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The Manufacture of Zinc and Zinc White.

That beautiful snow white substance, the oxide of zinc, which, during the past fifteen years, has come into extensive use in the arts as a substitute for white lead in paints, is produced in enormous quantities in this country. One of the most extensive manufactories of zinc and zinc white is at Bethlehem, Pa., and is described as follows by an able correspondent of the New York *Times:*

At the works of the Lehigh Zinc Company, two processes are carried on the manufacture of oxide of zinc and the manufacture of metallic zinc for rolling into sheet zinc, etc. Either process is very interesting.

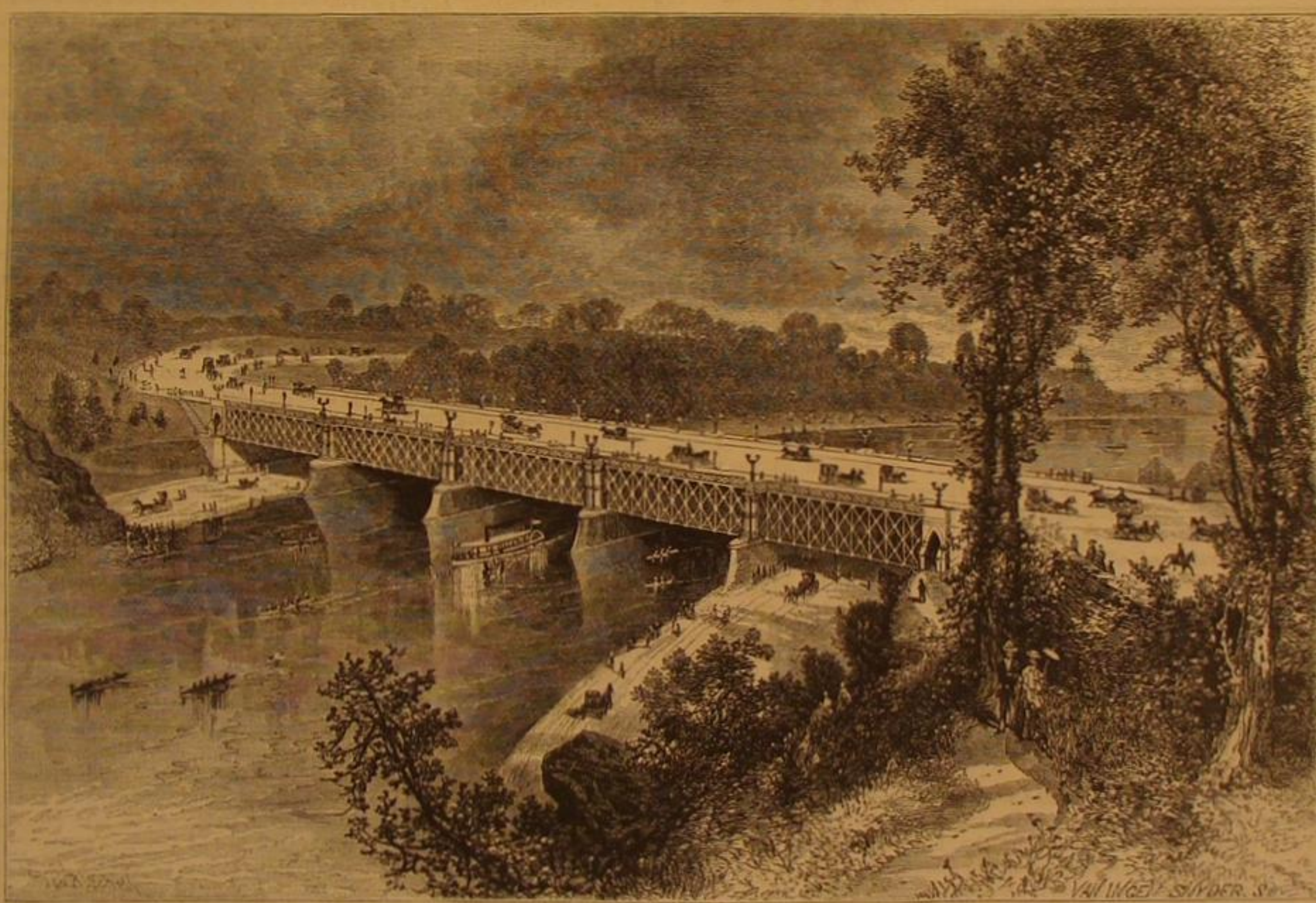
The making of metallic zinc—or spelter, as it is termed in the markets—is one of those wonders of the chemical world which are so astounding and so fascinating to witness. The three kinds of zinc ore—sulphuret, carbonate, and silicate of zinc—are found in the company's mines. From the two first the sulphur and carbonic acid can be expelled by roasting the ore; the silex, however, cannot be got rid of. When the ore is ready for the furnaces, the zinc in it is composed of oxide of zinc and oxide of zinc combined with silex. The ore is then mixed with 33 per cent of crushed coal and placed in dry clay retorts, each holding 27 lbs. of the mixed coal and ore. These retorts are placed in layers, fifty-six in a furnace, the face of which is sealed up with fire clay, the orifices of the retorts being cemented in conical shaped tubes of baked fire clay, which project 18 inches from the furnace, and act as condensers.

The firing up is then carried on till the heat of the furnace is 2,160°, Fah. the vaporizing point of zinc.

The reduction of the zinc in the ore into metallic zinc vapor is done by means of the carbon and carbonic oxide gas depriving the oxide of zinc of its oxygen, and liberating metallic zinc as a vapor. This vapor is carried forward by the gases (which are formed by the reduction of the oxide of zinc) into the conical tube condensers, which project outside the furnace, the temperature of which is far below the vaporizing point of zinc attained in the retorts inside, and sufficiently low to condense the vapor into liquid metal. When this condensing process is going on, men go round the different furnaces and, with iron hooks, draw out the melted zinc into large ladles, from which the zinc is poured into iron molds and cast into slabs of 30 lbs. weight. The gaseous flames which issue in great force from the orifices of the condensers are intensely brilliant and of all the colors of the rainbow—the brightest yellows, reds, violets, and greens. As there are sixteen stacks of furnaces, each having fifty-six retorts, the beauty of the colors at night may be easily imagined. The furnaces are charged twice in the twenty-four hours, each charging taking 1,500 pounds of ore and coal. This process is known as the Belgian process.

While still hot, the slabs of metallic zinc are taken from the molds and rolled into rough thick plates, which are cut into two pieces. From nine to twelve of tnese pieces are placed in iron boxes in muffle heating furnaces, and are heated up to 300°, hot enough to make water dance upon them in spherical globules before it evaporates. As soon as this heat has been attained, the pack of plates is taken out and they are all rolled out together. In twenty-five minutes the plates, two of which formerly made a slab of 10 by 18 inches, are rolled out into sheets which, when trimmed, are 7 feet by 3 feet. Of the importance of these works it is unnecessary to say more than that their capacity is nearly equal to producing one half the metallic sheet and oxide of zinc consumed in this country. The company makes annually 3,600 tuns of metallic zinc, 3,000 casks of sheet zinc, and 3,000 tuns of oxide of zinc.

To make oxide of zinc, the carbonate and silicate of zinc, beyond being crushed and mixed with thirty-three per cent of coal, is put into large fire brick furnaces just as it comes from the mines. Air is blown into the furnaces, and the oxygen in it oxidizes the metallic zinc vapor, for which it has a great affinity, as soon as it is liberated. The oxide of zinc is thus formed, and is propelled by air forced into the furnaces into a high tower in white flocculent particles, with which are associated coal ashes and particles of other foreign substances. It is driven by powerful blowers through a series of chambers connected by pipes; the majority of the oxide associated with impurities deposits in the tower, and the less impure in the chambers and cooling house, the most flocculent and purest passing through pipes, to which muslin bags are attached and in which it is collected. The best is like white wheat flour, though very much heavier, an almost impalpable powder. There are fifty-two of these brick furnaces in the works. They are charged every four hours, from 750 to 1,000 pounds making a charge. The pressure of air forced in is twenty-four pounds to every square foot of furnace.



GIRARD AVENUE BRIDGE, PHILADELPHIA.

How to Search for Metals.

A correspondent, C. G., Virginia city, Nev., having read an article on this subject on page 133 of our current volume, states that, in his experience, all the gold and silver west of the Mississippi is found on the Sierra Nevada and not on the Rocky mountains. He also states that gold has been found in limestone, some of the richest ore he has ever seen being rock of that description; and that it is often found in the beds of rivers, those of the Yuba and Feather having continued to yield it from the year 1849 to this day. Leads of gold ore do not become poorer as the search is prosecuted to a greater depth, and silver ore becomes more plentiful under similar circumstances. C. G. has seen both gold and silver in limestone, black spar, white spar, granite, slate, porphyry, and conglomerate in which everything seemed o be melted together.

Peat Ashes as a Fertilizer.

M. Lebœuf, a large cultivator of asparagus and strawberries, of Argenteuil, France, has recently obtained some advantageous results from peat ashes used as a fertilizer. He filled three pots with the substance without any other admixture and planted in one oats, in another wheat, and in the third strawberry plants; leaving them through the winter without attention, germination took place, the wheat and oats sprouted and bore large and heavy grains, the stalks attaining for the wheat a hight of 4·5 feet and for the oats 3·6 feet. The strawberries were unusually vigorous. M. Lebœuf has repeated the experiments several times with uniform success.

Railway Management.

The London *Railway News* gives some interesting comparisons between English and American railway returns. In regard to rolling stock and train earnings, it is surprised to find that our roads are more economically run than their own. Taking four roads in each country, aggregating about 4,000 miles, it is found that the American road has only ·33 of a locomotive and 6·72 freight cars per mile, while the English has ·93 of a locomotive and 28·83 cars. The New York Central, with a heavier traffic than the London and Northwestern, has not half the locomotives per mile. The English refuse to believe that the superior size and strength of American locomotives account fully for this difference. The earnings for instance of an American locomotive are 70 per cent more than those of an English, and the entire rolling stock, which, in England, barely pays for itself in a year, in this country pays for itself and 65 per cent more.

The *News* also discovers that, while passenger fares are 30 per cent lower than in England, the earnings per train here are 40 per cent more, and on freight trains 15 per cent more. It concludes that it is time for English managers to study our system.—*Railway Review.*

Hints to Inventors.

A correspondent, J. W. K., says: If manufacturers of rubber goods would get up a style of rubber picture frames that would permit the picture to be easily removed, they might sell many of them. The frames should be made so as to exclude dust and rain from the picture, and would then be useful for outdoor advertisements or bulletins.

Cannot some one manufacture an apparatus to obviate the necessity of turning the leaves, in short hand or long hand reporting? A tablet with a roller at the upper and lower ends, the upper rollers to work with a spring so as to move the paper the proper distance each time the spring was touched with one of the fingers of the left hand, and thus present a fresh surface of paper to the writer, would be very useful. It might be arranged so that the reporter could have his eyes at liberty to watch the speaker during most of the time and yet write legibly and in straight lines. Such an apparatus would be convenient for the blind, for persons with weak eyes, and for writing where the light was insufficient. The paper should be made in sheets long enough for one or two hours' writing in phonography.

DURING the visit of the late Mr. Seward to China, while in Pekin, he visited the residence of a wealthy native who was withal a mandarin and an intelligent man, somewhat scientific in his tastes and well acquainted with the modern appliances for household purposes. Among other objects contained in this Chinaman's residence was a Yankee cast iron pump. To Mr. Seward's enquiry as to the use he made of the pump, Yang Fang replied: "It is set up to extinguish accidental fire, and I put the women under it when they quarrel." He had five wives.

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Contents:

(Illustrated articles are marked with an asterisk.)

MEDICAL PRACTICE IN EARLY TIMES.

History teaches us that, at the dawn of civilization, the two vocations of medical practice and spiritual authority were usually combined. This was the case over all the world. Even when Greece, that most advanced nation of antiquity, had reached quite a high standard in art and literature, the priests were also physicians, and the famous temples of Æsculapius were the special resort of patients suffering from severe ailments, who implored the assistance of the gods by the intervention of the priests. It is not known if the latter had a regular tariff of charges; but the gratitude of the patients was often manifested by gifts, and tablets were erected in the temples, giving a full account of the symptoms of the disease and the means of cure. These tablets, of course, soon became very valuable to all who studied the medical art, and in this way these temples became medical colleges, as well as dispensaries, and the incorporation of the ecclesiastical and medical professions was more and more complete.

There was, however, a prevalent notion, which for a long time paralyzed all attempts at the relief of society from epidemics, etc., by sanitary regulations; it was the belief that every ailment was due to the revenge of offended divinity. These ideas prevailed among the best informed of men, and religious acts, such as sacrifices, invocations, pilgrimages, penances, etc., formed the chief part of all medical treatment. We regret to say that, even in our own times, such notions prevail among certain classes, especially among the ignorant, who indulge in prayers and useless penances, but neglect personal, domestic, and municipal cleanliness, and appear to be totally unable to realize the beneficial effects of fresh air and sunlight on all highly organized beings.

It was reserved for the great and good Hippocrates to entirely upset the theological treatment of diseases, and to replace it by a practical and material theory, founded on the most careful and admirable observations concerning the causes, symptoms and general courses of different ailments. This glorious revolution was indeed one of the greatest triumphs of human genius; but it was not accomplished without a struggle, which ended in the complete separation, among civilized nations, of the business of the priest from that of the physician, and it is for this, especially, that the memory of Hippocrates should be honored as a successful reformer and intellectual revolutionist. His works abound with the proofs of his profound study of the medical art; and his descriptions of symptoms have never been surpassed. For instance, his sketch of the physiognomy of the dying is still copied in our works on the practice of medicine, and the characteristic appearance of the patient in that last stage is so inimitably described by the great master that it is still called "the Hippocratic countenance."

While rejecting all the imaginary notions about supernatural influence, in vogue in his time, he attempted to impute all symptoms to their true physical causes, and to substitute the action of Nature for the action of the gods. He did not give himself any concern about the opposition of the priests, to whose interests it was to refer every disease to the anger of some divinity, and who taught that health could only be restored by a reconciliation with the same, by gifts to his temple, sacrifices, etc. Hippocrates was the first to teach that every disease will run its natural course; and his greatness consists chiefly in his masterly conception of pathology, which caused him never to attempt to check or prevent this physical process, but to watch the critical period, and to modify and bring relief at the right moment by assisting in the elimination of what he called the peccant humors, which he considered to be, by poisoning the blood, the cause of almost all ailments. By his fearless war against superstition, he created a beautiful example to all who have succeeded him in his important profession, teaching them not to hesitate to resist ignorance and prejudice, and courageously to encounter the opposition and disapproval of their contemporaries, being sure that the appreciation of a not very remote future will offer a glorious reward for those who are in the advanced guard of progress.

THE HORSE POWER AND THE POWER OF THE HORSE.

Some of our readers are finding great difficulty in reconciling the definition of horse power, as given by writers on engineering subjects, with their own knowledge of the power of the horse. There are three terms which we must define with precision, before attempting to place the subject before our readers in such a manner as shall give them an accurate notion of the meaning of the term first referred to.

Force is defined to be anything which produces or tends to produce motion, or change of motion, in bodies. The force of gravitation, of electrical and magnetic attraction, of heat repulsion, of steam pressure, and of a compressed spring, are illustrations. It is measured by the weight which will counterpoise it.

Work is force acting through space, and is measured by multiplying the measure of the force by the measure of the space. A force which overcomes a resistance of 5 pounds through a space of 7 feet, does 35 "foot pounds" of "work." A weight of 2 tuns is raised 5 feet, or 60 inches, by the expenditure of 10" foot tuns," or its equivalent, 120 "inch tuns."

Power, as the term is only properly used by engineers, is the amount of work done in any given example, in some known time. Its unit is called the "horse power." Thus, a machine doing 33,000 foot pounds of work in a minute develops one horse power. The same machine, working in the same manner, would do 550 foot pounds of work in each second, or 190,000 foot pounds during each hour that it might be continuously worked. The horse power, therefore, is a rate of work.

A horse cannot usually exert a great power; but the term was first introduced by James Watt, and since its actual value is a matter of no consequence so long as it is well understood what that value is, engineers have not thought it advisable to change it. The actual power of horses varies immensely, being sometimes more than a horse power, and often much less. The average power of a good draft horse is about three quarters of a horse power, but it can only be sustained about eight hours a day. The same horse drawing in a gin or a mill would exert a power which would average for eight hours work a trifle more than a half horse power. An ox is said to have about two thirds the power of a horse, or to be capable of exerting about a half horse power. The ox can pull as heavy a load as the horse, but moves more slowly, and hence does less work in a given time, and rates less horse power.

The mule pulls about one half the load of a strong draft horse, at about the same speed. He may therefore be rated at $\frac{1}{2}$ of $\frac{3}{4} = \frac{3}{8}$ of a horse power. The ass rates at about $\frac{1}{4}$ of the power of the horse, or $\frac{1}{4}$ of $\frac{3}{4} = \frac{3}{16}$ horse power.

On a direct pull, the average lift which a horse can exert in steady work over a single pulley is about 120 pounds. The maximum is probably double this figure. Professor R. H. Thurston, in the paper on "Traction Engines" of which we gave an abstract some months ago, says: "Experiments made by Captain Robert Merry, at the Jackson Iron Mine, Negaunee, Mich., and the observations and experiments of the writer, indicate the maximum direct traction force of a good horse to be about 250 pounds." This weight, raised at the rate of 250 feet per minute or about three miles per hour, would give $250 \times 250 \div 33{,}000 = 1{\cdot}9$, nearly two horse power for the power of such an exceptionally strong animal; but we should not expect any horse to keep up such exertion for more than a very short space of time. The estimates before given were for average work, kept up eight hours a day for days and weeks together.

British engine builders use a term, in giving the size of steam engines, which is known as "nominal horse power," and is much smaller than the actual power of the engine, which is usually known as the "indicated horse power," or the "dynamometrical horse power," according as it is determined by the indicator or the dynamometer. Thus the engines of the British iron clads, Devastation and Thunderer*, if driven at the slow speed and with the low steam used in the time of James Watt, would be of about 800 horse power. They still are said to be of 800 nominal horse power, but the Thunderer, in her recent trial, developed 5,700 indicated horse power. In this country, this unfortunate and confusing application of the term "nominal" horse power is almost unknown, and we indicate the size of an engine by specifying its diameter of cylinder and length of stroke. The engines of the Thunderer, for example, have two cylinders for each of her twin screws, which are 88 inches diameter and 39 inches stroke.

CHEMICAL HEAT INDICATORS.

A method of exhibiting the temperature of solutions in vessels without the use of the thermometer is suggested by the *British Journal of Photography*. It consists in painting the exterior of the vessel with the double iodide of mercury and copper. Two drachms of iodide of potassium are dissolved in an ounce of water, to which is added a small quantity, drop by drop, of a saturated solution of bichloride of mercury (corrosive sublimate) until the red precipitate ceases to dissolve. A minute quantity of the iodide will then clear the solution. $1\frac{1}{2}$ drams of sulphate of copper dissolved in the least quantity of water are now added, when the desired compound is precipitated. The clear liquid is then poured off and the precipitate dried for use. The double iodide of mercury and copper thus prepared is a rich red crystaline powder, distinct in color from the simple scarlet iodide of mercury.

When paper or other substances are stained with the double salt mentioned, the red color changes to black when heated to 130° F., and the intermediate variations of temperature are indicated by modifications from red to black. The red color returns when the temperature sufficiently falls.

Professor Mayer, of the Stevens Institute, suggested some time ago the use of the iodides of mercury and copper as a paint for car wheel boxes, to indicate the heating of the journals. He also used the salts for illustrating the spread of heat in conducting bodies, and also for the demonstration of the unequal heat-conducting powers of different sections of crystals. It seems quite possible that chemical investigators may be able to discover other salts still more sensitive to heat than those mentioned, and that this method of heat indication may become practically useful for many purposes.

* Vide Science Record, 1873, p. 222.

LEAPING BY MACHINERY.

Among the sensational amusements now going on in this city, the performances of a young feminine gymnast, Lulu by name, at Niblo's Garden, are noticeable. The deliberate attempts at neck-breaking which she nightly undertakes attract immense audiences of ladies and gentlemen, who enjoy the sensation amazingly, and recommend it to their friends as a worthy and thrilling sight.

The astounding feat consists in what appears to be a direct leap, thirty feet high from the stage floor, and the grasping of a pair of bars at that elevation, directly over the heads of the audience. We need hardly say that the flight is assisted by mechanism.

The performer, costumed in stage tights, totally unembarrassed by petticoats, exhibiting all the charms of her well proportioned physique, stands upon a small iron step, which forms the extremity of a lever that projects up through the stage floor. Below the stage and connected with the lever is a weight of 4,000 pounds and a trigger arrangement. At the appointed moment, the gymnast places herself upon the step, assumes the required position, an attendant taps the floor as a signal, the trigger below is moved, and the gymnast shoots up like an arrow through the air to the bars above. It is a dreadful trick, for the least variation in the force of the mechanism, or the most trifling deviation in her course through the air, would drive the gymnast away from the friendly bars and send her headlong upon the iron chairs below. We sometimes marvel at the strange taste of the Spaniards who still find enjoyment in the gory spectacle of the bull fight. But what shall we say of the sensibilities of Americans, whose popular evening entertainments depend for their chief zest upon the antics of a company of half nude ballet dancers coupled with the fearful risking of human life by methods such as we have described?

LOSS OF THE POLARIS.

Telegraphic despatches bring the news of the probable loss of the United States exploring steamer Polaris and the end and failure of the Arctic exploring expedition. On the 15th of October, 1872, in lat. 77° 35', a party of the crew, altogether some nineteen souls, left the ship to place some provisions on an ice floe. A severe storm came on, causing the Polaris to part her moorings. The few remaining aboard got her under steam, but were unable to render any assistance to their comrades on the ice, who, to their dismay, saw their vessel disappear among the surrounding fields and bergs. The tide and wind, it seems, fortunately drove the great floe, bearing the survivors, down through Baffin's Bay and Davis' straits until, on the 30th of April last, they were rescued after one hundred and ninety-six days on the ice, by the British steamer Tigress, in lat. 53° 30' near the coast of Labrador.

Captain Hall died of apoplexy on the 8th of October, 1872, after returning from an expedition on sledges, in which he reached within 7° 44' of the North Pole. The Polaris, the survivors state, was without boats and leaking badly at the time of her breaking adrift, so that there is but little chance of her present safety. The sufferings of the rescued party are described as terrible, but all were taken off their perilous raft uninjured and in comparatively good health.

IMPORTANT DECISION IN RESPECT TO ASSIGNMENTS.

We publish, in another column, the text of a recent decision of the United States Circuit Court, District of California, by Judge Sawyer, in which he holds, substantially, that the purchaser of a patented article, obtained from a *bona fide* owner of a territorial patent right, may use and sell such article outside of the territory owned by the seller. Thus, in the case of the Egg-case patent, the Judge held that the purchaser, who bought the patented goods of parties owning the patent for Illinois, had the right to send the goods to California, use and sell them there, notwithstanding the protest of the party who held the patent for California.

If this doctrine is sound, then the selling of patent rights in specified territorial divisions is a farce, and new restrictions become necessary in the assignment, as Judge Sawyer suggests.

THE DEATH OF LIEBIG.

It was in 1826 that Justus Von Liebig, then only 23 years old, and already Professor of Chemistry of the University of Giessen, Germany, opened there the first chemical laboratory for the use of students in practical chemical operations, and thus soon attracted pupils from nearly all parts of the civilized world. By this, the little university at Giessen soon rose to great eminence as a scientific school, and was, erelong, in advance of all others. The influence which such instruction had on the industrial progress of Germany and of all Europe cannot be over-estimated, and is one of the most lasting merits of the great man who so long maintained the lead in this branch of science.

The early education of Liebig was imparted in his native place, Darmstadt, and was of a very ordinary kind. After leaving school, his predilection for chemistry caused his father to place him with a druggist, but soon after he entered (at the age of 16) the university of Bonn, and afterwards went to Erlangen, where he graduated before he was of proper age. Here one of the good acts (too seldom) done by princes was of great benefit to him. The Grand Duke of Hesse paid his expenses for a residence of two years in Paris, where he enjoyed the instruction of such men as Gay-Lussac, Dumas, Pélouse, and Mitscherlich. By an able report on the fulminates, he obtained Humboldt's friendship, and an introduction to his many scientific friends, which at last resulted in his being offered the professorship at Giessen.

Eleven years later, when his name had become known over all the scientific world, he visited the meeting of the British Association in Liverpool, where he read some valuable papers; and he afterwards dedicated his celebrated "Organic Chemistry applied to Agriculture and Physiology" to this same body. This work shed so much light on the processes of nutrition, respiration, waste of system by motion, the theories of disease and of reproduction, etc., that it was at once published in German, French and English, in the three countries respectively.

