SCIENTIFIC AMERICAN

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

Vol. XXXV.—No. 4. [NEW SERIES.] | NEW YORK, JULY 22, 1876. | $3.20 per Annum. [POSTAGE PREPAID.]

THE CENTENNIAL EXHIBITION.—THE CAMPBELL PRINTING PRESS.

About 200 feet west of Machinery Hall, upon a commanding eminence, is situated the building illustrated on page 391, volume XXXIV, which has been erected by the Campbell Printing Press Company, at their own expense. On one floor of the building are ten of the different styles of printing machines manufactured by this company, the most noticeable of which is the perfecting and folding press. This machine uses duplicate forms, and is claimed by the inventor to print on both sides, from a continuous web of paper, fold, lay away in piles, and count 30,000 copies of an ordinary daily newspaper per hour: a figure which will be readily comprehended when reduced to 500 sheets per minute, or 8⅓ per second: and, as they are printed on both sides, it is equal to 16⅔ impressions in each second of time

Our illustration shows this machine in perspective; on the right is seen the roll of paper from which it is fed, with spare rolls ready to replace the one in process of being printed on. From this roll, the paper passes, first to the upper, then to the lower impression cylinder, and thence on to the left side of the machine, where it is cut, folded, and counted; which latter operation is recorded on the register shown just above the pile of paper on the front.

When the rotary press of Richard M. Hoe was the acknowledged fastest press of the world, the paper was printed on one side only; it needed a second feeding through to perfect it, and required as many feeders as the machine contained impression cylinders, which ,in the largest size, were ten; and as the sheets from each cylinder were laid away by a separate fly, there was no difficulty in disposing of any number of sheets properly, as fast as the machine could print them. But when the perfecting or web press had been so far improved as to overcome the difficulty of preventing the offset of the ink, there was a difficulty in disposing of the sheets as they came from the press. In the printing of a newspaper at the rate above-mentioned, the paper must issue from the machine at the rate of nearly 2,000 feet per minute; and for laying away in an orderly pile such sheets of paper, issuing from a machine and succeeding each other at the rate of 8 or 9 in a second, the ordinary fly was out of the question. The Campbell press not only lays the sheets out in perfect order, but folds them twice, thus dispensing with one of the most vexatious and costly (in point of time wasted) suffixes to the labor attaching to the newspaper printing press.

Underground Pumping.

At a recent meeting of the Society of Engineers, London, Mr. V. Pendred, President, in the chair, a paper by Mr. Henry Davey, on the underground pumping machinery at the Erin Colliery, Westphalia, was read. The paper described what is probably the largest example of underground pumping engines extant. The system, which was originated by the author, may thus be briefly described. In the mine (which is 1,200 feet deep), 920 feet from the surface, is placed a pair of compound differential pumping engines, capable of raising 1,400 gallons per minute to the surface, at the same time supplying power through the medium of the rising column to two differential hydraulic pumping engines placed at the bottom of the mine, and employed in lifting 1,000 gallons per minute to the main engines. Steam is carried down to the main engines, from the surface, at a pressure of 70 lbs. per square inch. After passing through the engines it is condensed, and a vacuum of from 24 to 26 inches of mercury is obtained by means of a separate condenser which produces at once the vacuum on the engine, and enables it to start to work against the full column. The methods of actuating the valves in the steam and hydraulic engines were fully shown. In the latter case the valves are worked without any metallic connections, by means of a modification of the differential gear. The paper was illustrated by detail drawings of the steam and hydraulic engines, and also of the separate condenser, as well as by working models of the machinery

American Kaolin.

