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DOUBLE TENONING MACHINE.

The chief points of advantage to be noted in the improved form of double tenoning machine, illustrated in the accompanying engravings, consist in the mechanical devices by means of which the cutter heads, aside from their individual motion, can be so connected together that when the cylinders are adjusted to the required thickness of tenon, both heads can be moved at once. They can thus be arranged at a suitable hight from the carriage to give the desired depth of shoulder.

A, Fig. 1, is the carriage upon which the material rests while being operated upon. B is the pulley which drives the cutters, C and D, one of which is shown more clearly in Fig. 4, through the medium of the smaller pulleys on the arbors, E F. These arbors work in composition boxes in frames which have a free vertical motion on the main stand, and which are coupled together by the right and left hand screw, G, working in suitable nuts. This screw, G, is rotated through bevel gear, H, by the hand wheel, I, and serves both to adjust the cutters, C D, parallel to each other and also to raise and lower the cutter frame as desired. By referring to Fig. 5, the reader will understand how this is accomplished. J is a section of the hub of the bevel gear, H, through which the lower portion of the screw is seen passing. K is a plug, tapped on its end so that it will form a part of the gear nut thread, which is slipped into the hole made for the set screw, L. When this set screw is not tightened, the plug will press against the screw, G, with sufficient friction to turn it: and consequently, when the bevel gear, H, is rotated, it will elevate or depress the screw, and with it the cutter frames in which it operates. If, however, the plug, K, be tightly clamped, so as to bite against the screw, G, the latter will be compelled to revolve with the gear; which, as it is threaded in opposite directions, will cause the frames to recede from or approach each other in accordance with the direction in which it is turned. By this ingenious arrangement it is clear that the two cutters, C and D, can be arranged in any suitable position either relative or together, according to the desired thickness of the tenon shoulder. Their vertical adjustment being thus provided for, a horizontal motion may be imparted to the heads in order to cause them to cut to a required depth, as, for instance, in cases where it is necessary to make one shoulder of a tenon deeper than the other. This is effected by connecting the rear ends of the journals of the arbors, E F, with sliding boxes. In the extremities of the latter, screws are tapped which are actuated by the small hand wheels, M. The wheel, N, on the screw, G, enables the latter to be revolved in order to cause slight changes in the position of the cutters. O is a tightening pulley, and is shown more clearly in Fig. 2. It runs in a frame which is moved up or down in accordance with the adjustment of the cutters by means of the rack, P, connecting with a pinion, Q, which communicates with a ratchet, lever, and weight (not shown) on the back of the machine.

The portions thus far described serve to cut a single tenon. To make a double tenon after the patterns shown in the foreground of Fig. 1, other devices come into play. R (Fig. 2) is a vertical shaft which revolves in a sliding frame, S, just back of the tenoning cylinders. On its upper end is a horizontal cutter head, T, shown partly in section in Fig. 2, and in perspective in Fig. 1. U is a bevel gearing actuated by the lower of the two hand wheels shown, which communicates with the screw, V, which works in a nut in the sliding frame, S. By this means the cutter, T, can be placed in any desired position vertically, or it may be thrown entirely out of the way while making single tenons.

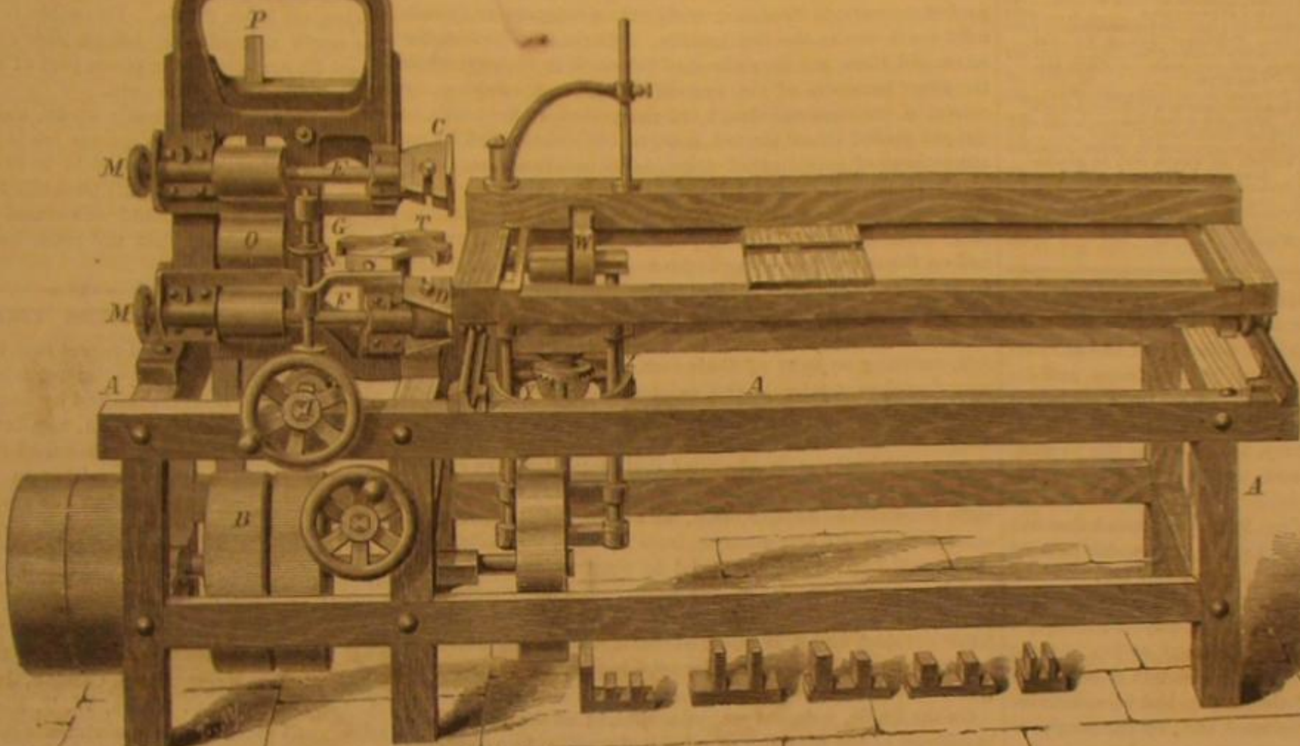
W, Figs. 2 and 3, is the gaining cylinder, which is actuated at the back of the machine, where the operator stands while using the same. It runs in metal boxes placed at the upper ends of the wrought iron rods. These rods are connected, as shown at their lower ends, by a cast iron bar, in the center of which is tapped a nut which receives a screw which, by the bevel gear, Y, communicates with the hand wheel, Z, at the rear of the machine. By this mechanism the operator is enabled to move the gaining cylinder up or down to any desired point, or he can place it altogether out of the way, so that the carriage will pass directly over it, when making single or double tenons. As the belt which drives this cylinder will necessarily vary in length as the latter changes position, a tightener, Z', is provided, arranged in an iron frame as shown, which presses upon the belt, and is of sufficient weight to fulfill all requirements.

The machine is self-contained, having one countershaft underneath, on which is a sufficient number of pulleys to drive its different parts, and a second countershaft, suspended on bracket hangers (shown broken in Fig. 2), bolted on the back of the apparatus to actuate the double cutter shaft.

From the above explanation of the essential parts, the method of operation is readily followed. The timber to be tenoned is placed upon the carriage, which is suitably mounted on trucks, and in this position is passed between the tenoning cylinders. As it emerges, cut in one thick tenon or in the outlines of two, it comes in contact with the cutter on the vertical shaft. This makes its way through the center of the thick tenon, cutting out a space and completing the double tenon. The gaining cylinder cuts gains from the under side of the timber as it passes over it while on the carriage, making them from one sixteenth to two inches in depth, and by forming several cuts, of any length. The machine is particularly suitable for use in railroad workshops, as it is claimed to be capable of operating upon the largest and longest timber used in the construction of railroad cars.

Patented February 25, 1873. For further information address the manufacturers, Messrs. Collins & Baxter, Lebanon, N.H.

Fig. 1



BUCK'S DOUBLE TENONING MACHINE.

Fig. 4

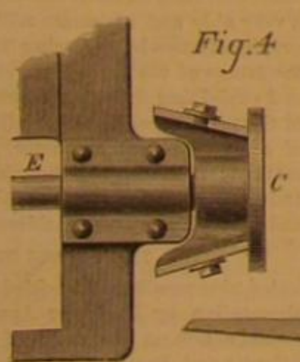


Fig. 2.

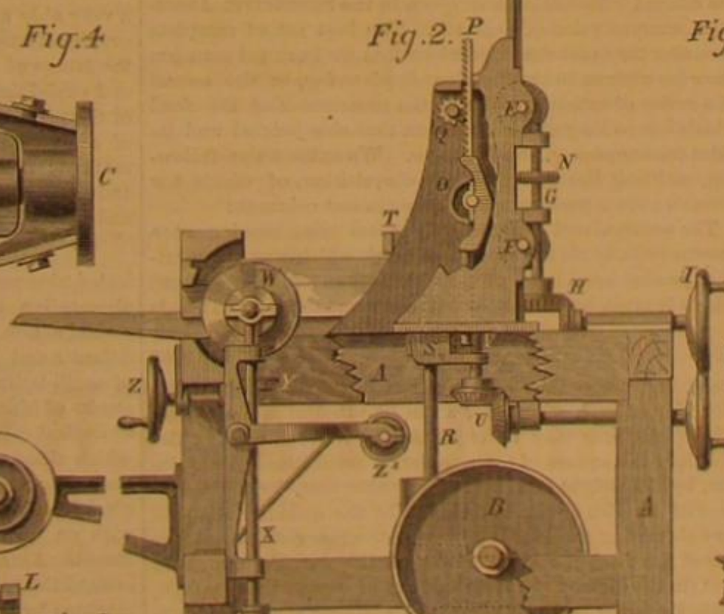
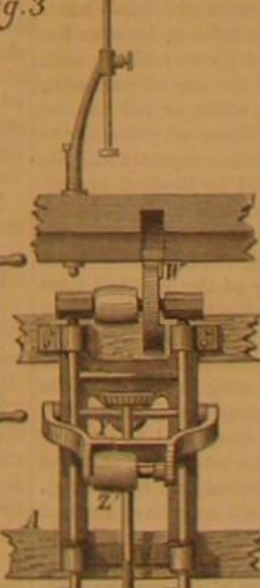


Fig. 3



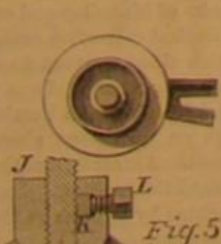


Fig. 5

Mammoth Remains.

In 1872 a party of Americans, led by P. Pavy, left San Francisco to endeavor to reach Wrangel Land in the Arctic Sea. They landed near the mouth of a large river running from the N. W., and, about eighty miles inland, observed many indications of mammoth remains. On clearing away the snow from one of the spots, the whole of a well-preserved animal of this genus was exposed to view. The head was beset with long thick white hair, and the tusks, eleven feet eight inches in length, were curved backwards towards the eyes. The animal was in a kneeling position, the hinder part of the body being deeply buried in the snow, and in such an attitude as it would take if it had died while endeavoring to extricate itself from the bog. In its stomach was found bark and grass. These remains were distributed for miles over the plain, and were so abundant that it appeared as if a numerous herd had perished there. The place swarms with polar bears, which live upon the bodies.—*Geolog. Reichsanstalt, Vienna.*

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Contents:

(Illustrated articles are marked with an asterisk.)

THE PHYSICAL CONDITION OF THE PLANETS.

While the savants of former centuries have, with the utmost minuteness, determined all the details of the motions of the bodies which constitute our planetary system, and definitely settled the astronomical aspect of the question, it was reserved for the astronomers of the present day, the latter half of the nineteenth century, to determine the particulars of their actual condition, and to settle the physical aspect of the question.

First of all, astronomy having long ago proved that our earth contains scarcely the four hundred thousandth part of the matter constituting our planetary system, and that she has a common origin with the rest of the same, the new science of geology proved that our earth had passed through a gradual cooling process, that many portions of her surface were to all intents and purposes equivalent to a burnt up cinder, while other portions of the surface had been disintegrated, washed, dissolved, precipitated, etc., by the long prolonged action of water. We are, as it were, driven to the conclusion that the history of the other members of our planetary system must be similar to that of our earth, that sooner or later they have gone or will go through the same phases of existence, and that the fate in store for our earth may be learned from the condition of those planetary bodies which are the furthest advanced in this slow cooling process.

The celebrated French naturalist Buffon was the first to make experiments in order to determine the period of time required for highly heated bodies of different size to cool off by radiation; he had very large iron balls cast of different sizes, exposed them freely to the air in order to cause them to cool down, and noticed carefully the difference in time required by the large as compared with the small ones. He thus found the law regulating the relation between the size of the ball and the time required for its cooling; and, applying this law directly to a ball of the size of our earth, in the supposition that it was once white or red hot, he found the lapse of millions upon millions of years necessary for her cooling down to the present temperature. His experiments were more recently verified by Bischoff in Germany, who had balls cast of certain furnace slags similar to basalt; some of these balls were of colossal size. He came to similar conclusions, supporting the evidences of the geologists in regard to the immensity of the period of time required for the past history of our planet. This consideration alone makes the now almost antiquated idea, that the planets are all inhabitable at the present period of their existence, if not untenable at least very doubtful. The planets are of very different sizes; they therefore require different periods of time for cooling down, and as they originated from the same nebulous mass of matter, and had after its first condensation, by gravitation (not by cooling), nearly the same temperature, they must now have reached very different conditions of heat, which vary according to their sizes.

Let us now see what the combination of the modern spectroscope, photometer, and telescope reveals to us in this respect, and whether these conclusions are confirmed by the most scrutinous observations of the present day. Fortunately one of the smallest bodies of the planetary system, and therefore one of those which must have cooled the soonest, is the nearest to us, our moon. Observations point to the undeniable fact that, in the moon, all effects of its own heat have utterly ceased, that the whole satellite is cooled down to a low temperature, scarcely reached on earth by the tops of the Himalayas and Andes; that all former volcanic action, of which she bears strong evidences, has utterly ended, and that all water ever possessed by her has long ago been absorbed by her lavas and rocks as water of hydration; while no trace of an atmosphere can be discovered, so that we even do not know whether she ever had one.

The next body of which we have some definite knowledge is the planet Mars. Although he is at several hundred times greater distance from us than the moon, we can observe his atmosphere, clouds, and changes of seasons in his two hemispheres, by the periodical increase and decrease of the ice belt around his poles. In fact, there is no heavenly body in which the conditions are so similar to those of our earth at the present time; but the planet is much smaller than our earth, and is further from the warming influence of the sun; therefore the probability is that he is farther advanced in the cooling process, and this is confirmed by the closest modern observations. Clouds and water are much more scarce there than on our earth, and the fate awaiting us, of drying up of vegetation by want of sufficient water, has commenced to be realized there on a large scale, as on our earth it is realized over limited surfaces, such as the Asiatic and African deserts.

In order to understand the reason of this continual diminution of the amount of water on a planet, we have only to consider that after every volcanic eruption, by the hydration of the cooled lavas, a certain amount of liquid water is withdrawn from the general provision and solidified in the rock, and that the liquid interior of our earth contains enough of this material to absorb many times all the water of our oceans; as these extend down to scarcely the one thousandth part of the earth's diameter, while only a comparatively thin solid crust covers the hot interior. These two bodies, the moon and Mars, are thus ahead of the earth in history, while the other members of the system are behind. Jupiter, by reason of his immense size, 1,000 times that of the earth, is not yet cooled below the red heat, and is surrounded by an atmosphere of superheated steam, as we mentioned on a former occasion; Venus by its neighborhood to the sun, being nearly of the same size as our earth, is in very much the same condition as Jupiter, only cooled down a little further, and on the eve of becoming fit for vegetable and animal life. Of Mercury, still nearer to the sun, we know nothing, but the probability is that he is hotter than Venus. The satellites of Jupiter have been proved to be darker than the planet itself, emitting no light of their own, as the planet does, and may therefore rejoice in the existence of life, if the other complex conditions of proper atmosphere, water, etc., are favorable; but this is improbable, as the main planets appear to appropriate the atmosphere of their satellites. In regard to Saturn, it appears that this planet is very much in the same condition as Jupiter, only, on account of its somewhat small disk and greater distance from the sun, its cooling has progressed further, as evidenced by observations. Uranus and Neptune are too far off for us to found any conclusions or observations; while of the moons of all these planets we know nothing, and it is reserved for future astronomers to come to any positive conclusions in regard to their conditions.

On the whole, we must recognize that, in all the discussions in defense of the plurality of inhabited worlds, two elements have been overlooked, time and space. The first is eternal, the latter infinite; and if even only one inhabitable world exists at a time, and if each of their great number has its turn to become the scene of life, eternity is long enough to give such an opportunity to every world in the infinite universe.

THE FLY WHEEL.---EXACT FORMULAS BY WHICH TO PROPORTION IT.

A correspondent wrote recently, asking us to quote known authorities upon the subject of proportioning fly wheels, and the desired information was given in the SCIENTIFIC AMERICAN, current volume, page 177. The best set of complete formulas for exact determinations that we have yet seen has since been given in the London *Engineering*, in the course of a series of articles written in the prosecution of the feud which has so long existed between that able journal and its elder contemporary, the *Engineer*. We extract the following, omitting the mathematical disquisition, of which the formulas are a part, as out of place in our columns:

The accumulated work in a fly wheel rim, moving at a known velocity, is the amount of work which was necessarily expended upon it to give it its motion, and the amount which it must itself do before it can come to rest. This is equal to $W = \frac{N^2wb(R^4 - R'^4)}{3738}$, or $= \frac{N^2WbR^4}{3738}$, for the two cases, first where the revolving body is a disk, like a grindstone, or, second, where it is a rim like that of a fly wheel. These equations may be expressed by the following rule: Multiply the square of the number of revolutions per minute, by the weight of material per cubic foot, by the thickness of the disk or rim in feet, and by the quantity obtained by subtracting the fourth power of the inner radius of the wheel rim from the same power of the outside radius in feet (in the disk by the fourth power of the outside radius, since the inner radius is zero), and dividing the whole product by 3738. The result is in foot pounds, that is, it represents the product of any resistance, or driving force, in pounds by the distance through which it must act to do an amount of work equal to that accumulated in the wheel. Thus, for a grindstone 6 feet in diameter, $1\frac{1}{5}$ feet thick, and weighing 144 lbs. per cubic foot, we get $120^2 \times 144 \times 1{\cdot}2 \times 3 \div 3738 = 53912$ foot pounds.

An iron fly wheel rim, similarly, would require, to stop it, if making 20 revolutions, having a diameter of 20 feet outside, 18 feet inside, and rim 6 inches thick, the weight of metal being, say, 444 lbs. per cubic foot:

$W = 20^2 \times 444 \times \frac{1}{2} \times (10^4 - 9^4) \div 3738$, more than 80,000 foot pounds, and this, if expended by stopping the wheel in one minute, would yield a mean of two and a half horse power.

The stress on the rim of a cast iron fly wheel is given by $S = \frac{RN^2r^2}{952}$, or the rule: Multiply the section of the rim, in square inches, by the square of the number of revolutions and by the square of the mean radius of the rim, and divide the product of 952. Thus, a wheel having a section of rim = 72 square inches, a mean radius of $9\frac{1}{2}$ feet, and making 20 revolutions per minute, would have a strain upon its cross section of $72 \times 20^2 \times 9\frac{1}{2}^2 \div 952 = 2730$ lbs., which would tend to tear the rim apart.

The weight of a wheel of cast iron weighing 444 pounds per cubic foot $= 38{\cdot}75rR$, = the product of the mean radius by the cross section and by 38·75. The weight assumed is equivalent to a specific gravity of 7·1, which is a fair figure for ordinary cast iron.

These formulas and rules, together with those already given in the earlier numbers of this paper, will afford our readers the information necessary to correctly proportion the fly wheel in any case that is likely to present itself, and to determine the power and weight of one already constructed.

THE NEW OCEAN TELEGRAPH CABLE.

The British steamer Kangaroo has arrived at New York with the shore portion of the new telegraph cable which is to be laid this summer between England and the United States, *via* Nova Scotia. The cable is to be landed here on the south side of Long Island near Rockaway beach. The Great Eastern, with the ocean part of the cable on board, is expected to arrive here soon.

The French cable recently broke, and communication was suspended. It will be a serious job to fish up and repair the wire. The break is supposed to be at a joint 230 miles out from the French coast. All business is now done over the Atlantic or Newfoundland cable, and such is the pressure of work on the line, that the rates have been advanced to $1.50 per word.

ANOTHER PHASE OF THE VIENNA EXPOSITION.

It is a source of national regret that the information which has reached the State Department, relative to irregularities alleged to have been committed by some of the commissioners to the Vienna Exposition, appointed under the act of 1872, has been considered as based on sufficient proof to warrant the investigating committee in Vienna, Minister Jay and Mr. McElrath, in advising the suspension of these officials, pending further examination, and also the appointment of a temporary commission in their stead. The exact nature of the charges is not yet made public, but it is hinted that permits for restaurants, saloons, etc., have been sold. The recommendation has, however, been approved by the President, and the necessary orders were recently forwarded by cable, placing Messrs. L. B. Cannon, Jackson S. Schultz, W. H. Aspinwall, S. C. Ward, W. T. Blodgett, and others in office until permanent appointments can be made.

The suspensions, it is understood, are not to be taken as an opinion pronounced against any particular person suspended, and therefore any of the original commissioners may be recommended for re-appointment; nor does the measure affect the skilled artisans, scientific or honorary commissioners, holding office under the act of 1873, whose appointments were made subsequent to the irregularities under investigation.

THE GEOGRAPHICAL WORK OF THE WORLD IN 1872.

Chief Justice C. P. Daly recently delivered before the American Geographical Society, of which he is the president, a very able and elaborate address on the progress of geographical knowledge during 1872, giving a full account of the labors of the various surveys and exploring expeditions, and explaining the work accomplished up to the beginning of the present year. After alluding to the physical events, of a geographical character, which have been especially marked: including earthquakes, atmospheric disturbances and similar phenomena: the subject of American explorations and surveys was first considered.

THE VOYAGE OF THE HASSLER

lasted nine months. The chief scientific results have been the observation by Professor Agassiz of the evidence of post glacial action on the coast of South America: both on the Atlantic and Pacific sides, below the thirty-seventh parallel of south latitude, with the detection of existing glaciers in the straits of Magellan and on the coast of Chili: and an immense zoological collection embracing 100,000 specimens, the fish in which alone amount to 30,000. The conclusion drawn by Professor Agassiz, from what he saw, was that during the glacial period both hemispheres must have each been capped with an enormous sheet of ice, one moving northwardly from the Antarctic and the other southwardly from the Arctic, toward the equator. Ice, he considers, has been the great machine by which the rocky surfaces of the globe have been fashioned.