In 1843, he published his theory of "Motion of the Liquids in the Animal Body;" in 1849, "Researches in the Chemistry of Food"; then his well known "Familiar Letters on Chemistry in relation to Industry, Agriculture, and Physiology," and several other works and reports, to the number of nearly three hundred.

Although at the present day some of his views have been upset by additional information resulting from the always accumulating store of discovered facts, it must be acknowledged that he deserves the credit of having first attempted to bring system into organic chemistry, and above all that he has very greatly simplified the processes employed for organic analysis, which before his time were so complex as to be, in a great many cases, impracticable. He was so universally esteemed that he was invited to fill many chairs of chemistry, which he declined. Among them was that of Heidelberg, which had been filled by Gmelin, then just deceased. In 1845 the Grand Duke of Hesse created him a baron; and the British Royal Society, the French Academy, and nearly all the leading academies of the world elected him to membership, and he earned the Copley Medal, for original investigations. He finally accepted a professorship in the University of Munich, and then became President of the extensive laboratory there. A fund of $5,000 was raised by subscription in Europe in order to give him a testimonial, as a proof of the value set upon his researches; and with it was bought five pieces of plate, one for each of his children.

He died in Munich last April, at the age of 70, after a short illness; and as he to the last filled his useful position, it will be acknowledged that, notwithstanding his advanced age, his death took place too early for science, which cannot afford to be deprived of such glorious apostles, as long as they are able to add to the progress and diffusion of the most useful of all human pursuits.

THE FALLING OF THE DIXON BRIDGE.

A terrible casualty, resulting in the killing of forty-five persons and the wounding of a large number additional, recently happened through the falling of a bridge over Rock River, at Dixon, Illinois. Baptismal ceremonies were being performed in the stream a short distance below the structure, which, from the view it commanded of the scene, became thronged with some one hundred and fifty people, all of whom were gathered upon one side, outside the truss. Suddenly, with a quick crash, the main western stringer of the north span of the bridge snapped, and the fabric, falling, dislodged the stays from the abutments. The shock ran along the whole length like lightning, and span after span was drawn from the piers and sunk sagging to the water's surface till the whole five literally folded up, crushing and heaping upon the mass of human beings precipitated into the rushing flood beneath. Help was speedily at hand, and the reports of the disaster detail heroic efforts, made in extracting the wounded held in the fearful wreck. Many were killed outright by the falling iron, and others were drowned in the river, which at the point is some thirty feet deep. The number of wounded is not definitely stated, and it is believed that twenty-five more bodies are still entangled in the *débris*.

Turning from the heart-rending details of this latest horror, it is of importance that the public should understand the construction and plan of the fabric, to the inefficiency of which the lives of so many have been sacrificed. It was a wagon and foot bridge with five spans of 132 feet each, making it 660 feet long. Its width at the center was thirty feet, and it stood fifty feet above the water. The roadway was twenty feet wide and the foot paths were enclosed with a heavy filagree work of iron. The structure was a double truss, and was erected by L. E. Truesdell & Co., of Chicago, in 1868, and cost $80,000. Both shore spans are broken to pieces, while the three middle ones, resting entirely upon heavy stone piers, remain hanging by the wrought iron members of the main chords from six to eight feet below their proper places. Between the roadway and foot path were 12 foot high partitions of lattice truss work, directly under which was the main chord. This is broken in every case about twelve feet from its bearing on each pier, or where the first truss bolts to it. The truss bars, of wrought iron, were only half inch by one and one eighth inches iron, filling in between the upper and lower chords perhaps every five feet. The metal work throughout the whole fabric was exceptionally frail. The accident is explained by the fact that the northern span was thickly crowded and bore a weight of twenty tuns or more on the extreme westerly side. The weight strained the trusses, and, at the point where the first of the truss lattice bars passed over the 12 foot cast iron pillar and bolted to the lower main chord (some twelve or fourteen feet out on the pier), the cast iron part of the north shore span first broke. In quick succession, and at about the same point in each span and in both the main chords, this snapping of cast iron chords took place. The breaking is described to have sounded like a volley of musketry.

From the information gleaned regarding the superstructure, there is little question but that its theory of construction was wrong and the material poor and clearly inadequate. The principle of the Truesdell patent, upon which it was based, is to lock joint all supports. Each bar has a crook in the center and all are locked together, the joint being covered with a cast iron shoe. It has been the opinion of many engineers that the idea is a total failure. Too much light and cast iron is employed, and the lock joint arrangement so weakens the metal that its full strength cannot be gained.

If this casualty were the first that had happened from the use of this bridge, it might be considered inevitable and unforeseen. But when the facts are on record, not only of the falling of a structure (its counterpart) but of the pronounced opinions of experts that this very fabric was unsafe, the fault must be plainly attributed to neglect. The first Truesdell bridge fell in Elgin, Illinois, in December, 1868, and was repaired and said to be strengthened by the inventor. Subsequently, on a strolling menagerie passing that way, an elephant, with curious sagacity, tested the fabric and refused to venture his weight upon it. On the 4th of July, 1869, some two or three hundred spectators gathered upon it to witness a race in the river, when a span, some sixty-eight feet in length, fell, carrying down over a hundred people, though fortunately killing but few. It is said that this disaster destroyed, as well it might, all confidence in the bridge, and that Truesdell could get no more contracts, and eventually died bankrupt. Later experience has proved that not a structure of the kind has been built which has not sagged or required extra trussing within a year.

What with the frequent marine disasters, boiler explosions and kindred horrors that have crowded upon us of late, it seems an almost useless task to repeat in the present instance the denunciations of criminal negligence which so often have found place in our columns. Here was a structure which any competent engineer should have been able to perceive at a glance was improperly built and unsafe, even were he not aware of the experience of others with its defects. Yet we are told that a city council examined it and were suspicious of its strength, and still it was allowed to remain. Naturally, the people are indignant, and in the midst of their sorrow call loudly for the exposure and punishment of the guilty parties; but private grief will, doubtless, soon overcome the complaints of those bereaved by the catastrophe, while the general public, shocked by the sensation for a day or two, will relapse into its usual apathy until again awakened by some new calamity, adding further evidence of the cheapness and insecurity of human life.

Death of John Stuart Mill.

We regret to announce the death of John Stuart Mill, a writer and thinker of great celebrity, whose works are known to the civilized world. He was the son of James Mill, the author of a "History of India" and a speculative philosopher of great reputation. It is as a logician of the highest order, whose reasonings led him to sympathize with the cause of freedom in all countries, that John Stuart Mill will be remembered. He died at his country house at Avignon, France, in the 67th year of his age, on the 9th of May.

SCIENTIFIC AND PRACTICAL INFORMATION.

CURARIC POISONS.

M. Rabuteau has discovered that the iodide of methyl-ammonium and the iodide of tetramyl-ammonium act upon animals in exactly the same manner as curare poison, paralyzing muscular movement without blunting the sensibilities, and with the same subtlety and energy. A fraction of a grain of these substances will kill a dog in a very few minutes.

FIRST ASCENT OF COTOPAXI.

Professor James Orton, of Vassar College, N. Y., has published an interesting account of the ascent of the great South American volcano of Cotopaxi, made in 1872 by Dr. Reiss, a German naturalist. The hight of the volcano was found to be 19,660 feet, and the depth of the crater, 1,500 feet. The inner surface of the crater is very steep, and is lined with innumerable fumeroles, which send forth dense masses of hot gas, and also emit deposits of sulphur, gypsum, and chloride of lime.

NEW METHOD OF EXHIBITING THE CARBON POLES.

Mr. S. H. Landy, of Columbia College, New York city, has succeeded in effecting a decided improvement in projecting the carbon poles upon the screen. The old manner of showing them is to place them behind the condenser in the interior of the lantern, and then throw them upon the screen, giving but a faint and confused image. Mr. Landy's method is to place them in front of the condenser (a sufficient distance to avoid injuring the glass, about an inch); and then, by using an ordinary objective, they are thrown upon the screen greatly magnified and clearly defined. The electric current is then established, the carbon poles are drawn apart and we have a magnified arch of about eight inches, making visible to an audience the transfer of the incandescent carbon from the positive to the negative pole. By placing caustic potash upon the positive carbon, the arch is greatly extended; by the use of thallium, silver, or copper, the characteristic color of each element is gorgeously depicted upon the screen, making altogether a most beautiful and instructive experiment.

NEW METHOD OF PREPARING ALUMINUM.

The oxide of aluminum is first prepared by any of the processes now in use, either from kaolin or clay. It is then mixed with wood charcoal in the proportions of 40 parts charcoal to 100 of alumina, and heated to a red heat. While still hot, the mass is placed in retorts heated to dark redness, and chlorine gas is passed over it from a gasometer. The volatile chloride is condensed in the receiver, and afterwards decomposed by the battery; the chlorine which is set free is returned to the gasometer to be used over repeatedly. The electric current, employed by Garneri, was produced by a magneto-electric apparatus.

PREVENTING MOLD ON SOLUTIONS OF GUM.

A new preventive of mold on solutions of gum Arabic, more efficient than sulphate of quinine, is simple sulphuric acid. According to Hirschberg, a few drops of strong sulphuric acid are added to the gum solution, and the precipitated sulphate of lime allowed to settle. Solutions prepared in this way a year and a half ago have neither become moldy nor lost their adhesive power.

AN AIR BATTERY.

Drs. J. H. Gladstone, F. R. S., and Alfred Tribe recently read before the Royal Society a paper on a new air galvanic battery, constructed on the principle that if pieces of copper and silver in contact are immersed in a solution of nitrate of copper in the presence of oxygen, a decomposition of the salt ensues, with the formation of cuprous oxide on the silver and a corresponding solution of the copper, while a galvanic current passes through the liquid from copper to silver. To employ the oxygen of the atmosphere and facilitate its contact with the silver and dissolved salt, the silver plate is placed in a horizontal position just under the surface of the liquid, with the copper plate beneath it, connection being established by a wire as usual. Holes are made in the silver tray to shorten the communication between the air surface and the copper plate, and to facilitate the movements of the salt in solution.

The conclusions determined are briefly as follows: The current gradually diminishes on account of the using up of the dissolved oxygen in the neighborhood of the silver, but is augmented by merely moving the liquid so as to bring fresh parts of the solution against that metal. A similar result is gained by stirring the silver crystals so as to expose new surfaces. If the wire be disconnected for a time, so as to allow the oxygen to diffuse itself from other parts of the solution, and if the connection be again made, the current is found as strong, or nearly so, as before. Oxygen is taken up with the greatest avidity, the solution absorbing even minute quantities from the surrounding gas. Six per cent was found to be the best strength of the copper nitrate solution. As regards the best proportion between the areas of the metallic surfaces, the increase of the copper has little effect, while that of silver, the negative metal, causes an almost proportionate increase in the chemical action. Heat increases the action of the cell greatly, the augmentation being more rapid in the higher than in the lower ranges of temperature, from 68° to 122° F. The internal resistance of the battery is small. As to the electrolytic power of the current, six cells were sufficient to decompose dilute sulphuric acid slowly, and dilute hydrochloric acid pretty quickly, copper electrodes being employed.

The theoretical interest of this battery lies mainly in the fact that it differs essentially from every other galvanic arrangement, inasmuch as the binary compound in solution is incapable of being decomposed either by the positive metal alone or by the two metals in conjunction; it cannot serve, in fact, as the liquid element of the circuit without the presence of another body ready to combine with one of its constituents when set free. The practical interest centers in the fact that the device is an approximation to a constant air battery. By employing chloride of zinc, power may be obtained at a minimum of expense. Such a battery would appear to be specially adapted to cases where the galvanic current has to be frequently broken, as in telegraphy; for at each period of rest, it renews its strength by the absorption or diffusion of more oxygen from the air.

PROGRESS OF THE HOOSAC TUNNEL IN APRIL, 1873.—Heading from east advanced westward, 163 feet; heading from west, advanced eastward, 136 feet; total penetration during April, 299 feet. Length opened from east end westward, 13,798 feet; length opened from west end eastward, 9,294 feet. Total length opened to May 1st, 23,092 feet. Length of the tunnel, 25,031 feet. Leaving rock to be perforated, 1,939 feet, being 179 feet more than ⅓ mile.

I. H. P. says: "The chief defect of mowing scythes is that they are too light at the heel. More than half the scythes I have used have, after a few weeks or months, broken in two at the junction of the blade with the heel. This part of the scythe should be made wider and stronger, as nearly the whole strain comes at this particular point."

THE smallest known race is that of the bushman of Southern Africa, the largest that of the Patagonian of South America. The mean hight of the bushman is four feet three and a half inches, and that of the Patagonian five feet eight inches.

JUDSON'S PATENT LATHE CHUCK.

This invention is an improved lathe chuck, which is so arranged that the pressure of the screw toward the center also presses the jaw firmly against the face of the chuck, thus holding the work with great security, while the minimum force is expended in turning the screw. It is claimed to be sensitive, strong, durable, to economize power, and never to require re-adjustment in order to take up lost motion.

Fig. 1

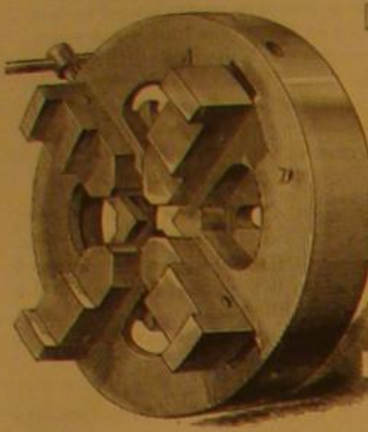
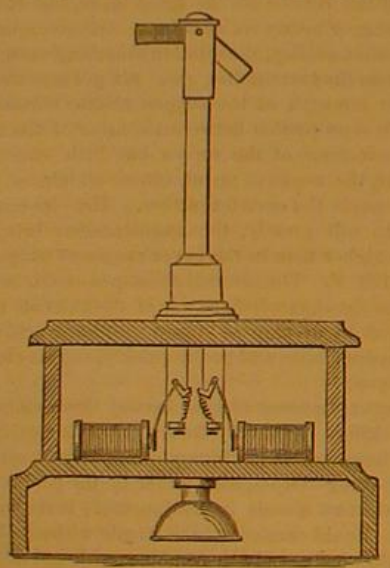


Fig. 2

Fig. 1 is a perspective view, and Fig. 2 a vertical section of the device. A is the jaw, B the nut, C the screw, and D the bed of the chuck. The jaw, A, is formed with an angle bearing, against which the nut, B, with a similar bearing, is brought in contact. The nut slides in grooves planed in the bed, D, which allow of its travel in the direction of the length of the screw, C, but guide it in all other directions. The lever for revolving the screw is shown in Fig. 1. This chuck is manufactured and sold by Dwight Roberts, Wythe avenue, between Hewes and Penn streets, Brooklyn (E. D.), N. Y., from whom further particulars may be obtained.

ELECTRIC RAILWAY SIGNAL.

We find in *Iron* the accompanying illustration and a description of a new electric semaphore block-signalling instrument, the invention of F. Russell. The apparatus consists in a case within which the armature of an electro-magnet is connected with one end of a rocking crank lever, the other end of the lever being connected with a wire. When the electro-magnet is excited, the armature approaches it, depressing one end of the rocking lever and elevating the end in connection with the wire. The latter rises in a hollow



column some 18 inches high, and moves a semaphore arm at its upper extremity. Two of these arms—red and white—and two electro-magnets are employed, as represented in the engraving. On top of the case, a switch lever is arranged which serves to throw the battery current into the line wire. In front of the instrument is a tapper or ringing key for sounding the bell at the other station. The bell is shown at the lower part of the case.

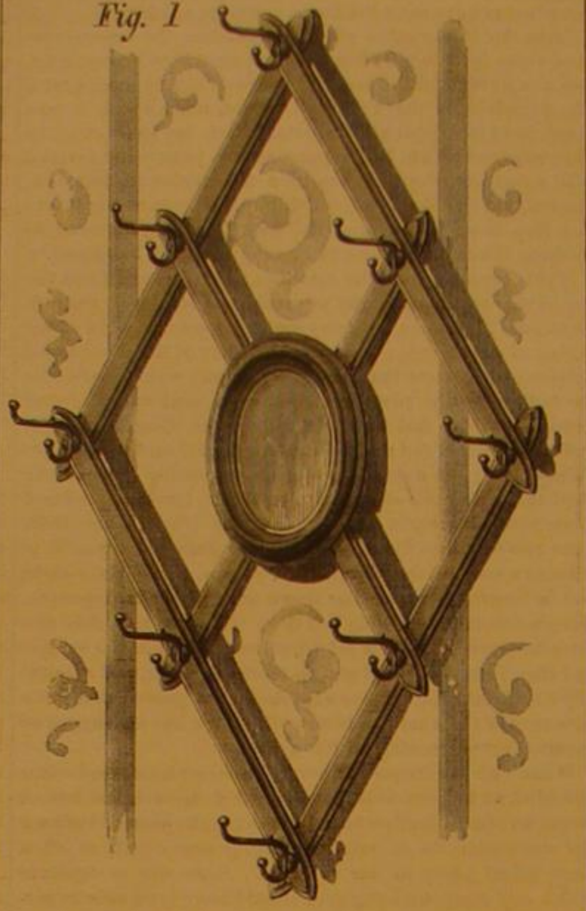
The device is adapted for use on lines upon which two trains or engines are not allowed to run on the same section of road at the same time. The same signals are used to denote "line blocked" and "line clear" as are actually exhibited to the engineer of the train. In its normal position the instrument denotes "line blocked," that is, with the arms up. So long only as a current is caused to flow from the battery to the line will the arm fall to "line clear," because the moment the current is cut off from any cause, the arm flies up to danger, the whole apparatus being in equilibrium. As the red arm can only be lowered from the station towards which the train is approaching, the signal must be under the sole control of the signalman of that station. The white arm is worked electrically by the switch of its own instrument, and shows the signalman the position in which he has placed the electric signal at the other station. In this arrangement three wires are employed for bell, signals, and arms, for a pair of roads.

The use of bronze in the manufacture of field guns has been abandoned both in England and Germany.

HAT AND COAT HOOK.

This is a convenient invention, designed to replace the ordinary wooden pin commonly used in expansible and swinging hat and coat racks, and consists principally in the metal hook shown in Fig. 3. A portion of the shank of the device, it will be noted, is threaded, while that part nearest the curve is made plain. The object of this arrangement is to enable the hooks to be secured to the slats or bars forming a hat or coat rack, and at the same time to unite the two sets of slats together without the aid of any other fastening.

Fig. 1



Of the bars which constitute the rack, the inner set, Fig 2, next to the wall, remain always horizontal and parallel to each other; the outer slats, though also relatively parallel, can be swung to the right or left, so as to give the frame a diamond or rhomboidal form. As the hooks have upon them the securing device, the putting together of the rack is a very easy matter. Holes are bored through the slats where they cross each other, those through the outer bars being somewhat the larger. The shank of the hook is passed through the hole in the outer slat, and screwed into the hole of the inner one until the shoulder, A, brings up against the wood. The outer slat, therefore, swings freely on the plain portion of the shank, while the inner bar is held by the screw part.

Fig. 2

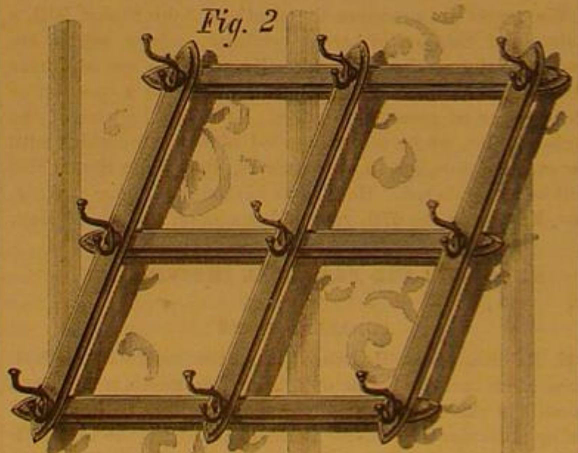


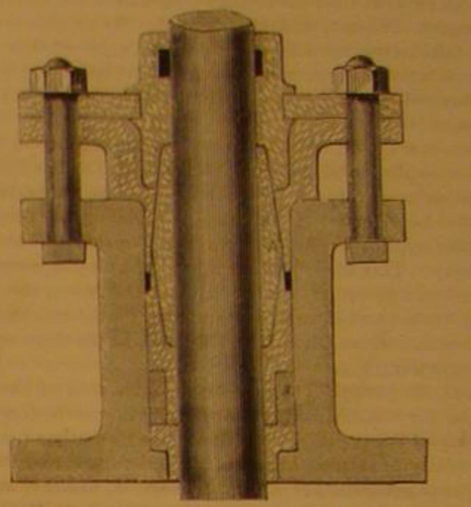
Fig. 3

The frame thus united can be hung, as in Fig. 2, thus allowing the use of all its hooks; or it may be provided with a mirror attached to its center and suspended from an angle, as represented in Fig. 1. The hooks necessarily have double the holding capacity of single wooden pegs, are more ornamental, and are claimed to be much stronger and cheaper. The rack can be folded into compact form for shipping, making, the inventor states, a package, without the glass, less than three inches thick and two feet long. It can be readily taken apart when desired.

Patented March 18, 1873. For particulars regarding the purchase of this article complete, separate hooks, territory, etc., address the inventor, Mr. John Danner, Canton, Ohio.

IMPROVED METALLIC STUFFING BOX.

The accompanying illustration represents an improved metallic stuffing box recently patented by Mr. Watteeu, of Middlesborough, England. This invention has been applied in France to nearly one thousand locomotive engines, and stationary engines of every description are daily being fitted up on this system. So says the *English Mechanic*. In forge hammers, which soon burn their packing, the invention has been applied with great advantage. The metallic packing, A, composed of an anti-friction metal, has a double conical shape; by means of the coiled spring, B, in the bottom of

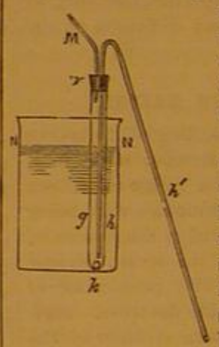


the box, it will always be forced against the piston rod, as it is made in halves. In locomotive engines the metallic packing has been found to last a year without being renewed, while the cost of maintenance is insignificant. After that time the metal can be remelted. It is stated that there is much less friction than with any other packing. After it has been at work for some time, both piston rod and packing acquire a smooth and glassy appearance; and in no case has the metallic packing been found to damage the rods in any way.

A New Siphon.

Jos. Sedlaczek says, in *Poggendorff's Annalen*: It is, in many cases, desirable to withdraw liquid from a vessel by means of the siphon, and a form of the instrument used for certain liquids is that in which the longer arm is furnished with a suction tube, in order that no portion of the liquid may enter the mouth (though this object is not always attained). With harmless liquids, a simple bent glass tube may suffice as siphon; but suction with the mouth at the end of the longer arm is somewhat inconvenient.

The following arrangement is simple, and presents certain advantages:—A glass tube g, ·8 inch wide, and 12 or 16 inches long, contracted at the lower end, has, at its upper end, a cork stopper, in which the mouthpiece, M, and the siphon, hh', are fixed airtight. The shorter arm, h, of the siphon reaches nearly to the bottom of the tube, and limits the play of the glass ball, k, which acts as a valve. The diameter of the ball is about ·4 inch, that of the siphon ·2 inch.



The instrument thus arranged, being dipped into the vessel to be discharged, the tubes g and h become filled with liquid to the surface, N N. Instead now of sucking, as with the common siphon, one blows into the mouthpiece M; and in consequence of the compression of air, the lower opening is shut by the ball k, while the liquid rises in h, and begins to flow through h' in the usual way.

If the vessel to be emptied is not full, or the column of liquid is a small one, it is then necessary, before blowing into the mouthpiece, to suck it slightly, in order to obtain a larger volume of the liquid in g; as one condition for the right action of the instrument is that $h\ h'$ should be filled before the column of liquid in g sinks to the mouth of the siphon at k, when one blows through M.

A Large Casting.

At the South Brooklyn Steam Engine Works, in Brooklyn, the second immense anchor plate for the East River bridge was recently cast. Four weeks were occupied in forming the mold alone. A circular excavation was first made, twenty-five feet in diameter and three feet deep, at the bottom of which was placed an iron plate. Upon this a course of brick, eight inches thick, was laid in a mortar of fine sand and fire clay; the upper surface was then leveled off and baked with charcoal. This surface served as the base of the mold, which was of loam, secured by brickwork and iron girders built in sections.

The anchor plate is of oval shape, seventeen feet six inches by sixteen feet in dimensions, with a thickness at the ribs of three feet. It weighs 47,000 pounds when cleaned, and its cost is $3,200. About 60,000 pounds of iron were melted, transferred to a huge tank, and thence allowed to flow into the mold. The casting took place without accident and was allowed one week to cool.

Telegraph Service of the United States.—For the 1st of January, 1873, the telegraphic system of the United States may be thus approximately estimated: Aggregate nominal capital, $60,000,000; length of lines, 80,000 miles; length of wire, 180,000 miles; number of stations, 6,300.

