceiling with a brush and abundance of clean water, and then whitewash.

J. W. asks: What are the principal surface indications of a lead or silver vein, and does said vein always keep in one direction? If so, will it not terminate at some point? Answer: The ores of silver belong chiefly to primitive rocks, and occur in veins which traverse granite, gneiss, micaceous and argillaceous slates, greenstone, sienite, hornblende and porphyry. They have also been observed in veins which traverse graywacke, compact limestone, etc., but seldom or never in more recent secondary rocks. Galena, or sulphuret of lead, usually contains more or less silver, and occurs most frequently in secondary rocks, especially in compact limestone. In Silesia, galena occurs in a bed of brown ferruginous marl, in the famous mines of Missouri in red clay, often marly, containing masses of quartz and resting on limestone; in Pennsylvania in limestone; in New York traversing a slaty rock; in Massachusetts at Southampton the bulk of the vein is quartz; in Maine in granite. Veins are often divided into several branches which sometimes terminate in the contiguous rocks and sometimes wind and return into the principal vein.

W. asks: What is the difference in the weights of a ball that weighs 10 pounds in air and the same ball 100 feet under water? Answer: Under water, its weight would be diminished by the weight of an equal volume of water.

C. F. H. asks: How can I guard against the deleterious effects of the dust arising from emery wheels and belts used in grinding and polishing iron and steel? Is there any kind of shield, that can be worn by a workman, that will prevent the fine metallic particles from finding access to the lungs? Answer: Put a hood over the wheel and run a small pipe to an exhaust air blower. The suction will take off all dust. This plan is used in many establishments, one blower serving to take the dust from several wheels.

A. F. G. says: I accidentally found that I can temper gun or other springs under the hammer by using the following recipe: 1 oz. corrosive sublimate and 1 oz. sal ammoniac, a few handfuls salt, dissolved in water, putting fine salt in the smithy fire while at work. Dip your hammer in the solution and keep the anvil wet all the time. Work the steel till nearly cold. This will give the required temper without any other process. Answer: We do not think that your chemicals have much to do with your success in tempering steel, but the welding, hammering and gradual cooling have a great deal.

D. R. K. states that the lamp black in his ink for marking packages floats at the top of the fluid. Answer: There is no method of preventing the lamp black from rising to the top, unless you make the fluid thick enough or of sufficient consistency to hold it, as it will not dissolve. We offer you a recipe for a marking ink, which we hope will prove better and cheaper than the other: Lampblack (previously heated to dull redness in a covered vessel), ¼ oz., triturate with good black ink, gradually added, 1 pint. Observe similar proportions.

S. W. G. asks: I wish to elevate water 115 feet in half a mile, from the spring to a reservoir, from which I have 23 feet fall to the ground; what is the best means for the purpose? Is not the hydraulic ram the best for a stream only large enough to fill a two inch pipe? What per cent of volume could be elevated to that hight, and what size of pipe would be the best? Answer: We would not like to give a decided opinion on such a matter without knowing more about it. A good engineer should be consulted in a case like this.

B. P. asks: Is there any method by which I can utilize the domestic supply of water for motive power? Would a small turbine wheel attached to the water pipe furnish sufficient power to run three printing presses? Answer: A small turbine would do the business. Some years ago we witnessed the operation of the large presses of the *Traveller* newspaper in Boston by means of a turbine, and probably you can get the information you wish at that establishment.

H. asks: Can I warm a room 15x20 by the aid of a gas stove in order to make it sufficiently comfortable for a sitting and sleeping room? Answer: Unless your room is exposed, or has a large glass window surface, you could probably make it comfortable by means of a gas stove. But unless you can provide a small pipe to carry off the products of combustion, we would not advise you to use it.

G. A. W. asks: 1. What are the uses of collodion, and (2) of what is it made? 3. What are the best solvents for the same? Answers: 1. Collodion is extensively used in the art of photography, in combination with chemical agents that are sensitive to light. It is also used in surgery, both in the natural state and combined with medicinal substances. As a dressing for wounds, it unites the cut or torn surfaces closely, and prevents the action of the air; and it being transparent, the wound can be inspected when necessary. 2. Collodion is gun cotton or pyroxylin dissolved in a mixture of alcohol and common ether. Pyroxylin is made by immersing clean carded cotton for 4 or 5 minutes in a mixture of equal parts of concentrated nitric and sulphuric acids. The cotton is then squeezed free of acid, afterwards washed thoroughly and finally carefully dried by hot water or steam at a heat not higher than 180° Fah. 3. Collodion will dissolve Venice turpentine, castor oil iodine, etc.

A. B. asks: How is fire communicated to the gas in a kerosene lamp, thereby causing an explosion? Is it through the wick, or does it take fire from the heating of the lamp? Answer: Generally there is a leak; and when the oil gets low, the space above it is filled with gas, which is thus readily inflamed. In the case of very poor oil, the heat is sufficient.

R. W. asks: How can I make blue and green glazing for common earthenware? Can I make a glazing without melting the ingredients into glass before it can be applied to the work? Answer: A glaze for common earthenware is made as follows: White lead (pure) 53 parts, quartz or ground flints 36 parts, Cornish stone or felspar 16 parts, white flint glass 5 parts; reduce to an impalpable powder, grind with water to a very thin paste, dip and fuse. This may be colored blue by oxide of copper, added in quantities according to the shade desired. Earthenware may be glazed by throwing common salt into the heated furnace containing the ware.