PROFESSOR HAYDEN'S EXPLORATIONS, IN UTAH, IDAHO AND MONTANA

were principally devoted to examination of the valleys of the Yellow Stone, Madison and Gallatin rivers, a tract of 3,575 square miles which has been set apart as a grand national park. The event of the season was the ascent of the Grand Teton, 13,762 feet above the sea, the summit of which no white man had ever before reached. A rude enclosure was found there, evidently designed as a protection against wind and probably hundreds of years old. On Lake Shoshonie a new geyser basin was discovered, containing over one hun dred springs. All this wonderful region was carefully surveyed and mapped.

EXPLORATIONS IN THE ALEUTIAN ISLANDS

have been carried on by Mr. W. H. Dall. He has discovered in these islands the remains of a people antecedent to the race which now inhabits them. Around the sites of ancient villages, he found burial caves in which the dead bodies had been placed so as to indicate their ordinary occupations: men in canoes, as in the act of rowing, women dressing skins, holding children, etc.

THE DARIEN EXPEDITION

was dispatched for the second time in the winter of 1871, under Commander T. O. Selfridge, U. S. N., to explore the route by the Atrato and Tuyra rivers, which was done, and found impracticable. Another route was, however, surveyed from the Pacific to the Atrato, which appeared so favorable that at the close of last year Commander Selfridge was sent back to complete the work. If a canal by this route is practicable, its construction will shorten the voyage from New York to Hong Kong for sailing vessels from 110 to 83 days. There is also an expedition for a survey across Nicaragua at work at the present time.

THE AMERICAN PALESTINE EXPLORING EXPEDITION

is in charge of Lieutenant E. Z. Steever, U. S. Engineer Corps, who, with three associates and a number of natives, will explore the country east of the river Jordan and in the northern part of Syria. Besides the labors above described, the geographical work accomplished in 1872, and in progress, in this country, comprises the continuation of the survey of the 40th parallel, explorations west of the 100th meridian, a reconnoissance of the basin of the Yellow Stone river, explorations of the Colorado river, surveys for the building of the Northern Pacific Railroad, and some others principally devoted to cartographical objects. The various

ARCTIC EXPLORATIONS

and their present condition, we have recently referred to at length. The Swedish expedition wintered in Mossell Bay, Greenland, and during the coming summer will endeavor to reach the pole by sledges. Another party sailed from Sweden, during the year, to establish a colony on the southwest coast of Spitzbergen, for the obtaining of phosphates for artificial manure. Count Wilczek, of the Austrian expedition, returned home in November. The Tegethoff, the remaining vessel of the fleet, intended to penetrate the sea east of Nova Zembla. Nothing has been heard from the Polaris since August 5, 1871. Captain Hall was then in latitude 73° 21'' north, longitude 56° 5' W., and all were well. He sailed for Smith Sound, following the route of Kane and Hayes. An interesting relic has been found by the master of a small Swedish sloop, who succeeded in passing the north east point of Nova Zembla. It was the hut left by Barentz, the Dutch navigator, 276 years ago, and which has since never been entered by man. The sleeping berths, halberds, muskets, and clock upon the wall, were untouched, and among the books was found a description of China, the country the explorers hoped to reach by the north east passage. The remains were purchased by the Dutch government.

GENERAL GEOGRAPHICAL LABORS.

Government surveys are in progress connected with the publication of maps of various European countries. The Challenger has been fitted out by the British government to examine the great ocean basins of the world. A group of islands in the South Pacific known as the New Hebrides have been explored and other investigations have been made of general scientific value. Among the

ARCHÆOLOGICAL DISCOVERIES

of the year is that of lake dwellings or lacustrine villages of the prehistoric inhabitants of Europe at Bienne in Switzerland and elsewhere, the finding of a skeleton of a man at Mentone in France, which is supposed to be of great antiquity, and the exploration of pit dwellings in England. In the United States, the ruins of what was once a populous city, covering an area of 3 square miles, have been found in Arizona. The entire space within the enclosing wall of sandstone had been covered with houses, built of solid sandstone without mortar. The ruins consisted entirely of stone, not a stick of wood being visible. On the N. W. coast of Asia Dr. Schliemann claims to have found the remains of ancient Troy. His excavations have led him through ruins of successive settlements, at the lowest of which were structures built of massive stones. A wall of huge stones joined together with clay, and the ruins of a solid tower of masonry forty feet thick, built upon the primitive rock, were found. General Di Cesnola's Phœnician antiquities we have already fully described; they are at present being arranged in a suitable museum in this city. The principal

ASIATIC EXPLORATIONS

have been made by English engineers in Persia, for the location of telegraph lines. The Russian government has had under consideration a canal connecting the Black and Caspian seas, which, although only about six miles in length, will require the labor of 32,000 men for six years. Surveys are being made for a railroad from Scutari, on the Bosphorus, to Shikapore, in India, and another line is proposed from Moscow to Pekin. In

AFRICA,

the results of the year have been the rescue of Dr. Livingstone by the *Herald* reporter, Stanley, and the knowledge of the explorations of Dr. Schweinfurth, in the regions west of Khartoum and to within 3¾ degrees of the equator. The latter traveller has found a race of pigmies, or dwarfs, supposed to be the same described by Herodotus. M. Alfred Grandidier has devoted his labors to Madagascar, and has fixed the latitude of 188 points, and examined the coast line for 1,250 miles. Karl Mauch, the discoverer of the gold fields in 1871, has found a ruined city on the east coast of Africa, containing massive stone structures of great antiquity. He thinks the spot to be the famous Ophir so long sought for, to which Solomon sent for gold and precious stones. Sir Samuel Baker left Gondokoro in 1871, since which time no authentic news has been received from him. Sir Bartle Frere has arrived at Zanzibar, and communicated with the Sultan, relative to the suppression of the slave trade, and two English expeditions have been despatched to coöperate with Dr. Livingstone.

THE PROBLEM OF THE COMING TRANSITS.

In resuming the consideration of this subject, commenced in our last week's issue, we must remember that, as photography was an undiscovered art at the time of the last transits, it could not of course be made use of. The same results were aimed at by the method proposed by the great astronomer Halley. According to this method, the observer, instead of attempting the hopeless task of determining the planet's exact position on the sun's disk at any moment, merely notes the duration of her transit, which is necessarily different for different stations. Having the exact time occupied by the planet in traversing her chord of transit, the length of the chord can be calculated, and consequently its distance from the sun's center. A comparison of two chords obtained from the observations made at two stations suffices to show, as in the photographs, the planet's displacement for the two stations; the distance between the stations being known, the planet's distances from the earth and from the sun follow as before. This method requires simply that each observer shall note the exact beginning and end of the transit as seen at his station, and that his clock shall measure the interval correctly; but as the planet appears as a comparatively broad disk on the sun's face, it is no easy matter to determine the precise instant when her center crosses the sun's edge at the beginning and end of the transit. To do this, the observer has to note with infinite precision the moment when the edge of the planet first touches the sun's rim, that is, her first external contact; next, the instant when the planet is just wholly immersed and the broken edge of the sun appears to close, that is, her first internal contact; and lastly, he must repeat both observations in reverse order when the planet leaves the sun's disk. The obstacles to the easy and exact observation of these phenomena are numerous and apparently insurmountable. To secure the requisite distance between the points of observation, it is necessary that one station be as far north, the other as far south, as possible; hence the sun cannot fail to be near the horizon, at which times the outline of his disk is greatly distorted. Atmospheric causes very frequently aggravate this difficulty by giving the sun's edge an uneven or rippled appearance. Then the planet, when just in contact with the sun's edge, always assumes a peculiar pear-shaped aspect which makes it all but impossible to fix the exact moment of contact, and this is a time when a fraction of a second is all-important.

There remains one more method, which can be described in few words. It is known as Delisle's, and is especially valuable in that it aims to determine the sun's distance in a manner entirely different from those thus far noticed, and is applicable at times and places altogether unfavorable to Halley's method. Again our ball and circle may help to make the matter more easily comprehensible. Suppose the camera to be placed as before and the ball be made to pass from left to right between the instruments and the screen at a uniform rate of motion. It is obvious that the ball will come in line between the edge of the circle and the left hand camera first. After an interval, depending on the ball's rate of motion and the distance between the points of view, the ball will come in line between the right hand camera and the edge of the circle. When it reaches the other side of the circle, the appearance will be reversed; that is, it will seem to the observer at the left hand camera to leave the circle sooner than to the one at the right. Let us confine our attention to the first case. If each observer notes the exact time when the ball appears to him to touch the rim of the circle, the difference—say four seconds—will measure the interval occupied by the ball in passing a certain distance. Now if that distance can be exactly calculated, the ball's rate of motion can be easily ascertained.

We know the distance between the cameras (12 inches). The position of the ball, relative to the cameras and the screen, is also known, since it divides the whole space into parts having to each other the ratio of two to five. Hence, by a simple geometrical principle, the space passed over by the ball, in the given interval, is to the distance between the cameras as five to seven; which gives $8\frac{4}{7}$ inches. If the ball moves over $8\frac{4}{7}$ inches in four seconds, its rate of motion must be $2\frac{1}{7}$ inches a second.

In like manner the rate at which Venus moves in her orbit is calculated from the interval between two observations of the same phase of transit as seen from two stations. The time which the planet takes to make a complete circuit of her orbit is known; this time, multiplied by the planet's rate of motion, gives the circumference of her orbit in miles, whence its radius, or the distance of Venus from the sun, is easily found. The ratios of the planetary distances being known by Kepler's third law, the sun's distance from the earth or any other planet in miles follows by a simple proportion as soon as his exact distance from one is determined.

The advantages of this (Delisle's) method are many. Its disadvantages arise from the fact that the exact moment at which the planet's ingress or egress occurs must be known. Besides the obstacle to the nice determination of these phases, this method involves the further difficulty that the clocks made use of at each station must show absolutely true time at the moment of observation. And since, to determine the exact interval between different observations the local time at each station must be changed to some common standard, say Greenwich time, it is essential that the longitude of the stations be determined with especial accuracy. Halley's method, on the contrary, requires only a relatively rough determination of the observer's position, and a timekeeper which shall not vary appreciably in the course of four or five hours. Both methods, supplemented by photography, will be employed in the observation of the coming transits. The reasons which govern the choice of stations for each method are not within the scope of this article. The main point is that the stations shall be sufficiently numerous and carefully selected to give the minimum risk of the thwarting of all observation by foul weather.

SCIENTIFIC AND PRACTICAL INFORMATION.

HIPPOPHAGY IN PARIS.

There are forty stores in Paris devoted to the sale of horse meat as an article of food. During 1872, 9,725 horses, 866 asses, and 51 mules were consumed by the inhabitants. *Les Mondes* says that the animals are prepared for the market in the ordinary way, and that the meat sells for about half the price of beef. The horses are inspected at the slaughter house with the greatest care. It may be noted as an interesting fact that hippophagy is decidedly on the increase, as 2,408,076 pounds of equine meat were eaten in 1872 as against 1,113,024 in 1869.

ADULTERATION OF ULTRAMARINE.

Ultramarine may be adulterated with some finely ground white substance, like alabaster, gypsum or isinglass, by contriving to color the outside of the particles with ultramarine. This is accomplished, according to Dingler's *Polytechnisches Journal*, by sifting them together, then moistening the compound with a very fine sprinkler until it packs in the hand and no dry powder remains. It is left for 3 or 4 hours, then sifted, dried, etc., in such a manner that the blue still adheres to each white grain.

The adulteration can easily be detected by rubbing a little of it on a piece of paper with a knife, thus exposing the white surface of some of the grains, so that on comparing it with the original sample it has a lighter color.

PREPARATION OF PURE SULPHATE OF POTASSIUM.

Commercial sulphate of potassium usually contains a large amount of sulphate of sodium. To free it from this, on a large scale, E. Sonstadt proposes the following method: 664 parts of the salt is dissolved in boiling water and 149 parts of chloride of potassium added in small quantities. Thereupon pure sulphate of potassium immediately separates as a fine crystaline powder, and as the liquor cools a fresh quantity crystalizes out. The mother liquor may then be concentrated by evaporation, until saturated at the boiling temperature. It is then allowed to cool, and a crust of pure sulphate of potassium forms on top. The process may be repeated three or four times before the liquor is sufficiently concentrated for the chloride of sodium, formed by the mutual decomposition, to crystalize out. Common salt is also as soluble in cold water as in hot, which the sulphate of potassium is not, and a solution not saturated with the former when hot will not deposit it on cooling.

TOILET SOAPS BY THE COLD PROCESS.

There are two methods by which toilet soaps may be prepared; these are known as the hot and the cold processes. The fine English soaps are chiefly made by boiling, while most of the fancy soaps in this country are made by the cold method. When made by boiling, a weak caustic lye is used and the soap is boiled until it is almost perfectly free from alkali. The soap which is then in solution is separated from the water by "salting out;" the glycerin, of course, remains in the water and is lost. The cold process is briefly as follows: The fat is melted in a well cleaned iron or copper kettle at a low temperature, then filtered through fine linen or muslin into another kettle, and cooled to 101° Fah. or lower; a very strong lye, usually about 36° B. is added, 80 lbs. of fat requiring about 40 lbs. of lye. It is then stirred with a wooden paddle until a ring made by stirring may be recognized. At this time the coloring matter and perfumery are added. It is next run into frames lined with muslin, closed, and left for 12 hours, by which time saponification will have taken place, the temperature rising to over 175° Fah. It is now ready to be taken from the frame, cut, dried, and sold. Soaps made by this process are softer and pleasanter, because they contain the glycerin; but they are unfortunately always more or less alkaline, no matter how much care is bestowed upon their preparation. A Frenchman named Mialhe claims to have invented a method of neutralizing the free alkali and thus combining the advantages of both methods and making a perfectly neutral glycerin soap. This is accomplished by taking the ordinary soap prepared by the cold process, shaving it up fine, and spreading it out on grates in suitable chambers, where it is exposed to the action of carbonic acid gas until all the free soda is converted into the bicarbonate of soda. Thus a perfectly neutral soap is obtained, which contains all the glycerin present in the grease and a certain quantity of bicarbonate of soda.

THE railroad tunnel at Baltimore, which is to unite the roads on the north and south sides of the city, is to be completed before the end of June, and, until the completion of the Broadway Underground Railway in New York, will form the largest underground railroad possessed by any city in America.

GENERAL GEORGE S. GREEN, formerly Chief Engineer of the Croton Aqueduct, New York, has been appointed Chairman of the Engineer Commissioners who are to supervise the construction of the Broadway Underground Railway.

THE ORNAMENTAL USE OF METAL.

The custom of embellishing parks with statuary and other ornamental objects, arising with the Greeks, was never carried to so great an extent as in the famous pleasure grounds of Italy. In the neighborhood of Rome there still exist the celebrated villas of the Dorias and Di Medicis, while near Genoa the great Pallavicini gardens yet form the principal attraction of the city. It was in these grounds that the famous sculptors of the Middle Ages designed their choicest works, and even now, too weather worn and injured to meet places in the museums, a few antique vases and figures still stand in the same spots where centuries ago they were first placed.

It has been asserted that the art of sculpture, as now practiced, is but reproductive, and that the genius of the present age tends more toward the rejuvenation of ideas of the past than toward the development of original conceptions. The reason, perhaps, may be traced in the fact that the world is no longer content with a single embodiment of a grand or beautiful thought, but demands its infinite multiplication—calling upon modern invention for processes reiterative of ancient prototypes rather than for fresh creations of the imagination. The same figures of Flora, of Venus, of satyrs, dryads, and wood nymphs, which, buried in ancient foliage, decay in the villas or are admired by millions in the museums of Italy, are now trite and every day ornaments. We turn the cover of a work before us, and their familiar forms appear upon the initial sheet. Metal has replaced the stone, the molder's flask and the melting furnace have superseded the sculptor's mallet and chisel; and while the originals remain immured in the cities of Europe, their counterparts, by thousands, beautify the pleasure grounds of the New World.

Ornamental work in metal, as now carried on, is not however entirely reproductive. Our larger illustration represents an article of garden furniture of exquisite and entirely original design, which, for grace and beauty, will favorably compare with many similar works of ancient art. The vase in the smaller engraving is, it is true, copied, but from an object the fame of which is worldwide, the celebrated Warwick Vase, still existing in Warwick Castle, England. Filled with flowers and trailing plants, no more elegant ornament could be desired.

There is another thought suggested by these tasteful objects, and that is the great progress which is being made in adapting the metals, especially zinc and iron, to all kinds of ornamentation. The latter is becoming more and more employed for architectural decoration to the exclusion of stone; the former, in the hands of a skillful artist, is capable of the most finished and expressive treatment. For counterfeiting the fine lines of statuary, and more especially floral subjects, it is excellently suited, as the thin petals and leaves of plants can be worked out in it, in all their infinite variety. As a material for out-door exhibition, in connection with iron, it is superior to either stone or terra cotta, being neither as expensive as the one nor as easily injured as the other. A coat of paint protects it from the effects of the weather, and insures its durability while giving it the appearance of the marble or other material it is intended to represent.

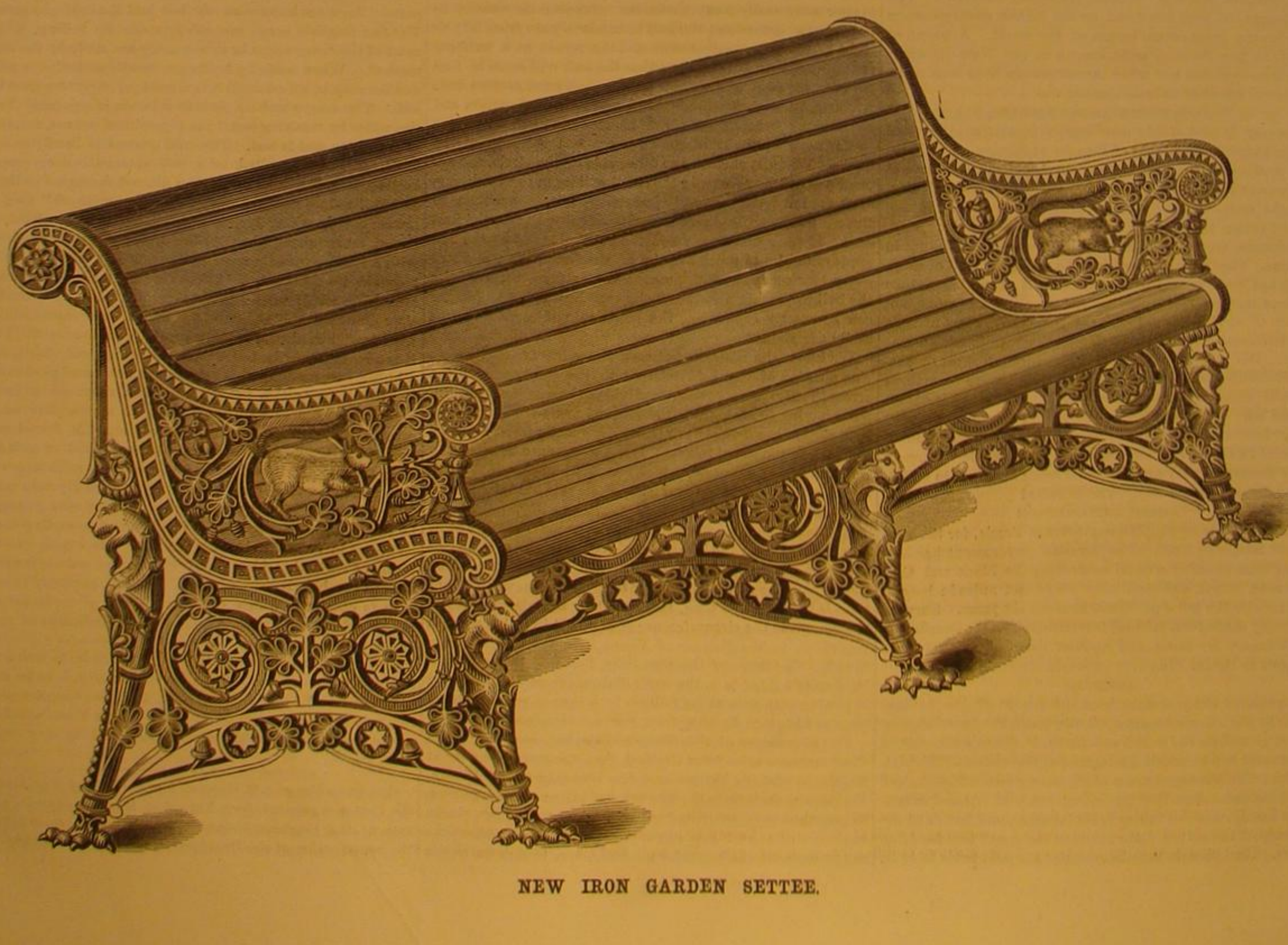
We select the accompanying engravings from a number of beautiful designs of various objects of art and ornamentation in the catalogue of the J. L. Mott Iron Works, No. 90 Beekman street, in this city, one of the largest establishments devoted to the specialty of ornamental work in the United States.

THE WARWICK VASE, REPRODUCED IN IRON.

Glue Making.

According to Yardley's process, the bones are put into an apparatus in the shape of a hollow globe, and made of wrought iron (copper cannot be used because the gelatin has a very powerful action upon it). The first process is to cleanse the bones by immersing them in a pit or cistern of water, where they remain about twelve hours; the water is then drawn off and fresh water added to them; this operation is sometimes repeated to remove any dirt, etc. The water being withdrawn from the bones, a solution of lime, in the proportion of one bushel of lime to 500 gallons of water, is to be poured into the cistern for the more perfect cleansing of the bones and the removal of any superfluous matter. After three or four days' saturation, the lime solution should be drawn off and fresh water added, to get rid of the lime. Thus prepared, the bones are placed in the globular vessel called the extractor, which is filled with them by removing the interior plate which covers the manhole; this aperture is of an elliptical form, and allows the plate to be slipped round and refixed in its place by turning a nut which draws it up tight against the interior surface of the extractor, and the junctures are made air-tight by luting. The extractor turns upon a horizontal cylindrical shaft; one half of this shaft is made hollow, or consists of a strong tube, which tube also proceeds downward towards the center of the vessel to conduct the steam beneath the grating upon which the bones are laid. The steam, of about 15 pounds pressure, is admitted by the cylindrical shaft, proceeds first to the bottom of the extractor, then rises up through the grating and among the bones, until the vessel is completely charged; previously to this, however, the air in the extractor is got rid of by opening a cock at the top of the extractor, and closing it after the admission of steam. While the steam is acting upon the bones, the extractor is occasionally turned round by means of a hand winch. When at rest, a quantity of fluid gelatin is collected at the bottom of the extractor, whence it is discharged by means of a cock into a tub beneath, after opening the air cock to allow it to run off. This done, steam is again admitted from the boiler into the extractor to act upon the bones for another hour, when the second portion of condensed liquor is drawn off. When the products thus obtained have become cold, the fat which has formed upon the surface is to be carefully removed by skimming, and the gelatinous portion only is to be returned to the extractor by means of a funnel through the cock on the top. The steam is then admitted to the extractor for another hour, after which it is finally drawn off into another vessel to undergo a simple evaporating process until it arrives at a proper consistency to solidify when cold, previous to which some alum is added to clarify it. When cold, this gelatinous mass is cut into square cakes and dried as usual in the open air.