THE WONDERS OF THE EGG.---III.

[LECTURE BY PROFESSOR AGASSIZ.]

Having seen something of the great diversity among the eggs, characterizing different classes of the animal kingdom, we may now consider the functions of the egg itself—that is, the part which eggs take in the history of generation. I cannot dwell too emphatically upon the fact that eggs are produced and grow without any agency of the male animal. They are a production of the female organism. So true is this that the ovarian egg may be found in animals before they have reached maturity, before they have completed their physical growth—nay, ovarian eggs have even been observed in the embryo before birth. Neither do successive generations begin with the birth of new individuals, but with the formation of the egg from which these individuals proceed. We must look, then, upon the egg as the starting point of the complicated structure of the adult being. It is, as it were, a sieve through which the qualities transmitted by parents to their offspring are sifted. Whatever peculiarity there may be in the new being has its foundation in the egg. Within those narrow limits are circumscribed all the conditions of change; and therefore it is of paramount importance to know what the egg receives and what it transmits. We cannot investigate this part of the subject too closely. It is of vital importance to the question. And yet I have not seen it discussed in connection with the various explanations of the origin and diversity of life recently attempted. The egg arises in the maternal organism, without the co-operation of the other sex, and it can transmit only what it receives directly from the maternal organism, or from the paternal organism through contact with the maternal, or from ancestors through one or both. There has never yet been recorded an instance in which an egg has grown to be anything but a being similar to its parents, and yet the possibilities of modification are so numerous under these conditions, and the range of variation so great, as to make us wonder the more at the constancy of types.

MODIFICATIONS DUE TO ANCESTRY AND SEX.

Suppose, for instance, that a male and female (I deal here with the subject in the most general way without reference to any particular species or type of animal) produce three new individuals. The three may be all males or all females, or two may be females and the third a male, or *vice versâ*. The three may all resemble the mother, have her features, her stature, her physical tendencies generally; or they may all resemble the father; one or two of the three may resemble the mother, the third may resemble the father; or only one may resemble the mother, the other two being like the father; or they may all combine the physical features of both parents; or one may present such a combination, and the others follow distinctly one or the other parent. Any one case, be the offspring more or less numerous, will show us what a variety of modifications arises merely from the contact of two beings to produce one or more new individuals. But the matter is still further complicated. These new individuals have had a grandfather and grandmother on the paternal side. You are all familiar with the singular fact, well known to us in the human family and often observed throughout the whole animal kingdom, that children may not resemble their parents at all, but be strikingly like their grandparents. Thus in the new individuals, the same combinations which might arise from their immediate progenitors may also pass to them from a previous generation, from their grandparents, or even from their great grandparents, or further back still. This reproduction of the features of nearer or more remote ancestors in their descendants is so well known and recurs so frequently that it is looked upon by naturalists as a law, and is called the law of atavism. There are historically recorded instances of the reappearance of characteristic family features after a lapse of several generations.

All these intricacies of inheritance, so frequently interrupted and seemingly so capriciously reproduced, must be connected with the egg through which influences pass to the new being. Suppose, for instance, that any features or traits, physical, moral, or intellectual, are handed down from a male grandparent through the paternal side. In such an instance the egg, which produces the new individual, does not receive the direct transmission of inherited qualities, for, as I have said, that egg arises in the maternal organism, and has a life and growth of its own before the act of fecundation takes place. Through that act of fecuntion must be made the impression by which these inherited qualities are received and transmitted to the new individual. Where the new individual reproduces the maternal features only, or features characteristic of the maternal line of descent, the case may seem at first sight more simple; but when we analyze it in all its bearings, we shall see that there is matter enough for wonder, and that we as yet know almost nothing about the mysterious problem of life. What can there be of a material nature transmitted through these bodies called eggs, themselves composed of the simplest material elements and arising in the female organism without co-operation of the male, what influence can there be, I repeat, by which all peculiarities of ancestry belonging to either sex are brought down from generation to generation?

The egg, as we have seen, is, in its incipient condition, only an organic granule arising between the structural cells of the ovary. It grows there and acquires a remarkable complication before it has completed its successive phases as an egg. Not until it has reached the state which I have described as that of the perfect egg does it receive the contact of the spermatic cells from which dates the formation of a new being, either male or female. This in itself is a strange thing—that a mother produces, not necessarily a being like herself, but quite as often beings so unlike herself in structure as to be endowed with all the peculiarities of the male sex. In the origination of a new species, this double series of influences must be included and combined in the proportions necessary to produce a being differing from all foregone species, and capable of maintaining its pattern generation after generation.

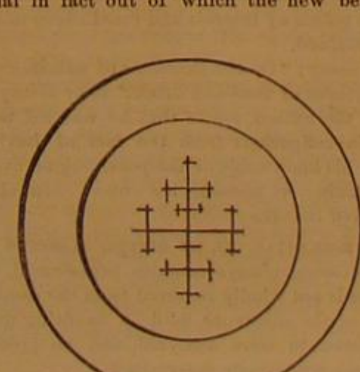
There is one feature in the growth of the egg of which I have as yet said nothing. The yolk, that homogenous substance, which fills the vitelline membrane, in which swim the germinative vesicle and germinative dot, must undergo a very remarkable change before it can give rise to the new individual. It is self-kneading, broken by the process of its own growth into a smaller or larger number of distinct fragments.

This breaking up of the whole substance which simulates disintegration ends in a recementation; these fragments reunite to form the mass out of which the new germ is to be developed. This process is known as segmentation, and has been observed in the eggs of all animals. The process of segmentation has been studied in the mammalia, in birds, in reptiles, in fishes, among articulates, among mollusks and radiates. This process may or may not be initiated by fecundation. There are some animals in which the first appearance of segmentation may precede fecundation; others in which it is always subsequent to fecundation; in no animal is the process known to be completed without fecundation. Neither does it take place in all animals in the same manner.

EGG OF MAMMAL DURING SEGMENTATION INTO TWO PARTS.

Within the vitelline membrane, occasionally it would seem that the whole yolk is not taken in; there are sometimes little fragments left out from the larger masses. Whether these separate balls of yolk have envelopes of their own is a question difficult to decide. The most skillful naturalists differ about it. The original yolk being thus divided in to 4, the same process goes on till the 4 are divided into 8, the into 16, the 16 into 32, the 32 into 64.

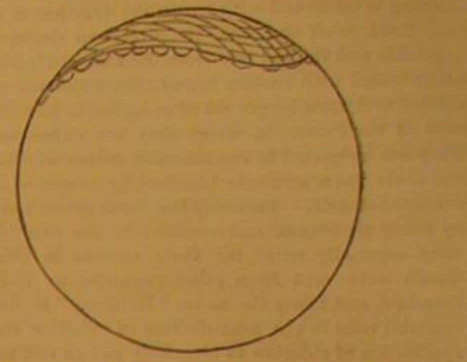
Beyond this it is almost impossible to track them individually; it is difficult to bring the whole yolk under the microscope, so that each fragment can be counted; and if it is pressed, however slightly, the whole mass then runs together, so that no division whatever can be traced. Occassionally, however, the self-division has been followed even beyond sixty-four. By this time, the yolk is transformed into a body which has much the appearance of a mulberry, and this condition of the yolk has been called the mulberry stage. When it has become so far subdivided that every separate particle, owing to its diminutive size, is difficult of microscopic observation, even under very high power, each such particle seems like a cell, and may indeed be considered as a cell. This self-division of the yolk mass ends in an accumulation of cells which differ from those of the initiative yolk, and are the basis for the formation of the new being, the material in fact out of which the new being is to be built.



EGG OF TURTLE DURING SEGMENTATION.

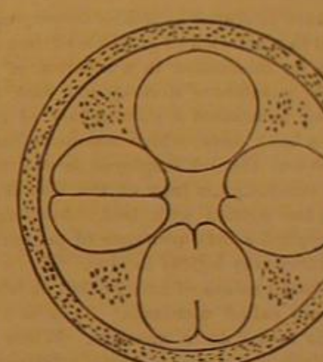
If we now compare the egg of a reptile, that of our common snapping turtle for instance, with the mammalian egg, we find that the process of segmentation differs somewhat, and does not penetrate the whole substance in the same manner. A portion of the surface of the yolk becomes plowed, as it were, by furrows at right angles with each other. These furrows do not extend over the whole surface but encroach upon it only for a certain circumscribed area, the remainder of the yolk remaining in its original condition of yolk cells, while the furrowed area rests upon it as a skin or layer. There is now a difference between above and below, marked by the distinct character of the upper and lower portions of the yolk. We shall presently perceive a difference between right and left, between front and back also.

Take, for instance, the highly magnified yolk of a mammalian egg, with the germinative dots already formed on the the side. The vitelline membrane surrounding such a yolk is rather thicker than in a bird's egg, and forms a sort of transparent zone outside of the yolk. When the process of segmentation begins, the yolk shrinks slightly upon itself and no longer fills the vitelline membrane completely. Presently a slight indentation becomes visible on one side of the yolk, and another corresponding to it on the opposite side. This indentation grows deeper and deeper until it cuts the yolk through, and ends its total division in two halves,



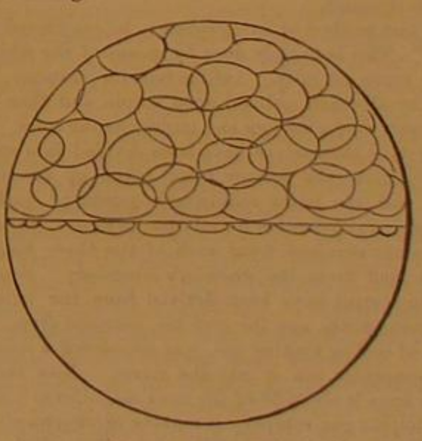
EGG OF TURTLE IN MORE ADVANCED STAGE OF DEVELOPMENT.

the two halves remaining, however, in close contact. While this process goes on, the germinative vesicle vanishes, if indeed it has not disappeared before. In some animals this vesicle is dissolved before the segmentation begins: in others, during the process. This division of the yolk in halves being completed, the same change begins now in the two halves. Indentations are seen on either side of each half, and these indentations deepen till they meet and sever the two masses of yolk; and now, where we had one yolk mass, we have four distinct lumps side by side; they become rounded in form, and look like four soft balls.



EGG OF MAMMAL UNDERGOING SEGMENTATION INTO EIGHT PARTS.

In the eggs of the frogs and toads, there is still another mode of segmentation. The yolk divides, as in the mammalian egg, into halves. But only one of these halves proceeds with the self-division and multiplies itself into an indefinite number of cell-like particles. The other half of the yolk remains unchanged.



EGG OF BATRACHIAN.

You will easily understand how difficult it has been for embryologists to put together in their true sequence these phases of development. Not only must the exceeding difficulty of the microscopic observation be considered, but also the fact that, in order to find every single link in the chain, to obtain, for instance, a sight of the mammalian egg just at the process of self-division or at any one point of it, the mother must be killed at a given moment of the segmentation. Suppose a naturalist to be investigating the process in some of the higher mammalia, for instance, such as produce but one young only at a time; it is evident that he must meet extraordinary, almost insuperable, difficulties at every step. No one has ever seen the segmentation of the egg in a mare or a cow, or even in a sow. These are too expensive to be sacrificed for the study of embryology. Professor Vischoff made his investigations upon the rabbit, and that one investigation cost him ten years of his life. Science must be conquered; and these conquests bespeak the high intellectual culture of those who make them. It is easy to fling theories into the world broadcast, based upon a few imperfect and shallow observations, and palm them upon those more ignorant than their originators; but it is one thing to theorize about what nature may do, another to know, by virtue of patient and intense study, what she does.

C. E. says: "I have taken your paper during the past two months; but if I could not get another, I would not take $10 for the balance of the year's subscription."

STEVENS INSTITUTE LECTURES.---DYEING AND CALICO PRINTING.

BY PROFESSOR CHARLES F. CHANDLER.

The fourth lecture of the spring course before the Stevens Institute of Technology was by Professor Charles F. Chandler, of Columbia College, New York city, on "Dyeing and Calico Printing." He said: The materials of which our clothing is made, and with which the dyer has to do, are cotton, linen, wool and silk, the first two derived from the vegetable and the last two from the animal kingdom. They occur mixed with various impurities, which are more or less colored and must be got rid of so as not to impair the clearness of the colors in which they are subsequently dyed. They are subjected to the alternate action of dilute alkalies and acids and afterwards bleached by means of chlorine or sulphurous acid. Formerly the linen goods were bleached by being moistened and exposed to the sun. The Dutch were especially noted for their success in this industry. Goods were sent from other countries to Holland to be bleached, and hence the name "Hollands" to designate the material used in the manufacture of window shades. The application of chlorine to bleaching put an end to this trade.

Dyes are fastened upon fabrics in various ways. Some are insoluble in water but soluble in other substances. If cotton is dipped in a solution of chromate of zinc in ammonia and dried, the ammonia evaporates and the chromate of zinc, being insoluble in water, remains imprisoned in the fibers.

In some cases the color is developed by exposing the impregnated fabric to the action of the oxygen of the air. This is called "ageing." When indigo, for example, is mixed with sulphate of iron, lime and water, it dissolves to a nearly colorless liquid, which has the property of absorbing oxygen from the air and turning blue. When cloth is steeped in this liquid and then aged, the change to blue takes place in the fiber.

Some colors are produced by double decomposition. When cloth is dipped in a solution of sulphate of iron and dried, it will turn blue on immersion in a solution of prussiate of potash, the two substances decomposing each other. Professor Chandler mentioned a curious case of restoring the signatures on a bank note, which somebody had taken out with acid. When the ink employed is the ordinary nutgalls and iron compound, a trace of the iron is usually left after treating the writing with acid. Availing himself of this fact, he applied a little prussiate of potash and brought out the signatures very legibly in blue.

A very important means of fixing colors on fabrics is by the use of what are called mordants. Alum is a good example of what is meant by a mordant. When an alkali is added to a solution of alum, a white, gelatinous substance contained in it is thrown down. This is alumina, which has so strong an affinity for coloring matters that it will take them out of solution and precipitate them. When a fabric is impregnated with it and then steeped in the dye, the precipitation will take place in the substance of the stuff. Another mordant is the chloride of tin, which, in addition to fixing the colors, hightens them. Compounds of iron change the tints and enable us to obtain a long series of colors from a single dyestuff.

The last method of fixing colors to be considered is "gumming." This is usua.ly done by means of the white of egg or the curds of milk. Aniline red, for iastance, is mixed with the albumen, printed upon cotton and then steamed. The steam cooks the egg and imprisons the color.

The dyes themselves have been divided into substantive and adjective; the former being taken up directly by the fabric, and the latter requiring a mordant. Safflower, for example, is substantive for silk but adjective for cotton.

Dyes are obtained from each of the three kingdoms of nature and from the chemist's laboratory. Some of the most important have been derived from the latter source. Not many years ago the coal tar, obtained from the distillation of coal in making gas, was considered a nuisance and gas companies ran it into the rivers. Now the chemist makes from it about 56 of the most magnificent colors. The Philadelphia gas company is making arrangements for mining it from the bottom of the river, into which they had thrown about $150,000 worth.

The most ancient dye, known as the Tyrian purple, was obtained from two species of shell fish, each of which contained about a drop of it. It was not purple but red, and was considered so precious that a pound of wool dyed with it sold for what is equivalent to about $150 in gold. Cochineal is the dried body of an insect found on a species of cactus cultivated for that purpose in Central America. Its coloring principle is carmine. It is used for dyeing wool scarlet, the mordants being chloride of tin and cream of tartar. With alum, it gives a crimson. The dried precipitate with alum is called crimson lake, a "lake" being a compound of a coloring matter with alumina.

In the vegetable kingdom, the dyes are obtained from the roots, the wood, the bark, the fruit, and in fact from every portion of plants. Among the roots, the most valuable is the madder, largely cultivated in France and other countries. It is estimated that about ten millions of dollars are invested in its cultivation. Before long, however, all this capital must find another employment; for the chemist has succeeded in preparing artificially the alizarin or coloring principle of madder. By the use of different mordants we obtain from madder a great variety of shades, from Turkey red to chocolate. Besides the color, madder contains sugar in such quantity that most of the alcohol in France is manufactured from it. When, therefore, madder ceases to be cultivated, Frenchmen will have to get their whisky from a different source. Alkanet and turmeric are other examples of roots, the latter furnishing us with test paper for alkalies and for boracic acid. Among the woods, logwood, Brazil wood and fustic are the most important. Their coloring principles are extracted by boiling, in a vacuum pan or closed vessel to which an air pump is attached. The air being exhausted, the water boils far below its ordinary boiling point by reason of the diminished pressure. By this method there is no danger of destroying the colors from too high a heat. The same principle is applied to sugar boiling, evaporating down our jellies, etc. A good example of a bark is quercitron, which gives a brilliant yellow. Safflower is the fruit of a species of thistle. This substance, the professor remarked, has stood more in the way of human progress than perhaps any other, being the color with which red tape is dyed. It is almost the only dye which is "substantive" to cotton. Tannic acid, contained in nut galls (the excrescences produced on a species of oak by the sting of an insect), in sumach, etc., gives a black color with salts of iron. Ink is also made from it. Most blacks, however, are made with logwood and acetate of iron or bichromate of potash with the addition of some fustic, because logwood alone gives a blue black. Indigo, which has already been mentioned, is obtained by fermenting the leaves of several species of the *indigofera* genus in water. A yellow liquid is produced, which absorbs oxygen and turns blue. The indigo precipitates, and is sold in cakes. Woad is another similar vegetable blue, chiefly interesting from the fact that the ancient Britons used it as a war paint to smear their bodies with.

Among the mineral dyes, we have a fine yellow made by dipping the cloth first in acetate of lead and then in chromate of potash. To make this orange, it is boiled in lime water. A blue color is made by using, first acetate of iron and then prussiate of potash. Ultramarine, which is now prepared artificially by the chemist, is fastened on to the fabric by means of white of egg. Chrome green, made by heating chromate of potash with borax and treating with water, is used in the same manner.

On distilling coal tar, the first, or light, portion contains benzole, which by means of nitric acid is converted into nitrobenzole or artificial oil of bitter almonds. When this is acted on by acetic acid and iron filings, aniline is the result. By the oxidation of aniline with chloride of tin, arsenic acid, etc., aniline red, fuchsin, or magenta is obtained, and all possible shades between this, through purple and violet to blue, are made by heating it with more aniline and stopping when the desired shade is obtained. Besides these shades, green, black and yellow dyes are made by processes which we must omit for want of space. In the heavier portions of the coal tar distillates is found a substance called anthracene, from which a long series of splendid colors are prepared; among them artificial alizarin, which rivals that from madder in beauty.

The above lecture was copiously illustrated by means of specimens, and a practical dyer produced some beautiful results in silk dyeing before the audience. The portion of the lecture relating to dyeing occupied so much time that the professor was obliged to omit the subject of calico printing.

SANITARY NOTES.---FLAVORING SUBSTANCES FOR FOOD AND DRINK.

The State Board of Health of Massachusetts publish in their fourth annual report a number of very exhaustive and valuable papers on important sanitary questions of the day. These essays are from the pens of well known physicians and scientists, and contain the newest and most reliable information on the subjects of which they treat. As the approaching warm weather renders all matters relating to the public health of timely importance, we shall present, under the heading of "Sanitary Notes," in the present and subsequent articles, condensations of these treatises, in which the various points of interest and conclusions drawn will be carefully retained.

The first essay: "On the character of substances used for flavoring articles of food and drink:" is by Henry K. Oliver, M.D., and the author states that he was led to make the necessary investigations from the fact of having a case brought to his knowledge of the poisoning of five individuals by partaking of *pistache* ice cream. Inquiry into the matter proved that the

ESSENTIAL OIL OF BITTER ALMONDS

used for flavoring always contains prussic acid, which it is safe to infer is not wholly removed fsom the commercial oil. Specimens of the substance used in flavoring the ice cream above referred to were analyzed, and the presence of the deadly poison was clearly determined.

Very little essential oil of bitter almonds is made in this country, but it is largely imported. It is always employed when an almond or peach flavor is desired, one or two drops sufficing to impart the taste to large quantities of material. Some idea of the poisonous nature of the ordinary essential oil may be gathered from the fact that experience has proved that two teaspoonsful have destroyed life in ten minutes. According to Dr. Taylor, one hundred parts of the oil contain nearly thirteen parts of anhydrous prussic acid. One drop is sufficient to kill a cat. It has a yellowish color, a bitter, acid, burning taste and the odor of the almond kernels in a high degree. Virey says that accidents occasionally happen among children in Paris from their eating freely of macaroons, which are sometimes too strongly flavored with the substance. In 1871 one hundred and forty-nine pints of the oil were imported to Boston. Of this quantity, the author estimates that forty-nine pints were employed for flavoring—equal to 2,750 fatal doses. It may not be out of place, he adds, to state what became of the other hundred pints, 5,500 doses; it all went to a manufacturer of patent medicine.

NITRO-BENZOLE, OR OIL OF MIRBANE

is the result of the action of nitric acid on benzole, which is one of the lighter products of the distillation of coal tar. It closely resembles the above described substance, and hence is called artificial oil of bitter almonds. It is principally used in the manufacture of aniline colors and for scenting soap and perfumery, and, on account of its cheapness, it is employed to some extent by confectioners. It is a very active poison, eight or nine drops being sufficient to cause death, and its vapor is also dangerous.

ARTIFICIAL FRUIT ESSENCES.

The compound ethers have been found to possess the odor and flavor of certain fruits, and hence are largely substituted for the genuine sirups and extracts. Butyric ether is prepared by mixing butyric acid with sulphuric acid and alcohol. The former acid is obtained by mixing decaying cheese with grape sugar and chalk, and allowing fermentation to take place. The ether dissolved in another portion of alcohol forms pineapple essence. Pelargonic ether is prepared by digesting pelargonic acid with alcohol at a gentle heat. Pelargonic acid is the result of the action of nitric acid on oil of rue. This ether with alcohol forms quince essence. Acetate of amylic ether, a distilled mixture of fusel oil, acetate of potash, and sulphuric acid, forms the essence of Jargonelle pears. Valerianate of amylic ether, made by the action of sulphuric and valerianic acids on fusel oil, forms apple essence. A mixture of acetate of amylic ether with butyric ether gives banana essence. Other mixtures of ethers, modified by the addition of various agents, as nitrous ether, acetic acid, camphor, tincture of orris, vanilla, the volatile oils, result in imitations of the strawberry, raspberry, apricot, currant, and other flavors. Taken into the stomach in an undiluted form, these compounds would be highly dangerous; but as in confectionery they are largely mixed with other substances, their noxious effects are much lessened. Children are more susceptible to their influence than adults, and have been known, after eating candies with liquids within, to become seized with alarming sedative symptoms requiring prompt medical treatment. These artificial essences, though employed to a great extent for flavoring soda water, are rarely used by reputable druggists, though the latter all agree in substituting citric or tartaric acid for lemon juice, on account of the difficulty of keeping sirup made from that fruit. Both of these acids are derived from fruit and hence are not deleterious in an occasional summer beverage. Sarsaparilla sirup, sold by street pedlars of soda water, is generally innocent of the root, being nothing more than molasses and water flavored with oil of anise. Cochineal is generally added to give sirups an attractive color.

SPURIOUS ALCOHOLIC LIQUORS.

The most important part of Dr. Oiiver's report is under the above heading, and it exposes the abominable compounds which are sold to the poorer classes in the reeking taverns and gin mills in the obscure portions of great cities. An individual named Eichler (we give him the gratuitous advertisement) publishes a circular giving recipes for the composition of these liquid poisons, which he says will save hundreds of dollars to those in the business. We select a few of these recipes at random, from a long array: *New York Whisky.*—Concentrated essence Bourbon, four ounces; compound tincture of green tea, one pint; tincture of capsicum, one pint: tincture of grains of paradise, one pint; corn whisky, twenty gallons; water, twenty gallons. *Port wine.*—For forty gallons. Port wine ether, four ounces; aromatic tincture, eight ounces; tincture of rhatany, eight ounces; tincture of orris, twelve ounces; simple sirup, three gallons; rectified spirits, three gallons; wine coloring, two gallons; plain or raisin wine or fermented cider, thirty-two gallons." The former recipe, it will be noted, contains less than half poor whisky, and the latter not a drop of the wine it is intended to represent. "An imitation champagne is made of a delectable compound of sugar, water, white argols, cider, and yeast," mixed with a little rectified spirits and orris; and even so innocent a beverage as sweet cider is counterfeited by water with a little cider flavoring, brown sugar, and yeast. The manufacturer, with an impudence which borders closely upon the sublime, remarks that these doses "improve very much by age."