T. W. D. asks: What substance is there, the vapor or fumes of which, expelled or liberated by heat, will bleach vegetable substances on a large scale? Sulphur will not do. Answer: Chlorine is probably the most effective bleaching agent known; and in the form of chloride of lime is very extensively employed. You can use gaseous chlorine instead of the usual solution of chloride of lime, and in the same way as sulphurous acid gas. The vegetable substances must first be boiled in a weak solution of soda or potash to remove resinous matters, grease, dirt, etc., and then hung up after washing, in a capacious room, into which chlorine gas is admitted. You can make chlorine as follows: In a leaden retort, capable of being heated by steam underneath, mix cautiously oil of vitriol and water each 7 parts, and allow to cool. Add, when cool, common salt 4 parts mixed intimately with peroxide of manganese 3 parts. The gas comes off slowly at first, but a gentle heat causes it to rush forth in large quantities.

J. W. H. says, in reply to H. M., who asked how to make good ice cream: Take 1 gallon of good milk or cream, the yolks of 15 eggs, 1½ lbs. of sugar, and 2 vanilla beans; and you will have the ingredients for 1 gallon of vanilla ice cream. Any other flavor may be used. Take the yolks and the sugar (well pulverized) and beat them well together. Mash the beans well and add them. Put the milk over the fire, boil it, take it off, add the eggs, etc., and again boil it, being very careful not to burn it; in a few minutes take it off. Let it get cool, after which you may freeze it in the ordinary way, and you will have nice ice cream.

J. D. replies to a querist, who asked if a 12 horse power separator will run harder with tumbling rods than with a belt: "If you drive with an engine, it will take 20 horse power to stand with rods what 10 will do with a belt. I know this by experience."

MINERALS, ETC.—Specimens have been received from the following correspondents, and examined with the results stated:

I. O.—Your pebbles are quartz. The largest one is colored by oxide of iron. They are of no value.

COMMUNICATIONS RECEIVED.

The Editor of the SCIENTIFIC AMERICAN acknowledges, with much pleasure, the receipt of original papers and contributions upon the following subjects:

On Patent Systems. By T. W.
On the Marsupialia. By N. B. H.
On Flying Spiders. By T. C. E.
On the Witch Hazel. By S. F. C.
On a Proposed Balloon. By J. C. W.
On Cooking Stoves. By D. R. W.
On Poisonous Undershirts. By J. N.
On Patent Rights. By H. A. W.

Also enquiries from the following:
A. Y. H.—A. G. G.—W. E. W.—A. B. C.

Correspondents who write to ask the address of certain manufacturers, or where specified articles are to be had also those having goods for sale, or who want to find partners, should send with their communications an amount sufficient to cover the cost of publication under the head of "Business and Personal," which is specially devoted to such enquiries.

[OFFICIAL.]

Index of Inventions

FOR WHICH

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WERE GRANTED FOR THE WEEK ENDING

September 16, 1873,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

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Windmill, Atwood & Bodwell 142,885
Wire way, elevated, Lantis & Davis 142,857
Wrench head, L. Coes 142,771
Yoke holder, neck, G. R. Huntley 142,852

APPLICATIONS FOR EXTENSIONS.

Applications have been duly filed, and are now pending for the extension of the following Letters Patent. Hearings upon the respective applications are appointed for the days hereinafter mentioned:

26,408.—KINDLING COMPOSITION.—E. Bellinger. Nov. 26.
26,475.—BREECH LOADING ARM.—B. Burton. Dec. 3.
26,487.—SCREW TAP.—W. Foster *et al.* Dec. 3.
26,506.—WATER TRAP.—J. A. Lowe. Dec. 3.
26,582.—HARVESTER.—J. Gore. Dec. 10.
26,599.—HORSE HAY RAKE.—S. Lessig. Dec. 10.
26,891.—SPECTACLE CASE CATCH.—G. N. Cummings. Jan. 7.

EXTENSIONS GRANTED.

25,484.—GRAIN SEPARATOR.—J. L. Booth.
25,499.—CAR SEAT.—E. Wheeler.
25,506.—LAMP.—H. Halverson.
25,508.—SHEARS.—R. Heinisch.
25,544.—TRY COCK.—J. F. Cook.

DESIGNS PATENTED.

6,882.—LAMP BOWL.—J. S. Atterbury *et al.* Pittsburgh, Pa.
6,883.—TUG CLIP.—J. Letchworth, Buffalo, N. Y.
6,884.—CHAIN.—H. H. Markley *et al.* San Francisco, Cal.
6,885.—OIL CLOTH.—C. T. Meyer *et al.* Bergen, N. J.
6,886.—FRUIT JAR.—S. B. Rowley, Philadelphia, Pa.
6,887.—AQUARIUM FRAME.—G. E. Smith, Chicago, Ill.
6,888.—CARPET.—H. Smith, Kidderminster, England.
6,889.—KNITTED FABRIC.—T. Langham, Philadelphia, Pa.

TRADE MARKS REGISTERED.

1,451.—MEDICINE.—S. Bonsall, Philadelphia, Pa.
1,452.—SAWS, ETC.—H. Disston & Sons, Philadelphia, Pa.
1,453.—CIGARS.—Goldsmith Bros. *et al.* Chicago, Ill.
1,454.—CIGARS.—J. Heller, Chicago, Ill.
1,455.—MASS LICORICE.—Hoffman & Co., Baltimore, Md.
1,456.—LICORICE PASTE.—Hoffman & Co., Baltimore, Md.
1,457.—STOVES.—W. J. Keep, Troy, N. Y.
1,458.—MANILA PAPER.—J. Robertson & Son, Putney, Vt.
1,459.—BARRELS OF WHISKY.—W. S. Stewart, St. Louis, Mo.
1,460.—PETROLEUM.—Atlantic Refining Co., Phila., Pa.

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