THE Commissioner of Patents, Canada, has presented to Parliament a bill for the further amendment of the Canadian patent laws. The amendment simplifies the preparation of the application, and does away with a great deal of the red tape proceedings now required. The design is to assimilate both the proceedings in preparation of papers, and the procedure before the Patent Office to those of the United States.



NEW IRON GARDEN SETTEE.

STEVENS INSTITUTE LECTURES.---MOONLIGHT AND ITS SOURCE.

BY PRESIDENT HENRY MORTON.

The moon shines, as is well known, by reflected light; and a consideration of the nature of reflected light will therefore be a profitable introduction to the study of the moon itself. When a pebble is dropped in the smooth water surface of a pond, circular ripples or waves will be formed, constantly expanding as they recede from the center of disturbance. In like manner, a source of light produces a disturbance in the ether pervading all space, thereby throwing it into ripples or waves, which differ from the former only in being spherical instead of being confined to a flat surface. When one of these advancing waves of light strikes against an obstacle, it will be thrown back as an india rubber ball would be when thrown against a wall, returning with the same force with which it struck, because the impinging ether is perfectly elastic.

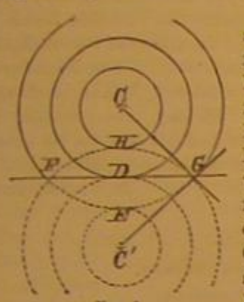


Fig. 1.

In the accompanying figure are seen a series of waves proceeding from the center, C. One of them has arrived at an obstacle, D, but for which it would have reached E, as shown by the dotted lines, F,'E, G; as it is, however, the wave is thrown back with the force with which it struck, evidently describing the curve, F, H, G, just as far above the obstacle as the unobstructed wave would have gone below it. The other waves would be reflected in the same manner and give rise to a series of curves having a center at C', as far below D as C is above it. When speaking of reflection, it has been customary to explain the phenomena by using the term "rays;" but it must be remembered that these only represent the direction in which waves proceed, and not the manner of their propagation. If a line joining C and G represent the direction of the wave striking at the latter point, the direction of the reflected ray will be indicated by a line joining C' and G, thus furnishing an easy proof of the law that the "angle of reflection is equal to the angle of incidence."

After the above new explanation of the familiar law, the lecturer exhibited the reflection of waves upon the screen, by means of a beautiful piece of apparatus. The light of an oxycalcium burner was reflected by means of an inclined mirror through a flat horizontal glass tank filled with water. By means of puffs of air, waves were produced upon the center of the water surface, and these were reflected upon the screen by a large inclined mirror above the tank. The sides of the latter were made to slope considerably outward, so as to avoid reflection from them; and the audience was thus enabled to verify what had been stated about the propagation of waves. A glass plate held in the water on the side of the tank reflected back the waves of water, in circles having very much the appearance of those in Fig. 1.

After dwelling briefly upon the well known laws of reflection, and exhibiting in illustration some of those beautiful Yo Semite views where the eye strives in vain to discover which is the landscape and which the reflection in the river, the lecturer described how objects thus reflecting light become of themselves secondary sources of illumination. A number of objects, lighted up by the lime light and thrown upon the screen by means of a lens, appeared in bold relief and startling proportions. The engraving herewith, representing the professor's hand, will give some idea of the effect.

It is in this manner that the moon receives its light from the sun and becomes in turn a source of illumination to us.

Passing thence to the consideration of the moon itself, photographs representing its different phases were exhibited. These, the lecturer stated, made by Mr. Rutherfurd and Dr. Draper, were productions of which America might be justly proud, as nothing had ever been produced in other countries that would bear comparison with them. The topography of the moon has been accurately studied and the different portions of her surface have received names, some of them poetical. Thus we have the Sea of Nectar, the Sea of Storms, the Frozen Sea, the Lake of Sleep, the Lake of Death, the Misty Marsh, the Meadow of Dreams; the mountains have been named after distinguished men. Some of the most important are Tycho Brahe, Ptolemy, Herschel, Archimedes, Copernicus, etc. The different regions containing these various parts were separately discussed. It seems that the moon is composed of burnt out craters of immense volcanoes, some of them a hundred miles across the top, and that there is no vestige of water or atmosphere about it. Consequently the stars will be visible thence, even when the full blaze of the sun is upon it, during its day of fourteen terrestrial days, because there is no diffusion of light. It is the presence of our atmosphere that prevents us from seeing the stars in daytime. The manner of measuring the hight of lunar mountains is by observing their shadows at different times of day. They are carefully measured by means of the micrometer; and from their length and the accurately determined relative position of sun and moon at the time, the astronomer is enabled to calculate the hight of the mountains. Different views taken from paintings by Mr. James Hamilton, an artist of note, of what must be the appearance of portions of the moon by earth-light and by daylight were then exhibited. They gave an excellent idea of what is believed to be the condition of the moon's surface. All we know of the moon is of one side only; for she never turns the other towards us. Professor Janssen accounts for this fact by supposing that the greater part of the mass of the moon lies on the side away from us, and that our side is comparatively light and frothy, thus giving it an eccentricity which would prevent the other side from ever turning towards us. If there existed any water or air on the moon, it would, according to this hypothesis, be drawn away from our side towards the opposite one.

It has been advanced as a theory that the moon has passed through the different stages which geology teaches us took place on the earth; that finally, by cooling off, all the air and water have been absorbed and that she is now a dead planet, devoid alike of animal and vegetable life, burnt out and frozen. This is represented to be the ultimate destiny of our earth and of all the planets, though millions and millions of years may be required to accomplish it. The earth, we suppose, has partially cooled from a liquid, molten mass, and the greater part of her interior is still in that state. Afterwards she was covered by immense glaciers, which have left their imprints upon the rocks all over her surface. These stages of development can be seen now going on simultaneously in the other planets. Jupiter being greatest in bulk and consequently requiring a longer time to cool, according to the hypothesis, has not yet arrived at our stage. Observations by Professor Mayer and others demonstrate that it has for some time been undergoing changes and sending out more light than it received from the sun; while Mars has passed our stage and exhibits the phenomena of huge snowstorms and evidences of an Arctic period. Maps of the two planets, showing their characteristics, were produced upon the screen in this connection. According to this bold hypothesis, the moon represents the very remote future of the planet on which we live, a time when it will be no longer a fit habitation for man.

THE WONDERS OF THE EGG.---SECOND LECTURE.

The following lecture was recently delivered by Professor Agassiz, before the Museum of Comparative Zöology, at Cambridge, Mass.:

I closed my last lecture with the remark that before approaching the question of origin it was indispensable to be familiar with the conditions under which organized beings were multiplied. It is a feature which is too frequently neglected in any discussion of this kind. I propose to bring before you, as plainly and methodically as I can, the conditions accompanying the maintenance of animal life upon the earth. Do you realize that all the living beings which surround us, however great their diversity, have a short time since been eggs; that there is not a human being, nor a quadruped, nor a bird, nor a reptile, nor a fish, which has not been an ovarian egg; that generation after generation these ovarian eggs bring forth new beings like those from which they were produced, and that this is an indispensable condition for the very existence of all the life with which we are familiar? But this is not all. Besides the individuals capable of producing eggs, there must be a corresponding set of individuals from whom the egg receives an impulse, leading to the formation of the new being within it; in other words, the egg must be started by an influence from without, that is, by contact with sperm cells, into those successive changes or transformations by which the new being is produced. This is true of all beings not provided with the power of reproduction by budding or self-division; although, as I said in my last lecture, there are occasional exceptions to the rule, as among bees and certain moths and butterflies, known to produce living beings by means of non-fecundated eggs. We have many animals among the lower organisms, and especially in the class of radiates, that combine the three modes of reproduction: multiply by eggs, buds, and self division at various times. Others propagate by the two first processes alone, without the last. Among the higher animals propagation by eggs is the only method known. Neither mammal, bird, reptile, nor fish multiplies its kind in any other way. All eggs arise in what are called ovaries. These are clusters of cells, forming bunches of a somewhat glandular character in appearance. Between these cells the eggs are formed and in such a way as at first to be hardly distinguished from the cells themselves. The same is true of sperm cells, which arise in organs of the same character as the ovary, and are formed in a manner perfectly similar to that of the formation of the egg. So we have these two spheres of growth which characterize sex in the animal kingdom, arising in conditions so very similar that the essence of the two is hardly to be determined by observation. It is only by the process of growth, by the influences produced by the one upon the other, and by the consequences of these influences, that we recognize the essential difference which distinguishes them.

In order fully to appreciate what eggs are, we must remember—what has been known for about a half a century only—that all organized bodies are composed of little bags which are called cells, and which are formed and multiplied in various ways. Most of these cells are so small that they can only be perceived by the aid of high magnifying powers. There are, it is true, a few cell structures large enough to be seen with the naked eye, as for instance, the cells of common elder pith, or the coarse cells of the orange. It is one of the great problems of modern research to ascertain how these cells are formed and what is their mode of reproduction. For it does not seem that cells are formed in the same way under all circumstances. Some naturalists assume that in the animal substance secreted by a living body, such as milk, which is secreted by the mammary glands or similar substances secreted by other organs, certain particles become centers of action, around which other particles crowd; and when a little collection of this kind, microscopically small, has been formed, an envelope arises around it, and we have the utricle or cell. Others believe that minute, imperceptible particles of animal substance swell and enlarge, and become hollow, so that a little bag is formed, a cell envelope in short, which fills as it enlarges into a fluid substance.

As yet we know but imperfectly what cells are; still more imperfectly do we know how they are formed, and still less do we understand their function. Yet the amount of facts already ascertained respecting them is truly overwhelming. This much, however, may be positively stated: between ovarian eggs in their earliest condition and cells in their elementary state, such as constitute the substance of all animal bodies, there is no essential difference.

THE EGG OF THE MAMMALIA.

Let us now consider the ovarian egg as we know it in mammalia, and then proceed to compare it with the ovarian egg as far as is known in other classes of vertebrates. When it has acquired its ultimate growth, prior to the formation of the germ, the egg of the mammalia presents a bag the walls of which are exceedingly transparent. This bag is filled with a substance which is itself transparent, and yet which appears, under a very high magnifying power, to be granular, as if dotted with particles floating in the fluid. In that outer bag is another diminutive bag containing also a transparent fluid. This inner bag occupies an eccentric position with reference to the periphery of the outer bag, and in it are contained one or several dots. These parts of the mature egg have received names. The outer envelope is called the vitelline membrane, because it has been ascertained by comparison that it corresponds exactly to the exceedingly thin skin inclosing the yolk in the hen's egg. A yolk is called the vitellus, and hence the name. The bag contains the yolk; and however transparent this fluid may be, it retains the name of yolk. To the naturalist the word yolk no longer designates that peculiar substance contained in the bird's egg of a yellowish color. The yolk may be any substance which is contained in the outer envelope of the egg. The inner bag is called the germinative vesicle. That name was given to it under the impression that from it the germ arises. The name has been retained, though I wish at the outset that you should free yourself from the idea that it has any special connection with the formation of the new being. The dot or dots within the germinative vesicle are ordinarily called the germinative dots. From their discoverers these parts have also had some other name applied to them. It was Professor Purkinje, of Breslau, who discovered the germinative vesicle, and in his honor some physiologists call it the Purkinjen membrane or vesicle. Professor Wagner of Göttingen discovered the presence of the dot in the germinative vesicle, and in his honor it is occasionally called the Wagnerian dot or dots.

The dimensions of such a mammalian egg are very small. It comes just within the range of the power of the human eye. Practiced embryologists may detect, without the use of the lens, an ovarian egg in its organ when it has reached

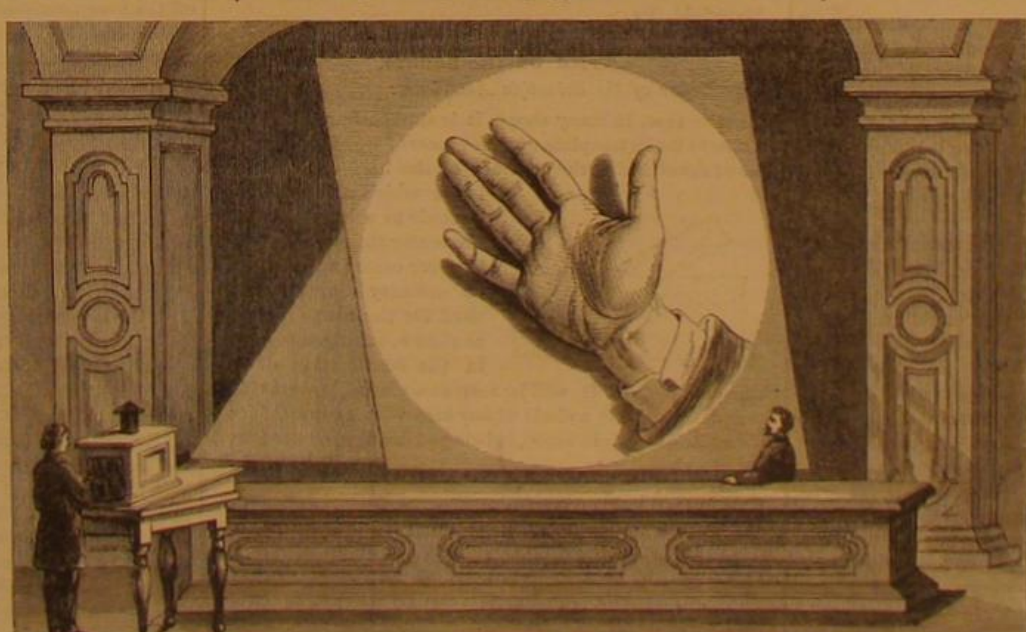


Fig. 2.—ILLUMINATION BY RADIATION.

maturity. Owing to the difference in the power of human vision, some observers will easily detect the egg in its natural position in the ovary with the naked eye, while others are unable to see it except by the aid of the magnifier. Place the ovary under the microscope and you will find that it contains eggs of various dimensions in various stages of growth. In some the amount of yolk is less than in others; in some the germinative dot exists; in others it is not formed; indeed vesicles are found in the ovary in which neither germinative dot nor germinative vesicle exists, and which are supposed to be eggs in process of formation.

Correspondence.

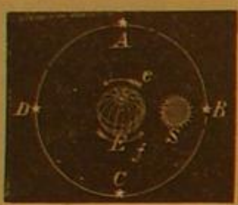
The Retrograde or Direct Motion of the Sun.

To the Editor of the Scientific American:

In your issue of March 12, a scientific friend, C. H. B., has very kindly tried to set me right in relation to precession; he thinks that I am "wrong in some of his [my] views." Well, may be I am; I will not assert that I am absolutely right; but I have the strongest kind of evidence to show that I am right, namely, proof, and I am satisfied that C. H. B. and many others of your readers will be astonished to see it, if you will allow me to present the same to them.

C. H. B. says that "the retrograde motion of the equinoxes is real, and does not necessarily involve the idea of a direct or other motion of the sun," etc. By this language I understand him to mean that the earth makes a gyratory wabble, retrogressively, as Newton said, and as all Newtonians assert, and that it is independent to solar movement altogether.

Now let us test the truth of this by diagram, and we will soon find out who is in error. E is the earth; S, the sun; A B C and D, stars in the ecliptic, or in a circle surrounding the pole of the ecliptic, and at all points 23½° from it. E is understood to be rotating always at a regular rate, in the direction of the arrows. Consequently, in rotating, it will take the same time exactly to turn round from S and come to S again that it will require to turn from A B C or D and return to it again. The pole of E is now inclined to A, but must be understood as gradually leaving it and traveling towards B, passing it and moving to C, and so on, until it comes to A again in 25,868 years.



Now the first lesson we learn from this diagram is that the Newton notion of the earth making a retrograde gyratory wabble is not true; for, when we suppose that the pole of E, now laying towards A, gradually moves retrogressively and comes to B, we find that solar and sidereal time would both be the same. Why? Because it would take the same time, as we have already said, for E to turn from S and return, as it would to turn from any of the stars marked A B, etc., and return to them. If the earth was really making any such independent revolution, there would be a recession of the equinoxes, it is true; but where would be the difference between solar and sidereal time? Could there be (if S remained where it now is) one single moment's difference in ten thousand years, aye, or in ten thousand recessionary revolutions? This simple little trifle, to wit, no difference between solar and sidereal time, kills the Newtonian notion entirely; for Nature yields a difference annually of 20 minutes and about 23 seconds.

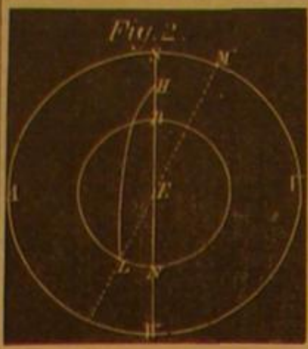
Further, suppose S to continually move in the direction of B, and E to swing her poles round in the direction of A B C D in 25,868 years. In every revolution E made from A to A, a recession of the equinoxes, and, of course, of the four seasons of the year, would result. But, in all that time, and with such direct solar motion, not a single minute's difference in solar as compared with sidereal time would result. Is not that plain? Is not that a fact? Where is Newton's notion now?

Again, suppose S were to pursue a path towards *e*, and E to keep swinging her poles and rotating on her axis, as we have supposed. Would not solar time, then, be longer than sidereal time? Would not B be in the meridian before *e* could? And would not the increase of solar time depend upon the rate of advance of S to *e*? These facts are so manifestly true that none who study the subject enough to understand it would attempt to deny any one of them. Such a result is not the result of Nature; therefore we know that the direct motion of the sun, which popular astronomy so universally claims to be true, is not true, and never was. What say you to that, popular astronomy?

Again, and lastly: Suppose S to be moving in the direction of *f*, and E to be rotating and swinging her poles round, as before supposed; would not solar time be shorter than sidereal time? Would not E (the earth), in her rotary movement, arrive sooner at *f* than she would at B? And would not the degree of shortening be in proportion to the rate of retrograde motion of S to *f*? Now such a result is the yield of Nature; hence we know, certainly, that the sun (S) is pursuing a retrograde orbit in the direction of B C D A. These, my much respected friend, C. H. B., are facts, which I think you will be willing to admit, when you next write. Although, as you say, the retrograde motion of the equinoxes does not necessarily involve the idea of a direct or other motion of the sun; yet the difference between solar and sidereal time does; and it is by this that we know that the sun is moving retrogressively in his orbit. Nothing is clearer in all astronomy.

As to the one day, so called, of precession, I would remark that it cannot be a day of 24 hours. It may be called (if we must call it a day) an equinoctial pole day of 25,868 years' length.

It is true that from the moment the pole of the earth prolonged leaves H (I allude to C. H. B.'s diagram, Fig. 2, annexed), or A in my own diagram, it cannot return thither again until about 25,868 years. But in respect to the rotary movement of the earth or sidereal time, as compared to solar time, is not the difference 1 in 25,868? And if so, then a solar day is shorter than a sidereal day to the amount of one day in 25,868 days, and to one year in the same number of years.



I hope, at some future time, to give a diagram of my theory of solar motion, showing how precession of the stars, and recession of the four seasons of the year, is produced, which I believe will be both interesting and instructive to your many scientific readers, as well as to my friend C. H. B., who, I hope, will send me his full name, so that I can privately thank him with much gratitude for the kind and gentlemanly manner in which he has made an endeavor to convince and correct me.

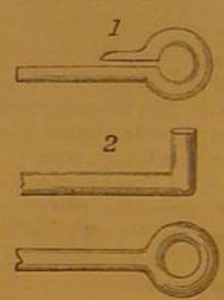
JOHN HEPBURN.

Gloucester, N. J.

Wrinkle No. 2.

To the Editor of the Scientific American:

I noticed a short time ago, in your journal, an article entitled "A Wrinkle;" the idea is undoubtedly of benefit to the practical workman, and you will allow me to suggest another, which may be of equal value. It is customary with blacksmiths, in making hooks for chains, clevises, and other like articles having an eye, to draw out the bar, bend it over to form the eye, and then weld down the lap, back of the eye. This always makes an imperfect eye, to say nothing of overheating the end of the part turned, which is invariably the beginning of a fracture. (1.) Now let the smith cut off the iron, or leave it on the bar, as he may think proper, bring the end to a welding heat, and bend (over the edge of the anvil), at right angles, as much as he desires, to form the head; then draw it on the face of the anvil, with end up (2); strike on the end thus turned until flattened down (this must be done while there is a welding heat on iron); then punch a hole back of the center of the head, and work out the eye on the horn of the anvil as large as desired. There you have it.



To such as are accustomed to draw out and form the eye in the old way, I would suggest the above plan; and should they find reason to be thankful, let them bestow a favor on the SCIENTIFIC AMERICAN and its many readers. If they know of any process by which their class will be benefitted, and by which we may become more intelligent and skillful workmen, give us the benefit of such knowledge.

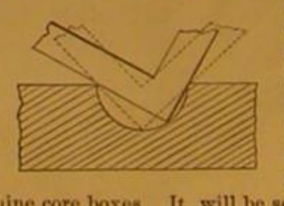
N. P. Q. R. S. T.

Mansfield, Pa.

Tried on the Square.

To the Editor of the Scientific American:

I notice that, in many shops, it is the custom of pattern makers to make templets of thin pieces of wood, for the purpose of determining the accuracy of the half circle in core boxes which are chambered or made to a larger circle in the center than at their ends. It never occurs to them that an ordinary square may be used for the above purpose, as shown, saving much time in the construction of machine core boxes. It will be seen at a glance, however, that the square will test a circle of any size with as much accuracy as it does a right angle, it being 90 degrees, or the fourth part of a circle.



GEORGE B. DURKEE.

Farmington, Ill.

The New Patent Law Bill in England.

To the Editor of the Scientific American:

As one of the Committee of London Patent Agents, who prepared the new patent law bill which was severely criticized in your issue of March 29, permit me to explain its object and its bearing on the cause of patent law reform. In the years 1871–2 a select committee of the House of Commons sat "to enquire into the law and practice and the effect of grants of letters patent for inventions." The result of this enquiry was a report embodying several recommendations which were supposed to be needed for improving the working of the patent laws. These recommendations commanded by no means the general approval of patent agents, and some of them were even denounced as impracticable. It was however thought, and, I venture to say, not unreasonably, that if the recommendations were to be followed, the putting them into working order, so that the least possible amount of mischief should accrue therefrom, might be the best effected by those whose experience enabled them to judge of their ultimate action. The patent agents therefore undertook to embody in one bill the existing statutes, and clauses which would include the machinery for working out the recommendations of the Committee of the House of Commons.