TARTARIC ACID AS A SUBSTITUTE FOR FRUIT

is put up in boxes and sold as "fruitina." "One package," says the maker's circular, "makes twenty-five pies or sixteen pounds of jelly. Twenty-five ples for thirty-five cents." As might be imagined, it is endorsed by forty female names, the owners of which are principally boarding house keepers. Some of the prescriptions for its use are refreshing; for instance: "To make lemon pie: Pare and boil a *turnip*, add a teaspoonful of fruitina and a cup of sugar; season and bake." A quantity of common starch, fruitina, flavoring matter and sugar makes "a delicious jelly," and a wonderful mixture of the acid, molasses, milk, eggs, crackers, and spice undergoes some incomprehensible change in the oven which transforms it into a "pumpkin pie." Tartaric and citric acids, even in considerable quantities, may be swallowed without fatal results, and, dissolved in water, form a refreshing drink in fevers; but it is a cheat to use either of them as a substitute for fruit in domestic economy, and it is not unlikely that they may do harm if partaken of too freely.

As regards the opinion that strychnin is used to impart a bitter flavor to ales and beers, the writer considers it erroneous. English imported ales are absolutely pure, a fact determined by careful analysis of samples from different breweries throughout the kingdom.

A PLANT has been discovered in Angola, Africa, so sensitive that it closes its leaves at the mere sound of a footfall.

Correspondence.

The Atlantic Disaster.

To the Editor of the Scientific American:

The late lamentable disaster and sacrifice of life off the coast of Nova Scotia must render it painfully evident to the public, and particularly to those acquainted with the sea, that the present system of saving life from shipwrecks by means of the boats usually carried for that purpose is almost useless; and I quite coincide with the views expressed in a recent article in your valuable paper as to the desirability of the scientific world discovering some effectual and reliable life preserver at sea, which shall be capable of rapid manipulation and render sea voyages less fraught with such fearful danger and anxiety to ship passengers as the late examples of the Northfleet and Atlantic are justly calculated to inspire. I have been a passenger on the ocean several times during my life, and can readily understand the awful difficulties that have to be contended with in rescuing human beings from shipboard in the face of fire, rock or tempest. In such cases, which generally occur at night, all is darkness and confusion; and, with the exception of a few whose minds, accustomed by training to the sea, comprehend the situation at once and do their duty nobly, all lose their presence of mind and, in their frantic efforts to escape, only hasten their destruction. In such cases, also, time is so short that the attempts made to lower the boats carried by the ship are generally futile. Some of the boats are perhaps found to be leaky and stove in by previous storms, others never reach the sea owing to derangement of their lowering tackle, while the remainder are generally swamped by heavy seas after leaving the wreck. I beg, therefore, to offer to your notice a plan for dealing with this subject, which may or may not be the desideratum sought. If the idea should meet with the approval of the nautical world, who are alone capable of judging as to its character, I shall be happy to furnish full particulars of my proposed plan; if condemned, I shall still have the satisfaction of having endeavored to aid in the cause of humanity.

My plan is as follows: I propose to place on the uppermost after deck of a ship a false deck, in the form of a raft, say 100 feet long from the stern by 45 feet wide, according to the length and beam of the ship, and of suitable thickness, constructed with alternate layers of planking and cork thoroughly secured together, and capable of supporting from 500 to 600 persons without inconvenience. This false deck or raft is to have sides or bulwarks of thin plate iron, in the form of air tight tubes (which might be used for the stowage of provisions and for other purposes); the ends are to be closed with lattice girders or strong wire rope netting. Other suitable gear is also to be provided thereon for the safety of passengers. When not required for use, the raft would simply rest on and form a raised portion of the ship's deck; but in case of accident, I propose to launch it, by simple, powerful, rapid and efficient gearing, from the stern of the ship into the sea.

The following are some of the most important features of my proposed raft:

1. From the nature of the materials used in its construction, as well as from its form and size, the raft would be unsinkable, and could be made of any floating power.

2. In case of fire, the raft could be instantly launched from the stern of the ship and the passengers and crew betake themselves to it.

3. In the case of the ship foundering, the raft would of itself float free from the wreck with its living freight.

It is not my intention, in this short letter, to describe how I propose to secure the raft (when not in use) to the deck on which it is to be placed, or the manner of launching the same, or to meet the many objections which may be justly raised to its adoption, such as the disposition of the wheelhouse, mizen mast, skylights, and other impeding gear; these objections, serious as they may appear at first sight, are mere matters of detail which can be easily overcome, and which I am prepared to meet. In case of its adoption, alterations would necessarily have to be made in the disposition of the steam gear of a ship; but the importance of the subject is such that no expense should be spared; and those alterations once made, my proposed raft would form the safest, simplest and most efficient life preserver at sea ever invented.

I beg to inclose my card and to solicit the interest and support of the scientific world in developing my invention.

Toronto, C. W. EDWARD W. FURRELL, C. E.

Girdled Trees.

To the Editor of the Scientific American:

In your issue of April 19, I find an article headed "A Cure for Girdled Trees," in which a system is shown by which to unite the bark below and above the wound by the use of scions of last year's growth of wood. In my home, the ravages of field mice and rabbits in winter make it a very common matter to have the young trees in our fields and orchards girdled, and the system shown has been tried, but without the best of success, the winds causing the tree to be so shaken as to loosen the scions and prevent the connection from forming between the old bark of the trees. "Necessity, the mother of all inventions," caused me to adopt a plan by which all the evils in your system are overcome, and almost perfect success attained; and as the matter may be of interest to many of your readers, I will describe my system. When a tree is entirely girdled, I cut out, on either side of of the stock fixed upon, a space large enough to admit in a limb from ½ inch to 2 inches in diameter, according to the size of the tree, fitting in the parts of the limb to meet the bark both above and below the wound; then with nails sufficiently large, I nail the limb into the tree stock, fastening it securely, using two or more nails, placing three or four of these limb jointers upon each other, according to its size. When this is done, I bank up with soil sufficient to cover the connections, which will be all-sufficient.

In case the wounds should be too high for banking, a mixture of clay and cow dung can be used, being held in place by a canvas covering securely nailed in the tree. This system can be used up to the middle of July.

Tuckerton, Pa. ADAM DEYSHER.

The Proposed Great Telescope.

To the Editor of the Scientific American:

The limits of size, with our present machinery, are nearly reached by Lord Rosse's six foot, the Melbourne four foot reflectors, and the large silvered glass mirrors of Foucault and Draper; but reflectors are inaccurate and unwieldy.

The world's great lenses comprise at present, to the best of my recollection, a twenty-nine inch, twenty-eight feet focus, by Merz, of Munich, Bavaria, not tested by experts; a twenty-four inch by the same maker; a twenty-five inch by the late Mr. Cooke, of York, England; the new Washington twenty-six inch, by Alvan Clark, of Cambridgeport, Mass.; and the Chicago eighteen inch, by the same maker. The two latter are, perhaps, the best object glasses in existence. The life time of an artist optician would hardly suffice for the slow and toilsome process of correcting, for chromatic and spherical aberration, a single pair of huge lenses, say, six feet in diameter, even if we could obtain the glass. We must, therefore, to make any decided advance in space-penetrating power, divide up our "telescope of the future" into small fragments, much as the Fresnel lighthouse lenses are built, each portion presenting no great difficulty of construction.

As the subject has been a hobby with me for several years, I will describe a method of constructing a composite telescope of any required power, which presents no difficulty except the cost.

The unit of construction is a stationary, hexagonal fragment of the great telescope lens into which a movable heliostat mirror reflects the object observed. Each part of the lens is of the size and cost of an ordinary ten or twelve inch object glass, and is to be corrected mechanically by a local polisher. The necessary calculations may be made and verified by completing and using Mr. Babbage's analytical engine, which applies the principle of the Jacquard loom to any possible computation.

Supposing ourselves to be in possession of unlimited skilled labor and machinery, with sufficient funds, we select, in the far northwest, an elevation where the sky is generally clear. On its southern slope, we dig and build a tunnel pointing to the pole, 80 feet in diameter at base, and narrowing upwards for nearly a thousand feet. At the upper end of this tunnel is placed the observatory, containing the binocular and microscopic eye pieces of the great telescope, a frame to hold the eye piece in use, and a meridian circle, for time. Outside are buried clocks in air-tight vacuous cases, and electric batteries and wires for adjusting any one of the five thousand prismoidal lenses below, and for moving their mirrors. At the lower end of the tunnel is mounted the great compound lens, and outside of this, the mirror frame. Each mirror is driven westward, against the earth's daily movement, by a spring governor clock, keeping time with its fellows. All are controlled to follow the planets or moon, by a mercurial pendulum clock of absolute perfection. Its wearing parts are faced with boron or iridium, with black diamond bearings. This main driving clock is moved by many water batteries and its electro-magnets, in an exhausted glass case containing rarefied hydrogen and the wires, through which, every second, the clock sends its electric beats. The flat glass heliostat mirrors are coated on their front surfaces with platin-iridium from the Oregon iron sands, polished to reflect nine tenths of the incident light.

To find a star with our telescope, one has only to move a pointer forward on a telegraphic dial, for the difference between the star's right ascension and the local sidereal time. Each mirror turns on its polar axis, moved by an endless screw, as is the type wheel of the stock printing telegraph, by its ratchet wheel and electro-magnets. At another touch of an index on a second dial, indicating declination above or below the celestial equator, the star flashes into the field with overpowering brilliancy. Touch an index on a third dial, and the mirrors are all clamped and will follow the object round and round the world, and have it yet in view at its third rising.

Such a telescope could be built in fifteen years for inside of fifty millions of dollars. If every part could be kept at a uniform temperature, or compensated, it would enable us to contemplate the moon as from a distance of two miles.

According to the nebular theory, as the outer planets are the oldest, their inhabitants, if such there be, must have developed a civilization far superior to ours. The chief value of such a telescope would be to assist in opening communication with them by means of the ordinary Morse night signal flashes, so that we may learn from their experience instead of slowly evolving the arts and sciences for ourselves.

New York city. S. H. MEAD, JR.

To the Editor of the Scientific American:

I am greatly pleased to see that there are so many would-be stockholders in the telescope stock company, but the company is not started yet, and so no one knows where he can send his ten dollars. Being the one who started the project, I claim the right to propose some rules, and also to nominate some officers, providing that they meet with the approbation of those who are also interested; and I propose Mr. O. D. Munn as our president, and Mr. Peter Cooper as our treasurer, both gentlemen being known to be friends of the working man, and to be very popular among the working classes. I hope that they will accept, and also that the nomination will be approved of; for if these gentlemen accept the offices, I will be the first one to buy stock.

I see nothing in our way to prevent us from going ahead with our mammoth undertaking, so let us build ourselves a lasting monument that will be useful as well as ornamental. A million dollars appears to be a large sum, but it will be nothing more than Peter's pence among so many.

I propose that no stockholder shall hold more than twenty shares, so that we small fishes may not be swallowed up by whales; and I hope that all those who are in favor of these nominations will signify their acquiescence in the SCIENTIFIC AMERICAN.

Let us hurry up matters, as there is not much time between now and 1876. AN OLD MECHANIC.

Hudson, N. Y.

To the Editor of the Scientific American:

I would like to add my mite towards the million dollar telescope. I think the joint stock plan the most practical, and will take at least three shares, and perhaps more, provided they are ten dollars each. Do all you can to make the thing a success, and count on me as an humble supporter.

Hockanum, Conn. F. C. VIBERT.

To the Editor of the Scientific American:

I go in for the million dollar telescope. At $10 per share there will be only 100,000 shares; and as everybody wants the telescope, it will doubtless be easy to dispose of all the shares. The idea of a correspondent of allowing each subscriber to use the instrument in proportion to the amount subscribed is capital. But probably not more than two hours out of the twenty-four are suitable for star gazing; and as one half of this time would be consumed in focusing the instrument for different eyes and in looking through the finder, the time allotted to the owner of a single share would be about thirteen seconds a year; and if he did not see much during that time, still he could congratulate himself that he had looked through the big telescope.

Having had in my college days the care of a large telescope, I can say from experience to your correspondents that a telescope in the hands of the unscientific is only a big plaything, with but little play in it. The pleasure derived from manipulating the instrument, with the aid of the *Nautical Almanac*, clock and micrometer, was far greater to me than that of simply gazing at the stars or nebulæ. And further: No one who is not perfectly familiar with the management of a telescope should ever be allowed to meddle with one, or hardly to look through it. A big telescope should be approached by the uninitiated with silence, uncovered heads and light steps, but—Hands off! J. H. P.

A Mysterious Noise.

W. A. M. reports that he recently heard a succession of strange crackling noises out of doors at night; and had great difficulty in finding the cause. The sounds came from some fallen walnut tree leaves, and he naturally expected to find that some species of insect caused the leaves to rustle. "At the next spot where I examined, I closely watched the *modus operandi* and saw the dry, brown leaves gradually curling open, moving like little automata; one, opening, would touch another, and that in turn rolled open, with the peculiar rustling sound that had at first attracted my attention. But there was no worm there. What then was the power that carried on this general movement? Upon meditating a little, the truth flashed upon me; it was simply that the day had been remarkably warm for an April day, and the heat of the sun had warped the leaves, curling them up like a voluta; but as the sun set, the northeast wind had blown the clouds and moisture from the Atlantic, and, coming in contact with the dry leaves, had caused them to uncurl. Thinking that some motion would accelerate their movement, I stamped upon the ground, and immediately the whole garden seemed alive with motion. The occurrence seems of small account, but it illustrates in a perfectly natural way the force and effects of variations in temperature."

Utilization of Slag.

Mr. Woodward, of Darlington, has patented, says *The Builder*, a plan for manufacturing bricks from scoriæ, and the system is now at work at the Eston works of Mr. Thomas Vaughan. The slag is taken as it comes from the blast furnace. It runs into a series of molds, placed at regular intervals on a revolving table. After being removed from the molds, the bricks are thrown into a kiln or furnace close at hand, where they are annealed; and afterwards they are used in any ordinary structure for which clay bricks are suitable. The fracture is said to be close and firm, and they are capable of resisting an intense heat. So far as strength is concerned, they will withstand a crushing force of 3 to 4 tuns per cubic inch, or four or five times more than that of common bricks. The scoriæ brick remains unaffected by exposure to the atmosphere, it is said, but this does not accord with what has been said of slag (used for roads) which is said to contain sulphur, and to be liable to disintegration. This should be disproved, if possible, of the bricks. There is a considerable loss by breakage, but once solidified they are as hard as granite. It is calculated they can be made for 8s. per 1,000, or even less, whereas ordinary bricks cost 20s. and upwards per 1,000. A new company has been formed, on the limited liability principle, to work Mr. Woodward's patent, and they have acquired the right to the slag of all the blast furnaces on the Tees, including those above and below Middlesborough.

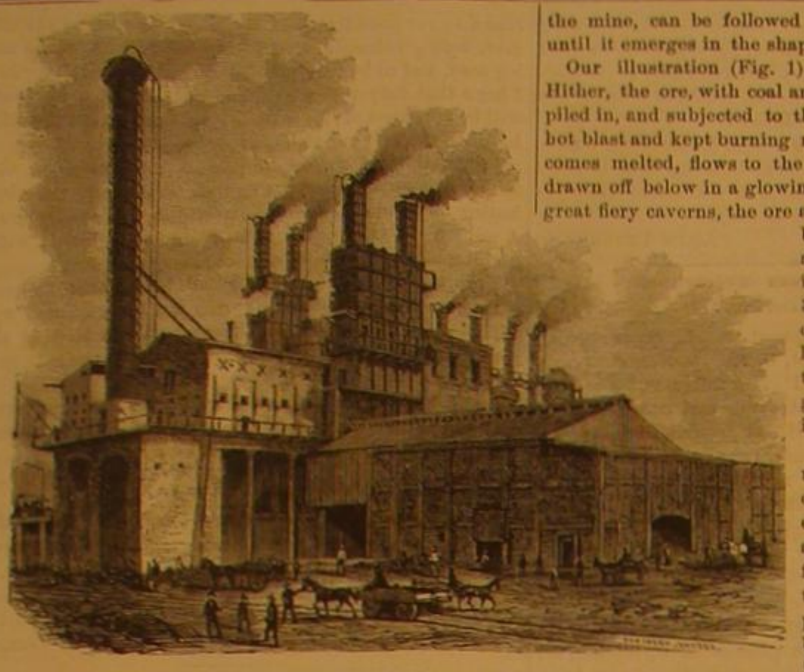


Fig. 1.—THE PHŒNIXVILLE BLAST FURNACES.

IRON BRIDGE CONSTRUCTION.

The various processes by which iron is prepared to be used in bridge building are many of them as new as is the employment of this material for the purpose. The subject is one of considerable public interest, and hence we extract from an album of designs, recently published by Messrs. Clarke, Reeves & Co., the well known iron bridge builders, the accompanying engravings and description, deferring, to a subsequent article, illustration and notice of some of the most remarkable structures constructed at the extensive establishment of the above firm.

Fig. 6.—BOILING FURNACE.

The Phœnix Iron and Bridge Works are located in Phœnixville, in the Schuylkill Valley, Pa., and were founded in 1790. At the present time over fifteen hundred hands are constantly employed, and the establishment is probably the only one in the world where the crude iron ore, fresh from the mine, can be followed through all its transformations until it emerges in the shape of a finished bridge.

Our illustration (Fig. 1) represents the blast furnaces. Hither, the ore, with coal and a flux of limestone, is carried, piled in, and subjected to the heat of the fires, driven by a hot blast and kept burning night and day. The iron, as it becomes melted, flows to the bottom of the furnaces, and is drawn off below in a glowing stream. Into the tops of these great fiery caverns, the ore and coal is dumped, being raised by elevators (Fig. 2) operated by a blast of air, and then thrown in by the men, as shown in Fig. 3. The blast for the furnace is driven by two three-hundred horse power engines, and is heated by the consumption of the gases evolved by the material itself.

The engine room, with its giant machines, forms the subject of our fourth engraving. Twice every day the furnace is tapped, and the stream of liquid iron flows out into molds formed in the sand, making the iron into pigs (Fig. 5). Next follows the boiling process, the furnace being an oven heated to an intense heat by a fire urged with a blast (Fig. 6). The cast iron sides of the furnace are double, and a constant circulation of water is kept passing through the chamber thus made, in order to preserve the structure from fusion by the heat. The inside is lined with fire brick, covered with metallic ore and slag over the bottom and sides, and then, the oven being charged with the pigs of iron, the heat is let on. The pigs melt, and the oven is filled with molten iron. The puddler constantly stirs this mass with a bar let through a hole in the door, until the iron boils up or "ferments," as it is called. This fermentation is caused by the combustion of a portion of the carbon in the iron; and as soon as the excess of this is consumed, the cinders and slag sink to the bottom of the oven, leaving the semi-fluid mass on the top. Stirring this about, the puddler forms it into balls of such a size as he can conveniently handle, which are taken out and carried on little cars, Fig. 7, made to receive them, to the squeezers. In the latter (Fig. 8) the ball is placed and forced with a rotary motion through a spiral passage, the diameter of which is constantly diminishing. The effect of this operation is to squeeze all the slag and cinder out of the ball, and force the iron to assume the shape of a short thick cylinder, called a bloom. This process was formerly performed by striking the ball of iron repeatedly with a tilt hammer.

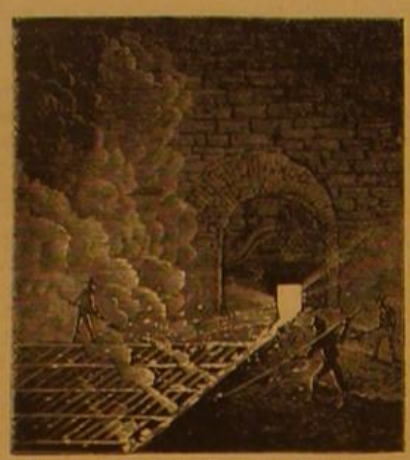


Fig. 5.—RUNNING METAL INTO PIGS.

The bloom is now reheated and subjected to the process of rolling. The rolls (Fig. 9) are heavy cylinders of cast iron placed almost in contact, and revolved rapidly by steam power. The bloom is caught between these rollers and passed backward and forward until it is pressed into a flat bar, averaging from four to six inches in width, and about an inch and a half thick. These bars are then cut into short lengths, piled, heated again in a furnace, and re-rolled. After going through this process they form the bar iron of commerce. From the iron reduced into this form the various parts used in the construction of iron bridges are made, by being rolled into shape, the rolls through which the various parts pass having grooves of the form it is desired to give to the pieces. These rolls, when they are driven by steam, obtain this generally from a boiler placed over the heating or puddling furnace, and heated by the waste gases from the furnace. This arrangement was first made by John Griffie, the superintendent of the Phœnix iron works, under whose direction the first rolled iron beams over nine inches deep that were ever made were produced, at these works. The process of rolling toughens the iron, seeming to draw out its fibers; and iron which has been twice rolled is considered fit for ordinary uses. For the various parts of a bridge, however, where great toughness and tensile strength

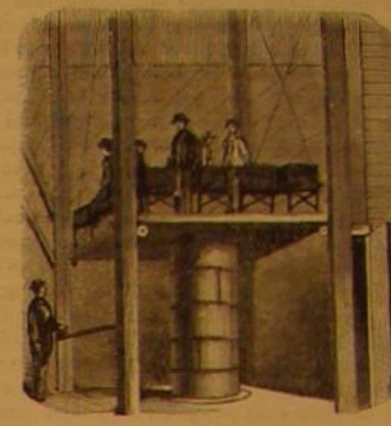


Fig. 2.—ELEVATOR.

Fig. 8.—ROTARY SQUEEZER.

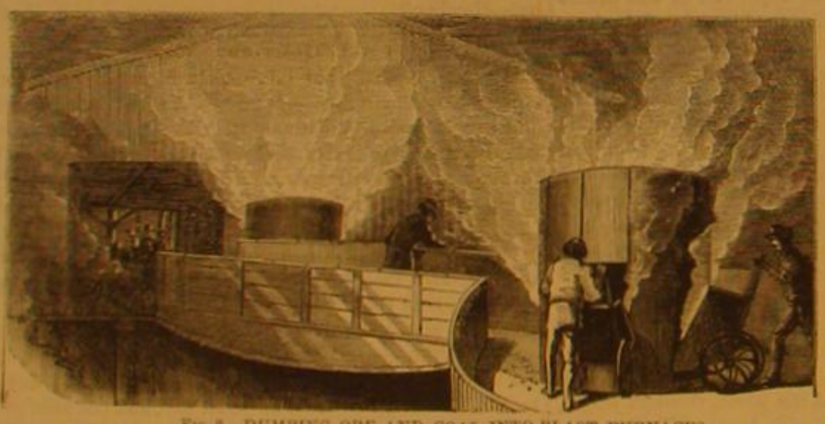


Fig. 3.—DUMPING ORE AND COAL INTO BLAST FURNACES.

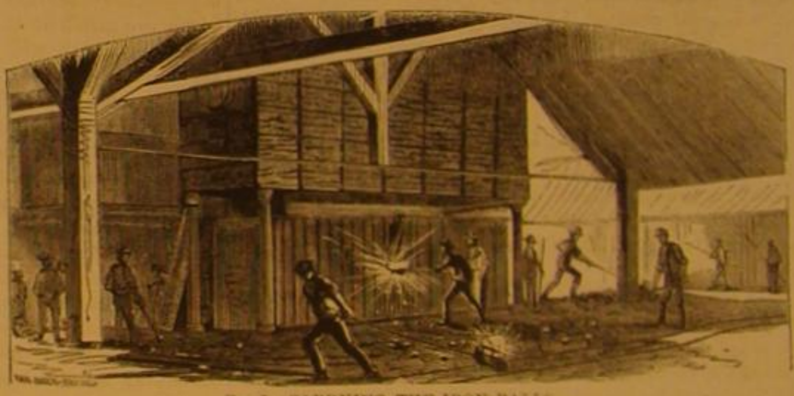


Fig. 7.—CARRYING THE IRON BALLS.

Fig. 4.—THE ENGINE ROOM.

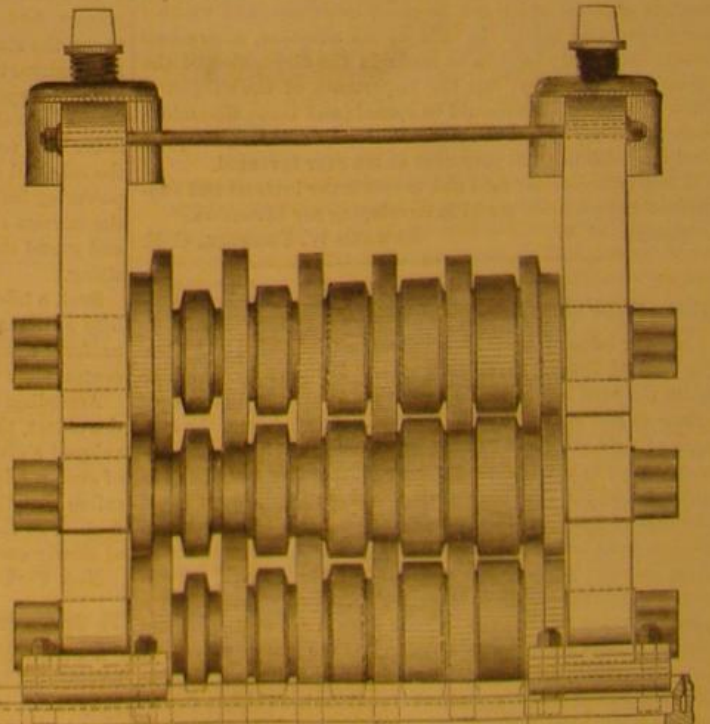


Fig. 9.—THE ROLLS.

as well as uniformity of texture, are necessary, the iron is rolled a third time. The bars are therefore cut again into pieces, piled, re-heated, and rolled again. A bar of iron which has been rolled twice is formed from a pile of fourteen separate pieces of iron that have been rolled only once, or "muck bar," as it is called; while the thrice rolled bar is made from a pile of eight separate pieces of double rolled iron. If, therefore, one of the original pieces of iron has any flaw or defect, it will form only a hundred and twelfth part of the thrice rolled bar. The uniformity of texture and the toughness of the bars which have been thrice rolled

FIG. 10.—COLD SAW.

are so great that they may be twisted, cold, into a knot without showing any signs of fracture. The bars of iron, whether hot or cold, are sawn to the various required lengths by the hot or cold saws, shown in the illustrations, Figs. 9 and 10, which revolve with great rapidity.

For the columns intended to sustain the compressive thrust of heavy weights, a form of the firm's own design is used in this establishment, to which the name of the Phœnix column has been given. They are tubes made from four or from eight sections, rolled in the usual way and riveted together at their flanges (Fig. 12). When necessary such columns are joined together by cast iron joint blocks, with circular tenons which fit into the hollows of each tube.

To join two bars to resist a strain of tension, links or eye bars are used, from three to six inches wide, and as long as may be needed. At each end is an enlargement with a hole to receive a pin. In this way any number of bars can be

FIG. 13. FURNACE AND HYDRAULIC DIE.

joined together, and the result of numerous experiments made at this establishment has shown that, under sufficient strain, they will part as often in the body of the bar as at the joint. The heads upon these bars are made by a process known as die forging. The bar is heated to a white heat; and under a die worked by a hydraulic pressure (Fig. 13), the head is shaped and the hole struck at one operation. This method of joining by pins is much more reliable than welding. The pins are made of cold rolled shafting, and fit to a nicety.

The general view of the machine shop (Fig. 14), which covers more than an acre of ground, shows the various machines and tools by which iron is planed, turned, drilled, and handled as though it were one of the softest of materials. By means of this application of machines, great accuracy of work is obtained, and each part of an iron bridge can be exactly duplicated if necessary. This method of construction is entirely American, the English still building their iron bridges mostly with hand labor. In consequence also of this method of working, American iron bridges, despite the higher price of our iron, can successfully compete in Canada with bridges of English or Belgian construction. The American iron bridges are lighter than those of other nations, but their absolute strength is as great, since the weight which is saved is all dead weight, and not necessary to the solidity of the structure.

Before any practical work upon the construction of a bridge is begun, the data and specifications are given, and a plan of the structure is drawn, whether it is for a railroad or for ordinary travel, whether for a double or a single track, whether the train is to pass on top or below, and so on. The calculations and plans are then made for the use of such dimensions of iron that the strain upon any part of the structure shall

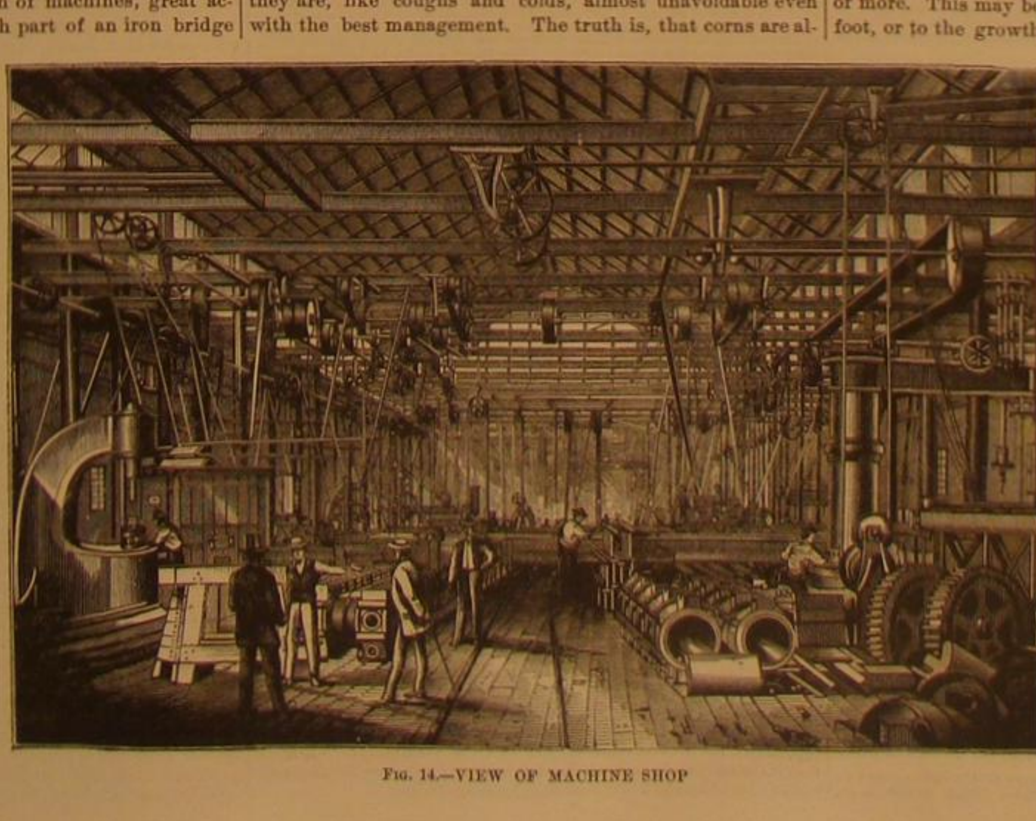


FIG. 14.—VIEW OF MACHINE SHOP

not exceed a certain maximum, usually fixed at ten thousand pounds to the square inch. As the weight of the iron is known, and its tensile strength is estimated at sixty thousand pounds per square inch, this estimate, which is technically called a factor of safety of six, is a very safe one. In other words, the bridge is so planned and constructed that, in supporting its own weight, together with any load of locomotives or cars which can be placed upon it, it shall not be subjected to a strain of over one sixth of its estimated strength.

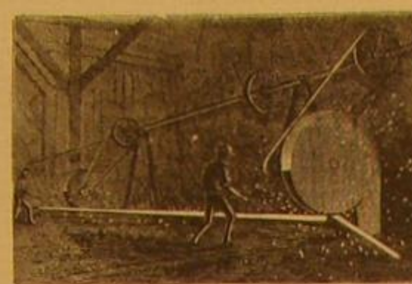


FIG. 11.—HOT SAW

After the plan is made, working drawings are prepared and the process of manufacture commences. The eye bars, when made, are tested in a testing machine at double the strain to which, by any possibility, they can be put in the bridge itself. The elasticity of the iron is such that, after being submitted to a tension of about thirty thousand pounds to the square inch, it will return to its original dimensions; while it is so tough that the bars, as large as two inches in diameter, can be bent double, when cold, without showing any signs of fracture. Having stood these tests, the parts of the bridge are considered fit to be used.

When completed, the parts are put together or assembled, as the technical phrase is, to see that they are right in length, etc. (Fig. 15).

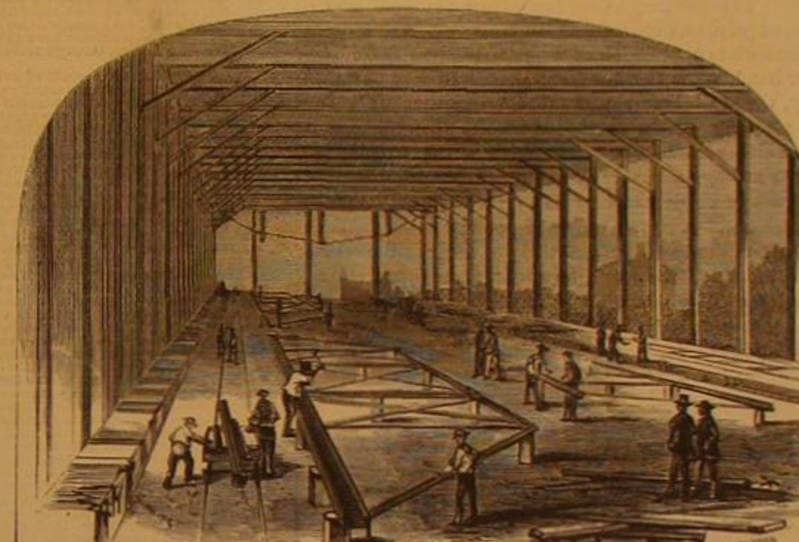


FIG. 15.—ASSEMBLING BRIDGE UNDER SHED

Then they are marked with letters or numbers, according to the working plan, and shipped to the spot where the bridge is to be permanently erected.

As an example of the architectural beauty as well as the engineering skill displayed in the manufacture of these fabrics, we give on our front page an engraving of the Girard avenue bridge, in Philadelphia, Pa. Its width is one hundred feet, equal to six railroad tracks. It has three spans of one hundred and ninety-seven feet and two of one hundred and thirty-seven feet, with seven trusses.

Corns in Horses.

There is a wide-spread fallacy that corns usually depend upon some peculiar form of foot, and that with such feet they are, like coughs and colds, almost unavoidable even with the best management. The truth is, that corns are always caused by an ill-fitting shoe. So long as a level shoe rests evenly upon the proper bearing surface of the foot, no corn can occur, but when the surface of either foot or shoe is irregular, then the most prominent point of contact is pressed upon unevenly and bruised. A corn is a bruise and nothing more, save that usage has confined the term to bruises of one part of the foot—the angle of sole between the wall and bar. This part of the foot is most liable to injury by uneven pressure, because it is in relation to the termination of the shoe. If the end of the shoe does not reach the extremity of the heel, it forms a point upon which the yielding horn is pressed at every step. Short shoes then are most objectionable, and, we find, a frequent cause of corns. They are often purposely employed on hunters, and on horses with capped elbows, seldom really necessary, but if so, should be very carefully fitted. By way of avoiding corns, it is the common practice of many farriers to "ease the heel of the shoe," that is, to so fit it that the last inch of the shoe takes no bearing on the foot. A space is thus left between the shoe and foot in which one might place a penny piece. This is one of the greatest evils of shoeing, for not only is an

FIG. 12.—RIVETING A COLUMN.

inch of the best bearing surface of the foot unused, but increased pressure is thrown upon the spot where shoe and foot are in contact. Instead of preventing corns, it is a common cause, and why it should be so will be understood when we say that the seat of the corn is about an inch in front of the extremity of the foot, in fact, just at the spot upon which this "eased heel" throws most weight. Corns may be due to an uneven surface of foot, not of shoe, as when the wall at the heels is lower than the bar, in which case a level shoe is almost certain to act as an exciting cause.

Lameness from corn usually shows itself about a week after the horse is shod, depending of course upon the degree of pressure existing. In some cases, however, a corn is the cause of lameness after a shoe has been on for a month or more. This may be due to the shoe having shifted on the foot, or to the growth of horn carrying the shoe forwards and within the wall.

The inside heels of the fore feet are most commonly affected, because the shoes for them are always fitted closer on the inside than the out, and hind feet are hardly ever affected, because the shoes for them are always fitted long and wide.

Let us repeat, a corn is simply a bruise, similar in every way to a bruise of our nails. There is injury to the sensitive parts, followed by discoloration of horn. When a horse is lame, if on removing the shoe and gently trying the foot all round with the pincers, tenderness is shown at the heel, we suspect a bruise or corn. The farrier would at once cut away the horn at the part until he saw it discolored, and then would say he "had found a corn." Imagining this discolored horn to be the offending substance, he would proceed to remove it, layer after layer, until he reached the sensitive and now bleeding tissues. We need hardly point out the absurdity of this practice. The stained horn is simply a sign of injury to the sensitive foot, and the removal of this horn, while it does no good to the bruise, leaves the foot miserably weak for weeks or perhaps months. What would be thought of a surgeon, who, because his patient had a discolored nail, the result of a bruise, proposed to remove the stained horn and lay bare the sensitive tissues? No medical man would do such a thing, and no patient would permit it. Yet veterinary surgeons and farriers follow this practice on the horse's foot, and horse owners assent to it. The result is, that corns assume a fictitious importance, and the heel, robbed of its horn, is liable to fresh injury for a long time.

We may be told that the horn is removed so as to release any matter formed as the result of inflammation. It is certainly a plausible excuse, but not a true one. A professional man should be able to diagnose the presence of matter without injurious explorations, and matter is never present unless a horse is worked for two or three days after the appearance. In about 80 per cent of the cases in which a farrier professes to have let out matter, he has simply let out a straw-colored effusion which would have been naturally reabsorbed in a day or two after the cause of injury—the shoe—had been removed. The remaining percentage of corn cases show matter because from negligence or ignorance the shoe has been allowed to remain on the foot, continuing the injury, and thus set up active inflammation.

The rational treatment of corn is to remove the shoe, and foment the foot with warm water—in other words, to remove the cause of injury, and help nature to reabsorb any effusion. If matter forms, it must be thrown off. Nature does this through an opening at the top of the wall, between hair and hoof; man endeavors to do it by an opening through the sole. Now, we believe in nature's plan, and experience show us that it is the best, if not the quickest, course for the horse's foot. Warm fomentations facilitate this course, and therefore the treatment we have suggested is applicable to all stages. This treatment does not injure the hoof, and a cessation of pain, and consequent lameness, can be followed by the immediate application of a properly fitted shoe. On the other hand, when the bars are destroyed and the sole cut away, the wall is left without any support. It is too weak to properly sustain weight: if it rests upon the shoe it is pressed either inwards or outwards, and the recently injured parts are again hurt. Thus, and thus only, it is that the existence of corns can be said to predispose a horse to their recurrence. A corn is only a temporary accident, like a bruised finger; the one is just as likely to recur as the other. If a horse remains lame over a fortnight, there is something more than a corn—either a badly fitted shoe, or the injury inflicted by the farrier's knife—to account for it. Verily, the ordinary cure for corns is worse than the disease. Horses are, we know, frequently lame or tender for months after having had a corn. Let such animals be properly shod, no cutting out of the heel allowed, and we guarantee a speedy cure. Remember that a corn is only a bruise of a horn-covered part. Treat it as you would your own finger under similar circumstances, and very little trouble will be entailed.—*Land and Water.*

PATENT OFFICE DECISIONS.

THE DISINTEGRATING FLOUR MILL PATENT.—CARR *vs.* DAVIDS.

[Appeal from the Board of Examiners-in-Chief in the matter of the interference between the application of Thomas Carr, of Bristol, Eng., and the patent of G. B. Davids, of Baltimore, Md., granted December 14, 1869, for a disintegrating mill.]

LEGGETT, *Commissioner:*

It is proved and admitted on the part of Carr that Davids made his invention in September, 1868. Carr obtained a patent for his invention in England, which was enrolled April 6, 1869. He introduces testimony to show that he made the invention in England long before that date, which testimony has been ruled out by the Examiner of interferences and the Board, in conformity with the established practice of the courts and the Office. (See Howe *vs.* Morton, 1 Fish., 595; Brooks *vs.* Norcross, 2 Fish., 661; Bain *vs.* Morse, 1 B. app., p. 222; *ex parte* Jno. Cochrane, Com'rs D. 1869, p. 60; Tucker *vs.* Davis, O. G., vol. 2, p. 224.)

I do not find sufficient ground in the argument presented in behalf of Carr for a departure from this practice. The statute is explicit in declaring that any inventor may obtain a patent for his invention, provided it has not been patented or described in a printed publication in a foreign country before the date of his invention. Davids made the invention before it was so patented or described, and his right to a patent is clear.

No evidence of the date of an invention in a foreign country, other than that of a patent or a description in a printed publication, ever has been or can be received under the law. Inventions abroad are ignored by the statute until made to appear through one or the other of the channels named. Therefore Carr did not make the invention in contemplation of law till he patented it, April 6, 1869, and Davids preceded him. Without the light of controlling precedents, I should be unable to place any other interpretation upon the statute than that which constitutes the established practice of the Office in like cases.

The decision of the Board is affirmed.

DECISIONS OF THE COURTS.

United States Circuit Court,---District of California, Ninth Judicial Circuit.

IMPORTANT DECISION CONCERNING THE RIGHTS OF ASSIGNEES OF PATENTS.—PATENT EGG CASE.—DAVID MCKAY *vs.* JOHN B. WOOSTER *et al.*

[In Equity.—Before Sawyer, Judge.—Decided April 7, 1873.]

SAWYER, *Judge:*

On February 26, 1867, a patent was duly issued to J. L. and G. W. Stevens, of San Francisco, for an "improvement in cases for transporting eggs."

In August, 1872, said patentees, by deed, granted and assigned to H. F. Billings, of Chicago, in the State of Illinois, "for, to, and in all the States and Territories of the United States east of the Rocky Mountains, all the right, title, and interest which they, the said John L. and George W. Stevens, had in and to the said letters patent, and the invention as secured to them by said letters patent, and all their rights, liberties, privileges, and franchises which they had or might acquire by or under the said letters patent," which said deed was duly recorded. Since said assignment, said Billings has erected a manufactory for said patent cases for the transportation of eggs at Chicago, in the State of Illinois, and has manufactured, in accordance with the specifications of said patent, and he still continues to manufacture said cases; and he has sold and continues to sell the same "to the public, or to whomsoever desires or desired to purchase them, without any restriction or reservation whatsoever."

On the 17th of October, 1872, said J. L. and George W. Stevens made a similar transfer of all their right, title, and interest in said patent and invention, in and to all the States and Territories lying west of the Rocky Mountains, to the complainant, David McKay, who thereupon entered upon the manufacture of said patent cases at San Francisco, and he has ever since continued to manufacture and sell the same for use in that portion of the United States lying west of the Rocky Mountains.

The defendants are commission merchants doing business at San Francisco, receiving goods consigned by merchants east of the Rocky Mountains and selling the same on commission. M. Evans & Co. are merchants doing business at Ames, in the State of Iowa, and a part of their business is dealing in eggs. Said Evans & Co., between the 17th of October, 1872, and the filing of the bill in this case, purchased in the usual course of business at Chicago, of said Billings, "without any restriction or reservation" on his part, a number of said patent cases manufactured by him as aforesaid, filled them with eggs in the State of Iowa for the purpose of transportation, and shipped them so filled with eggs to defendants at San Francisco, who received them and sold the eggs on commission in the regular course of their business as commission merchants.

The use of the aforesaid cases in the transportation of eggs from the Rocky Mountains to San Francisco is the infringement complained of; and the threatened continuance of the practice, and further use and sale of the cases so received, the injuries sought to be restrained. Numerous other parties are engaged in similar transactions.

Under the view I take, the only question necessary to determine seems to be precisely the same decided by Shepley, Circuit Judge, in Adams *vs.* Burke, 4 Fisher's Patent Cases, 392, namely: "*Does* the purchase of a patented article, *lawfully* manufactured, and *sold without restriction or condition*, within his territory by the territorial assignee of a patent right, convey to the purchaser the right to use or sell the article in another territory for which another person has taken an assignment of the same patent?"

The learned judge answers the question in the affirmative. This is the only case I have found in which the precise question has ever been considered. One would suppose that a question of so much importance, and so likely to arise, would long since have been presented to the Supreme Court and authoritatively determined, but it does not appear to have been done. It is insisted that the case cited is not correctly decided, and argued with a great deal of force, that since Lockhart and Seeley, in that case, and Billings in this, only purchased the right of the patentees in a limited territory, they did not themselves have the right to supply, either directly or indirectly, other territory than that purchased; that their right only extended to making, using, and vending *to be used* in the specific territory purchased; that, as they had themselves no right to use in other territory, their vendees could acquire no greater right than they themselves owned; that their purchase of the right to a specific territory necessarily limited their power to sell the machine to be used in that territory alone; that this limitation and restriction is necessarily implied in the sale, even without any express stipulation to that effect; that the patent under the fifth section of the act of Congress of 1836 in terms gives the patentee "the full exclusive right and liberty of making, using, and *vending to others to be used*" the said invention throughout the jurisdiction of the United States; that the eleventh section authorizes him to assign the whole or part of his interest for "any specific part or portion of the United States;" that when he assigns his entire interest for a specified part, he assigns the right acquired under the fifth section of "making, using, and vending to others *to be used*" in that specific part, and "to be used as well as to make and use in that part *alone*;" that, therefore, when an assignee of a specific territory sells a machine in that territory, the machine so sold is taken out of the monopoly as to that territory only, there being no power in the vendor to withdraw it from the monopoly as to other territory in which he has no monopoly or control, and that he can only dispose of his own share of the monopoly, or liberate therefrom to the extent of his own interest therein. This, it is argued, is the reasonable construction of the law, and the contract of assignment of the right of the patentee to a specific part of the territory authorized by the act. The consequences of a different view are also urged in support of the position taken, some of which, it is said, find a striking illustration in this case. Thus, it is argued that, labor and materials being cheaper, and the other facilities for cheap manufacture being greater at Chicago than at San Francisco, the patent cases for transporting eggs can be made at a cost so much lower at Chicago than at San Francisco, that the purchaser of the Chicago manufacture could undersell the complainant in his own territory. Eggs also being so much cheaper east than west of the Rocky Mountains, large quantities are there purchased and sent to these western markets. The transportation of the patent cases costs nothing, because it is necessary in shipping to use boxes or cases of some kind, and these require no more room than others.

The freight is paid on the eggs as merchandise, and the greater security against breakage and the improved condition of the eggs brought in these cases more than compensate for their cost at Chicago. Those dealing in eggs, therefore, can purchase these patent cases at Chicago, ship them with eggs from any part of the United States east to parts westward of the Rocky Mountains, and after disposing of their contents sell them at half cost, or even give them away, and still make a remunerative profit on their transactions. There is no use for the cases for return freight. Thus the entire market west of the Rocky Mountains, including nearly one third of the territory of the United States, can be wholly supplied, indirectly, through middlemen, at prices less than it is possible to make the article for here, by parties who have only purchased the territory east, to the utter loss or ruin of those who have purchased and paid for the territory west of the Rocky Mountains. So, again, it is said it may well be in the case of many inventions that some particular locality affords such facilities for cheap manufacture that the whole United States may be supplied from that point at prices that would defy competition in any other locality, so that it would only be necessary to purchase the right for the territory on which the factory is located in order, through middlemen, to practically enjoy a monopoly of the whole country.

It is easy to see that the result of supplying the whole country indirectly through the merchant, who is usually the seller to the consumer, is precisely the same as though the maker himself directly sells to the consumer.

It must be confessed that these arguments are entitled to grave consideration. Enough has been said in this, and in the case cited, to render it manifest that great practical inconvenience may result from either view.

In the absence of an authoritative adjudication, I should hesitate long before venturing to dissent from a well considered decision of so learned, experienced, and eminent a jurist as Judge Shepley. But in this instance I can perceive no good ground for doubting the soundness of the proposition laid down in the guarded form in which it is stated in the case cited.