All that is new, therefore, in principle in the bill, the Commons committee is answerable for, and all that is old is the work of the legislature. Our self-imposed task was simply to supply the details for putting the resolutions into a working shape. For my own part, I agree with you that "nearly all the changes proposed in this bill are steps in a backward direction," but you will understand that it is of no small importance for the legislature to have before it, whenever the amendment of the patent laws may be taken in hand, not only the whole law as it exists, but also the recommendations of the Committee in a working shape, combined in one document. Moreover, suggestions may at the first blush seem to possess some value, but when put into working shape their impracticability may be demonstrated. If this result has been attained by the labors of the Committee of Patent Agents, and your remarks seem to indicate that it has, I venture to say that good service has been rendered, by the drafting of our bill, to patent law reform. At any rate you may rest assured that the bill will never become law in its present form if it is within the power of the London patent agents to prevent it.

A. V. NEWTON.

66 Chancery Lane, London.

Superheated Steam.

To the Editor of the Scientific American:

Knowing how much every one using steam power is interested in producing it economically, I send you the following facts, which have added very much to my opinion of the advantage of using superheated steam:

We have been using in our business for some years an upright tubular boiler, the tubes passing entirely through the steam space, giving us very dry steam. This boiler furnishes a little more power than did a horizontal tubular boiler, having more fire surface and using more fuel, which was used to run the same machinery. I was still more impressed with the economy of our boiler by the following comparison: Last summer a foundery and machine shop was established in a building adjacent to ours. They put in an ordinary two flue horizontal boiler. By a careful estimate, I judged they used about three quarters the power we do, while they consumed nearly one half more coal. I noticed that they worked very damp steam, which was evident from the water escaping from the cylinder cocks, which were always open. Their boiler has a dome and mud drum; ours has neither; and although our middle gage is only 15 inches from the top of the boiler, it never foams unless we are using very dirty water. We are not using any "lime or dirt extractor," although we take water from the Missouri river, which is often very muddy. After three years' use, the boiler appears to be very slight incrusted with scale. I account for this from the fact that our engineer pumps water into the boiler after he has drawn the fire, which seems to settle the impurities, which he blows out through the mud cock. The only trouble we have with our boiler is that it sometimes gets to leaking around the upper end of the tubes, which we stop in a few minutes with an expander. I lay this fault to the engineer, who, when late, makes up a very hot fire to raise steam in a few minutes, which causes the upper end of the tubes, not surrounded with water, to become red hot. I do not think this would ever occur with slow firing at the start, for I am of the opinion that steam under a slight pressure would take off the heat nearly as fast as water.

S. E. WORRELL.

Hannibal, Mo.

Professor Young on our Knowledge of the Sun.

To the Editor of the Scientific American:

In your journal of March 1, 1873, pages 131, 132, is a part of one of Professor Young's lectures on the sun; and, if he said what is there reported, it is hard to see how his statements can be reconciled. In speaking of the heat of the sun, quoting Sir John Herschel, he says: "Suppose ice could be formed into a rod forty-five miles in diameter, and that rod of ice should be darted at the sun with the velocity of light: if all the heat of the sun could be concentrated upon the javelin of ice, it would never approach the sun, for the point would melt off as fast as it came." At that rate the sun would melt 305,363,520 cubic miles of ice in a second, if light moves 192,000 miles in a second. He says again: "Suppose we should take two and a quarter miles square of solid ice, and should concentrate upon that the heat of the sun, it would take just one second to melt it." If he means, by "square," to imply a cube of that size, he would make the sun melt $11\frac{25}{64}$ cubic miles of ice in a second. Now if by one estimate the sun will melt over three hundred million cubic miles of ice in a second, and by the other, less than twelve cubic miles, there is certainly an appreciable difference in the estimates: the ratio being over twenty-five millions to one, not very close for an "exact science."

But perhaps these estimates are about as satisfactory as any that can be made on the subject of the solar heat, for I notice that by different scientists the sun's heat is estimated at from less than 212° Fah. to eight or ten million degrees of the same scale.

The Professor thinks that "if the sun were of solid coal, it would have been completely burned out in 5,000 years." I have seen it estimated that it would burn out in less than five minutes. And the latter estimate seems more correct, as it was based on the ratio of the sun's mass and radiation, compared with a globe equal in diameter to the earth's orbit. He thinks also that "meteors" help to keep up the solar heat. But, according to the SCIENCE RECORD, the meteors are only the dust from the comets' tails, blown off by the atmosphere. Of the thousands which have been seen in the August and November showers, I have never heard that a single person has been able to light his pipe from the heat they have produced. If, then, the known effect of the greater part of meteors is so small, upon what principle is so great an effect attributed to them as that of contributing largely to heat up such a body as the sun, and through it the vast space of the solar system? Can any one tell? Does not the Professor's lecture need to have its statements better harmonized?

JACOB DAVIS.

Florida, Mass.

Ignition by Superheated Steam.

To the Editor of the Scientific American:

I have noticed the letters that have appeared in your journal lately, on steam ignition, and I will give you a singular fact which occurred in my own experience a few days ago.

I had prepared some gun cotton, and after washing it a little from the acids, I laid it on the T joint of a steam pipe to dry, 80 yards distant from the boilers; the pipe runs 40 yards of the distance under ground. In about three minutes, there was a flash like lightning; the cotton I laid on the T joint had exploded by spontaneous combustion.

I have often seen cotton yarns and raw cotton, that have been dyed with sulpho-nitrates and nitro-muriates, ignite in a few hours, being in contact with superheated steam pipes. May not wood, under certain circumstances, absorb inflammable gases, and thus be rendered more liable to spontaneous combustion?

JACQUES NICHOLSON.

Frankfort, Ky.

Retardation by Ocean Tides.

To the Editor of the Scientific American:

In the SCIENTIFIC AMERICAN of April 12, there is a paper on this subject alleging that the "tidal wave spends its force, moving from east to west, on the coasts of Africa and America, retarding the rotation of the earth"; but the wave does not remain there, and the reflux would be equal to the afflux. Without surface oceans, no thought of retardation by the moon's attraction would be entertained; and, if surrounded freely with ocean water, the earth being supposed to be stationary, a swell of the water directly under the moon would result; and as the earth might begin its rotation east, that side of the swell would fall back or recede, and the western progress of the moon's attraction would continue to renew the swell from the approaching western supply. Thus the swell would undulate around the earth, without change of place as a whole

T. W. B.

Pittsburgh, Pa.

CHEMICAL NOTES.

Zinc and Aluminum in the Sun.

The observation that the number and length of the lines in the spectra of metallic vapors depend upon the density of the absorbing or radiating vapor, and that only the longest lines remain visible when the vapors are rarefied, obtains additional importance by the author's discovery that the inverted lines in the solar spectrum are without exception the longest lines observed in the spectrum of the vapor of each element. The presence of zinc and aluminum in the sun had hitherto been extremely doubtful, as only very few lines of their spectra had been found inverted in the solar spectrum; this doubt we may now consider as removed, since the author has found that the lines corresponding to these elements in the solar spectrum are the longest lines of the spectra of their vapors.—*N. Lockyer.*

The Spectrum of Nitrogen.

According to A. Schuster, the true line spectrum of nitrogen invariably shows a bright green line followed (towards the blue end of the spectrum) by a green band. The fluted spectrum shows shaded violet bands.

Phosphoretted Hydrogen and Ammonia.

K. B. Hofmann says that the spectrum of phosphoretted hydrogen shows four green lines, lying between D and F (Fraunhofer). The green color, according to the author, is not due to burning phosphorus, because phosphorus burned alone shows no spectral lines; nor is it due to the burning of the gas phosphoretted hydrogen, because this gas when heated is split up. The chemical process going forward in the mantle of the flame is supposed by the author to produce beams of constant refrangibility, and the green color to be due to these.

The spectrum of ammonia is yellow. This spectrum is not to be accounted for by the decomposition of ammonia and the burning of the nitrogen.

Production of Light by Atomic Movements.

Many bodies emit light at ordinary temperatures. This fact forms the basis of a speculation by the author, in which he supposes that the atom of a substance may rotate without any appreciable movement of the molecules, and that the production of light may, in many instances, be due to such atomic movements.

These movements will depend upon the mass of the atoms and the chemical force binding them together. When these movements are so extensive as to cause a disruption of the molecule, a new substance is formed, accompanied by a greater emission of light. The tension of vapors and the change of volume upon increase of temperature are to be regarded as caused by molecular movements. The atomic movements causing emission of light waves may be taken up by the molecules, and so we have absorption of light.

As the sphere of action between any two atoms must be limited, chemical decomposition will ensue as soon as the atoms pass out of this sphere; if their excursions exceed the distance between the middle points of the neighboring molecules, a complete breaking up of the molecule must ensue.—*Journal of the Chemical Society.*

Interference Colors of Gold.

W. Stein observes that gold in thin plates, or when precipitated from very dilute solutions (by action of sulphur dioxide in water), manifests dichroism, appearing indigo blue by transmitted light, but reddish yellow by reflected light. But if the particles of gold be very small (as when gold is precipitated from its solution by means of stannous chloride) the laws of interference come into play and the gold appears purple. Such gold the author calls molecular gold, and he thus distinguishes three modifications of gold, (1) ordinary, (2) dichroitic, (3) molecular. Ruby glass he regards as a solution of molecular gold in glass.

Recent Experiments with Oxyhydric Illuminations.

With a recent issue of the *American Gas Light Journal* there is published, as a supplement, a careful translation, by the editor, of a report made by Simon Schiele, a distinguished gas expert of Frankfort, Germany, on the subject of oxygen illumination in that country. He does not coincide with the conclusions of Le Blanc on the Tessié du Motay process as tested in Paris.

Mr. Schiele's report says that the illumination by the Tessié du Motay method comes no dearer than any other mode of lighting, and that it is perfectly well adapted for public illumination. The carbon in the rich gas is consumed, in all cases, more completely and with greater light-production than in any other mode of combustion hitherto practiced. When the two gases are adjusted to the proper relative proportions, in suitable burners like the Andreae, there occurs no waste of either the one or the other gas.

As carburreting at the place of burning may, by recent improved methods, be averted, this objection becomes futile. The gas may be conducted into the interior of houses and through all parts thereof. By the recent improvements in Vienna, rich gas of uniform quality can be delivered through pipes to very remote localities; and there is no doubt but that oxygen also, of nearly uniformly good quality, can always be sent forward through mains over wide spaces. The results of the Vienna experiments prove the practicability of the oxygen illumination for all towns and even for large cities, while the profits of the plan are as little to be doubted as those of any other gas-lighting enterprise. There is no necessity of delivering the oxygen in a state of compression to consumers when it can be readily, as proved, transmitted through pipes. With regard to the hygienic value of oxygen lighting, as compared with ordinary gas lighting, Mr. Schiele observes that when the oxygen necessary to combustion is furnished specially and directly to the flame, that of the room lighted by the latter is of course not drawn upon; and when the hydrocarbon employed for the production of an equal amount of light is diminished in amount, the quantity of carbonic acid resulting from the combustion must be proportionally less than in the case of ordinary gas lights.

Volcanic Eruption in Iceland.

A great eruption of the Skaptar Yokul, a volcano in Iceland, took place on the 9th of January. It lasted over four days, and the magnificent sight it presented was visible from most parts of the country. The Yokuls, or enormous ice mountains, are among the greatest elevations in Iceland. The Oreefa Yokul, 6,280 feet in elevation, is the most lofty of which any accurate measurement has been obtained. The celebrated volcano Hecla is more remarkable for the frequency and violence of its eruptions than for its elevation, which is only about 5,200 feet. Besides more than thirty volcanic mountains, there exists an immense number of small cones and craters, from which streams of melted substances have been poured forth over the surrounding regions. Nine volcanoes were active during the last century. Twenty-three eruptions of Hecla are recorded. The most extensive and devastating eruption ever experienced in the island happened in 1783; it proceeded from the Skaptar Yokul, a volcano (or rather volcanic tract, having several cones) near the center of the country. This eruption did not entirely cease for about two years. It destroyed twenty villages and 9,000 human beings.

New Musical Instrument.

If into a glass tube two flames of convenient size be introduced, at a distance of one third the length of the pipe, counting from its base, these flames will vibrate in unison. The phenomenon continues as long as the flames remain separate, but the sound ceases the moment they are brought in contact. If the position of the flames in the tube be varied, it is found that the sound decreases until one half the entire length is approached.

Based on these facts, M. Kastner has constructed a new musical instrument of a very peculiar timbre, closely resembling that of the human voice. The "pyrophone," as it is termed, has three key boards; each key of which is, by simple mechanism, placed in communication with the conduit pipes of the flames in the glass tubes. By pressing upon the keys, the flames separate and sound is produced. When the pressure is removed, it is instantly stilled by the junction of the flames.

CONICAL JOINT FOR IRON PIPES.—In the manufacture of cast iron tubes, the practice has been introduced, with satisfactory results, of turning off one end conically, and boring out the end of the tube to which it is to be united at the same angle, the end of one tube being thus inserted into the other without the necessity of applying any cement, the junction being effected in this way very readily, and the joint being perfectly tight.

The Hartford Steam Boiler Inspection and Insurance Company.

The Hartford Steam Boiler Inspection and Insurance Company makes the following report of its inspections in the month of February, 1873:

During this month, there were 855 visits of inspection made, and 1,520 boilers examined, of which 443 were carefully inspected internally and externally, the boilers being blown down and cool; 151 were tested by hydraulic pressure. The number of defects in all discovered were 782, of which 192 were regarded as dangerous. These defects were as follows:

Furnaces out of shape, 39—8 dangerous; fractures, 76—25 dangerous; burned plates, 52—15 dangerous; blistered plates, 106—13 dangerous; case of deposit of sediment, 133—14 dangerous; incrustation and scale, 134—13 dangerous; external corrosion, 60—15 dangerous; internal corrosion, 27—10 dangerous; internal grooving, 16—12 dangerous; water gages defective, 29—9 dangerous; blow-out defective, 13—3 dangerous; safety valves out of order and overloaded, 26—4 dangerous; pressure gages defective, 101—19 dangerous, varying from −20 to +20; boilers without gages, 1; cases of deficiency of water, 14—10 dangerous; cases of broken braces and stays, 24—11 dangerous; boilers condemned as unsound and unfit for use, 18.

There were 10 boiler explosions during this month. None of them, however, were under the care of this company: 3 were of rolling mills, 3 locomotives, 1 cotton mill, 1 flour mill, 1 agricultural works, and 1 mill the occupation of which we were unable to ascertain. By these explosions, 23 persons were killed and 55 injured. We were unable to gain any satisfactory particulars of some of these disasters. Coroner's juries on such occasions are not usually composed of practical men, and the verdict is generally "low water" or "a Providential visitation," both of which may be true; but it would be very satisfactory sometimes to those investigating the subject of boiler explosions, and studying their cause and cure, to be permitted to examine fragments of the exploded boiler, and see if some corroded spot, broken brace or defective safety valve, might not be made the cause of the accident, and the responsibility thereby shifted from Providence to a mercenary steam user, who, to save (?) expense, had employed an incompetent engineer or run a weak and over worked boiler for months, and perhaps years, without examination or repair. Every month of our work reveals the grossest carelessness in the care and management of boilers, and why they do not oftener explode is more than we can say.

How the Transit of Venus will be Photographed.

The following method, devised by M. Janssen, is to be employed in photographing the apparent contacts of Venus with the sun's edge. The sensitive plate of the apparatus is in the form of a disk, fixed upon a plane which rotates on an axis parallel to that of the telescope. The disk is eccentric, so that the images are formed near its circumference. Before it, a second disk forming a screen is arranged, in which is made a small aperture in order to limit the photographic impression of the portion of the solar image to around the locality where the contacts take place. The circular plate which carries the sensitized material is toothed and placed in communication with a small escapement apparatus actuated by an electric current. At each second the pendulum of a clock interrupts the current, the plate turns ahead one tooth and thus disposes, under the hole in the screen, a blank part of the negative for another impression. If, therefore, the disk has 180 teeth, the plate will receive 180 images of the solar edge. The photography can thus be begun a minute and a half before the presumed instant of contact; then when the series relating to the first contact is obtained, the sensitive plate is withdrawn and replaced by another which gives the second contact and so on for the four. The plates are afterwards examined at leisure with the microscope.

Cornell University.

The annual report of the President and Register of Cornell University furnishes a gratifying exhibit of the rapid and substantial growth of that institution. There are at present five hundred students, and the faculty consists of forty professors and instructors. We note the erection of a college of mechanical engineering, provided with machine shop and all accessories through the munificence of Mr. Hiram Sibley of Rochester. The college library ranks third in size, and second in value, of those of its kind in the country. The university now comprises five large buildings of stone, three of brick and two of wood, constructed almost entirely by the aid of money, aggregating $1,400,000, donated by friends. The regulations of the institution state that its benefits are open to all, but only students resident in the State of New York receive free instruction. It is not a manual labor school though opportunities are offered for work, but employment is not guaranteed to any student. It is stated that a limited number of good practical machinists, who have already a sound English education, who wish to become thoroughly scientific master mechanics, may be able to do something toward their own support by making models of instruments, apparatus, etc., for the museum in the new machine shop. This requires skilled labor and a good knowledge of the use of tools.

NEW YORK CITY is supplied with early vegetables from the Bermuda Islands. New potatoes are found in our market from the above locality in February. Strawberries from Charleston, S. C., are now selling here for $2.50 per quart; green peas from Florida, $8 per barrel; hot house cucumbers, $5 a dozen; Bermuda new potatoes, $10 a barrel.

THE TAY BRIDGE.

We are indebted to the *Engineer* for the accompanying illustrations, representing operations in the construction of one of the greatest civil engineering works ever undertaken in Great Britain. The bridge, which will be the largest iron structure of its class in the world, will cross the Tay river, in Scotland, about one and a quarter miles west of Dundee, bringing the great coal fields of Fifeshire into direct communication with that city, and adding much to its importance as a shipping port.

The total length of the bridge, from shore to shore, is 10,320 feet. Commencing from the south, or Fife side, there will be three spans of 60 feet, two of 70 feet, twenty-two of 120 feet, fourteen of 200 feet, sixteen of 120 feet, twenty-five of 66 feet, one of 160 feet, and six of 27 feet. The first three spans (60 feet), south side, are on a descending gradient of 1 in 100, the two 80 feet spans are level; the bridge then rises with a gradient of 1 in 353 to the center of the 200 feet spans. It again descends with a gradient of 1 in 73·56 to the north shore, passing at a hight of about 48 feet over Magdalen Point and the esplanade now being constructed.

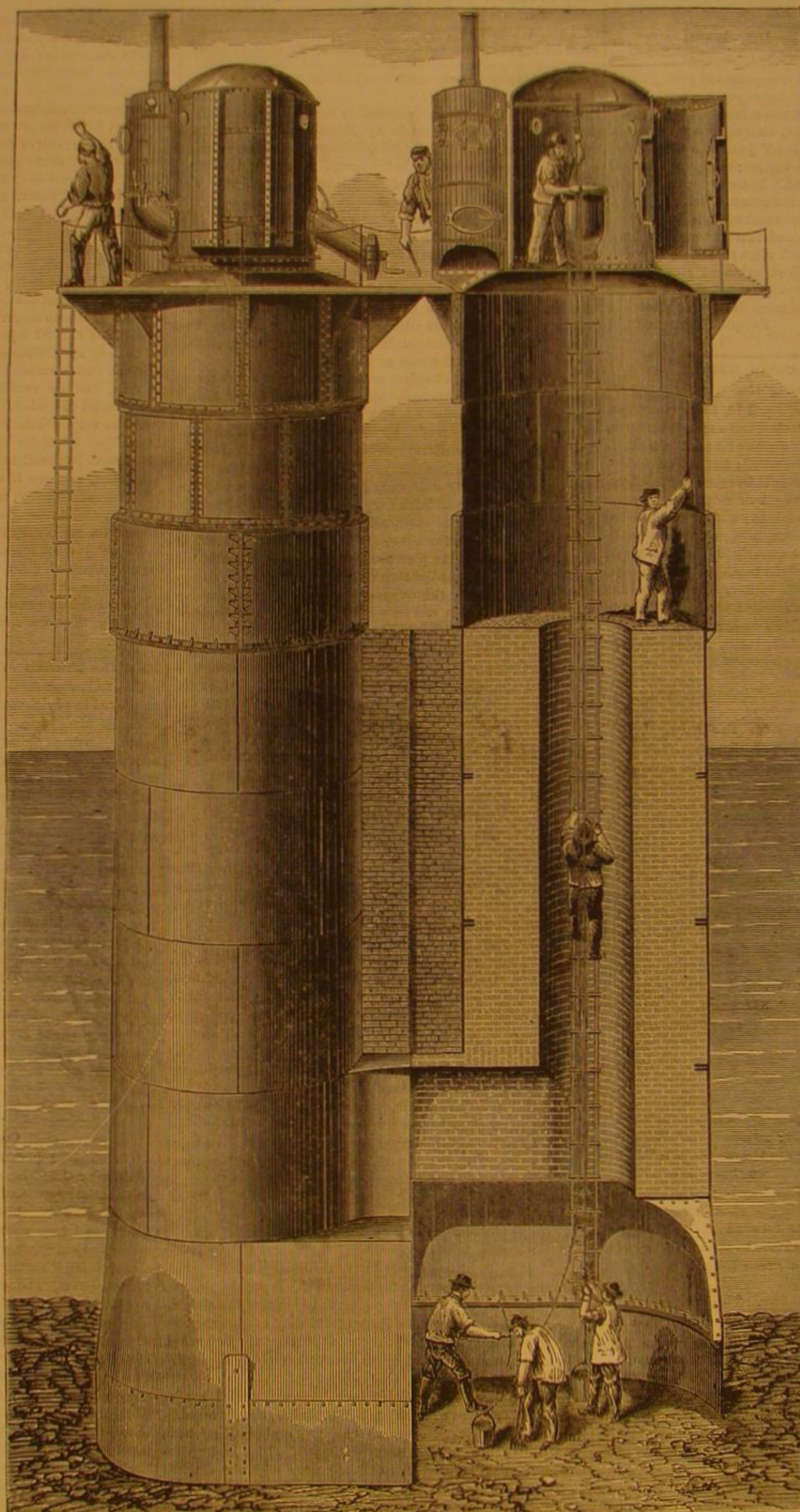
The bridge thus comprises eighty-nine spans, and at the commencement on the south side the rails are 78 feet above high water, running over the tops of the girders as far as the 200 feet spans which cross the navigable channel of the river.

The greater part of the piers are built of brick, varying in diameter from 6 feet to 15 feet.

The method of building the piers and sinking them to the foundation is carried out in a novel manner, and specially adapted to rivers having strong currents, and with little soil overlying the rocky bed—which here in one case did not exceed 4 feet—prohibiting the use of timber staging, as heretofore used for such structures.