An important question not discussed by the learned judge may, however, arise as to when, or under what state of facts, a patented machine may be regarded as "*lawfully * * * * sold without restriction or condition within his territory, by the territorial assignee of a patent right.*"

In the case now under consideration it will be seen by reference to the stipulated facts that the assignment to Billings was made in August, 1872, while that to complainant was not made till October following. If there is any conflict, therefore, in the rights claimed by the parties, the complainant's assignment, so far as the conflict is concerned, being subsequent in time, was taken in subordination to the prior grant to Billings—that is to say, he could only take by his assignment what was left after Billings' interest had been carved out. At the date of the assignment to Billings the patentees were still the holders of the entire interest under the patent. Had they at that time, at Chicago, sold one of the patented articles in question without restriction or condition, that undoubtedly would have been a lawful sale without restriction or condition, and the article so sold would have been taken out of the monopoly, and the purchaser, or any one deriving title through him, would have been entitled to use it till worn out in any part of the United States. The patentee himself could not by a subsequent assignment of his patent have limited the right of the purchaser already vested. The vendor being at that time entitled to the whole monopoly for the entire jurisdiction of the United States, it was competent for him to wholly emancipate the article sold by taking the entire royalty for the use in any part of the territory. And a sale without restriction or limitation would work such emancipation. In such case any party subsequently purchasing the right to any specific portion of territory would take that right subject to the use of the machine so sold at any point within the territory purchased. What the patentees could do with respect to one machine, they could do as to any number of machines in existence or to be brought into existence. What they could do themselves they could by contract authorize or convey the right to any other party to do. As the patentees themselves could *lawfully sell* these patented articles at Chicago *without restriction or condition*, so as to authorize the purchasers, or those claiming under them, to use the machines anywhere in the United States, they could convey the right to Billings to lawfully do the same. This authority to emancipate from the monopoly by an unrestricted sale was a part of their "right, title, and interest in the invention secured by the patent," that could be exercised and enjoyed at Chicago or other places east of the Rocky Mountains as well as elsewhere. The assignment to Billings is in the broadest terms. It is of "all the right, title, and interest which the said John L. and George W. Stevens had in and to the said letters patent, and all their rights, liberties, privileges, and franchises which they had or might acquire by or under said letters patent," "for, to, and in all the States and Territories of the United States east of the Rocky Mountains." There is no limitation of the power to vend within the territory. The patentees could lawfully make without restriction or condition, could use without restriction or condition, or could *vend without restriction or condition* anywhere within the specified territory, and all their rights they conveyed to Billings without *restriction or condition*, who thereupon stepped into the shoes of the patentees as to the territory sold. Had they intended to limit the right of vending "to vending to be used" by the purchasers within the territory sold only, they should at least have so specified the intention, and by some apt words restricted the right of use in the deed of assignment. This unrestricted assignment of the right to vend put it in the power of Billings to *lawfully* vend the patented article within his territory without restriction or condition, and thereby wholly emancipate from the monopoly the articles so sold. The complainant subsequently purchased his territory, and, whatever the terms of his grant, he could of course only obtain what was left of the franchise or monopoly. As the patentees, after their sale to Billings, could not object to sales by him without restrictions or conditions, their subsequent assignee cannot object. The latter's right is subject to the right of Billings and those who have lawfully purchased without restriction or condition from him. This is as far as it is necessary to go in this case. It is unnecessary now to consider the effect of an express limitation in the deed of assignment of the right to vend for the purpose of use only within the purchased territory, or how far the complainant, being a subsequent purchaser of territory, can lawfully vend without restriction or condition, so as to wholly emancipate the article sold from the monopoly, and enable the purchaser of the patented article of his manufacture to use it in the territory of Billings.

If there is any practical hardship in the construction adopted of the law and contract under it, and it should turn out to be the correct construction, then the patentee, when he desires to assign, must consider whether he can afford to do so without restriction, and the subsequent purchaser, when he wishes to buy, must determine whether he can afford to do so with the burden entailed upon his territory by a prior grant unlimited in the particulars indicated. There must be a decree for defendants. Let the bill be dismissed with costs.

Holland & Spencer, for complainants.
Churchill & Haight, for defendants.

NEW BOOKS AND PUBLICATIONS.

TEXT BOOK IN INTELLECTUAL PHILOSOPHY FOR SCHOOLS AND COLLEGES, containing an Outline of the Science and an Abstract of its History. By J. T. Champlin, D. D., President of Colby University. Price $1.50. Also, by the same author: CHAPTERS ON INTELLECTUAL PHILOSOPHY, designed to accompany the above. New York and Chicago: Woolworth, Ainsworth, & Co.

These two treatises are lucid and well written exponents of a branch of study which deserves more attention than it usually receives. The object for which they are written is carefully kept in view by the author, who has, throughout, abstained from wandering into the higher metaphysics. To the "Text Book" is added an appendix, containing questions on each section of the work, which will be valuable both to teachers and pupils.

PHILOSOPHY OF RHETORIC. By John Bascom, Professor of Rhetoric in Williams College: Author of "Aesthetics, or the Science of Beauty." Price $1.50. New York and Chicago: Woolworth, Ainsworth, & Co.

This is a valuable essay, written in an agreeable style which makes it acceptable to the general reader as well as to the student. There is much thought in small space in Professor Bascom's writings; and the work now before us is written in a very terse and expressive manner.

Recent American and Foreign Patents.

Improved Extensible Ladder.

John C. Hearne and Duston Adams, Pleasant Hill, Mo.—This invention consists of two "lazy tongs" contrivances connected together at the middle joints of the bars by cross bars long enough for the ordinary purposes of the cross bars of a common ladder, the cross bars being connected, near each end, by cords, which limit the extension of the lazy tongs frame, and support the weight of the climber. The top cross bar is provided with hooks or other devices for suspending the ladder, and a rope is attached to and passed from the lower cross bar up over the top one, or through an eye suspended from it, so that the ladder can be folded up out of the way by pulling the cord down; the ladder can be quickly let down when required for use by releasing the rope. The whole constitutes a convenient and efficient ladder for scuttles and the like, not frequently wanted for use, and where it will be out of the way when so folded up.

Improved Turbine Water Wheel.

John C. Green, Flanders, N. J.—This invention is an improvement in turbine water wheels, in which the objectionable feature—the termination of the wheel case at the bottom flange, which renders it difficult to make the joint tight within the outer edge to prevent water leaking through the flange at the holes for the bearings—is done away with, and the case is extended below the bottom flange, and a special flange is provided to rest on the floor, support the wheel, and make a joint around the discharge hole; and this flange also serves to support the wheel so high as to prevent heavy bodies from being carried into the wheel. By this arrangement, it is claimed, the water leaking through the flange at the holes for the journals will remain in the flume.

Improved Addressing Machine.

Francis A. Darling, Fayetteville, N. Y.—This invention relates to an improved addressing machine, intended particularly for use of newspaper publishers and such other persons whose business requires them to send at frequent intervals documents or mail matter to the same subscribers or persons, whose interest it is, therefore, to retain the address of such persons in position for use in printing. The invention consists in the employment of an endless chain passing around a prismatic presser block, and having the address or printing plates removably secured to it by springing their ends into slots formed in the links of the same. The invention also consists in hanging the chain around a drum or wheel that is supported by a sliding frame, and in forming a toothed segment engaging with opposite ratchet wheels on the arbor of the lower chain holder or presser, for the purpose of turning the same one quarter revolution at each downward motion of the frame, and for retaining the same in position immovably during the upward motion of the same.

Improved Door Bolt.

Adolph Hofstatter, New York city.—This invention has for its object to furnish an improved attachment for bolts, by the use of which it will be impossible for the bolt to be worked back and the door unfastened from the outside of said door. By suitable construction, when the bolt is pushed outward so as to bring its knob into the space between the forward end of an open central keeper and the rear end of a forward keeper, and a semi-cylindrical plate has been moved laterally upon the bolt so as to cover the opening or slot in the central keeper, it will be impossible for the bolt to be drawn back without first moving the plate to one side to uncover the said slot and allow the knob to pass through it. Upon the rear end of the plate is formed a small projection, which, when the said plate is adjusted to cover the opening in the keeper, may be slipped into a notch in the forward end of the rear keeper, and which, when the said plate is moved to uncover the said opening, may be slipped into a notch in the rear end of the open keeper, to prevent the said plate from getting out of place accidentally when in either position.

Improvement in Recovering Tin from Waste Scrap.

Henry Panton, New York city.—The inventor proposes to utilize the tin on scrap tinned plate cuttings, etc., by recovering it by mercury amalgamation. For this purpose he cuts the chips into small pieces and places them in a revolving cylinder, into which a shower of mercury is constantly falling. Besides the method of recovering the tin, the patent covers a process of converting the remainder scrap iron into steel, as well as the cylindrical apparatus already described.

Improved Folding Chair.

Asahel C. Boyd, Worcester, Mass.—The invention consists in forming each front leg and superposed arm in a single side piece that is reversely curved at its opposite ends. It also consists in providing the side pieces with a round that serves the double purpose of a connecting pivot for the links and a rest for the upper ends of the legs.

Improved Car Dumper.

Owen M. Avery, Pensacola, Fla.—The invention consists in dumping a car on the side by means of rocking beams pivoted to the middle of a beveled bolster. It also consists in a peculiarly constructed and operated shifter, by which the rock beam is made to perform its intended function. It also consists in a locking device applied at each end of the shifter. It also consists in a double notched lock bar applied to the middle of the shifter. It also consists of means for throwing the line of gravity from the median line of the truck and to that side of the car on which the load is to be dumped. It also consists in a peculiarly simple and convenient mode of coupling car dumpers together.

Improved Fertilizing Material.

James Whitehill, Frederick, Md.—The invention consists in grinding or reducing limestone to a granular state so that it will pass the drill evenly and may be applied in small quantities with as great effect as in large quantities. Thus it is sold in packages, air tight or approximately so.

Improved Vacuum Pan.

Dr. Aurelius P. Brown, Upperville, Va.—The invention consists in a method of producing and maintaining a vacuum in the condensing coil of a vaporizing apparatus whereby the continued action of an air pump (although one may be used to start it, if desired) is rendered entirely unnecessary, and a great saving is thereby produced in the ordinary process of distillation.

Improved Horse Collar.

William Gulifoyle, New York city.—The object of this invention is to construct a horse collar which not only is stronger, cheaper, and more durable than those at present in use, but protects, also, the neck of the horse against scalds and bruises caused by the undue pressure of the collar. This invention is intended to obviate these defects by strengthening the leather part with a metallic shoulder piece having a projecting rim, by which the usual hames are dispensed with and the strain on the collar distributed over the whole surface, protecting not only the neck of the horse, but also furnishing a stronger and more durable collar. Suitable trace hooks are applied to the metallic covering and connected by a strong wire piece, with rings attached to hold the harness together.

Improved Convertible Freight Car.

William Worsley, Little Falls, N. J.—The invention consists in V shaped detachable sections applied to the floor of a grain car, to give the necessary pitch to the bottom, and a nozzle combined with a swiveled elbow spout, so that the grain may be discharged on either side of the car from the same nozzle.

Improved Hose and Pipe Coupling.

Theodore E. Button, Waterford, N. Y., assignor to himself and L. Button of same place.—The invention consists in the improvement of pipe or hose couplings. The joint where the two pipes are connected may be either ground or packed. A nut, made in two parts, has each part hinged to a swivel working on one pipe. The other pipe screws into this sectional nut, which draws the pipes together. The two parts of the nut are held together by a ring which is made to fit the conical surface of the outside of the nut. The taper of this surface must be sufficient to allow the ring to be easily pulled off. The ring is provided with lugs to which are attached chains which are made fast to some fixture. Now, by a slight movement of either the coupling or the fixture, the ring is pulled off and the coupling disconnected. Each pipe is provided with a pressure valve. When the pipes are connected these valves are open; but when the pipes are separated, they close automatically or by the pressure.

Improved Railroad Rail Joint.

Thomas V. Allis, New York city.—This invention consists in making, in a rail or other joint in which the rails or bars are subject to expansion and contraction, the holes for the joint bolts of the same size in the crosswise direction of the rails or bars as the threaded portion of the bolts; and said bolts are made as much smaller in the parts which are in said holes as the depth of the grooves of the thread, or thereabout.

Improved Nut.

William Van Anden, Poughkeepsie, N. Y.—Nuts for screw bolts that are made by punching or cutting them from bars of rolled metal have the fiber or grain of the iron disposed diametrically to them in some parts, so that a splitting or bursting strain on the nut acts on the metal in the direction of the least adhesion—that is, transversely to the grain—so that they split open easily. In this invention, before cutting up the rods into the short pieces required for the nuts, they are twisted to cause the grain of the metal to extend in its lengthwise direction from a half to two thirds of a coil around the nut, so as to cross the lines of the bursting strains, or the directions in which these strains act, and thus oppose them in the direction in which the adhesion of the metal is most powerful.

Improved Hydraulic Cane Crusher.

Charles H. Dickinson, Rosedale, La.—The invention consists in the improvement of cane crushers. The cane being dumped from the cart into crushing cylinders, pistons are forced down upon it by hydraulic presses with great force, crushing the cane far more effectually than it can be by the common roller presses, and expelling the juice into the pan below. The pistons are then partially withdrawn; the bagasse is saturated with steam introduced through a pipe for the purpose of dissolving the crystallized particles so that they can be expelled; then the pistons are brought down to act a second time upon the bagasse and expel the remaining portion of the juice or the greater part of it. Water may be used with good results instead of the steam for saturating the partially crushed bagasse, but steam is much more effective.

Improved Window Mirror.

Alfred Olander, Glen Gardner, N. J., and Albert Olander, New York city.—It is quite common in cities to place mirrors outside the windows, so adjusted as to enable persons within to see pedestrians on the side walk reflected in the mirror. The above inventors propose an arrangement of a double mirror mounted on vertical pivots at the center, to turn about a quarter of a revolution, so that either side can be used by changing it slightly. For changing it a pull piece is carried inside of the room, connected to the mirror by a bell crank and rods for turning it in one direction, and a spring in the space between the two mirrors acts on one or both of the pivots for turning it in the other direction; and for holding it against the action of the springs, the pull piece has ratchet notches and engages with a catch.

Improved Lady's Work Box.

Wm. Brace, Washingtonville, O.—The invention relates to ladies' workboxes, in which are kept their spools of different numbers of threads or silks, needles and other matters. It consists in making them portable and easy to be handled, by the construction and arrangement of their parts.

Improved Butcher's Implement.

John Baggs, Easton, Md.—This invention has for its object to furnish an implement, adapted especially for butchers' use, which embodies a knife, saw, and spring balance, so that meat can be sawn, cut and weighed, at one and the same operation, without removing the hand from the handle.

Improved Dovetailing Machine.

Thomas Cullen, Blackstone, Mass.—The invention consists in the improvement of dovetailing machines. The saws are triangular in cross section, with teeth formed on each side, and on the corners. They are fitted in holes through studs, and fastened by binding screws to turn on their longitudinal axes, to adjust them to the work properly. The crank shaft, by which the saws are worked, is arranged at the center, around which the saw gate oscillates in adjusting the saws for working obliquely, and provided with a driving pulley behind the face plate. A scale is arranged on part of the face plate, and an index finger is arranged on the saw gate to sweep it and indicate the degree of the inclination of the saws. Adjustable stops arrest the saw gate at the right points in shifting it forward and back in sawing tenons, the said stops being set by the scale and index at the top, so that the changes, which in this kind of work are of necessity frequent, can be made without reference to the scale. The adjusting screw holds the gate in position after it is adjusted. The studs by which the saws are held are swiveled, to allow them to turn as is necessary for the shifting of the saw gate, and shifted more or less distant from each other according to the distances the notches are to be apart, which vary considerably in the different kinds of work. The saws are only used in the vertical position, and the board is fed to and from the saws obliquely, to form the side, but for cutting the bottom sides it is fed at right angles by the screw. For the direct feed for cutting the bevel edges of the tenons, and the cross or transverse feed for cutting the bottom of the notches, merely two ordinary sets of ways, at right angles to each other, with corresponding feed screws and carriages, are needed; but for the oblique feed for the sides of dovetail notches, the ways can be shifted around obliquely to the plane gang of saws. Mechanism is provided to prevent the table from turning with the carriage and to cause it to keep the work square to the saws. The shifting of the carriage for the bevel sides of the notches is effected by a shaft, turned by hand to screw the feed table forward until it is arrested by a stop coming against a lug; then the feed screw will be turned to slide the work to the left by the carriage to cut the bottoms of the notches, and during this time the shaft will be thrown around to the right to shift the ways around to correspond with the sides of said notches, ready to feed the work back from the saws and from said sides as soon as the limit of the transverse movement for cutting the bottom is reached, and the movement stopped by one of the *stop* middle pins and a stop; then the board is taken out and the other end presented to the saws, and the work continued by feeding it up.

Improved Plow.

Stephen L. Stockstill, Medway, O., and Henry D. Kutz, Harrisburg, Pa.—This invention is an improvement in the class of plows provided with one wheel, or connected to and supporting one end of an axle having a wheel on the other end; and the improvement consists in the adjustable connection between the axle and plow beam for the purpose of allowing vertical adjustment of the axle.

Improved Cotton Stalk Knocker.

Marvell M. Garruth, Helena, Ark.—This invention is an improvement upon the machine for which letters patent were granted to George Gorman, September 20, 1853; the objects aimed at being to isolate the gearing from danger of contact with the cotton stalks, to secure free space for the operation of the revolving knocker, and also to secure rapid rotation of the latter from a slow forward movement of the machine over the surface of the ground. By suitable construction, as the machine is drawn slowly forward, a shaft is revolved rapidly, and its bars strike, knock down, and break into small pieces the cotton stalks, enabling the plowman to readily cover them with his plow, so that they will fertilize the soil.

Improved Coffee Roaster.

James Hart, Kekoskee, Wis.—The object of this invention is to furnish a simple utensil, by the use of which coffee beans may be quickly roasted, preserving all the fragrant volatile oils, and producing thereby a more aromatic coffee. The invention consists of a lens-shaped metallic vessel provided with a handle and adjustable slide covering the aperture for the admission of the beans, which is slowly turned over the fire till the beans are properly roasted.

Improved Machine for Cutting and Perforating Cigars.

Jacques Levy, Theodore Levy and Armand Levy, New York city.—The object of this invention is to furnish to cigar manufacturers a machine which, by mechanical means, pierces the heads of form cigars, and cuts at the same time the tucks of the same, improving thereby the smoking quality of the cigars and economizing the time consumed in piercing by hand. It consists, mainly, of a working table, to which upright guide bolts or standards are applied, which carry the needle bar, held by strong springs and acting by a treadle connection. The cigar bunches are placed under the needle bar in the form blocks, adjusted thereon, and pierced by the descending needles. A sharp blade at the edge of the table serves to cut the tucks of the bunches when passing the form blocks to the needle bar.

Improved Composition Paint Oil.

James McCafferty, New York city.—This invention has for its object to furnish an improved paint oil, simple in composition, causing the paints to flow freely and dry without scaling or cracking, which may take the place of linseed oil for most purposes, and will be much less expensive. The invention consists of the paint oil formed of resin boiled with oxide of manganese. Boiled linseed oil is then poured in, and the mixture is then taken out and poured into a tank containing refined petroleum oil and dissolved india rubber. The mixture is then thoroughly stirred and allowed to stand for twenty-four hours to settle.

Improved Cutter for Tonguing and Grooving Lumber.

Daniel Perrin, McGregor, Iowa.—This invention has for its object to furnish improved cutters, spurs, or trimmers for matching tongued and grooved lumber, which will enable more and better work to be done with less expense and less wear and strain upon the machine than when the ordinary cutters are used. The invention consists in the cutters for trimming off the sides of the groove and tongue, made of equal breadth with and of half the thickness of the other cutters to adapt them to be used in pairs.

Improved Oil Cloth Printing Machine.

Charles Rommel, Elizabeth, N. J., assignor to himself and Wisner H. Townsend, New York city.—This invention relates to machines which permit the successive printing of oil cloth or other fabrics in different colors, and has for its object the substitution of the hand coloring of the printing blocks, and the adjustment of the fabrics by such means that the whole apparatus may be driven by steam power, and the manufacture of oil cloth and other fabrics be accelerated. The invention consists in the arrangement of suitable coloring rollers with boxes on a spider frame in such a manner that the requisite number of printing blocks are successively colored and the cloth carried forward as soon as the printing of the blocks is completed. The shaft of the printing roller is connected by pawl and ratchet arrangements with the printing bed and movable frame, which regulate the forward motion of the cloth and the return of the supporting frame at the time required.

Improved Animal Cage Trap.

Sylvester W. Rice, Roseburg, Oregon.—This invention relates to a new self-setting animal trap; and has for its object to effect the continuous operation of the trap, and to cause each animal, as it is entrapped, to reset the trap for its successor. The invention consists in providing the trap with a treadle having perforated end plates or gates, which, according to the manner in which the treadle is inclined, close or open the trap at the ends.

Improved Wagon Brake.

William B. Stanley, Groveton, N. H.—The invention consists in the improvement of wagon brakes. By means of short chains, a brake beam is connected with two levers which are pivoted to the reach behind the beam. The connection of the beam with the levers is made with the short ends of the latter; their long ends or arms are by rods connected with a lever which is pivoted to the front of the wagon body. When the lever is swung back by the driver of the wagon, the long arms of the levers will be swung forward and their short arms thereby carried back, so that they will draw the beam back in equal degree on each side of the reach, and thereby firmly apply the brake shoes against the wheels. The rods have parts formed of chains, so that the same can be extended or contracted at will, in conformity with the contraction or extension of the wagon reach, if it should be found necessary to vary the length of the same.

Improved Dentist's Flask.

Clemon Bailey, Kinston, N. C., assignor to himself and H. C. Bailey, of same place.—This invention relates to an improved construction of vulcanizing flask, used by dentists for preparing artificial gums, etc., and has for its object to keep the two parts of the flask properly together, and to obviate the necessity of tightening the connection while the flask is in the vulcanizer, and also to improve the shape and style of the flask. The invention consists in an improvement upon devices which are now in use to contract the parts of a dentist's flask when in the vulcanizer. A semi-elliptic spring, placed on top of the flask and connecting its ends with bars that project from the bottom of the flask, the said bars being secured to the flange under the flask, pulls the two parts of the flask firmly together, even if the other fastenings should, by unequal expansion in heat, fail so to hold the parts together.

Improved Musical Instruments.

Justin Whitney and Horace W. Whitney, Boston, Mass.—This invention relates to musical instruments in which hooks are made to vibrate to produce musical tones. Holes of any shape are bored in a bar or frame, into which the shanks of the hooks are inserted. These shanks are flattened horizontally, so that the bearings will be at right angles to the line of vibration, by which the tendency to produce harmonic tones is lessened. The hooks are of wire, which produces a quality of tone more agreeable than other forms of metal. When double hooks are used, a middle leg is soldered to them in the bow, by which to attach them to the bar, and a support is applied to this shank about midway between the bow of the hook and the bar, the said support being placed on the sounding board, to assist in sustaining the hook and to communicate the vibrations to the sounding board. A load of metal or other substance is also fixed to the bow of the double hook, to destroy the harmonic tone; and the base end of the sounding board is given freedom to vibrate.

Improved Wheel for Vehicles.

Orlando D. Spalding, Mankato, Minn.—This invention consists in the mode of forming an anti-friction bearing for axles. A tube passes through the hub and is fast therein, and at each end of the latter is a casing in which the rollers are placed. A cap screws on the end and confines the rollers. The casings are screwed into the tube, such screw portions of the shells being tubes through which the axle passes. This enables the shell to be screwed tight up to the ends of the hub. The rollers are simple solid cylinders of steel, the diameter of which is just sufficient to fill the annular space in the shell around the axle. The entire bearing at each end of the hub is on the two sets of these rollers. The rollers revolve around the axle as the wheel revolves.

Improved Harvester.

Charles H. McCandlish and John C. Naginey, West Rushville, O.—This invention has for its object to furnish an improved device for supporting the tongue of front cut harvesters to relieve the horses' necks from the weight. The invention consists in the particular means by which the wheel is attached to the tongue. To the upper part of a bar are pivoted the upper ends of other bars, which pass down upon the opposite sides of the wheel, and their lower ends are connected by a bolt which passes through the hub of the said wheel, and serves as its journal. To the lower end of the arm first mentioned is pivoted the end of a short bar which has a number of holes formed in it. The latter passes between the bars, where it is adjustably secured in place by a pin or bolt, which passes through a hole in the bars and through one of the holes in the bar, so that by shifting the said pin or bolt from one to the other of the holes the tongue may be adjusted higher or lower, according to the hight of the horses.

Improved Steam Washer.

Charles A. Bradley, Monticello, Fla.—This invention has for its object to improve the construction of steam washers in such a way that the steam and water can only escape through the discharge tube, and cannot escape through the return or ingress openings. The invention consists in the combination of downwardly projecting tubes, made V-shaped in their cross section, with the ingress openings in the plate of a steam washer. The tubes have holes in their lower ends, and extend to the lower edge of a flange so as to be always submerged, and thus prevent the possibility of the steam or water being forced out through said ingress openings, and insuring its passage through the discharge tube.

Improved Grapple.

John Burkhart, Brookville, Ind.—This invention relates to a new instrument for grappling and supporting heavy stones and other bodies during the building of houses, bridges, walls, embankments, or other structures; and consists in the combination, within a suitable clevis, of a pin or bar of adjustable grappling hooks, so arranged that they can be conveniently shortened or elongated to suit the sizes of the bodies to which they are applied.

Improved Sewing Machine.

John O'Neil, New York city, assignor to himself and R. A. Schoneman, of same place.—This invention consists in a simple and efficient arrangement of gear for working the rock shaft which carries the hook and works the feed. The machine is designed more particularly for securing the wire in the brim of a lady's hat frame. The stand is therefore constructed to allow of presenting the hat frame so as to be properly acted upon. The needle arm has an extension placed below the journals and connected at its lower end with the wrist pin of a drive shaft. This extension is also connected by a rod with a bell crank, which is attached to a block having a pin that enters a slot of the arm in a rock shaft which carries the parts for catching the upper thread, and also the feed operating cams, so that the reciprocation of the block turns the arm and shaft.

Obtaining Sulphur and its Compounds from Gas Lime.

Julius Kircher, New York city.—This invention is intended to provide a simple and efficient means of extracting sulphur, sulphuric acid, and sulphurets of sodium and potassium from gas lime. The lime is heated to 300° Fah. in a closed retort, and steam at 600° Fah. passed over it, evolving sulphuretted hydrogen, which passes to a leaden chamber, and is there ignited with atmospheric air to produce sulphurous acid; it is then mixed with nitric acid vapors, when the reaction produces sulphuric acid. The gas lime is mixed with clay, loam, or sand, and subjected to heat, when the silica or alumina unites with the lime and with oxygen, forming silicate of lime, etc., and liberating the sulphur. To produce the sulphuret of sodium or potassium, the gas lime, etc., is mixed with caustic soda or potassa, and allowed to stand until the reaction takes place.

Improved Manufacture of Gas.

Robert H. Patterson, Hammersmith, England.—This invention relates to the purification of coal gas, used for illumination, by the use of purifying vessels containing alkaline sulphides or sulphur finely divided and mixed with a substance which will permit the gas to pass freely; especially is the presence of this sulphide or sulphurous mixture necessary in the first of the purifiers, called the "decarbonating vessel," the other vessels containing the alkali to be converted into sulphide. The decarbonating vessel is recharged when the mixture therein is saturated with carbonic acid gas, which is indicated by the presence of that gas in the illuminating gas leaving the vessel; and when the gas issuing from the vessels containing the alkali to be sulphuretted shows the presence of sulphuretted hydrogen, the production of the sulphides is complete.

Improved Stop for Water Main Attachments.

William Young, Easton, Pa.—As a cheaper stop for keeping the water back while attaching service pipes to water mains until a connection is made, a pipe connection attached to the main is proposed, consisting of two sections coupled together by a union, with a disk of glass or any substance that will break readily by a crushing force, and packing washers between the two sections, which will stop the water until the connection is made and then let it flow by screwing up one section against the other, hard enough to break the glass.

Improved Corrugated Metallic Rolling Shutter.

Alexander Clark, London, England.—The object of this invention is to deaden or prevent noise in raising and lowering corrugated metal revolving shutters. The invention consists in applying a soft or pliant material—such as leather, webbing, sheet india rubber, or india rubber tubing—to the shutters and the grooves in which they move. When applied at one or more intermediate points in the width of the shutter, a strip or length of the material is used, fastened at one end to the top and the other end to the bottom of the shutter, and also at any intermediate points, as required, so as to coil up therewith, and form a cushion between the several coils of the metal shutter, and thus prevent the noise produced by the corrugations catching and slipping over one another when the shutter is being coiled or uncoiled. In addition to the said strips the edges of the shutters which move in the grooves are bound with india rubber or leather as well as the grooves themselves. The inventor is a very extensive manufacturer of iron shutters, metallic cornices, etc. The invention just patented is considered a very important improvement.

Improvement in the Manufacture of Acid Phosphates.

Henri Storck and Farnham Maxwell Lyte, Asnières, near Paris, France.—It has hitherto been found difficult to extract, from the phosphoric acid or superphosphate as usually produced, the sulphuric acid employed in the attack. The object of the present improved process is the extraction of this sulphuric acid. The inventors take mineral phosphates, bone earth, or any other form of phosphate of calcium, more or less impure, and treat them with the quantity of sulphuric acid requisite to convert them into phosphoric acid, or a soluble acid phosphate of calcium; the former, remaining in solution, is drawn off. This liquid is now treated with ydrate of barium, carbonate of barium, sulphide of barium, or any convenient compound of barium, by means of which the sulphuric acid may be withdrawn from the solution of phosphoric acid. Another method consists in forming an acid phosphate of barium, lead, or strontium, and adding this, in sufficient quantity, to the crude phosphoric acid or superphosphate. By either of these means the sulphuric acid contained in the crude phosphoric acid is precipitated, and the purified phosphoric acid or superphosphate may be drawn off by decantation or filtration.

Improved Press.

Warren E. Warner, Syracuse, N. Y.—The top of the press is a broad and strong metal cross head cast in one piece, with holes for the rods, lugs, and sockets for the upper ends of the toggle jointed bars, and with the strong projection from the under side downward from the center for guiding a screw and the ratchet nut. The follower starts level in the beginning of the operation, and does not require the powerful guiding follower stem (commonly used in this kind of press) with the double cross head, between which it works to keep it level at starting, as when pressing cider, hay, and the like. The cavities in the nuts for the round heads of the bars are made so that the heads of the two bars will meet at the bottoms of the sockets which run into each other and roll together, so as to transmit the force directly from one bar to the other, and relieve the nuts of the strain, besides changing the friction from sliding to rolling, and thus economize power and wear.

Improved Station Indicator.

James K. Magie, Canton, Ill.—In this invention an endless belt carries the names of the stations, and works over rollers, one of which is turned by a shaft and wheel connected by suitable gearing with a pin wheel, all to operate by a stop piece arranged on the track at the stations, against which one of the pins of the wheel comes, as these contrivances are usually arranged. Mechanism is provided in order to have the pin wheel turn further than it naturally will by the influence of the stop against which it comes, so as to have the next pin in advance high enough to clear the blocks in all contingencies when not set to be acted upon by them, and yet come down to a vertical line to be ready for the next stop.

Improved Clock Escapement.

Charles Fasoldt, Albany, N. Y.—This invention has for its object to so impart the impulse to the pendulum of an astronomical or other clock that the said pendulum will not receive it directly from the escape wheel, but indirectly by a gravity arm or lever whose oscillations are created by the escapement. In this manner a surplus power may be imparted to the clock without increasing the oscillation of the pendulum, and a complete regulation is obtained. The present invention is based upon the United States letters patent which were granted to the same inventor February 1, 1859, and March 7, 1865, more especially upon the latter.

Improved Dried Fruit Loosener.

Cornelius Hagan, Waterloo, Iowa.—This invention has for its object to furnish an improved device for loosening dried apples, dried peaches, and other dried fruit packed in barrels or boxes. The invention consists of a square steel rod, having its lower part flattened, coiled spirally and pointed and provided with a handle.

Improved Fruit Dryer.

John Stevenson, Sparta, Ill.—This invention consists in a fruit dryer having two separate but communicating chambers, which are provided, one with a series of superposed open frame supports for trays, and with steam pipes arranged beneath the open frames, and the other with a steam coil, which serves to heat the air preparatory to its passage to the drying chamber.

Business and Personal.

The Charge for Insertion under this head is $1 a Line.

Notes & Queries

A. P. asks: Is there an invention for extracting watery matter from meat for the purpose of preserving the meat?

S. A. says: We have serious difficulty in drying glue in making petroleum barrels during hot southerly winds in summer. Can you tell us of any preparation that will facilitate the drying of glue and not injure the oil?

A. E. S. says: I tried to make ink by following the recipe given in a recent number of your paper; but as soon as I put in the bichromate of potash, the water and coloring separated, and no amount of gum would make them unite again. Why did I fail?

U. E. asks: What are the cause of and remedy for the cracking of taps, etc., when in process of hardening in water? Oil will not always make them hard enough. The same trouble occurs with cutters, which crack and split off from the outside circle. It is usually accompanied with a report, especially in the cutters.

C. E. asks: Can you give me a reliable approximation of the horse power required to drive the different kinds of cotton machinery, namely, opening and lapping machines, cards, drawing, coarse, intermediate, and fine speeders, ring spinning, mule spinning, spooling, warping, slashing, weaving, etc.?

D. T. asks: What is the best process for imitating Russia leather?

R. C. K. desires to know the difference of strength, for farm purposes, in ashes made from white wood and from oak, maple, and birch.

J. H. P. asks for a formula for determining with accuracy the contents of a barrel or cask when only partly full.

S. A. T. asks for a recipe for a dead black for making a "black board" on white pine.

S. A. T. says: I should like a recipe for making hard soap for toilet use, say about 25 lbs. quantity, colored and perfumed.

W. H. R. asks: Can magnesium be obtained in a finely comminuted state? If so, where and at what price, and how are its characteristic qualities affected?

W. F. H. asks for the best method of cleaning empty cider barrels so that they will be sweet when wanted for use in the next fall.

J. H. W. asks: 1. If 100 gallons of proof spirit are mixed with 100 gallons of water, what will be the degree below proof and what the gravity? 2. How many gallons of water are required to reduce 100 gallons of spirit of 60 above proof to a spirit 20 below proof? 3. Is there a rule for reducing a high proof liquor with one of lower proof?

B. L. B. asks: Is the temper of steel knives impaired by cutting apples or other fruit? If so, why?

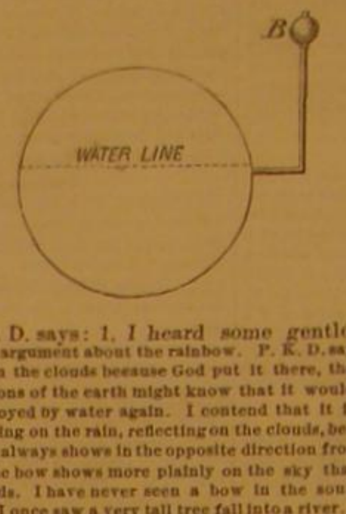
B. L. B. says: I have noticed that my varnish (gum shellac and alcohol), after standing a while in tin cups, becomes of a dark muddy color. Does the tin affect it?

J. W. K. asks: Would there be any advantage in using dry sponge as a filling for waterproof life preservers, rafts, etc.? Could sponge itself be made waterproof, so as to retain the buoyant properties of dry sponge?

Answers to Correspondents

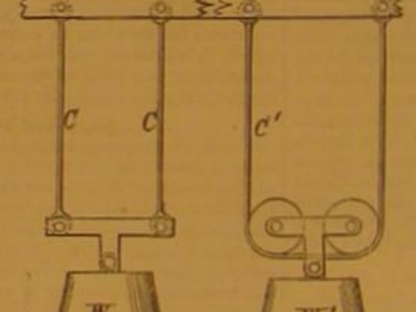
J. B. asks how to prevent food, put in a cupboard newly painted inside and grained outside, from tasting of paint. Answer: Wait till the smell has passed away, which will be when the paint, varnish, etc., are thoroughly dry.

E. J. M. says: Near here was a high pressure steam boiler, with a low water indicator attached, as represented below. During a cold snap, the little globe marked B was found filled with ice, and a piece was broken out. It puzzles us to know how the globe could have been filled with water, when there was nothing to prevent its flowing back to the boiler as fast as condensed. One says the pipe, being only ⅜ inch diameter, filled up and froze first. There's the rub, as how did any more pass, so as to fill the globe? A friend says that he took the indicator down, and that there was nothing in the pipe at all, neither ice nor anything else. Answer: With a small pipe, the water would not be able to circulate within and to allow of the entrance of steam or air to displace it. The pipe should be made at least ¾, and straight from B down to the lower end.



J. B. D. says: 1. I heard some gentlemen have an argument about the rainbow. P. K. D. says the bow is in the clouds because God put it there, that all the nations of the earth might know that it would not be destroyed by water again. I contend that it is the sun shining on the rain, reflecting on the clouds, because the bow always shows in the opposite direction from the sun. The bow shows more plainly on the sky than on the clouds. I have never seen a bow in the south or north. I once saw a very tall tree fall into a river. The water splashed up about 40 feet high, and came down in a fine sprinkle; there was as fine a rainbow shown as ever I saw. 2. I have heard it said that the machinery of a water mill ran 25 per cent faster in the night than in the day time. The water appeared to be the same. What was the cause of it? 3. I want to know the cause of the knocking in an engine. One engineer says it is in the cross head, another says it was an up and down or side knock in the wrist. Answers: 1. The cause of the rainbow is that supposed by our correspondent. The rays of light from the sun, reflected and refracted by the transparent rain drops, are brought to the eye in such a manner as to cause the beautiful colors that characterize the rainbow. The center of the curve, the sun, and the eye, are always in one line. Hence a rainbow cannot be seen at midday. The moon sometimes causes a rainbow to appear. The physical conditions necessary to produce the rainbow may have first occurred as stated in the Scriptures. Scriptural truths and the truths of nature never conflict, although our interpretation of the former often creates an apparent contradiction. 2. We do not know what is the cause of the phenomenon noted. 3. We cannot guess, but a good engineer should be able to determine by examination.

G. C. H. says: W W' represent two weights of equal heft and size; one is suspended by two wire ropes, C C, the other by one continuous rope C', passing under pulleys with smooth flat faces. Some assume that these methods of suspension are equally strong; others assert that the continuous rope will break quicker at A, than the two ropes, C C, for reason that the con-



tinuous rope is straining apart between the two pulleys. Which is the strongest, if there be any difference? Answer: There would be no difference in the amount of strain on the rope, and one would be just as likely to part as the other, if the ropes are equally strong. The tension on C' must be equal throughout, at A as well as elsewhere, and equal to that on each part of C.

J. B. P. says: A circular sawing machine, run by one or two men with cranks, has two light balance wheels, 22 inches in diameter. Would there be gain, or loss, by placing a large balance wheel beneath the floor, connected by a belt with the machine? If such a change is advisable, what size and weight of wheel would be necessary? We use an 8 inch saw. Answer: We should not anticipate a gain, and the friction of the added apparatus would cause loss of power.

R. & S. say: We are running an engine 7 inches x 12, cutting off steam at half stroke, and running 175 revolutions per minute; we use a 20 horse power boiler, and carry 70 lbs. of steam. Please state how many lbs. of steam we should carry to give one half of the power as described above, and also how we should run the engine to produce its full power. Answer: Answered in part on page 257 of our current volume. Probably 40 lbs. steam would give about half power. It can only be determined with certainty by the indicator or dynamometer.

E. says: One of our workmen from England gave us the following recipe for removing scale from boilers. Is there anything injurious to the iron or objectionable otherwise? 3 lbs. gum catechu, 3 lbs. black lead, 6 lbs. crystals soda. Answer: The mixture would do no harm, probably, unless when used in excess; the decomposition of the gum should produce vegetable acids. Let us know, if it succeeds, what kind of water you have, and the nature of the scale.

F. O. C. says: 1. I claim that in order to get perfect combustion, you must not admit any more air under or through the fire than it will consume, for if you do, it will tend to deaden the fire, and to lose the heat that you would get if only the right quantity were admitted. A friend claims that it does not matter how much air you admit to the fire, and that all the difference is, that the fire roars under my arrangement and not under the other; but still, he says, the fire is burning just as well as at first. 2. My friend says the classics are the foundation of everything in the matter of learning. I say they are not; and that, if a great part of the time spent on them were devoted to mathematics, mechanical drafting, drawing, natural philosophy and some other practical studies, there would be many less drones in the battle of life, and that we should have many more young men ready and willing to work. Many a father and mother will work to stuff their children with Latin, French and German; and when the parents drop by the way, dead, the children find their stay is gone. 3. My friend says the Christian Sabbath was not changed from the seventh to the first day of the week till a number of centuries after Christ, and that by the Pope. I claim that Christ changed it when He arose from the dead, and that that day was in reality our Sabbath, and that it has been so regarded by historians ever since that time; and that nowhere in the New Testament, after the death of Christ, can you find it mentioned as any other than the first day of the week. 4. On page 251 of your current volume, the directions for making sealing wax do not say what the proportion of shellac should be. 5. A book on astronomy says that light moves 288,000 miles per second; I claim that it is from 188,000 to 192,000. Which is right? Answers: 1. Were it possible to reduce the temperature of escaping gases to that at which they entered the furnace, your friend would be correct. Actually, however, he is wrong. It is, however, found usually necessary to supply about twice the quantity of air required to combine with the fuel, in order that complete combustion may take place. The excess causes some loss, but it is not so serious as would be the loss from incomplete combustion, were a less quantity supplied. About 12 pounds of air per pound of fuel would be sufficient, could time be given it to find and unite with every atom of fuel. It is, however, necessary to supply usually 24 pounds, although in some cases of forced draft the quantity has been brought as low as 18 pounds. 2. To a man of fortune, or to the man who proposes to devote his life to study, we should say that his education would be incomplete did it not include a knowledge of the classics. To the man of business, to the working man, or to any one who must depend upon his own intelligence, energy and education for support and for success in life, we should commend a thoroughly practical, technical course of study. Were we desirous of fitting a son for a high position as a workman, and to take a valuable position as superintendent of a manufactory, we should send him to some such school as the Industrial School at Worcester, Mass. If he aspired to excellence as a professional mechanical engineer, we might give him a higher course of study in such a school of engineering as that of the Stevens Institute of Technology, at Hoboken, that of the Massachusetts Institute of Technology, in Boston, or that of the Sheffield School, at New Haven. To make him a good civil engineer, we should go to a special school of engineering like that at Troy, N. Y. The necessity of such schools has long been seen by us, and in answer to the rising demand they are springing up all over our country. Their success is one of the most encouraging signs of the times. 3. Your friend is about right. The change, however, was a gradual one, beginning with the time of Constantine the Great, in the fourth century. 4. Six ounces. 5. You are right.

E. W. G. says: 1. I have two engines running a circular saw mill. They have cylinders 8x22, set about 5 feet apart and connected by a crank on each end of shaft. The boiler is an upright tubular. The steam pipe is 2 inches, about 30 feet from boiler to near the cylinders; then it branches to each steam chest with 1½ inch pipe. The question is: Is this 2 inch pipe large enough for the main pipe, and the 1½ inch for the branches? 2. The regulator valve is about half way along the main pipe; would it be better nearer the engines or the boiler? 3. My steam gage shows 10 lbs. when at rest, and we usually run the engines at 60 lbs. by it. Do we really have 60 lbs., or only 50 lbs.? Is there any way of adjusting the gage? Answer: 1. We should make the main pipe about 2½ inches diameter, and perhaps 3 inches, if the engine were running at high speed, and the branches 2 inches. 2. The regulator should always be as near the cylinder as possible. 3. Probably 50 lbs. Have the gage tested if you would be safe.

L. P. C. says: I would like to know how large a round chimney would be required for a boiler with 38 three inch tubes. In other words, ought the chimney to contain the same number of inches in its area as the sum of the areas of the tubes? Answer: The chimney is usually made of somewhat less cross area than the collective cross section of the tubes. A common proportion, when natural draft is employed, gives the area over bridge wall one eighth the area of grate, one ninth through the tubes, and one tenth in the chimney.

H. B. B. says: I have a saw mill with 54 inch saw; the engine is of 11 inches bore x 4 feet stroke. There is a drum of wood 12 feet in diameter, connecting with counter shaft, on which is a small drum, 22 inches in diameter, and a large drum about 3 feet in diameter. I use two cylinder boilers, no flues, 34 inches in diameter and 24 feet long, and have considerable trouble in keeping up steam, with wood sometimes partly wet. The smoke stack is of iron, 26 inches diameter and 30 feet long. What kind of grate surface should I have to burn saw dust and wet wood? Would a blast of air or steam help it? Which is best of the two, and at what point and in what way should it be applied? How many revolutions per minute should the saw make cutting soft cypress timber, and how much feed should there be to each revolution? Answer: Run the saw about 600 revolutions per minute. There are many devices for burning wet saw dust and spent tan bark, few of them satisfactory, however. A blast must be used to burn them on ordinary grates, but it is better to make special furnaces for them, with large area of grate, and with provision for drying them before burning, and allowing considerable air to enter above the grate.

S. B. E. asks: What injury, if any, would there be in oiling locomotives and other machinery with hot oil, say at boiling point? Which lens would be best for a miniature bull's eye lantern with very small flame, plano-convex or double convex? Answers: 1. There should be no injury to the machinery from the high temperature, unless where the parts are case hardened. But hot oil has less body than cold, and would be less valuable as a lubricant. Using hot oil would compel running journal brasses quite slack, to prevent binding and overheating in consequence of expansion with the heat. 2. Plano-convex, with plane side toward the source of light.

A. V. K. asks: How can the horse power of a boiler of given dimensions be ascertained? Answer: Already answered in earlier numbers. About one horse power for each twelve feet of total heating surface is a common proportion in the boilers of good builders.

F. F. M. asks: 1. What diameter of cylinder and what length stroke must I give the engine for a horizontal boiler 12 x 30, of ¼ inch iron, with no flues? The engine is to run 100 to 150 per minute. 2. What pressure can ¼ inch iron stand, and what horse power would such an engine be? Answer: 1. About a 1¼ or 1½ inch cylinder by 3 or 4 inch stroke. 2. It would be safe, if the heads were well secured and work well done, at 175 lbs. 3. Perhaps ½ horse power.

H. C. J. asks: 1. Will a boiler, under which there may be the usual amount of fire, make or lose steam if the blow off or safety valve is suddenly opened wide, or the engine started in the same way. 2. Have you ever published a report of a trial in regard to loss of weight and heat in coal from being stored in the open air? If so, please tell me where I can find it. Answer: 1. The rapidity of generation of steam would be temporarily increased by opening the safety valve or increasing the speed of engine. The pressure would not be increased, although the mass of steam in motion may carry a quantity of water with it sufficient to strike a dangerous blow upon any surface against which it may be thrown. 2. We cannot call to mind any such trial.

J. T. says: I cannot understand the answer to the crank question: 1. What do you mean by a line perpendicular to both the lines of the shaft and of the crank? 2. Have I found the proper thickness of cylinders in the two following cases, according to Van Buren's formula, $t=\cdot 03\sqrt{DP}$? A 10 inch cylinder with 90 lbs. pressure, I found to be 0·9 inches, and a 72 inch cylinder with 25 lbs. pressure, 1·27. 3. Please give me a plain, simple rule for obtaining the right size of a wrought iron connecting rod for any pressure of steam, and (4) also the right diameter and length of a parallel wrought bar to resist any pressure without deflexion. 5. Please let me know where you get the 806,000 when calculating the collapse of flues. 6. How does Van Buren arrive at his formula? In your answer draw all your reasoning right from the foundation or the strength of the material, so that I may know where and how every number is found. Answers: 1. Put on another crank at right angles to the first, and it will be at right angles both to that crank and to the line of shaft. 2. We make $\cdot 03\sqrt{DP}=0\cdot 9$ and $=1\cdot 35$ for the two examples. 3. We know of no simpler rule than that given by Professor Thurston, in an approximate formula: $d=\sqrt[4]{\frac{D^2pl^2}{20000}}+\frac{1}{16}D$. Rule: Multiply together the square of the diameter of cylinder in inches, the maximum steam pressure, and the square of the length of the rod in feet, between centers; divide the product by 20,000 and extract the fourth root of the quotient. Add $\frac{1}{16}$ D, and the result is the diameter of the rod in inches at its middle. 4. No rod can be made to bear any pressure with absolutely no deflection. 5. 806,000 is a coefficient derived by Mr. Fairbairn from experiment. 6. Van Buren's formulas are based upon the results of experiments made by trustworthy authorities, and by comparison with the experience of practical application.

J. G. H. says: I am using 3 plain cylinder boilers for grinding purposes, with a plain slide valve engine which works very well. The objection is that we use too much wood. Two of the boilers are side by side; the third is separated by a brick wall, and so constructed that we can shut off the feed water and steam connections, and use 2 boilers only; but we cannot keep up steam unless we have the best wood. What I wish to know is: Would it be safe to leave, and should I gain power by leaving, the steam pipe open from the boiler, with the feed pipe shut off and no fire under it? Would it answer for a steam dome, it being level with the boiler, or would it be dangerous and disadvantageous? What is the cause of the smoke stack getting red hot? It is 3 inches in diameter, of ⅛ inch iron, 25 feet long horizontally, then 4 feet high. Answer: The trouble is, first, that a plain slide valve is not an economical arrangement, although eminently satisfactory on the score of expense for repairs. If it has lap enough to cut off at about two thirds stroke, and both piston and valves are tight, nothing can be done to improve it, probably. If the steam pipe and cylinder are lagged, to prevent radiation of heat from them, the exterior is probably all right. The boilers have too little heating surface in proportion to the amount of wood burned, and therefore cannot absorb the heat generated, which consequently escapes through the smoke stack, heating it as described. More heating surface is wanted. The arrangement proposed to increase steam space would, probably, simply result in filling that boiler with water from condensed steam and priming. It would be better to keep both steam and feed pipes open, but even then we should not expect, on the whole, an advantage.

H. T. L. asks: How can I estimate centrifugal force? For instance, what will be the centrifugal force of a one pound weight, revolving at 100 revolutions per minute in a 4 foot circle around a perpendicular shaft, and what is the rule by which I can get at the force of any weight at any speed in any circle? Please give me an arithmetical answer, as I do not understand algebra. Answer: Multiply the square of the number of revolutions per minute by the radius of the circle in which the body swings, and by its weight in pounds, and divide the product by 100,000. Thirty-three times the resulting figure will be the centrifugal force in pounds. This rule, expressed algebraically is: $F=\cdot 00033WRN^2$. In this case, $F=\cdot 00033\times 1\times 2\times 100\times 100=6\cdot 6$ lbs. If our correspondent were to take the time and do some hard work in learning the principles of algebra, he would never regret such use of his time. A little patience and earnest effort would accomplish a great deal even without teachers.