The piers are first built up to the hight of 15 feet on the foreshore on a temporary basis of concrete; the girders, carried by the pontoons shown, are floated over the pier, and with the falling tide are left hanging to the pier by brackets, the pontoons being floated away and moored in the harbor. The pier is then built up to such a hight that, when resting on the bottom in its permanent position, the top will be above low water. The girders, on which are resting the hydraulic rams for lowering the pier, are then connected to the wrought iron lowering links with the base of the pier. The pontoons are floated underneath the girders, and the whole pier floated from its temporary resting place at high water and towed out to its permanent position.

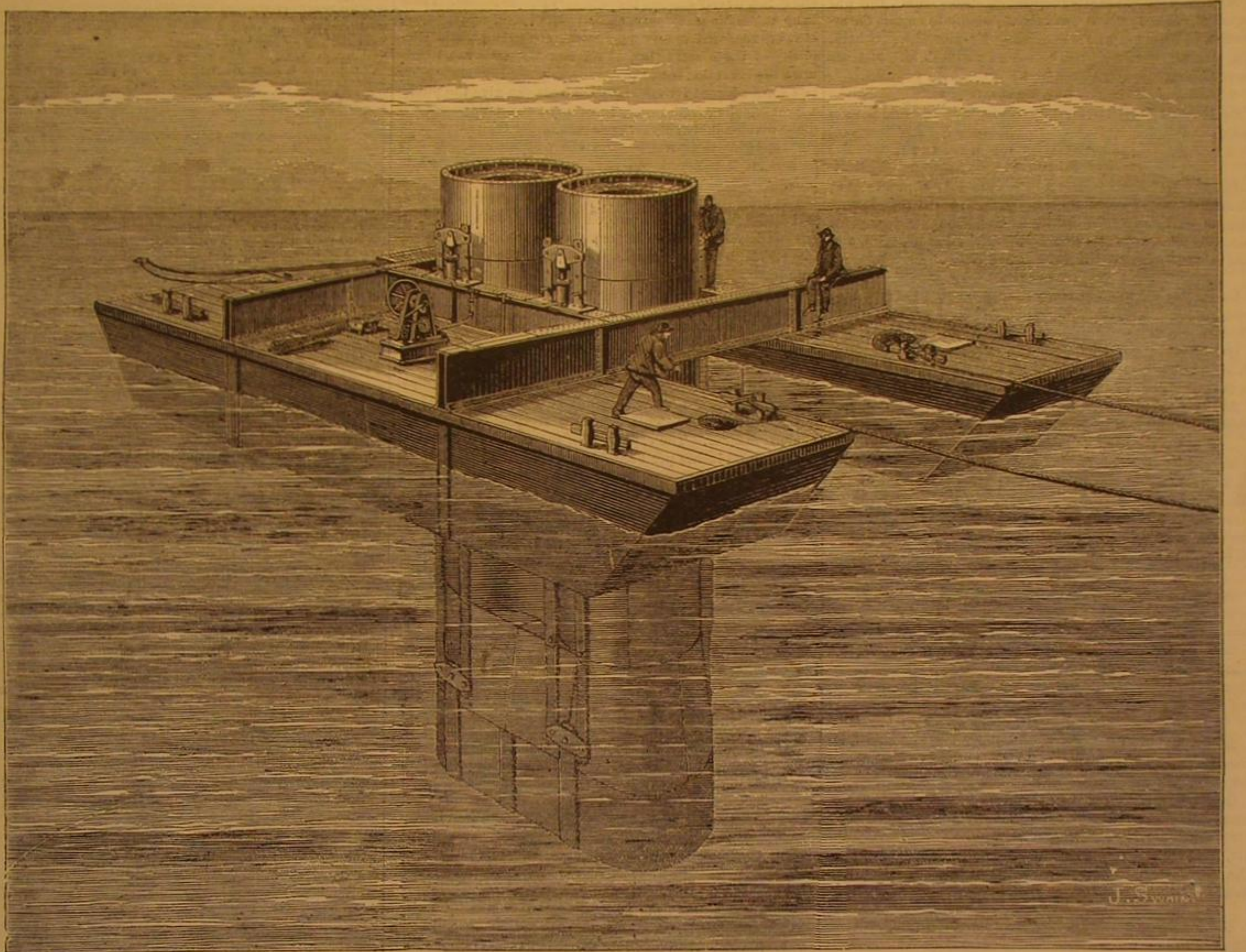
The caisson piers are formed by combining the two cylinders into one base, having long straight sides with circular ends. This base is provided with vertical suspending bars to which are connected a pair of balancing crosshead plates by a central bolt; the hydraulic rams are similarly provided with crosshead plates, and the upper and lower sets are connected with the wrought iron links already mentioned. The hydraulic rams have a stroke of 12 inches, and the links pass through slotted holes in their bases. These links are composed of wrought iron bars. In the first place the weight of the pier is carried out on steel pins passed through the holes in the links, and resting in bearings provided on the the bases of the rams. The whole mass is then towed out at high water to its place, the pier being then submerged to the extent of 8 feet only. The pontoons are securely anchored, and the lowering commenced. To begin lowering, the crossheads on the rams are connected by pins with the links at the top of the stroke. The hydraulic force pump—of which there is one on each pontoon—with a few strokes raises the pier about $\frac{1}{4}$ inch, so that the weight is no longer on the steel pins; they are then drawn out and placed in the link holes 1 foot higher up; by means of a suitable arrangement of cocks the water is let out of the rams, first on one side then on the other, and the pier lowered until the steel pins again rest on their bearings. The crossheads are then disconnected, and the rams pumped up again to the top of the stroke Links, which are 4 feet long, are added as the lowering proceeds, and the whole apparatus is under such control tha the time taken in lowering 1 foot is only $4\frac{3}{4}$ minutes. In the diagram the ram is at half its stroke downwards.



SINKING THE CAISSONS OF THE TAY BRIDGE.

The heaviest piers floated out weighed 145 tuns, and were lowered by six hydraulic rams. The lowering takes place during the ebb tide, and a little before low water the pier is grounded—the exact position having been ascertained by sighting lines from the shore, and a measuring chain from the last pier. During the last half hour of the ebb tide the pier resting on the bottom of the river is carefully watched with a spirit level, and any tendency to sink into the bed of the river unequally is checked by the hydraulic rams being pumped up on the lower side of the pier until the settlement is equal. When the pier has fairly settled, the links are disconnected above water and the pontoons floated away, the links being recovered by a diver.

The construction of the double or combined piers is represented in our engraving, giving half elevation and half vertical section, showing the men excavating the foundation. A wrought iron base, 3 feet high, 22 feet 7 inches long, and 10 feet 6 inches wide, with flat sides and circular ends, is laid on a concrete foundation on the foreshore, dry at low water. This is surmounted by a conical cast iron five feet length, provided with a broad top flange 2 feet 6 inches wide. This forms the working chamber during the time of sinking the pier. On the broad flange the brick work is carried up in two circular towers, 9 feet 6 inches in diameter, surrounded with cast iron cylinders of $\frac{3}{4}$ inch metal in four segments, each tower having a shaft left open 4 feet in diameter in its center. The brick work is carried up inside the cast iron caissons, a space of 2 inches being left between the brick work and the castings, which is filled in with cement grout, the castings being carried up to low water level. After the piers are in position, temporary cast and wrought iron caissons are put on to about 6 feet above high water, the brick work being also carried up until sufficient weight is obtained to prevent the pier floating when filled with air during sinking to its permanent foundation. Two air bells are fixed, as shown, on top of the caissons, with pumps and engines attached. Air is pumped into the pier until the bed of the river is dry inside, and the excavation is carried out in the ordinary manner, the soil being sent up to the top through lock shoots in the air bells. The man shown in the section of the bell operates the soil shoot on the inside, it being closed by a door inside and outside. These air bells, having to be shifted from pier to pier by a crane working on a barge, were designed by the contractors specially for the work. Lightness being a great object, they are, with the exception of the doors and shoots, made of wrought iron, and have answered the purpose admirably, each bell, with its accompanying boiler and engine, weighing only six tuns. It will be noticed that the 3 feet wrought iron and 5 feet cast iron lengths are hollow, making a working chamber 8 fee, high, sufficient for twelve men to work. As soon as the pier is sunk to its permanent foundation, concrete, in the proportion of one of cement to four of broken stone and sand, is sent in under air pressure, filling the work chamber, the flanges carrying the brick work being carefully packed and run in with cement concrete. The shafts are then filled up, the air bells and temporary caissons removed, and the brick work carried up to about 6½ feet above high water level. It will be noticed that the two circular shafts are connected with an arched passage immediately above the working chamber, this being provided to give room for packing the concrete under the broad flanges. During the progress of the pier downwards it is steadied by means of two hydraulic telescopic legs. These are placed on the south side. From the last pier finished, heavy chains are connected with the pier being sunk, which, with the hydraulic legs, effectually steady it during sinking. The superstructure consists of lattice girders continuous over four spans, each set being provided with its own fixed and expansion bearings.



FLOATING THE PIERS OF THE TAY BRIDGE INTO POSITION.

The brick work is built with Portland cement, in the proportion of one of cement to one of sand; and such is the its strength that, after a few months, those cylinders which capsized after being floated on to the foreshore could only be broken up by blasting.

There will be used in the construction of the bridge 3,600 tuns of wrought iron work, 2,600 tuns of cast iron work, 35,000 cubic yards of brick work, 87,845 cubic feet of timber, etc.

The construction is being carried out from the designs of Mr. Thomas Bouch, M. I. C. E., of Edinburgh. The whole of the work was undertaken by Messrs. C. de Bergue & Co., of London, Manchester, and Cardiff.

The Utilization of Coal Dust.

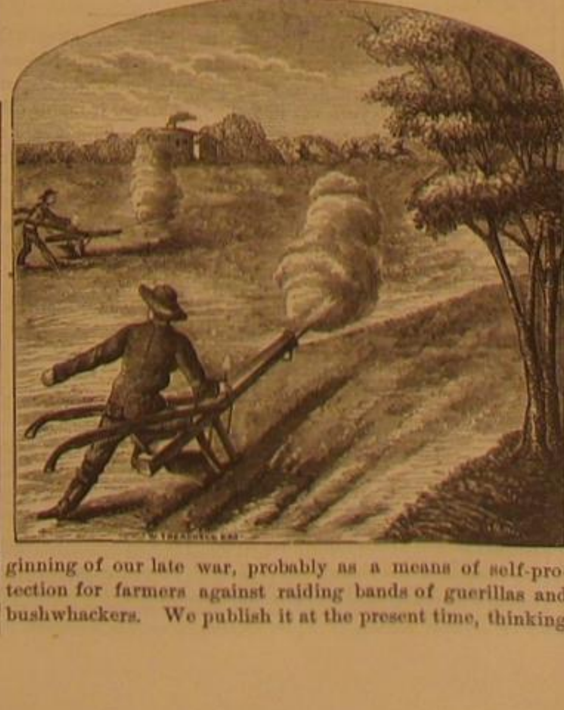
Dr. J. R. Hays, of Washington, D. C., has recently published a paper on a means of using up the dust coal which lies in heaps near the shafts of most coal pits. He mixes the coal dust with clay and coal tar, and estimates that the cost of these, together with labor, will not exceed $1.00 per tun; and if the waste coal can be delivered in the cities at $2.00 per tun, a fuel of great excellence can be easily prepared at $3.00 per tun, which will be an economical improvement of great importance to the poor.

Chemical Action of the Solar Rays.

M. Marchand, says *Les Mondes*, has just completed a long and careful study of the chemical action of solar rays. He exposed to the light a mixture of definite proportions of oxalic acid, perchloride of iron and water. Under the influence of the rays, the perchloride was decomposed and became protochloride; the chlorine, set at liberty, combined with the hydrogen of the water to form hydrochloric acid; and the oxygen of the water, uniting with the oxalic acid, transformed it into carbonic acid, which was disengaged. The quantity of carbonic acid thus given off is proportional to the intensity of the light, and serves as its measure. The difficulty was, however, to determine accurately the amount of carbonic acid without having recourse to mercurial apparatus, very expensive and hard to manage. M. Marchand has found, however, and *Les Mondes* terms it a great discovery in practical chemistry, that, for the determination of the carbonic acid, glycerin may be well substituted for mercury. He has also observed that his mixture, considered as a reagent of chemical rays, differs from the nitrate of silver in the particular that the maximum of its intensity is at the middle of the blue, while that of the nitrate is at or near the violet.

A PATENT CANNON PLOW.

This novel idea is the invention of Messrs. French and Fancher, of Waterloo, N. Y., and was designed at the beginning of our late war, probably as a means of self-protection for farmers against raiding bands of guerillas and bushwhackers. We publish it at the present time, thinking that it may be utilized or suggest a similar or better plan for defending our Western settlers against Indian depredations.



The idea is well explained by our engraving. Two farmers, for instance, are breaking up the prairie soil preparatory to planting their first crop. They are surprised by Indians, who, probably, having just received a new supply of ammunition from Washington, are bent on testing the quality of the same by robbing and murdering such citizens of the United States as may be in the neighborhood.

Naturally, the first thought of the hardy pioneers would be judicious retreat, and such a course they would undoubtedly adopt were they not fortunately provided with the cannon plow. Instead of running away, therefore, they coolly unhitch their horses, load the hollow metal plow beams with a charge of canister, scrap iron, old nails, pebbles, etc., drop a little loose powder in the vents, light their pipes, and seat themselves at the rear of their implements to await the arrival of the unsuspecting "Los." The latter gentry, advancing with the prospect of two easily obtained scalps, are suddenly astonished by a metallic hailstorm, which continues until they recollect a pressing engagement in another vicinity, and find it to their interest to defer their present operations until some more convenient time.

Protecting Iron.

Cast iron water pipes and other articles may be preserved by covering inside and out with pitch, heated to 300° Fahrenheit and kept at this point during the dipping. As the material deteriorates after a number of pipes have been dipped, fresh pitch is frequently added, and at least eight per cent of heavy linseed oil put to it daily; the vessel is also entirely emptied of the pitch and refilled with fresh material, as often as is necessary to insure the perfection of the process. Each casting is kept immersed from thirty to forty-five minutes, or until it attains a temperature of 300°. After the bath is completed, the castings are removed and placed to drip in such a position that the thickness of the varnish will be uniform. It is essential that the coating be tenacious when cold, and not brittle or disposed to scale off. The pitch or varnish is made from coal tar, distilled until all the naphtha is removed, the material deodorized, and the pitch like wax or very thick molasses.

Leprosy still prevails to an alarming extent in the Sandwich Islands. The doctors can find no remedy. The lepers are isolated and live in large communities by themselves, under rigid laws of exclusion from other mortals.

ASTRONOMICAL NOTES.

OBSERVATORY OF VASSAR COLLEGE.

For the computations, which are only approximate, in the following notes, and for much of the information, I am indebted to students. M. M.

Thermometer.

The highest recorded thermometer at 2 P. M. (up to this date, April 20) is 61° on the 8th and 11th.

The dandelion was first seen in this locality on the 8th, the crocus on the 9th, hepatica on the 13th, and blood-root on the 19th.

Auroras.

The aurora was noticed on the 16th, 19th, and 20th of April.

Meteors.

Meteors were unusually frequent on March 28th. One was reported at 7h. 15m. It was bright enough to attract the attention of a person who was reading by gaslight. Others, less marked, were reported between 7 and 8 P. M. Meteors were also reported on March 31st.

Sun Spots.

On March 17th and 27th, the spots on the sun could be seen with the naked eye.

Positions of Planets for May, 1873.

Mercury.

On May 1st Mercury rises a little after 4 A. M., and sets at about half past four in the afternoon. It is at its greatest elongation from the sun on May 3d, and should be looked for before sunrise. On the 31st Mercury rises at 3h. 58m. and sets at 6h. 30m.

Venus.

On the 1st Venus souths only 16 minutes after the sun, but, being in high northern declination, does not set until about 7h. 40m. P. M.

On the 31st it souths before the sun and sets at 4h. 31m. P. M., so that it must be looked for in the morning. It rises at that time about 3 in the morning.

At this time (April 20th) Venus appears as a very narrow crescent, which can be seen with a field glass.

Mars.

Mars, with its red light, is becoming a conspicuous object in the east during the evening. It rises on the 1st at 6h. 20m. and sets at 4h. 47m. the next morning.

On the 31st it rises at 3h. 46m. P. M., and sets at 2h. 24m. the next morning. It is moving westerly among the small stars of *Virgo* and *Libra*.

Jupiter.

On the 1st Jupiter rises at noon and sets at 1h. 54m. the next morning. On the 31st it rises at 10h. 17m. A. M., and sets at midnight.

On the 3d of April, Jupiter passed over its 1st and 4th satellite. Both became very dim as the planet swept toward them; the 4th, which is usually next to the largest, appearing no larger than the second.

Saturn.

Saturn is above the horizon only nine hours and a half. It rises on the 1st a few minutes before one in the morning and set about half past ten in the forenoon.

On the 31st it rises at 10h. 54m. P. M., and sets at 8h. 24m. the next morning.

Saturn is moving among the stars of Capricornus on the 1st, but becomes stationary on the 12th. It moves among the stars easterly before the 12th and westerly after that date.

Uranus.

Uranus rises on the 1st at 10h. 21m. A. M., and sets before 1h. the next morning. On the 31st it rises about half past 8, and sets about 11 P. M.

Neptune.

May 1st Neptune rises at 4h. 32m., and sets at about half past 5 the next morning. On the 31st it rises at 2h. 35m. P. M., and sets at 3h. 41m. of the next morning.

Progress of the Great Suspension Bridge between New York and Brooklyn.

The work on the foundations for the anchorages for the cables has lately been commenced; the towers on both sides of the river are advancing towards completion. The bridge will be supported by four cables—two outer ones and two near the middle of the flooring.

By a cable is meant six thousand wires laid out straight together and wound round with other wires, the whole composed of galvanized tempered cast steel, having a strength of one hundred and sixty thousand pounds per square inch. The cables have each a diameter of sixteen inches, and go through the tower near the top (together upholding the superstructure of the main span, the aggregate weight of which, including the cables, will be five thousand tuns), are carried straight to the anchorage, entering the masonry at an elevation of eighty-two feet above the river, and, after passing into the wall for twenty-five feet, form a connection with the chains. The latter, consisting of cast steel bars, thirteen feet long and ten inches wide by one and a half inches thick, go through the masonry in a curved line, and are fastened to the anchor plates at the base.

The four anchor plates are to be laid side by side at the base of the anchorage, imbedded in the masonry. One of them was lately finished.

The plate weighs twenty-three tuns, and is of a singular shape. It is seventeen feet and a half by sixteen feet over all, with sixteen radial arms extending from a solid center. In this center piece are eighteen openings through which the links pass, connected with the four cables spanning the river, and the wire work suspended from them will weigh not less than five thousand tuns. The links are held in each anchor plate by two massive iron pins.

Whitney's Gas Carbonizer.

Our attention has recently been directed to a gas carbonizing apparatus, arranged in the form of a neat and ornamental drop light, by the aid of which, it is claimed, a saving of half the gas consumed will be effected, while a better illumination will at the same time be obtained. The gas enters a carbonizing chamber on a stand adapted for the table, from which it has no outlet except through the vertical, perforated walls. In its progress through the latter it passes through fiberous material which is impregnated with benzole, and is thus supplied with sufficient carbon to materially increase its illuminating power. A protecting jacket of incombustible mineral substance surrounds the device, rendering it fireproof, and also serves to protect the hydrocarbon from the injurious effects of a varying temperature outside. Filling is easily and expeditiously effected through very simple means. There is no automatic machinery, and all glass tubes, cocks, gages, etc., are rendered unnecessary by the compactness and simplicity of the construction. Professor Doremus in a report upon the invention states that gas companies, by its adoption in a form adapted for meter attachments, can give the public a light equaling from twenty to twenty-two candle power and make dividends twenty-five per cent larger than at present. By employing the portable form above alluded to, gas consumers, it is believed, can save nearly half their present bills.

The drop lights are of various elegant patterns in plate and bronze, and are so arranged that by turning a key the gas can be changed from common to the carbonized light and *vice versâ*. They are manufactured under the patent of Mr. Samuel Whitney and sold at quite moderate prices by the New England Gas Carbonizing Company, 202 State Street, New Haven, Conn.

Ingenious Engineering.

During the construction of the bridge at Kuilenborg, Holland, says the *Chronique de l'Industrie*, one of the principal traverses, some 465 feet in length, was placed about one inch too far on the piles. This error was rectified in a very ingenious manner. The expansion of the mass of metal was exactly .0394 inches per Fahrenheit degree. At the locality of the work the difference between the temperature of the atmosphere by day and by night was 25° Fah. In the morning the too far advanced end of the traverse was securely bolted down, when during the day the heat of the sun expanded the metal so that the free extremity advanced ·985 of an inch. Then at night the latter end was fastened and the contraction caused a like movement of the opposite free extremity. This operation, twice repeated, brought the traverse into its proper position.

Temperatures at which Calcareous Salts are Deposited.

The temperatures at which calcareous matters are precipitated in boiler waters are as follows:

Carbonates of lime, between..........	176° and 248° Fahr.
Sulphates of lime, between..........	284° and 424° Fahr.
Chlorides of magnesium, between......	212° and 257° Fahr.
Chlorides of sodium, between..........	324° and 364° Fahr.

In order to free water from these salts, it must consequently be heated to the above temperatures.

MR. CHARLES STODDER writes to explain that when he stated, on page 194 of our current volume, that there was no chemical test for distinguishing flax from cotton, he referred to strictly chemical tests or analysis. The test by dyeing, described by Mr. H. M. Wilder on page 261, was well known to Mr. Stodder when he wrote the first letter.

ALL new subscriptions to the SCIENTIFIC AMERICAN will be commenced with the number issued in the week the names are received at this office, unless back numbers are ordered. All the numbers back to January 1st may be had, and subscriptions entered from that date if desired.

THE *Springfield Republican* records the death of Rev. P. Shehan, at Hinsdale, Mass., from poison by arsenic, derived from the wall paper of the sleeping apartment of the deceased. The paper was tinted with Paris green. The use of arsenical colors for such purposes should be by law prohibited.

NEW METAL BAND.—For use in collieries, suspension bridges, and for other purposes instead of wire rope, Messrs. Scott, of England, have recently patented a band composed of two or more layers of flat steel, charcoal iron, or other metal, of a suitable thickness and breadth. The layers are each made in one piece and are joined together by brazing, welding, or riveting.

A. K. says: I would not do without your paper for twice its cost now, and I consider that I have lost a great deal by not taking it before.

DECISIONS OF THE COURTS.

United States Circuit Court---Southern District o. New York.

HORSFORD'S PATENT PHOSPHORIC ACID.

THE RUMFORD CHEMICAL WORKS *vs.* JOHN E. LAUER.—SAME *vs.* JOHN HECKER *et al.*

The suit of the Rumford Chemical Works *vs.* John E. Lauer was a suit in equity, brought by the Rumford Chemical Works, a Rhode Island corporation, founded on reissued letters patent granted to the plaintiffs June 9, 1867, for an "improvement in pulverulent acid for use in the preparation of soda powders, farinaceous food, and for other purposes," as assignees of the alleged inventor, Eben N. Horsford. The original patent was granted to Horsford April 22, 1856, and was reissued to the plaintiffs May 7, 1867, and reissued to them a second time June 9, 1868. The infringement alleged in the bill was the making and selling by the defendant of pulverulent acid, in infringement of said reissued patent of 1868.*

The defenses set up were that Horsford was not the original and first inventor of anything which had been made and sold by the defendant, and that the defendant had not infringed the patent. On the question of novelty, the defendant undertook to establish that Horsford was not the original and first inventor of a pulverulent acid phosphate of lime suitable to be used with bicarbonate of soda, as a substitute for ferment or leaven, in the preparation of farinaceous food; and that an acid phosphate possessing all the properties and qualities of the acid phosphate described in the plaintiff's patent was known in the arts prior to the date of Horsford's invention. The article relied on by the defendant as antedating Horsford's acid was what was known as the three fourths phosphate of Berzelius, described in the Hand Book of Chemistry by Leopold Gmelin, volume 3, page 195, published in 1846.*

The conclusion was that the bill must be dismissed.

Before a decree was signed or entered on such decision a motion was made, on the part of the plaintiffs, to open the proofs in the case for further testimony and for a reargument. The ground of the motion was that two of the chemical experts for the plaintiffs did not, in preparing specimens which they produced as specimens of the three fourths phosphate of Berzelius, follow the process of manufacture described in the public works referred to, in that such specimens differed in chemical composition from such three fourths phosphate, and that they boiled the solutions they employed. It was also urged that a three fourths phosphate fulfilling the formula of Berzelius could be produced without the use of heat, and had been so produced by the plaintiffs' expert, and was, when so produced, practically inert and useless as a constituent of a baking powder. The court held that that branch of the case had not been fully developed in the testimony taken for the hearing; that the question as to the effect of using heat in the process had not been gone into to the extent which seemed desirable; that the question as to whether the substance produced as the three fourths phosphate was made by the process of Berzelius was a vital question in the case; and that both parties ought to be allowed to take further testimony as to the novelty of what was covered by the first and second claims of the plaintiff's patent, as affected by the descriptions in the public works referred to, the case to be then heard on the testimony already taken and on the new proofs to be taken.

The case now came on to be reheard.

BLATCHFORD, *Judge:*

A large mass of further testimony has been taken on all the points involved in the cause, and it has been reargued.

The process of the plaintiffs' specification is fully anticipated by the description of Lawes' process of making a dry superphosphate, which was not before the court on a former hearing. The Lawes process was published in England in 1845, in an article in volume 5 of the *Journal of the Royal Agricultural Society of England*, entitled, "On the action and application of dissolved bones." The article says: "Where calcined bones are used, owing to their containing merely the earthy portions of the bones, and to their being so easily dissolved, a dry superphosphate may be formed." For effecting this Mr. Lawes gives the following excellent and simple directions for making this superphosphate:

"Calcined bones are to be reduced, by grinding, to a very fine powder, and placed in an iron pan with an equal weight of water (a cast iron trough such as are sold for holding water for cattle will do). A man with a spade must mix the bone with the water until every portion is wet. While the man is stirring an assistant empties at once into the pan sulphuric acid, sixty parts, by weight, to every one hundred parts of bone. The acid is poured in at once, and not in a thin stream, as commonly recommended. The stirring is continued for about three minutes, and the material is then thrown out. With four common farm laborers and two pans I have mixed two tuns in one day. The larger the heap that is made the more perfect the decomposition, as the heap remains intensely hot for a long time. It is necessary to spread the superphosphate out to the air for a few days, that it may become dry.'

The evidence shows that the Lawes process is the same as that of the plaintiffs' patent. In each ground calcined bones are mixed with water and sulphuric acid, the proper chemical action and decomposition are allowed to take place, and the result is a dry product, capable of being pulverized.*

The processes being the same, the natural conclusion would be that the products would be substantially alike. The evidence is to that effect. It shows that the product of the Lawes process, as described, is to all practical intents and purposes the same thing as the product of the plaintiffs' process, and capable of being used for the purposes set forth in the specification of the plaintiffs' patent.*

The first two claims of the plaintiffs' patent are, therefore, anticipated by the Lawes process and product. This conclusion makes it unnecessary to consider any of the other matters discussed on the question of novelty.*

Bill dismissed with costs.

At the same time with the foregoing case the case of the same plaintiffs against John Hecker and George V. Hecker, founded on the same patent, was heard, being argued by the same counsel.

BLATCHFORD, *Judge:*

The patent involved in this case is the same one sued on in the case brought by the same plaintiffs against Lauer, just decided. The present defendants are charged with infringing all four of the claims of the patent. The first two are disposed of by the decision in the case against Lauer.

The third and fourth claims are as follows:

3. I claim the mixing in the preparation of farinaceous food, with flour, of a powder or powders, such as described, consisting of ingredients of which phosphoric acid or acid phosphates and alkaline carbonates are the active agents, for the purpose of liberating carbonic acid, as described, when subjected to moisture or heat, or both.

4. The use of phosphoric acid or acid phosphates, when employed with alkaline carbonates, as a substitute for ferment or leaven, in the preparation of farinaceous food.

The proper construction of the third claim is that it claims the mixing of the acid and the alkali with the flour, in a dry state, and stopping at that point, without applying moisture or heat. In other words, it claims the preparing of self raising flour containing the powder or powders named in the claim, and requiring merely the application of moisture or heat to enable it to be leavened. Against the novelty of this claim the defendants set up a patent granted by the United States May 1, 1849, to John Fowler, assignee of Henry Jones, the inventor. The specification of the Fowler patent says that the invention covered by it consists "in the adding to a certain weight of flour such quantities of alkalines and acids, sugar, and salt, as shall, by the addition of water only, enable such prepared flour to be manufactured into bread, etc., without the use of fermenting matter."*

In view of the Fowler patent it is impossible to see any patentable novelty in the third claim of the plaintiffs' patent. The prepared flour made with the ingredients named in said claim contains the phosphoric acid, or the acid phosphate, as a mere equivalent for the tartaric acid of Fowler's prepared flour; as much so as a screw or a lever is a mechanical equivalent for a pulley. Any pulverulent acid capable, on the application of heat or moisture, of liberating carbonic acid to make the dough porous, is, in the prepared flour, the equivalent of any other pulverulent acid having the like capacity, so far as regards such prepared flour, before heat or moisture is applied. Everything of substantive patentable invention in regard to prepared flour as composed of an acid in dry powder and an alkaline carbonate in dry powder mixed with dry flour is found in the patent of Fowler. Especially is this so in regard to the plaintiffs' patent, in view of the fact that the specification of that patent discloses no mode of practically mixing the ingredients composing the self-raising flour, but merely states that the acid "may be mixed with flour and bicarbonate of soda" as a substitute for cream tartar and tartaric acid "in the practical preparation of self-raising flour."

The fourth claim is a claim to the use of the acid and an alkaline carbonate, as a substitute for ferment in leaven, in the preparation of farinaceous food. This is a claim to the actual use of such acid and alkali in making raised dough. Nothing is shown which anticipates this claim, and the invention covered by it is patentable. Horsford was the first to use phosphoric acid or an acid phosphate for the purpose. It required experiment and invention to find out whether phosphoric acid could be used in place of tartaric acid practically and successfully, and with safety to health. As it is admitted and proved that the defendants have used what is substantially the same acid described in the plaintiffs' patent, mixed with an alkaline carbonate, as a substitute for leaven, in making bread from flour, they have infringed the fourth claim of that patent, and there must be a decree for the plaintiffs for an account of profits as to that claim. The question of costs reserved.*

Whether such infringement has taken place solely by a use of what is named in the fourth claim irrespective of any selling by the defendants of the mixture claimed in the third claim, or whether such infringement has taken place, also through sales by the defendants of such mixture, in connection with the use of it by the vendees under the fourth claim, will be a question to arise on evidence to be given on the accounting as to the facts attending such sales, in connection with the use by the vendees of the things sold.

William Whiting and *Clarence A. Seward*, for the plaintiffs.

Charles M. Keller, for the defendant.

United States Circuit Court---District of Michigan.

PATENT RAILWAY HAND CAR.—HENRY L. BROWN *vs.* JAMES D. HINKLEY AND HIRAM F. COLE.

Motion for a preliminary injunction to restrain an alleged infringement of a patent right on the bill of complaint and accompanying affidavits. The bill alleges that the invention in question is a new and useful improvement in hand cars for railroads, and that a patent therefor was duly issued to the complainant September 7, 1869, and was reissued in two divisions February 11, 1873. *

LONGYEAR, J.:

The original patent having been surrendered and canceled, all rights under it have ceased, except as they are secured by the reissued patent. Moffit *vs.* Gaar *et al.*, 1 Fish, patent case, 610. Our attention, must, therefore, be confined to the reissued patent.

In order to ascertain what it is that is patented, we look to the claim. Looking at the claims accompanying both divisions of the reissued patent, we find that it covers (as did the original) combinations only, no one or more elements of which are claimed or patented as new. It is a well settled rule of law, which does not need citation of authorities to prove, that the use of any number of the elements of a patented combination less than the whole, or their equivalents, or what is substantially the same thing, is no infringement. The use of two driving wheels of unequal size in the combination covered by division A of the reissued patent is a material element, and those being omitted in the combination used by defendants, and nothing being substituted for them which can produce the same result, there is clearly no infringement of said division A made out by the bill. On the contrary, any such presumption is rebutted by the express allegations of the bill.

The bill does however show, *prima facie*, at least, an infringement of the combination covered by division B of the reissued patent. But here we meet insurmountable obstacles to granting the relief by injunction in the present posture of affairs. The combination covered by division B was not covered by the original patent; therefore the complainant's rights and remedies as to it date only from the date of the reissue. As to it complainant is in no better position than if the reissue was an original patent instead. Poppenhusen *vs.* Falke, 2 Fish Pat. Cas., 181.

To entitle a patentee to the extraordinary writ of injunction it is not sufficient for him merely to show his patent and an infringement of it. His right must be further substantiated in one of two ways: First, by a possession accompanied by an actual use and enjoyment of it for a sufficient length of time to afford a reasonable presumption of the acquiescence of the public in its validity; or, second, by a judgment in his favor in a trial at law. The latter, however, is never necessary where the former exists; but I understand it to be essential in all cases that there should be a trial at law in the absence of such use and enjoyment. This has been the rule in England for more than a century, and it has always been the rule in the United States. *

In this case the patent has not been issued quite two months, and confessedly complainant has put his rights under it to no use whatever, even during that short time, and there has been no trial at law. I do not think a well considered case can be found in the books where a preliminary injunction has been granted under such circumstances.

The motion for a preliminary injunction is denied, with costs of the motion to the defendants.

Mr. Millard, for complainant.

Mr. Hunt, for defendants.

NEW BOOKS AND PUBLICATIONS.

NOTES ON THE FIRST BOOK OF BENSON'S GEOMETRY. By Lawrence S. Benson. New York: James S. Burnton, 149 Grand Street.

This author is a circle squarer, with at least the usual amount of self-possession; and he devotes as much space to quibbling on Euclid's definitions as Euclid does to his first ten or twelve propositions, which have laid the foundation, for all time, of the science of geometry.

COSMICAL AND MOLECULAR HARMONIES. By Pliny Earle Chase, M.A., Professor of Physics in Haverford College.

The author of this pamphlet discourses on a universal cosmical law. He claims to have found a connection between the wave length of sounds of the highest pitch and those of light, thus establishing a comparable relation between acoustic vibration and the prismatic spectrum.

PROCEEDINGS OF THE CALIFORNIA ACADEMY OF SCIENCES. Volume IV., part 5. Published by the Academy, San Francisco, Cal.

This issue completes the published transactions of the society for the year 1872. The Academy is doing good work in making thorough investigation into the geology, topography, and physical character of our extreme Western States, and exhibits a zeal in the cause that has already been repaid by discoveries of value to science. The zoölogy, botany, conchology, and archæology of California are being examined in detail by the Academy, and its labors will probably soon complete a natural history of the State, unprecedented in its extent and accuracy.

VIEWS OF NATURE, AND OF THE ELEMENTS, FORCES AND PHENOMENA OF NATURE AND OF MIND. By Ezra C. Seaman. New York: Scribner, Armstrong & Co., 654 Broadway.

This is a little volume of reflections on the cosmical and vital phenomena of the natural world. Its salient point is doubt of the truth of the vibratory theory of heat, and an assumption or presumption that "caloric is an element," "a subtile fluid," which "permeates everything and combines chemically with nothing." These few phrases will serve to characterize the book and the author, and the courage with which he does battle with Joule, Mayer, Tyndall, and other philosophers.

GEOLOGICAL REPORT OF NEW JERSEY.

Professor Cook, State Geologist of New Jersey, favors us with his annual report for 1872. The mineral resources of the State are succinctly described in this report, and many valuable suggestions as to the best mode of developing them are given. Professor Cook has the happy faculty of presenting a large amount of information in a very condensed form.

THE AMERICAN GRAINER'S HAND BOOK: A Popular and Practical Treatise on the Art of Imitating Colored and Fancy Woods; with Examples and Illustrations, both in Oil and Distemper. New York: John W. Masury & Son, 111 Fulton Street.

This is an elegant little volume of practical and sound information, published by a firm well known in the special industry whereof it treats. It is illustrated with specimens beautifully printed in colors, representing vividly the successful treatment of wood by a skillful grainer. It is a complete and trustworthy manual, and deserves to be read by every one practically interested in the art.

FIRST STUDIES IN DRAWING: Drawings for Little Folks; Drawings of Cottages; Drawings of Heads, Animals, etc.; Drawings of Landscapes. By Benjamin F. Coe, Teacher of Drawing. New York: John Wiley & Son, 15 Astor Place.

We have here five series of drawing lessons, progressively arranged, for the use of beginners and afterwards for more advanced pupils. The copies are admirably drawn and printed, and are accompanied by excellent instruction as to materials and manipulation. The publication is sure to be found useful to many teachers and students.

Inventions Patented in England by Americans.

[Compiled from the Commissioners of Patents' Journal.]

From April 4 to April 9, 1873, inclusive.

ELEVATOR.—C. Du Bois, Fishkill Landing, N. Y.
MONITOR VESSEL.—L. Goddu, Mass.
PRINTING TYPE, ETC.—W. Shaw, Hollister, Cal.
RAILWAY CARRIAGE, ETC.—W. D'A. Mann (of Mobile, Ala.), London, Eng.
SEWING MACHINE.—J. H. Mooney, C. C. Comstock, Providence, R. I.

Recent American and Foreign Patents.

Method of Flash Signaling by Reflected Light.

Martin M. Kenney, Travis, Texas.—The invention consists in a mirror susceptible of a vertical and horizontal adjustment, and unslivered as well as uncovered, or one portion of its back combined with an adjustable post for the purpose of verifying the place upon which a flash signal is to be made, and thus enabling the party signaling to be sure that the flash or flashes will certainly come under the observation of the party to be signaled.

Improved Brush.

Philipp Wagner, New York city.—The invention consists in a metallic cap disk, which prevents any ill effect from the shrinkage of the wooden ring that holds the bristles down in the socket. It consists also in forming a rib on the inside of the socket so as to cause the ferule to hold the bristles by a lateral pressure against said rib, thus firmly retaining the bristles in place. It also consists in applying a tapering ferule to the lower end of the handle, to prevent the latter from becoming loose.

Improved Oyster Rake.

Isaac A. Ketcham, Breslau, N. Y.—The invention consists in making the teeth of oyster rakes with an end-bent shank so that they can be readily removed and replaced. It consists also in making the rake bar with a groove for each tooth, so that the same may be prevented from lateral movement when at work. It also consists in a diagonally located plate over each end of the rake bar, to prevent the oysters from slipping off laterally when being borne backward into the bag or net placed to receive them. It consists also in the means employed for holding the lever gage at any position required, and also for holding levers while the rake is being drawn in and over the roller of the boat.

Improved Liquid Measuring Register.

Moritz Springwater, Evansville, Ind.—This invention relates to a new attachment to the tubs or vessels used in distilling or brewing machines with the object of ascertaining and indicating the exact quantity of liquor therein contained during any given length of time, and of thereby preventing or at least detecting fraudulent removal or false returns to the government revenue officers. The invention consists in the arrangement, within such a tub or vessel, of a concealed float or swimmer, which is connected with a locked recording apparatus so as to move the same in ascending, but not during a descent. Every addition of liquor within such tub or vessel will thus be recorded without interfering with the free withdrawal of the liquor.

Improved Machine for Making Spool Blanks.

John T. Hawkins, Salisbury, Vt., assignor of one half of his right to Geo. R. Holt, of same place.—The object of the invention is to furnish an improved machine adapted for turning thread spool blanks and other like articles from a suitable piece of timber, the more important agent for effecting this result being an oscillating reciprocating carriage for supporting and clamping the blank or bar of wood, arranged in such relation to a rotating cutter head as to carry the wooden bar up to the same and hold it till the spool blank is turned, and then into contact with a saw for severing the blank from the bar; the whole mechanism being automatic, and yet adapted to be thrown into and out of gear with the driving shaft.

Improved Hot Air Furnaces.

Dr. Charles L. Pierce, Natick, Mass., has taken out two patents for hot air furnaces.—The invention in the first consists in providing a double and perfectly uniform return draft, thereby greatly increasing the radiating capacity of the furnace and distributing the heat equally over the entire radiating surface. This insures great durability for the radiators which can never be heated red hot. It also consists in so arranging the different flues that each shall be self-cleaning. It also consists in the arrangement of a dust damper, by which the accumulations from the flues are emptied into the ash pit. It also consists in making the funnel project over the air chamber and, by its conical form, reflect the current of heated air back upon the top of the furnace, thus more thoroughly heating said air before it ascends to its destination. The second invention consists in a furnace having an indirect draft from the top of the combination chamber downward through vertical flues to a chamber below the ash pit, and passing thence up through a smoke flue, said flue being all in the air chamber. It also consists in an adjustable smoke flue, adapting the furnace to be properly set, no matter what may be the location which it is required to occupy in the cellar or basement. It also consists in the construction of the base of the furnace so that the smoke flue may be conveniently within the air chamber.

Improved Saw Setting Device.

Johan H. Schmid, Salem, Va.—This invention relates to a new instrument for setting, by one motion, two, four, or more saw teeth, one half into one side, and the remainder to the other. It consists in the application of a series of setting plates to the jaws of a pair of tongs, the plates being laterally adjustable, to be used on teeth that are more or less far apart from each other, and also in the combination of a saw teeth contracting tool with said tongs, the same being in form of projecting ears on the handles of the tongs, with a screw passing through one of the ears. By means of this screw, the tongs can be made to close to a certain distance, to allow the saw teeth to be raised more or less, and evenly, if they have been set too far aside for any one particular object, or if they were not upset quite regularly, the saw teeth being in that case drawn through between the ears.

Improved Hoisting Machine.

Ira Smith, Tomhannock, N. Y.—The object of this invention is to furnish a cheap and simple machine for hoisting weights. A projecting arm and brace are connected together. The post is attached to the side of a building or other fixture by hinges, so that the arm will swing like the arm of an ordinary crane. The hoisting wheel is supported by a shaft near the outer end of the arm. The rim of this wheel is grooved, to guide the hoisting belt. The power is applied to this belt either by hand or by means of a crank pulley, to which one end of the belt may be attached. The other end of the belt is attached to the wheel around which it is wound. A wheel is secured on the arbor which revolves with the main wheel. A belt or rope is wound around the latter wheel as the main wheel is revolved. A grapple is attached to the article to be lifted. The power applied may be greatly increased by means of a crank wheel so that a small boy may raise a heavy weight. This machine may be employed in loading and unloading cars at railroad stations and vessels at the dock, as well as wagons at the farmer's door.

Improved Can Opener.

John J. Reed, Lyons, Iowa.—This invention has for its object to furnish an improved knife for opening tin cans, such as fruit cans, oyster cans, etc. The blade is made with a sharp point, and upon its back, close to its point, is formed a shoulder or notch. The shoulder is intended to keep the blade from being pushed in too far when forcing the point into the can, and also to prevent the blade from sliding forward while making the cut.

Improved Sieve for Separators.

Byron Miller and Major Miller, Lowell, Wis.—This invention relates to a new construction of sieves for threshing machines, and is an improvement upon the Church sieve, patented June 27, 1846. It consists in constructing the sieve so that the tops of the perpendicular and inclined plates are brought into the same plane, while the inclined plates are short, and the adjacent ones in different planes.

Improved Doughnut Mold.

Georg Machlet, Newark, N. J.—The object of this invention is to construct a doughnut mold, by the use of which any desired shape may be given to the doughnuts, and the unsightly irregular form of the same be changed to a regular one, and fancy forms be produced, such as fishes, stars, rings, or others. The invention consists in two rims with handles, which support the two halves of the mold, formed of suitable wire gauze. The molds are connected by guide pins when used for baking the nuts.

Improved Marbleized Composition Stone.

Thomas Carson, Brooklyn, assignor to himself and Thomas F. Attix, of New York city.—This invention consists in the production of mantles, table tops, casings, panels, and the like, of composition stone or marble, with fine marbleized surfaces imitating in appearance the various fine marbles with variegated colors, the said imitation marble surfaces being applied to the surfaces of slabs or other forms of the ordinary composition stone or marble. It consists, chiefly, in first providing the surface to be marbleized with any desired color for the ground color by means of a brush or otherwise; second, immersing the surface to be marbleized in a bath of water, whereon another color—that which is predominate, ground in oil and dammar varnish, mainly the latter—is floated and broken by rapidly stirring, and another veining color, mixed mainly with oil, is also floated and broken; and, lastly, removing the surface and drying the coating so applied, after which a finishing coating of varnish may be applied to render the colors so applied clear and distinct.

Improved Device for Sharpening Scissors.

Thomas Halvorsen, New York city.—The object of this invention is to furnish to tailors, seamstresses, and the public in general, a small and convenient instrument which can be applied to a table or other convenient place for sharpening of scissors and shears. It consists of the arrangement of two files under a certain angle, so that by introducing one blade of a pair of scissors held in position by a strong spring, and sliding the same back and forth, the edge is sharpened rapidly and evenly by the files.

Improved Combined Garden Hoe and Roller.

Edmond Blanchard, Poolesville, Md.—This invention has for its object to furnish an improved tool designed for gardeners' use, which shall be so constructed that it may be used for opening a furrow to receive the seed, covering the seed, and rolling the soil down upon it. The hoe part of the tool designed for opening the furrow, trench, or drill, to receive the seed is formed upon a bend made U shaped, and the ends of its arms are twisted or inclined to give them the proper form for drawing in the soil from the sides of the trench or furrow to cover the seeds. To the arms of the part, at a proper distance from their ends, are rigidly attached two short arms, to the outer ends of which are pivoted the ends of the roller, which, when the arms are being used for covering the seed, follows in the rear of said arms and presses down the soil upon the seed.