W. W. says: 1. My employers and I appeal to you to decide a question about the horse power of a first class horizontal steam engine, cutting off steam at a point that will give it the most power. The size of cylinder is 10x18, pressure of steam 60 lbs. at boiler; the engine runs at 80 revolutions per minute, or 240 feet speed of piston; there is a 2 inch steam pipe 8 feet long. We are about ordering a new engine of a good firm, whence this dispute has arisen. I maintain it will give us nearly 20 horse power, if properly constructed. They say I am greatly in error in overestimating it. I also maintain that, if we speed it up to 100 revolutions, it will give us 25 horse power. 2. I would also like to know your opinion as to the most economical coal to use under a 25 horse power boiler (tubular) with a good draft. We are using large Lehigh. It is thought that a cheaper coal would be better. Answers: 1. We think our correspondent right on the question of power. 2. It is generally economy to use the best coal. The difference in price is rarely sufficient to compensate for the difference in heating power, and for the annoyances attending the use of poor coal.

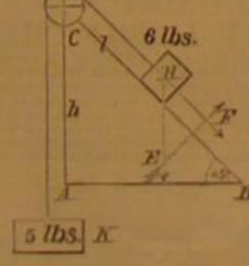
C. S. C. says: I have a small English toy locomotive, and I cannot make it go. It is eighteen inches in length, and runs on eight wheels; two of them are the drivers. The cylinders are about two inches, and oscillate from the end. The trouble is as follows: When I get up steam sufficiently to run it, I turn on steam, but the engine will not go; if I lift it up so that it will not touch the track, the wheels go around with lightning speed; but as soon as I let it down on the track, they stop. I always keep on sufficient quantity of steam. Can you suggest a remedy? Answer: Probably the valve may be set with too much lead.

D. K. asks for an explanation of the phenomena of polar attraction and magnetic variation. In this latitude, 40° N., variation west has increased 1° in fourteen years. Why is it that the annual precession is not the same everywhere? As you are supposed to know everything, I think that you can give a more satisfactory explanation than can be found in ordinary treatises on surveying. Answer: The directions of the magnetic and the geographical or true meridian do not coincide because the geographical and magnetic poles are many miles apart. The variation is westerly in the eastern states, and easterly in the western states. The line of no variation is nearly straight, passing in a north northwest direction from the extreme eastern point of South America, through Cape Hatteras, Cleveland, O., and Erie, Pa. The changes of variation are secular, annual, diurnal, and irregular. The latter may be comparatively great, are liable to occur at any time, and are subject to no known law. The diurnal change, though small in amount—a quarter of a degree at most—is quite enough to produce annoying differences in surveys of the same line taken at different times of the day. This change of a quarter degree amounts to about 25 feet in a mile. Annual changes of this diurnal variation are noticeable, this change being twice as great in summer as in winter. The secular variation extends over a period of centuries, and the amount of this change is, in Paris, where it has been longest observed, over 34 degrees. These changes correspond to and accompany the solar movements. The irregular are frequently—although not invariably—produced by solar phenomena. The diurnal accompany the rotation of the earth, which thus presents its sides successively to the sun's rays; the annual follow the motion of the earth in her orbit, and the secular probably have a close correspondence in period with secular changes in the relation of the sun and the earth. These variations have different magnitudes at different points on the earth's surface, in consequence of the fact, already stated, that the geographical and magnetic poles and meridians do not coincide; and hence, while the needle at Cape Hatteras may point north, at the north pole it would point south. The north magnetic pole is in 70° N. lat. in the Earl of Ross Strait. If our correspondent will trace meridian from it on a globe, he will readily solve all the problems which occur to him.

J. R. L. says: We have a gin connected with our mill. Is it possible to extinguish fire in a lint room with steam? If so, how should it be applied, with stationary pipe entering at bottom or top of room, or with hose? We only use forty pounds steam when ginning. 2. In cleaning out the furnace, I notice drops of water standing at one seam of boiler; is that a sign of rust or burning? It is clean and smooth inside. No water runs after the fire is started. Answers: 1. Steam will extinguish fire in a lint room, or in any other apartment where it can be sufficiently well confined to thoroughly pervade the enclosed space. It would be best applied by leading pipes into the room and making them fixtures. In an emergency a hose pipe could be thrust through a small hole cut in the door or a partition, and steam carried by hose, of gum or well greased leather. The nozzle should, of course, be covered with canvas or other covering to enable it to be handled. Forty pounds pressure, or even four, would be ample for the purpose. 2. No.

H. S. M. wishes to know where an indicator can be purchased, what it will probably cost, how it should be applied, and what the result will be. Answer: A treatise upon the construction, method of application, and the interpretation of the diagrams obtained by the steam engine indicator, would occupy far too much space for our columns. We have prepared a brief sketch for the general reader, but for such full accounts as every engineer should make himself familiar with, our correspondent must consult some such work as that of Chas. T. Porter on the Richards indicator, to be obtained through any bookseller. The instrument can be purchased of Elliott, of London, or of the dealers in engineers' supplies in New York or Boston. A pair of good instruments cost about a hundred dollars.

C. B. N. sends the following solution of the problem proposed by E. C. M., who said: "A body weighing 5 lbs. descends vertically and draws a weight of 6 lbs. up a plane whose inclination is 45°," and wishes to know "how far the first body will descend in ten seconds." Let A B C, in the figure, represent the inclined



plane, and H and K the weights, joined by a cord which works over a pulley at C. Let l=length of the plane, h=hight of the plane. From H, draw a line H E, perpendicular to A B and let it represent the pressure of the weight at H. Then resolve H E into components, H F and F E, parallel and perpendicular to B C. The component F E will be counteracted by the reaction of the plane and only the component H F will produce tension on the cord. To find the value of H F, we have, HE : HF : : l : h; or 6 : HF : : $\sqrt{2}$: 1; or, $HF=6\div\sqrt{2}=3\sqrt{2}$. To find the acceleration of the descending weight at K, we have the general principle that the mass multiplied by the acceleration is equal to the moving force; or, representing the acceleration by a, $Ma=f$, or $a=\frac{f}{M}$ (1.) In this case, f, the moving force, is the difference between the weight at K and HF, or $f=5-(3\sqrt{2})$. (2.) The whole mass moved is equal to the sum of the weights K and H F divided by g, the acceleration due to gravity; or $M=(5+3\sqrt{2})\div g$; or, since $g=32\frac{1}{6}$ feet at New York, $M=(5+3\sqrt{2})\div 32\frac{1}{6}$. (3.) Substituting the values of f and M (equations 2 and 3) in equation 1, we have $a=\frac{f}{M}=(5-3\sqrt{2})\div(5+3\sqrt{2})\times 32\frac{1}{6}=2\cdot 63$ feet. (4.) Again we have from the laws of falling bodies that the space through which the body falls is equal to the acceleration multiplied by the square of the time and divided by two, or $h=\frac{1}{2}at^2$. Substituting in this the value given for t (=10 seconds) and the value of a from equation 4, we have: The distance $=h=2\cdot 63\times 100\div 2=131\cdot 5$ feet. The principles involved in this problem are substantially the same as those upon which the action of the well known Atwood's machine is explained.

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

H. W.—Both are crystaline hornblende, of no value.

T. F. A.—Iron pyrites, of no value.

COMMUNICATIONS RECEIVED.

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

On Fast Side Wheel Steamers. By M. N. L.
On the Million Dollar Telescope. By O. M. and by F. C. V.
On a Vacuum Balloon. By F.
On Deep Sea Soundings. By H. N. C.
On Increasing the Crops. By A. W.
On Diving Bells. By Q.
On the Wheel Question. By H. S.
On the Aurora Borealis. By. A. C. C.
On Air and Gas Engines. By F. G. W.
On Sugar Boiling Apparatus. By A. W. J. M.
On Plows. By L. L. B.
On the Sea Urchin. By P. S.
On Tannate of Soda. By N. S. T.
On a Boiler Explosion. By W. J. S.
On Deep Sea Soundings. By A. R.
On Science and Revelation. By J. W.

Also enquiries from the following:

E. J. M.—S. W. J.—E. W.—G. W. T.—H. N. J.—A. B.—D. J. R.—L. P. A.—C. F. S.—G. F. M.—C. M. B.—M. K.—C. K. C.—B. H. G.

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 22, 1873,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents

Acid vessel cap, J. Matthews	138,171
Baby jumper, A. F. Spooner	138,209
Barrels, etc., rolling, B. V. Tamplin	138,055
Bed bottom, spring, Thompson & Kendrick	138,156
Bed spring fastener, D. A. Scott	138,203
Bedstead, invalid, G. W. Grote	138,083
Bell, door, J. Harrison	138,151
Belt fastening, J. E. Richard	138,194
Boats, detaching, J. M. Kilner	138,165
Boats, detaching, F. M. Munger	138,041
Boiler, wash, R. Langenbach	138,167
Bolt mechanism, T. R. & J. Pullis	138,099
Boot heel stiffening, Darrow & Wait	138,010
Book case, folding, E. Haskell	138,022
Book, pocket, L. Wendt	138,217
Boot, plow, C. H. Ricker	138,196
Bottle, nursing, G. R. White	138,219
Bottle washing apparatus, Schlich & Feyh	138,046
Box cover, blacking, J. B. Shaler	138,102
Box opener, L. Mills	138,177
Button, F. Washbourne	138,107
Bridge, draw, L. Schneider (r)	5,372
Bridge baluster, Sellers & Manly	138,049
Brush, P. Wagner	138,213
Canal, H. Hill	138,156
Car brake, J. N. Brush	138,126
Car brake, E. Farnsworth	138,141
Car, convertible freight, T. Fogg	138,142
Car heater and ventilator, C. F. Whorf	138,062
Car wheel, H. Merrill	138,096
Card machine, postal, J. M. D. Keating	138,023
Carriage axle box, Jones & Dunkerley	138,091
Carriage door, J. Cunningham	138,008
Cart, dumping, B. Fitzhugh	138,013
Cartridges, etc., capping, J. F. Nettleton	138,180
Cement for roofing, G. Howland	138,159
Chair, folding, A. C. Boyd	138,124
Chair, school, E. J. Piper	138,190
Chocolate, soluble, J. Correll	138,007
Churn, W. H. Holdsm	138,089
Churn, reciprocating, M. Litty	138,168
Cigar holder, T. J. Lewis	138,032
Clothes pounder, S. Hinkel	138,034
Clothes pounder, D. W. Rawson	138,044
Clothes wringer, R. S. Cathcart (r)	5,360
Clutch for machinery, W. B. Duckworth	138,139
Clutch, friction, J. J. Coburn	138,073
Cock, etc., blow off, E. G. Cushing	138,077
Coffin handle, C. Strong (r)	5,374
Cooler, beer, A. F. Rick	138,195
Cooler, milk, W. Hodgdon	138,088
Corn sheller, Brown & Shangle	138,125
Coupling, universal, H. S. Leland	138,031
Cradle, automatic, I. Goldman	138,144
Cultivator, J. Helm	138,085
Curtain fixture, T. Symonds	138,054
Curtain roller holder, B. G. Fitzhugh	138,014
Cutter bars, holding, W. H. Daniels	138,136
Dentist's tool, C. P. Grout	138,150
Derrick, J. E. Walsh	138,215
Desk and seat, A. E. Roberts	138,045
Drawer, B. J. Greely	138,017
Dredger, E. B. Bishop	137,998
Drill, grain, J. King	138,166
Door lock, J. Scott	138,048
Dyeing aniline black, J. Higgin	138,155
Egg beater, N. C. Miller	138,094
Elevator, A. C. Herron	138,154
Elevator, grain, H. Merrill	138,175
Eyelet, S. W. Young	138,221
Fabric selvages, uniting, T. Beven	137,997
Faucet, self-closing, A. & E. Buckman	138,128
File, paper, R. Henning	138,084
Fire arm, Holt & Marshall	138,157
Fire arm, D. Smith	138,207
Fire arm, revolving, G. W. Schofield	138,047
Fire escape, G. H. Shaw	138,051
Fire extinguisher, J. D. Bresnihan	138,068
Fire place back, G. W. Cummings	138,135
Fireproof ceiling, etc., J. W. Bassett	138,118
Fireproof floor, etc., W. Neracher	138,196
Fork, horse hay, H. C. Stouffer	138,211
Fruit basket, S. B. Conover (r)	5,361
Furnace, cupola, J. B. Pearse	138,184
Furnace, hot air, C. L. Pierce	138,188
Furnace, hot air, C. L. Pierce	138,189
Gas light indicator, etc., W. W. Goodwin	138,016
Gate, automatic, N. Long	138,033
Gate, iron fence, C. T. Bush	138,087
Generator, gas, D. H. Irland	138,160
Generator injector, steam, S. Rue, Jr.	138,198
Generator injector, steam, S. Rue, Jr.	138,199
Generator, steam, R. Hooper	138,025
Grater, G. Booth	138,122
Grater, nutmeg, A. L. Platt	138,191
Grater, vegetable, G. Booth	138,123
Gun lock, C. Gordon	138,145
Hame tug clip, J. P. Welpton (r)	5,376
Harness collar, H. B. Morrison	138,039
Harness check hook, H. A. Carlton	138,003
Harvester, S. L. McCollock	138,172
Harvester, corn, S. Patton	138,181
Harvester, cutter, C. Pomeroy	138,192
Hat ear covering, B. R. Morse	138,040
Heater, steam, E. Russell	138,200
Hedge trimmer, S. B. Turner	138,106
Hemmer, E. S. Yentzer	138,064
Hinge, gate, W. G. Franklin	138,081
Hinge, lock, M. C. Lee	138,092
Horse hoofs, paring, G. W. Schafer	138,101
Horse power, A. G. Waterhouse	138,108
Horse fly guards, suspender, G. Shelton	138,205
Hub, vehicle, A. Warner, (r)	5,366
Injector, engine, S. Rue, Jr.	138,198
Injector, engine, S. Rue, Jr.	138,199
Iron beam, wrought, L. Kirkup	138,029
Iron and steel, puddling, J. G. Blunt, (r)	5,367
Jack, lifting, W. M. Doty	138,078
Jack, lifting, H. H. Warren	138,059
Journal, anti-friction, M. E. Dayton	138,011
Knife, corn stalk, J. M. Brick	138,069
Knife, pocket, H. Staude	138,052
Lamp, G. Brownlee	138,070
Lamp, J. A. Pease	138,185
Latch handle, Ambrun & Olfermann	138,112
Lathe for wood, C. A. Blessing	137,399
Leather, boarding, O. Coogan	138,133
Lock for drawers, etc., E. G. Gory	138,148
Loom shuttle binder, Hammond & Tucker	138,020
Loom, lappet, F. W. Newton, (r)	5,365
Loom temple, N. Chapman	138,004
Loom for wire, S. Holdsworth	138,090
Lubricator, Lunkenheimer & Meehan	138,169
Marble, molding edges of, J. Finn	138,079
Mill hopper, grinding, G. S. Thompson	138,212
Mill pick, E. S. Forgy	138,080
Mill, rolling, J. E. Atwood	138,114
Millstone dress, J. P. Harris	138,021
Millstone spindles, oiling, J. J. Chubb	138,074
Millstones, cooling, Shanton & Shaver	138,050
Miner's bar, R. B. Platt	138,098
Mirror, signaling, M. M. Kenney	138,162
Molding machine, J. W. Gheen	138,015
Music notation, E. P. Stewart	138,104
Neck tie, R. R. Parker	138,097
Nut lock, W. B. Wait	138,214
Nut machine, J. Braun	138,065
Ordnance, C. Gordon	138,146
Ordnance, E. A. Sutcliffe, (r)	5,375
Oven, bake, J. J. Piggott	138,042
Oyster dredge, I. A. Ketcham	138,164
Paper machine suction, W. McLaughlin	138,173
Pavement, D. C. Heller	138,024
Pavement, concrete, J. W. & H. W. Krause, Jr.	138,030
Photographs, cutting out, J. Schofield	138,202
Pianoforte bridge, W. C. Ellis	138,012
Piano hammers, capping, I. Bullard	138,001
Pipe tongs, A. H. Jarecki	138,161
Pipes, mold for earthen, P. McIntyre	138,035
Pipes, etc., heating, Grimm & Corvin	138,082
Planter, corn, G. O. Houck	138,158
Planter, cotton, W. Price	138,043
Planter, seed, I. T. Suggs	138,105
Plow, J. M. Cobb	138,131
Plow, J. Roop	138,197
Pools, etc., cleaning cess, W. C. McCarthy	138,034
Press, embossing, G. Clisbee	138,130
Press, hay and cotton, G. W. Stewart	138,210
Propeller, screw, J. Montgomery, (r)	5,364
Propeller, operating screw, A. Lee, (r)	5,371
Pump, mining, G. E. Mills	138,037
Punch, portable, J. J. Safely	138,201
Railway snow plow, O. D. Baird	138,116
Rake and tedder, R. J. Colvin	138,132
Refrigerator, D. Mulcahy	138,095
Rule, square and bevel, C. M. Heffron	138,152
Sash holder, L. A. Tuttle	138,057
Saw mill carriage, B. F. & J. B. Smith	138,206
Saw scroll, H. B. Smith	138,103
Saws, sharpening, Davidson & Winningham	138,137
Sawing machine, band, O. Bonney, Jr.	138,121
Scissors, A. Whittemore	138,061
Scow, dumping, A. T. Morris	138,179
Screw making machine, J. Braun	138,067
Scrolls, drawing, E. E. Stebbins	138,053
Scrubbing machine, S. H. Bush	138,129
Scythes, rolling, H. Waters	138,216
Seat, J. Peard	138,183
Separator, middlings, A. R. Guilder	138,019
Sewing machine, M. H. Kernaul	138,163
Sewing machine chair, F. Chichester	138,073
Sewing machine ruffler, D. C. Carey, (r)	5,368
Sewing machine shuttle, W. Cooney	138,134
Sewing machine thread cutter, Henry & Wood	138,153
Shaft hanger, W. Bellis	138,119
Shafting bearings, casting, J. Miller	138,176
Shoe fastening, I. Banister	138,117
Shoemaker's finishing tool, Wilson & Foster	138,063
Sizing compound, T. Gorrel	138,147
Skate, roller, W. P. Gregg	138,018
Slate frames, finishing, J. H. & G. S. Coffin	138,005
Slate washer, W. Westlake	138,218
Snow shovel, H. C. Cole	138,076
Soda water cock, etc., W. Gee	138,143
Soda water fountain attachment, W. R. Cady	138,002
Soldering apparatus, J. Gulden (r)	5,362
Spikes, pointing, Waldron & Moore	138,058

Square, try, W. F. Arnold 138,113
Stamps, affixing, Benseman & Slocum 138,110
Stereotyping, rubber, G. H. Cooke 138,006
Stone, dressing, G. R. Ray 138,100
Stove, cooking, A. C. Barstow 137,998
Stove, cooking, D. G. Littlefield 138,095
Stove, reservoir, H. F. T. Hale (r) 5,369
Table leaf support, G. Payzant 138,182
Tanning, Davis & Armstrong 138,138
Telegraph line, E. H. Austin 138,115
Thill coupling, G. W. Hobart 138,067
Tobacco boxes, recessing, I. M. Beames 138,193
Toy, T. Morley 138,034
Toy house, J. B. Smith 138,208
Trunk, M. H. Bliss 138,000
Turn table, W. Sellers (r) 5,373
Vault cover, T. Sharts 138,204
Vehicle wheel, Wright & Jones 138,220
Ventilator, S. C. Maine (r) 5,363
Vessels, construction of, W. F. Morgan 138,178
Wagon, dumping, J. H. Adriaans 138,111
Wall, plaster, M. F. Lyons 138,170
Wash board, G. Elsey 138,140
Washer, spring plate, F. R. Gridley 138,149
Washing machine, J. C. Burgner 138,128
Washing machine, N. O. Wilcox 138,110
Watch pinion, reversible, F. Pickert 138,187
Watchman's time check, T. Hahn 138,084
Weather strip, J. & G. Bacon 138,065
Well boring, artesian, W. McPherson 138,174
Windmill, W. Peck 138,196
Window, S. Darling 138,009
Window button, A. D. Judd (r) 5,370
Wire cloth, drying painted, C. H. Waters 138,089
Wood, etc., bundling, H. A. House 138,026
Wood, etc., bundling, H. A. House 138,027
Wood finishing compound, F. Webster 138,109
Work stand, C. S. Caple 138,072

EXTENSIONS GRANTED.

23,730.—Animal Trap.—A. S. Blake.
23,771.—Cuffs, etc.—W. E. Lockwood. Three patents.
23,792.—Gas Pipe Cutter.—J. E. Stanwood.
23,795.—Pump Box.—F. & J. Stock.

DESIGNS PATENTED.

6,594.—Carpet.—J. Fisher, Enfield, Conn.
6,595.—Coffin Handle.—N. Hayden, Essex, Conn.
6,596 to 6,602.—Carpets.—H. Horan, Newark, N. J.
6,603.—Reed Organ Case.—J. R. Lomas, New Haven, Ct.
6,604 & 6,605.—Carpets.—L. G. Malkin, New York city.
6,606 & 6,607.—Carpets.—E. J. Ney, New York city.
6,608.—Carpet.—H. Nordmann, New York city.
6,609.—Frame.—B. H. Slusser, L. Pearson, South Bend, Ind.
6,610 to 6,612.—Carpets.—J. H. Smith, Enfield, Conn.

TRADE MARKS REGISTERED.

1,218.—Soap.—R. W. Bell & Co., Buffalo, N. Y.
1,219 to 1,222.—Whiskies.—Du Vivier & Co., N. Y. city.
1,223.—Hair Dressing.—E. A. E. Meyer, Watertown, N. Y.
1,224.—Cosmetic.—Miller Brothers, New York city.
1,225.—Yeast Powder.—Preston & Merrill, Boston, Mass.
1,226.—Starch.—Proctor & Gamble, Cincinnati, Ohio.
1,227.—Cigars.—Seidenberg & Co., New Yok city.
1,228.—Mineral Water.—A. L. Kane, Milwaukee, Wis.
1,229.—Flour.—Jones, Williams & Faxon, Boston, Mass.
1,230.—Grinding Mills.—Straub Mill Co., Cincinnati, O.
1,231.—Opera Glasses, etc.—Sussfield & Co., N. Y. 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.

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 1861 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

Design Patents.

Foreign designers and manufacturers, who send goods to this country, may secure patents here upon their new patterns, and thus prevent others from fabricating or selling the same goods in this market.

A patent for a design may be granted to any person, whether citizen or alien, for any new and original design for a manufacture, bust, statue, alto relievo, or bas relief, any new and original design for the printing of woolen, silk, cotton, or other fabrics, any new and original impression, ornament, pattern, print, or picture, to be printed, painted, cast, or otherwise placed on or worked into any article of manufacture.

Design patents are equally as important to citizens as to foreigners. For full particulars send for pamphlet to Munn & Co., 37 Park Row, New York.

Trademarks.

Any person or firm domiciled in the United States, or any firm or corporation residing in any foreign country where similar privileges are extended to citizens of the United States, may register their designs and obtain protection. This is very important to manufacturers in this country, and equally so to foreigners. For full particulars address Munn & Co., 37 Park Row, New York.

Canadian Patents.

On the first of September, 1872, the new patent law of Canada went into force, and patents are now granted to citizens of the United States on the same favorable terms as to citizens of the Dominion.

In order to apply for a patent in Canada, the applicant must furnish a model, specification and duplicate drawings, substantially the same as in applying for an American patent.

The patent may be taken out either for five years (government fee $20), or for ten years (government fee $40) or for fifteen years (government fee $60). The five and ten year patents may be extended to the term of fifteen years. The formalities for extension are simple and not expensive.

American inventions, even if already patented in this country, can be patented in Canada provided the American patent is not more than one year old.

All persons who desire to take out patents in Canada are requested to communicate with Munn & Co., 37 Park Row, New York, who will give prompt attention to the business and furnish full instruction.

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.

Foreign Patents.

The population of Great Britain is 31,000,000; of France, 37,000,000; Belgium, 5,000,000; Austria, 36,000,000; Prussia, 40,000,000, and Russia, 70,000,000. Patents may be secured by American citizens in all of these countries. Now is the time, when business is dull at home, to take advantage of these immense foreign fields. Mechanical improvements of all kinds are always in demand in Europe. There will never be a better time than the present to take patents abroad. We have reliable business connections with the principal capitals of Europe. A large share of all the patents secured in foreign countries by Americans are obtained through our Agency. Address Munn & Co., 37 Park Row, New York. Circulars with full information on foreign patents, furnished free.

Copies of Patents.

Persons desiring any patent issued from 1836 to November 26, 1867, can be supplied with official copies at a reasonable cost, the price depending upon the extent of drawings and length of specification.

Any patent issued since November 27, 1867, at which time the Patent Office commenced printing the drawings and specifications, may be had by remitting to this office $1.

A copy of the claims of any patent issued since 1836 will be furnished for $1.

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