Improved Fire Proof Shutter.

Washington M. Vars, Westerly, R. I.—This invention consists in a water tank shutter, and in a water conducting cap to the window or door. The water enters the shutter from the cap, which is opened at the top. The cap therefore acts as a conductor to convey the water thrown against the wall of the building into the shutter. The discharge cock being closed, the shutter may be kept full during a fire. Steam will, of course, be generated, but the water will flow in by its own gravity, while the steam will escape through the opening above. There may be holes through the front plate at the top of the shutter for the discharge of the steam. The windows of the building, therefore, instead of being the weakest and most inviting point for the flames to enter, become the safest part.

Improved Stop Cock.

John P. Mern, New York city.—The object of this invention is to permit the repair of the stop-cock spindle or stem, or its replacement when broken, without requiring the removal or elevation of the cock from or beyond the pipe. The invention consists in fitting into the upper part of the valve or cock a nut, into which the stem is screwed. This nut is confined between two outwardly projecting lips of the valve in such manner that when the stem is broken or requires to be repaired the nut may be turned one quarter of a revolution, and thereby brought with its narrow side between the said lips, so that it can be lifted clear out of the same, thus permitting the bodily withdrawal from the valve of the remaining portion of the broken stem and its detachment from the nut. The nut, and a new or repaired stem, may be replaced without disturbing the valve in the pipe or without opening the pipe.

Improved Breastpin Tongue.

Lewis H. Sondheim, New York city.—This invention consists in connecting the parts of the tongue together by means of screw threads, by which the pin is made detachable, and its full strength secured. The breast pin tongue consists of two pieces—the pin proper, and the plate or hinge socket piece, the latter having an eye by which it is jointed to the inner side of the breastpin by a pintle pin. A screw thread is cut upon the butt end of the pin to fit the hinge socket, and the two parts are screwed together, the screw thread of the pin cutting a thread for itself in the said hinge socket. No heat is required in thus connecting the pin, and the parts may be separated at any time by unscrewing, if desired. This latter feature is not so essential as to avoid the use of heat, although it is convenient to have the pin detachable. This mode of fastening avoids the use of solder or heat and is an effectual fastening.

Improved Locomotive Spark Arrester.

Joseph Gibbs, Opelousas, La.—The object of this invention is to provide efficient means for arresting the sparks and dust which escape from the smoke stacks of locomotive boilers. A hood covers nearly one half of the top of the smoke stack, and rises above it two feet, more or less, with a conical top. It consists of two semicircular recesses, the backs or walls of which are made partly of sheet metal and partly of wire gauze. The air strikes the hood when the locomotive is in motion, which will force the smoke and cinders which rise from the smoke stack into the hood. The smoke, sparks, and dust will slide to the right and left from a central rib, toward the wire gauze. The sparks and dust will lodge against the projecting edges of the gauze and drop by their own gravity into the tank, while the smoke *thus purified* will find its way through the wire gauze and escape. Water is put into the basin or tank, into which the sparks and dust fall, the sparks being extinguished by the contact. In this manner a railroad train may be relieved of dust and cinders.

Improved Horse Shoe.

Isaac De Mott, Cannonsville, N. Y.—The object in this invention is to so construct the shoes of horses and oxen, and so attach the calks thereto, that the latter may be readily removed for sharpening or renewal without removing the shoe; and it consists in the manner of fastening the calks to the shoe. A lip is turned up from the shoe at the toe and heel, to which the calk is doweled. These lips are turned so as to form angles with the face of the shoe, and the calks are fitted to the angles and are doweled to the lips, while the other branch of the calk is fitted to the face of the shoe, and fastened thereto with a screw. With the lip a single dowel and a single screw is all that is required to hold the calk firmly to its place.

Improved Post Driver.

Isaac V. Adair, Romulus, N. Y.—The invention consists in improving post drivers. Upon the wagon frame is placed a narrow frame resting on false bolsters. The end pieces of the frame are curved on the lower edge, to form a cradle on which the frame can vibrate laterally. Longitudinal displacement is prevented by a tenon on one of the pieces entering a mortise in the false bolster beneath. By a lever and link the rocking frame is connected with the reach of the wagon so that it can, by such connection, be locked at any suitable angle. This is for the purpose of bringing the hammer straight down upon the post, even if the wagon stands inclined. A shaft or windlass is hung in a windlass frame hinged at one end and connected with the spring at the other. By turning the windlass and a cam, which is under a lever, by horse power or otherwise, the lever will be alternately raised and dropped to have the desired effect upon the post under the hammer. The lever can be held elevated while the post is being handled under the hammer. The shaft of the windlass can be made to slide in the bearings and locked by a key and unlocked when the cam is to be drawn out from under the lever, and the operating rope rewound upon the windlass.

Combined Wrench and Grappling Tool.

Simon B. Dexter, Mason City, Iowa.—This invention relates to improvements in a combined pinchers and grappling tool for which letters patent of the United States have been already granted, to the same inventor, the invention consisting in the mode of connecting the shank and wedge shaped slide with the handle, and in the operation thereof. By turning a handle a swivel band is turned, and a swivel and slide is moved up or down on the shank rod. As they slide the long ends of the levers are spread apart or brought together and the jaws adjusted nearer together or further apart, as may be required. In this manner the jaws may be adjusted with the greatest nicety and forced toward each other with sufficient power to make the instrument valuable as a hand vise for many purposes. By suitable arrangements the jaws can be made to clamp and hold an article by simply lifting up the handle. By means of the swivel connection, the jaws are moved and made to compress with great force, and may be adjusted to a bolt head or nut with the greatest precision.

Improved Grapple.

Simon B. Dexter, Mason City, Iowa.—The object of this invention is to provide convenient and simple means for raising or turning stones and other heavy bodies for building or other purposes by means of derricks or cranes; and it consists in an adjustable grappling implement in which the jaws may be adjusted to the size of the stone or other object, as may be required.

Improved Wagon Loader.

Jeremiah Johnson, Iowa City, Iowa.—For loading wagons, carts, and trucks with earth in grading, digging canals, making embankments, and in other work where large quantities of earth are to be removed from one place to another, the inventor proposes to dispense with the laborious and inexpensive method of loading it with hand shovels, by the use of a hoisting and dumping platform in a portable frame and with power hoisting gear, so arranged that he can scrape the earth on the platform by horse scrapers, or draw it on by the scrapers and dump it; then raise the platform, drive the wagon to be loaded under it, and dump the earth from the platform into the wagon.

Adjustable Grain Wheel for Harvester Platforms.

George M. Patten, Auburn, N. Y.—This invention has for its object to furnish an improved device for connecting the supporting wheel of a harvester platform with said platform. An upwardly projecting flange is formed upon the outer end of the platform. To the flange is securely bolted an upright plate, flanged to receive the flanges formed upon the side edges of the face of a block. Upon the face of the plate are formed sets of ratchet teeth, the lower set pointing upward, and the upper set pointing downward. In recesses in the opposite ends of the block are placed pawls, which are held down upon the ratchet teeth by coiled springs. By this construction, one of the pawls holds the block from moving upward, and the other holds it from moving downward. When it is desired to move the block in either direction, the pawl at that end of the block is raised, and a ring or cross head pivoted to its stem is turned across the slot in the said block, which holds the pawl away from the ratchet teeth. To the block is attached the standard of the wheel that supports the outer end of the platform, according as it is desired to use a caster or rigid wheel. This construction enables the platform to be conveniently raised and lowered, to adjust it as may be required.

Improved Children's Swing.

William H. Alcorn, West Hoboken, N. J.—This invention has for its object to furnish a swing for children which shall be so constructed that a child sitting upon its seat and pulling upon a lever can give the seat an oscillating movement. The invention consists of the combination of the levers and connecting rods with the stationary frame and with the seat or carriage suspended by pivoted bars or cranks from said frame. To the sides of the seat or carriage are pivoted the rear ends of the connecting rods, the forward ends of which are pivoted to the levers, the lower ends of which are pivoted to the lower forward ends of the frame. The upper ends of the levers may be so formed as to resemble horses' heads, and may be provided with straps or reins extending back to the seat so that the child, by pulling upon the reins, may give an oscillating movement to the seat or carriage.

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Notes & Queries

E. J. E. asks: What kind of a crucible can I use to melt a few pounds of brass in?

H. R. asks: Will water that has been clarified with alum prove injurious to the health?

D. B. asks: How can I clean out a choked waste water pipe and prevent the smell from rising?

F. S. asks for a simple recipe for a marking fluid for marking boxes with a brush.

C. E. M. asks for a description of the process of galvanizing iron.

J. S. W. asks: What is the best kind of paint for use on tin that is exposed to the weather?

J. E. C. asks: What are the ingredients of a preparation to dip hot steel in before cooling in water, to temper it for drills, chisels, etc.?

Z. T. D. asks: Why is it that hop vines twine around a pole or tree in one direction, and bean vines in the opposite?

N. J. asks: Is there such a thing as an electro-magnetic clock which will keep correct time, and what kind of battery is used for such an instrument?

N. J. asks: 1. How can I lay out a line for a reversible steam engine? 2. Is there any work on the link motion which treats the subject without the use of algebra?

Z. T. D. says: Last winter my apple trees were greatly damaged by rabbits. Some of the trees are peeled completely around the stem. Can I save my trees, and how?

J. D. W. asks for a preparation to be applied to wooden boxes or troughs that shall make them hard and smooth so that any alkali will not penetrate into and raise the grain of the wood.

H. P. L. asks: What is the best material for laying up the arch for a steam boiler? I have one laid in common lime mortar, and it crumbles out. Is blue clay good for the purpose?

H. W. asks: Can any one inform me at what temperature, when regulated by a thermometer, a coiled spring 30 feet long and 2 inches wide ought to be drawn to 10 gage thick to ensure a good temper, one that will not set or break?

G. C. says: Suppose a pile driver of 2,500 lbs. weight, when it has just completed the distance of 25 feet in falling, strikes one end of a scale beam; with how many pounds will the pressure with which it strikes the end be equally balanced?

G. E. K. says: I am engaged in cutting dog wood timber, and find that it cracks very badly; so much so that I fear it is useless. Can you suggest any treatment by which it can be preserved from splitting? Boiling the blocks in water is valueless. The wood was cut down about the middle of March.

G. D. asks for a formula for finding the length of the braces in a Howe truss bridge, the length of panel and distance between chords being given? The braces are to be cut off at right angles to their own center line, and of such length that their corners shall just touch the chords and tie rods.

J. M. R. says: I would like to enquire what composition would make the best filling between a glass pump chamber and a galvanized iron case (⅜ inch space). Calcined plaster or hydraulic cement will wash out. A composition of rosin cement and asphaltum is too brittle in cold and too soft in warm weather for ship use.

H. L. asks: 1. If a piston leaks while in motion, would it show in the exhaust or would it cause bumping in the cylinder? 2. What effect would a slight derangement (say a looseness of the jam nuts or any other slight cause) of a slide valve have on an engine while in motion, and would it not give audible evidence of something being wrong?

G. F. wishes some practical individual to describe the process of manufacturing wagon spokes. What is the kind of machinery employed to promote saving of labor, the best mode of polishing, the grade of quartz used, and the length and speed of sand belts? What is the best season of the year for cutting spoke timber? Is there any machinery known that will dress spokes turned in the Blanchard lathe?

S. E. W. says: There is an objection to superheating steam in an upright tubular boiler, on account of the upper end of the flues or tubes becoming red hot, which causes them to leak. Could not steam be superheated in a common horizontal boiler without this fault in the following manner: Take an ordinary horizontal boiler, and run one or more small flues from end to end above the water line, so arranged as not to become too heated until there was a pressure of steam around them?

A. McK. says: I had a very simple and cheap heating furnace in the cellar; it consists of a common strong stove, 14 inches x 3 feet, for wood, enclosed with brick 4 inches from the stove all round, with a small opening in front below the door to admit pure air. To heat the rooms above, on each side there is a tin pipe, 6 inches in diameter, from the top of the furnace to a ventilator in the floor of each room. The pipe which conducts the smoke ascends directly above the stove into the hall, and through the upper flat hall, thus serving to heat both halls and the rooms in the upper flat quite comfortably. To prevent too much heat ascending in the smoke pipe, it is necessary to have a tee or four knees above the stove and inside the furnace. The only objection to this simple method of heating is that, when the fuel is being put into the stove, a little smoke escapes through the tin pipes into the rooms. Can you point out some remedy for this or give a simpler method of heating by furnace?

Answers to Correspondents

J. S. asks for a gold dip for brass. Answer: See J. L. B.'s reply to G. W. S., in this column.

J. S. asks what to put into glue to make it adhere to belting. Answer: Try the following composition: Gutta percha, 8 parts, India rubber, 2 parts, pitch, 1 part, linseed oil, 1 part. Cut the rubber in shreds and add the oil, which latter will soften the rubber in a few days. Melt the gutta percha and pitch together, and stir in the rubber solution, apply hot, and press the joined parts tightly together.

G. B. D. asks: 1. Does any body run faster than the water that carries it? What is the principle of the working of the air pump attached to the underground gas machine? Answer: 1. Yes. Boats may be driven by a stream obliquely across the stream, at a faster velocity than the water itself flows. 2. The air pump you refer to is generally of the rotating kind, something like a fan wheel. By its rotation it drives a stream of air through the oil or naphtha; the air takes up a portion of the naphtha, just as a sponge takes up water. And the naphtha inflames at the burner.

J. S. W. asks: What sized feed pipe is required to get the maximum power on an engine, 5x5 and 5 feet from a boiler carrying 100 lbs. pressure, the engine turning a propeller wheel 28 inches diameter? The lead of the wheel is fine. Answer: If our correspondent means to ask what is the proper size of steam pipe for an engine of 5 inches diameter of cylinder, and other dimensions as given, we should say about 1½ inches inside, and 1¼ would probably do very well.

J. W. says: I have ten acres of land which are overflowed to four or five feet deep continually, by a creek. A small stream about 1 foot deep and 2 wide falling 1 foot in the 100, runs through this land into the creek. I intend building a bank 6 feet high along the creek to keep the water off the land. Now by what process can I keep this land dry, letting this stream of 1 foot by 2 feet run under this bank into the creek, when the creek is 4 feet higher than the land? How can a sluice be arranged that will keep the land dry under above conditions? Answer: Only by running the sluice back several hundred feet, so as to still give fall enough to carry off its water freely when swollen by heavy rain, we should suppose. Probably no system of pumping would pay in such a case, and our correspondent can best determine the comparative value of the land and of the sluice which he must build.

E. J. E. will probably find the pickle described on p. 283, vol. 28, serve to clean his castings, and a recipe for lacquer in another column of this issue.

A. B. L. says: I contend that there is a point on the circumference of a wagon wheel which stands still when the wagon is progressing. When this point strikes on the surface, it has to stop for a moment until it leaves the surface again; the time that it stops is hardly perceptible, yet it stops, and at the same time the top of the wheel travels twice as fast as the wagon. Answer: We have often answered this question, and our correspondent is correct in his theory.

J. H. K. says: 1. My trade is that of a practical engineer; I have followed it for 14 years as striker, second and first, on high pressure boats, although I was not licensed till 1869, and then as the second engineer. In May, 1872, I applied to the local inspector of this district for a first engineer's license. After asking me some questions about setting boilers and lining engines, he told me that he did not think me competent to take charge of a boat, but that he would give me another hearing in August. He did not come down our way till the following March. I went to him again with an application signed by four out of the six chief engineers there are in this place. He asked me how to set a pair of boilers in a boat. My answer was: Run two lines across the boat parallel with the sheer planks, one at the after and one at the forward end of where you wish your boilers to come. He next asked me about lining up engines, and acknowledged that my way would do, but that it was a very old way. His next question was this: If, after a boat has run some time, the slides should have gone down below the center of the rod on the inside only, or the outer edges gone up, how would you get them in line again? My answer was that I would run a line through the center of the cylinder to the center of the shaft; then run two lines, one at the after and one at the forward ends of the slides, across the center line, and then true the slides to these lines. He contends that I am wrong, and refuses to give me license on the slide question. I have asked other engineers; they say that I am right. I wish you would give me your opinion. There are others besides myself who think that the Inspector is prejudiced against the concern I work for, hence the trouble in getting my license. Aboard the opposition boats, they are short of licensed engineers, and he has given licenses to men that have not been on the river more than eight months, putting them in this position, as I hold, contrary to law, for I believe that the law says that a man has to be three years on a boat before he can get a license. You may think that I should have complained to the Supervising Inspector, but he is 500 miles from here, and I would rather have your opinion. 2. What book should I get that will give me the rules for putting machinery in light water steamers? Answers: 1. Probably the Inspector may have thought that the replies were not full enough. Our correspondent would get his guides right, however. Who is the Inspector who lends himself to such injustice as that complained of? It is the duty of our correspondent to inform the Secretary of the Treasury and the Supervising Inspector General of the facts. 2. Get Bourne's "Catechism of the Steam Engine."

N. P. M. asks how to measure the velocity of the wind with accuracy. Answer: The velocity of the wind can be measured by the use of the anemometer, an instrument sold by dealers in philosophical apparatus for that purpose. It can be obtained with considerable accuracy either with this instrument or by measuring its pressure against a flat surface and deducing its velocity by the method of calculation given recently in these columns.

J. V. says: 1. I have seen in your columns a process for removing incrustation from steam boilers. The substance to be used is a solution of sal soda and petroleum, and is to be put into the boiler after cleaning. Then the boiler is to be filled and the oil, floating to the top of the water, comes in contact with every plate of the boiler. What I want to know is, must not this oil be blown off, before steam is generated in the boiler, and might it not prove dangerous to some extent by the heat of the steam if left there? 2. I would also like to know how a steam gage is tested, so as to ascertain its correctness. 3. What is the reason that the parts which are operated on by steam in the gage become rusty, and the gage consequently becomes useless? Answers: 1. The oil need not be blown out. Use heavy lubricating oil, not naphtha or benzine. No danger of exploding the boilers need be apprehended. 2. Steam gages are tested by comparison with standard gages, which are originally checked by a column of mercury and frequently themselves retested. 3. Because the spring is usually of steel, and steam or moisture are very apt to get access to it.

J. G. says: 1. On page 200 of your current volume, you say that Congress has passed a bill authorizing the President to cause such experiments and such information to be collected as, in his opinion, may be useful and important to guard against the bursting of steam boilers. I wrote to Hon. C. Sumner, on the subject and got no reply. I called on our representative, Mr. Hoar, and he informed me there was no such bill passed by Congress last session. I would like to know how the matter stands. 2. I have three different kinds of boilers that have not made their appearance in the market yet; will you inform me how I can introduce them? Answers: Write to the Secretary of the Navy, to whom, we are told, is intrusted the charge of the matter referred to. 2. To introduce a good boiler promptly and satisfactorily, get some well known and intelligent manufacturer to take hold of it, proving its good qualities by exact methods of test in presence of well known experts, publishing the results in the SCIENTIFIC AMERICAN and its contemporaries among the scientific and engineering journals, with illustrated descriptions where possible. See that every boiler built makes a good record and that the public are made aware of it.

L. W. asks: Does a magnet constantly in use, retain its power for any length of time? Answer: A magnet, kept in use, carrying a constant load, will probably never lose its power of carrying that load. Its strength may be increased to the point of maximum possible strength, or of saturation, as it is termed, by carefully and very slowly increasing the weight carried. It can even be given greater strength, or supersaturated, but the simple removal of the "keeper" or armature will destroy all the surplus strength. Where the use of the magnet involves the frequent removal of the armature, the magnet will gradually lose its strength, if not finally become devoid of magnetism.

R. H. says: I am building a small steam engine and boiler. The size of cylinder is 1x1½ inches, with a common slide valve. Would it be scientific to connect the governor with the valve stem in such a manner as not to allow the valve to move full stroke (when the engine runs too fast) which would not open the ports to the full, and would not allow the steam to fill the cylinder quite as readily? Would it work well that way? I can fix it in that way much more easily than I can shut off the steam with another valve, moved by the governor. I would like to ask a great many more "bo "questions," but your time must be occupied with other things. Answer: The regulator would probably answer very well, arranged as proposed. We are always pleased to have our younger readers ask intelligent questions, and shall always be glad to reply to them when the subject is one that will interest our readers.

T. A. P. says: On page 74 of your current volume, P. Bros. give you the proportions of their safety valve, which were as follows: Lever, 22¼ inches; from center of valve stem to fulcrum, 2¼ inches; diameter of valve 2⅜ inches; action of lever 20 lbs., (meaning, I presume, weight on lever.) He asks you to estimate at what pressure the valve will blow off. You answer that "the pressure on stem of safety valve must be $42\times22\frac{1}{4}\div2\frac{1}{4}=378$ lbs. + the weight due to the lever." This is all correct enough, as far as putting the figures together is concerned. But where do you get the factor 42, which goes to make up the result? Of course, you know that as the long arm of a lever is to the short, so is the power to the weight; or you can reverse the language, and have it the other way. Then the result of the preceding combination of figures should be: $20\times22\frac{1}{4}\div2\frac{1}{4}=180$ + weight due to the lever; but you make it 378 by the use of your 42, and I am at a loss to know where it comes from. But again, you contradict yourself on page 106, in answer to McD., who asks for a rule to locate the weight of safety valve, to keep in a given pressure. You answer: To find the total length of safety valve lever for a required maximum pressure, multiply the distance from center line of stem to pin on which the lever is hung, and divide by weight of suspended weight. Of course, this advice should be: Effective area of valve x pressure of steam x distance from fulcrum to valve divided by weight on lever. But you give no rule for estimating the pressure of lever of a given weight on valve; and this is what I want to get at. For example, if a safety valve lever is 40 inches in total length, weight 16 lbs., distance of center of valve stem to center of fulcrum 3½ inches, what will be its pressure in lbs. on the valve? And again, if the above mentioned lever is used on a valve 3 inches in diameter, at what distance from the fulcrum will I have to place a weight of 34 lbs. to keep in a pressure of 55 lbs. to the square inch? I have a way of estimating the pressure due to the weight of a lever. But a safety valve of the kind and proportions I mentioned blew off, by a new steam gage, at 15 lbs. less than I anticipated. And I want also to say that the gage did not indicate a bit of steam in the boiler, when there was actually enough in it to blow the whistle in a lively manner; and on raising the safety valve there was quite a rush out of steam. Was the gage made properly, or was the result due, in some way, to the air confined in the boiler? These difficulties may seem very simple to an expert, but they are somewhat perplexing to a novice like myself. Answer: There was an error in printing the first question referred to. We have not that communication at hand, but presume that 42 pounds was the weight suspended from the lever, and 20 pounds the pressure due the "action of the lever," and that our reply was correct. In the second case, an omission occurred, as indicated by T. A. P., the words "into pressure of steam" should be supplied. To determine the additional pressure due the weight of safety valve lever, balance the lever across a sharp edged or rounded support, and measure the distance from the point at which it balances—the center of gravity—to the pin. Multiply this distance by the weight of the lever and divide by the product of the effective area of valve into the distance of the valve stem to the pin. The quotient is the pressure per square inch due to the weight of lever unloaded. In case supposed, if the lever were straight, the center of gravity would be at its middle point, and this pressure would be $20\times16\div3\frac{1}{2}=91\frac{3}{7}$, which quantity, divided by the effective area of valve, would give the resulting pressure per square inch. The difference noted by our correspondent may be due to the same cause as that referred to at page 74 of our current volume, and not to error in his estimate. Unless a valve is made with a very narrow seat, it is often difficult to determine accurately its "effective area."

P. B. says, in reply to G. B. L., who asked if the number of teeth in a saw can be reduced with good result: I have run saws in soft pine, oak, walnut, and hard or southern pine, and, according to my experience, reducing the teeth would be bad business; yet it depends on what kind of timber you want to saw. The best rule among the mills sawing hard pine is a tooth for every inch of diameter, but that becomes too many when the saw wears smaller. From 40 to 48 teeth for a 56 inch saw is very good. A fine toothed saw will run longer without filing than a coarse one, but it takes longer to file it; a fine one will run on a stronger feed also. I have one saw now that once had only 26 teeth; the saw was 56 inches. I doubled the teeth, and the change is beneficial in every respect.

J. L. B., says, in answer to G. W. S., who asked what preparation is used for the bright yellow lacquer on brass castings: Take of seed lac, 6 ozs., amber or copal, ground on porphyry, 2 ozs., dragon's blood, 40 grains, extract of red sandal wood obtained by water, 30 grains, oriental saffron, 36 grains, pounded glass, 4 ozs., very pure alcohol, 40 ozs. To apply this varnish to articles of brass, expose them to a gentle heat and dip them into the lacquer. Two or three coatings may be applied if necessary. The lacquer is durable and has a beautiful color. Articles varnished in this manner may be cleaned with water and a dry rag.

J. P. H. says, in answer to W. E. G., who enquired as to the formation of minerals: I would say that you are right according to certain kinds of rocks, minerals, etc., and that your friend is right about some others. Take mineral coal, for instance; it is formed from the debris of forests, in swamps and elsewhere, wherever there has been any immense quantity of vegetable matter. This latter has slowly accumulated in vast beds which have in time changed from peat to coal. The limestones are mostly formed by vast accumulations of animal remains, such as shells and bones of extinct animals. The sandstones are formed by the sediment that has been carried down from hills and mountains by water, and deposited in various places to all thicknesses; they are simply the fragments of rocks, both worn and torn off by the action of water; there are seldom found, if ever, any fossil remains in them. Granite and kindred rocks are the only kind which were the foundations of all the other rocks, and in them are found all the best and purest of our minerals, such as the magnetic iron found at Port Henry, N. Y., the copper found at West Farley, Vt., and the gold in California. I would advise both correspondents to read up Dana's "Manual of Geology," or Lyell's "Elements of Geology," both standard works.

J. P. H. replies to N. J. J., who asked how to stock his lake with fish: Try the common perch, rock bass, Saco bass, and lake trout, with plenty of little minnows, shiners, and red fins, for bait and to feed the other fish on. Mr. Seth Green could probably give you all the necessary names and information about the right kinds of fish to plant in your lake.

G. A. H. says, in reply to E. C. M., who propounds the following problem: "A body weighing 5 lbs. descends vertically and draws a weight of 6 lbs. up a plane whose inclination is 45°. How far will the first body descend in 10 seconds?" In solving this problem we shall find in the first place the velocity which is generated in each second, that is, the acceleration; we shall then find the space passed over in 10 seconds by the well known rule that the space passed over in any time is equal to one half of the product of the acceleration into the square of the time. It is now well understood that the proper measure of the moving effect of a constant force which acts on a body, whether at rest or in motion, is the product of the mass of the body into the acceleration; or, as we may express it, force = mass × acceleration. In applying this relation to the problem before us, we must remember that the pound is a unit of mass, not of force, being the quantity of matter in a certain platinum weight kept in London. In this case, then, the mass moved is equal to the sum of the masses of the two bodies, that is, to 11 lbs. We must now find an expression for the force. For brevity, call the body weighing 5 lbs. P, and the other body Q. It is clear that a certain part of the weight of P is neutralized by holding Q in equilibrium on the inclined plane, and that the accelerated motion of P (together with Q) is wholly due to the action of gravity on the remainder of P. By the law of equilibrium on an inclined plane (power : weight :: hight : length) the portion of the weight of P which is required to balance Q is equal to $6\div\sqrt{2}=4{\cdot}243$ lbs., very nearly leaving an unbalanced weight of 0·757 lbs. to produce acceleration. We are here using the word pound in its secondary and very common sense of a unit of force, or rather of pressure. In this sense it is often called the statical or gravitation unit of force. But the primary meaning of the term is a certain unit of mass, and when employed, as is often convenient, to denote a unit of force, it denotes the pressure produced by the action of gravity on the unit of mass, or pound of matter. The unbalanced pressure, therefore, of 0·757 lbs. is that produced by the force of gravity acting on a mass of 0·757 lbs., and this force is measured in the usual way by multiplying the mass moved by the acceleration due to the gravity, or 32 feet per second, nearly. This gives as the measure of the force $0{\cdot}757\times32=25{\cdot}224$. Therefore the value of the acceleration actually given to the moving system of the two bodies is equal to $25{\cdot}224\div11=2{\cdot}293$ feet per second. The space passed over in 10 seconds will be $\frac{1}{2}\times2{\cdot}293\times100=114{\cdot}65$ feet. In general, if P and Q denote the masses of the two bodies, g the acceleration of gravity, a the angle of inclination of the plane, the space passed over in t seconds will be equal to $\frac{1}{2}[(P-Q)\sin. a]\div(P+Q)\times gt^2$. In fact, the conditions of motion are very similar to those in Atwood's machine, the only difference being that, in the present case, the motion of one of the bodies is rendered less simple by taking place on an inclined plane. We have supposed the inclined plane to be perfectly smooth. In point of fact such planes do not exist; all are more or less rough, the degree of roughness being expressed by a quantity called the coefficient of friction. If u denotes the coefficient of friction in any case it may be easily easily shown that in t seconds of time: Space passed over $=\frac{1}{2}[P-Q(\sin. a+u\cos. a)]\div(P+Q)\times gt^2$.

G. H. H. replies to H. M. who asked what was the cause of his journals heating: The tendency of the saw and mandrel is to move forward in the direction of the cut; and of the opposite end, to retreat. In other words, the mandrel would turn horizontally upon some undetermined center were it free from its bearings, like a gyroscope. I have a saw upon short steel mandrel, well balanced, and run by belt at an angle, down and back from the cut; this relieves the journal next to the saw, but keeps the opposite journal hot, and we are unable to prevent it; this journal is also constructed with ¼ more length of bearing surface than the other. H. M. runs his saw mandrel by friction. The driver, we would suppose to be either back of or beneath the mandrel, which will account for a hot journal next to the saw. If he must run his saw by friction, let him shift his driver as close to the free end of mandrel as possible, and add from ¼ to ⅓ more length to the box next to the saw. Or run by a belt, with the pulley as close to the saw as the business to be done will allow.

J. B. J. replies to W. H., who asked about a coöperative society, that the Fall River Working Men's Coöperative Association, Mass., is in operation.

A. H. G. replies to I. M. I. who asked what will be the resistance of the atmosphere to a flat surface containing one thousand square feet moving at the velocity of thirty miles per hour: The resistance increases as the square of the velocity. A flat surface of one square foot, moving in a still atmosphere at the rate of one mile per hour, is met with a resistance of $1\times1\times{\cdot}005={\cdot}005$. At thirty miles an hour, we proceed thus: $30\times30\times1000\times{\cdot}005=4{,}500$ pounds, equal resistance of 1,000 square feet. Am I correct, Messrs Editors? Answer: Our correspondent is right, according to Smeat. The maximum pressure of the wind is as great as 55 pounds on the square foot of flat surface, which figure is used in calculating the required stability of tall chimneys and lighthouses. For a cylindrical shaft half the latter is taken.

E. A. G. says, in answer to T. M. S., who asked about the force required to burst out the head of a barrel: I would say that a barrel, as described, would probably burst with 15 or 20 lbs. steam pressure. A well made barrel, ¾ inch staves, and 1 to 1¼ inches heads, of 28 to 32 gallons capacity, will bear 12 to 15 lbs., and from 45 to 48 gallons capacity, from 10 to 12 lbs. Strength is given mainly by thickness of head, which generally bulges out. Hoops, if good, rarely burst. T. M. S.'s barrel, having 1¼ inch heads and small diameter, would stand more than the average. The above figures are approximate, though I have burst many a barrel when steaming, preparatory to using for either cider or vinegar.

E. V. says that W. E. G., who believes that a rifle ball is at its highest velocity when it leaves the muzzle of the barrel, is right, and that its speed continually decreases till it comes to a state of rest.

O. B. V. says, in reply to C. E. C., who asked how to anneal gold: After the gold is melted in a crucible, flux it with corrosive sublimate; if it does not work the first time, keep melting until it does.

P. T. says, in reply to L. C. M., who asked how to make bright green pickles: If hard, green cucumber pickles are wanted, salt down in dry salt, putting a layer of salt in a jar, then a layer of pickles, and so on until full. This will produce pickles as green as they can be made, but it is more costly than making brine. If you have stock to feed the salt to, it will be better than the old process. Souring may be done in the usual way. Of course the above process is not calculated for manufacturers for market.

C. M. D. replies to F. S. T., who asked how to make a blackboard on a wall: Make a glue size and go over your wall, then take shellac varnish and lamp black mixed to a thin consistence.

G. W. says that T. A. B., who asked how to soften leather pump valves, should use castor oil freely, and manipulate with the hands till soft. Old boots and shoes can be made as soft as new leather in this way.

G. W. says that J. T. T., who asked how to hang wall paper on a horizontal ceiling: Cover your ceiling with cheap cotton cloth or print, stretched tight and tacked at the edges. Then paper on the cloth in the usual way. Any width of paper will do.

J. T. B. S. says: As many of your correspondents have enquired about machinery for steam launches, I will give some particulars of English practice. The following table gives the sizes of steam launches built by Yarrow and Hedley, of London, who make them a specialty, and build hundreds of boats for use in all parts of the world.

Length of launch.	Beam.	Horse power (indicated).	Draft of water.
23 ft.	5 ft. 3 in.	5	2 ft.
30 ft.	6 ft.	7	2 ft. 3 in.
37 ft.	6 ft. 6 in.	12	2 ft. 6 in.
43 ft.	8 ft.	16	2 ft. 9 in.
50 ft.	9 ft. 6 in.	30	3 ft.

John Penn & Son, of Greenwich, use about the same sizes. More speed can be had by sacrificing room, but the above is standard practice. When light draft is imperative, twin screws are used, in which case each screw has its own independent engine; but in ordinary practice single screws and single engines are employed. I have no data in regard to sizes of screws for the above boats, and know no better rule in designing than those on page 585 of Haswell's "Engineering." It is better to have the screw too small than to have it so large as to overload the engine. The engine illustrated on page 38, current volume of the SCIENTIFIC AMERICAN, is well designed, but there is too much complication. A single engine is much better on the score of simplicity, and can be built for about one half the cost of a double engine of the same power.

F. A. K. says that T. K. B., who asked how to prevent scale from forming on polished steel when hardened, should try the plan suggested to H. B., on page 75 of our current volume.

J. N. S. says that A. W. P., who asked how to soften an oilstone, should try boiling it to extract the oil, if that be the cause of its hardening. He should try a soft water stone, and use oil on it as on a regular oil stone. "I have one of that kind, and it works well. I use carbon oil on it."

N. L. T. says that R. W., who asked for a remedy for screws working out, can always prevent it by cutting a series of notches across the thread, around the screw, in such a manner that the thread will be formed into a series of teeth similar to those of a ratchet wheel. As the screw is inserted, these teeth offer no resistance; but on being turned the opposite way, they catch against the fibers of the wood and prevent the screw working out.

W. A. B. says, in reply to Z. A. S., who asked how to drill holes through glass without a diamond: I have drilled through soft glass, at a tolerably slow speed, with a common drill wet with kerosene or spirits of turpentine; but a better way is to drill with a lead or copper drill, if the hole is to be small, or with a brass or copper tube fed with oil and emery, if large. Do not run it too fast, and use gentle pressure. For the tube, use a wooden support for the bearings and a pulley fitted upon the tube for a driver. Put oil and emery inside, and any arrangement for forcing it down will suffice. It is to be understood that the tube is placed upright; it should have notches cut in the end to catch the emery.

G. W. says to J. H. L., who asked for opinions on his mode of building: If you build your house as proposed, you will have damp walls in wet and frosty weather. But if you put your brick edgewise, leaving an inch space between brick and weatherboarding, and also an inch space between the plaster and brick, lathing and plastering as usual, you will have a warm house with dry walls.

ERRATUM.—On page 282, fourth column, of our last issue, there is an obvious misprint in the answer to F. O. W.'s question. The fractions should be $\frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}=\frac{1}{32}$.

COMMUNICATIONS RECEIVED.

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

On the New Patent Law in England. By A. V. N.

On the Pulsometer. By J. H. H.

On the Bars at the Mouth of the Mississippi. By C. G. F.

On the Manufacture of Combs. By G. F. B.

On the Power of the Tides. By A. H. E.

On Creeping Rails. By C. O.

On a Newly Discovered Novaculite. By J. M. S.

On Distinguishing Fibers. By C. S.

On Aniline Inks. By G. E. D.

On the Proposed Panama Ship Canal. By S. T. F.

On Saving Life from Shipwreck. By F. D. and by A. R.

On the Wreck of the Atlantic. By J. L. G.

On Steam Boiler Explosions. By B. W.

On Water as Fuel. By W. H.

On the Ocean Tides. By W. H. P.

On the Dimensions of Ocean Steamers. By W. C.

On Terrestrial Retardation by the Ocean Tides. By T. W. B.

Also enquiries from the following:

B. A. C.—M. R.—W. T. V.—J. T.—R. A. R.—J. F. S.—C. R.—A. S.—O. F. C.—A. S., Sr.—W. B. C.—P. Q. L. R.—H. J.—B. & C. H.—A. D. L.—E. N. S.—M. H.—B. W.—P. S.

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

Letters Patent of the United States

WERE GRANTED FOR THE WEEK ENDING

April 8, 1873,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

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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:

24,734.—Paper Bag Machine.—W. Goodale. June 25.
24,748.—Paint Can, etc.—J. W. Masury. June 25.
24,779.—Hollow Auger.—A. Wyckoff. June 25.
24,906.—Pianoforte.—J. U. Fischer. July 9.
25,191.—Paper Bag Machine.—W. Goodale. August 6.

DISCLAIMER.

23,605.—Canal Lock Gate.—C. W. Williams.

EXTENSIONS GRANTED.

8,654.—Iron Fence.—H. Jenkins.
23,642.—Obtaining Fiber from Felt.—J. F. Greene.
23,643.—Disintegrating Felt.—J. F. Greene.
23,972.—Cooking Stove.—P. P. Stewart.
23,605.—Canal Lock Gate.—C. W. Williams.
23,596.—Screw Propeller.—J. Montgomery.

DESIGNS PATENTED.

6,558 to 6,560.—Carpets.—R. B. Campbell, Lowell, Mass.
6,561.—Carpet.—R. Carlton, Liversedge, England.
6,562 to 6,571.—Carpets.—J. M. Christie, Brooklyn, N. Y.
6,572.—Trimming.—J. B. Clarke, Brooklyn, N. Y.
6,573 & 6,574.—Printing Types.—J. M. Conner, N. Y. city.
6,575 & 6,576.—Carpets.—J. Hamer, Lowell, Mass.
6,577.—Fork Handle.—M. H. Mossman, Waterbury, Ct.
6,578 & 6,579.—Carpets.—C. A. Righter, Philadelphia, Pa.
6,580.—Plant Stand.—J. R. Robertson, Syracuse, N. Y.
6,581.—Carriage Pole.—A. Searls, Newark, N. J.
6,582.—Bottle Stand.—T. P. Spencer, Morrisania, N. Y.
6,583.—Paper File.—E. J. Steele, New Haven, Conn.
6,584.—Handle Socket.—J. S. Ray, East Haddam, Conn.
6,585.—Knife, etc., Handle.—W. Rogers, Hartford, Conn.

TRADE MARKS REGISTERED.

1,199.—Hams, etc.—W. G. Bell & Co., Boston, Mass.
1,200.—Brandy.—Cazade & Crooks, New York city.
1,201.—Glass Ware.—T. G. Cook & Co., Philadelphia, Pa.
1,202.—Paints, etc.—Harrisons & Co., Philadelphia, Pa.
1,203.—Baking Powder.—J. H. Lippincott, Pittsburgh, Pa.
1,204.—Bitters.—J. Cleve, Boston, Mass.
1,205.—Trimmings.—Erskine & Co., New York city.
1,206.—Medicine.—J. H. Hopkins, Providence, R. I.
1,207.—Whisky.—Morehead & Co., St. Louis, Mo.
1,208 & 1,209.—Rubber Paint.—Rubber Paint Co., Cleveland, Ohio.
1,210.—Lozenge, etc.—Townsend & Co., New York city.

SCHEDULE OF PATENT FEES:

On each Caveat	$10
On each Trade-Mark	$25
On filing each application for a Patent (17 years)	$15
On issuing each original Patent	$20
On appeal to Examiners-in-Chief	$10
On appeal to Commissioner of Patents	$20
On application for Reissue	$30
On application for Extension of Patent	$50
On granting the Extension	$50
On filing a Disclaimer	$10
On an application for Design (3½ years)	$10
On an application for Design (7 years)	$15
On an application for Design (14 years)	$30

VALUE OF PATENTS

And How to Obtain Them.

Practical Hints to Inventors

PROBABLY no investment of a small sum of money brings a greater return than the expense incurred in obtaining a patent even when the invention is but a small one. Large inventions are found to pay correspondingly well. The names of Blanchard, Morse, Bigelow, Colt, Ericsson, Howe, McCormick, Hoe and others, who have amassed immense fortunes from their inventions, are well known. And there are thousands of others who have realized large sums from their patents.

More than Fifty Thousand inventors have availed themselves of the services of Munn & Co. during the TWENTY-SIX years they have acted as solicitors and Publishers of the Scientific American. They stand at the head in this class of business; and their large corps of assistants, mostly selected from the ranks of the Patent Office: men capable of rendering the best service to the inventor, from the experience practically obtained while examiners in the Patent Office: enables Munn & Co. to do everything appertaining to patents better and cheaper than any other reliable agency.

HOW TO OBTAIN Patents. This is the closing inquiry in nearly every letter, describing some invention which comes to this office. A *positive* answer can only be had by presenting a complete application for a patent to the Commissioner of Patents. An application consists of a Model, Drawings, Petition, Oath, and full Specification. Various official rules and formalities must also be observed. The efforts of the inventor to do all this business himself are generally without success. After great perplexity and delay, he is usually glad to seek the aid of persons experienced in patent business, and have all the work done over again. The best plan is to solicit proper advice at the beginning. If the parties consulted are honorable men, the inventor may safely confide his ideas to them; they will advise whether the improvement is probably patentable, and will give him all the directions needful to protect his rights.

How Can I Best Secure My Invention?

This is an inquiry which one inventor naturally asks another, who has had some experience in obtaining patents. His answer generally is as follows, and correct:

Construct a neat model, not over a foot in any dimension—smaller if possible—and send by express, prepaid, addressed to Munn & Co., 37 Park Row, together with a description of its operation and merits. On receipt thereof, they will examine the invention carefully, and advise you as to its patentability, free of charge. Or, if you have not time, or the means at hand, to construct a model, make as good a pen and ink sketch of the improvement as possible and send by mail. An answer as to the prospect of a patent will be received, usually, by return of mail. It is sometimes best to have a search made at the Patent Office; such a measure often saves the cost of an application for a patent.

Preliminary Examination.

In order to have such search, make out a written description of the invention, in your own words, and a pencil, or pen and ink, sketch. Send these, with the fee of $5, by mail, addressed to Munn & Co., 37 Park Row, and in due time you will receive an acknowledgment thereof, followed by a written report in regard to the patentability of your improvement. This special search is made with great care, among the models and patents at Washington, to ascertain whether the improvement presented is patentable.

To Make an Application for a Patent.

The applicant for a patent should furnish a model of his invention if susceptible of one, although sometimes it may be dispensed with; or, if the invention be a chemical production, he must furnish samples of the ingredients of which his composition consists. These should be securely packed, the inventor's name marked on them, and sent by express, prepaid. Small models, from a distance, can often be sent cheaper by mail. The safest way to remit money is by a draft, or postal order, on New York, payable to the order of Munn & Co. Persons who live in remote parts of the country can usually purchase drafts from their merchants on their New York correspondents.

Reissues.

A reissue is granted to the original patentee, his heirs, or the assignees of the entire interest, when, by reason of an insufficient or defective specification, the original patent is invalid, provided the error has arisen from inadvertence, accident, or mistake, without any fraudulent or deceptive intention.

A patentee may, at his option, have in his reissue a separate patent for each distinct part of the invention comprehended in his original application by paying the required fee in each case, and complying with the other requirements of the law, as in original applications. Address Munn & Co., 37 Park Row, New York, for full particulars.

Value of Extended Patents.

Did patentees realize the fact that their inventions are likely to be more productive of profit during the seven years of extension than the first full term for which their patents were granted, we think more would avail themselves of the extension privilege. Patents granted prior to 1851 may be extended for seven years, for the benefit of the inventor, or of his heirs in case of the decease of fomer, by due application to the Patent Office, ninety days before the termination of the patent. The extended time inures to the benefit of the inventor, the assignees under the first term having no rights under the extension except by special agreement. The Government fee for an extension is $100, and it is necessary that good professional service be obtained to conduct the business before the Patent Office. Full information as to extensions may be had by addressing Munn & Co., 37 Park Row, New York.

Caveats.

Persons desiring to file a caveat can have the papers prepared in the shortest time, by sending a sketch and description of the invention. The Government fee for a caveat is $10. A pamphlet of advice regarding applications for patents and caveats is furnished gratis, on application by mail. Address Munn & Co., 37 Park Row, New York

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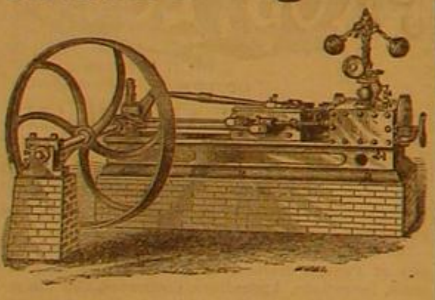

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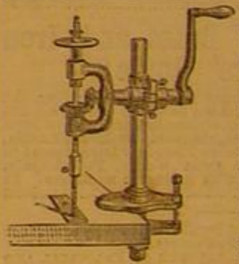

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