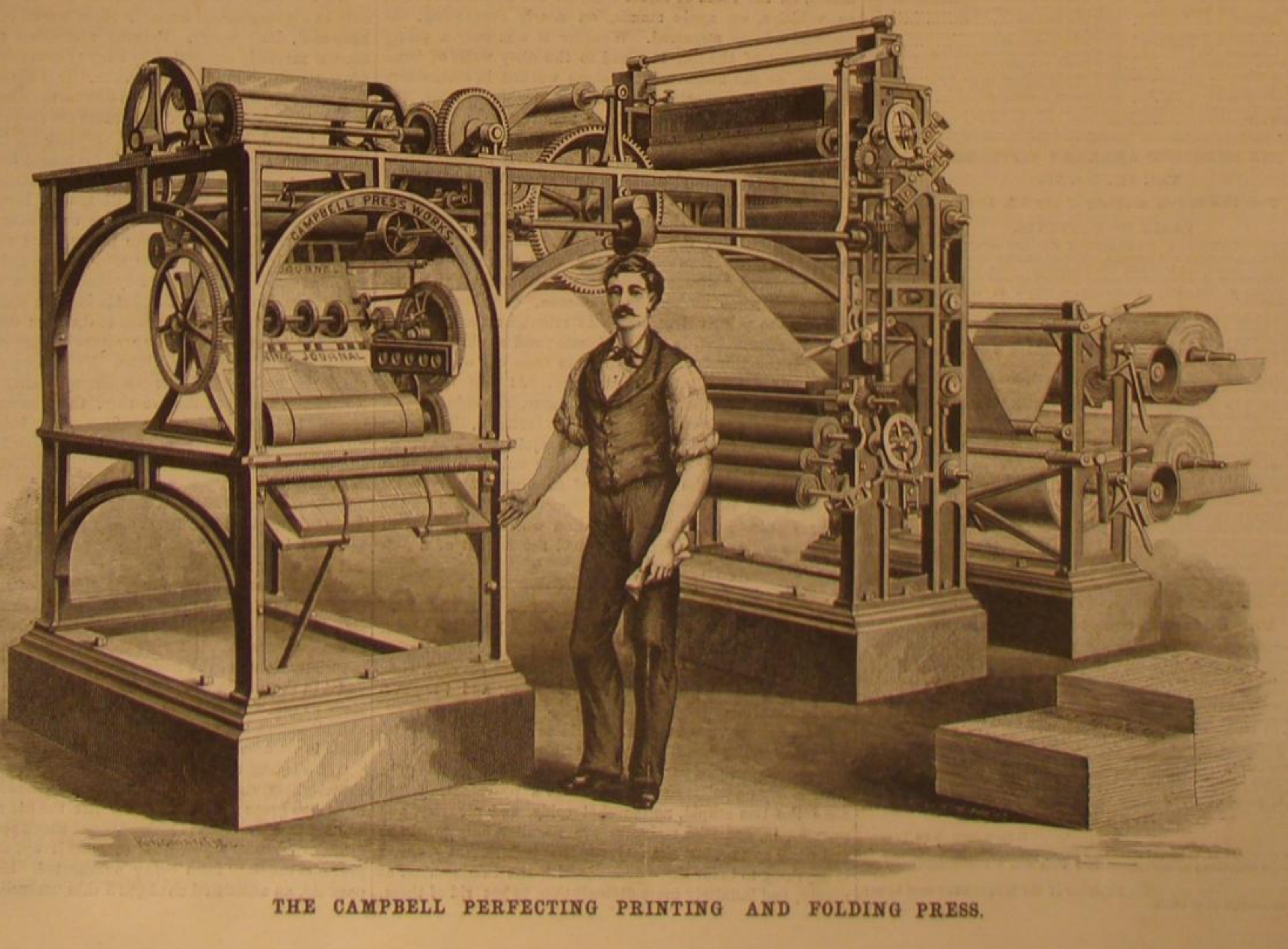
About a year ago, in describing the process of manufacture of porcelain, in the vicinity of this city, we called attention to the fact that beds of kaolin undoubtedly existed in this country, and all that was required was the enterprize necessary to develop them. There is every inducement, both in the shape of a demand for the material by potters and of a protective duty of $5 per ton, to attract our citizens to obtaining from our own resources the clay which now is imported from England, and, at the same time, there is the higher incentive of aiding in building up an American industry to supply us with the manufactured products which we now principally buy from France.

Since the publication of the article referred to, many of our readers have informed us of kaolin beds, located in various parts of the country; and this information has been, in the columns of this journal, laid before porcelain makers. The troub'e, however, with most of the native deposits is the impure nature of the material. To make fine porcelain, which must rival in purity and whiteness the famous productions of Limoges and other French towns, the material must be strictly pure. Clay that is coarse and contaminated with metallic oxides serves well enough for opaque stone ware, and we have never heard that any lack of that substance has been encountered; but it should be borne in mind that such will not answer for fine goods of the kind wherewith our potters hope successful y to compete against foreign manufactures, at least until some one discovers an excessively cheap and perfect method of purification. It is cheaper to import the English clay, a fact obvious when it is considered that the merest admixture of ocularly imperceptible iron impurities in the paste results in the finished goods being blotched with ineradicable spots, and of course in their ruin as first class marketable articles.

Whether the large deposits recently found in Illinois will turn out of sufficient purity for general use, we are not yet prepared to say. Mines of kaolin have been discovered over 120 acres of Union County, Illinois, and in adjoining localities; and a town named Kaolin has there been established. We are indebted to Mr. Moritz J. Dobschütz, the owner of a large portion of the tract, for samples of the material, and for information relative to the mines. The kaolin is of a pure white, blue, white and pink quality, and appears sometimes naked to the eye, and sometimes in pockets 60 to 70 feet deep. Mr, Dobschütz states that there is every facility for the establishment of a pottery in the vicinity.

Electroplating of Leaves, Insects, etc.

A new and improved method of metallization of organic substances, so as to fit them for receiving galvanic deposits, has been devised by M. Cazeneuve. It is both more rapid and more safe for the operator than the ordinary way. The nitrate of silver which serves for the metallization is dissolved in wood spirit, by which means a thorough impregnation of the object is obtainable. After maceration (more or less) the object is dried through rapid agitation, but while still moist it is submitted to a saturated solution of ammonia gas, and thus is formed a double nitrate of silver and ammonia, easily reducible. Drying is then completed at a mild temperature, and the object is then suspended in mercurial vapors and completely metallized in a few minutes. By this method, the author says, he has obtained a regular layer of copper on leaves, flowers, insects, etc.



THE CAMPBELL PERFECTING PRINTING AND FOLDING PRESS.

Scientific American.

ESTABLISHED 1846.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT
NO. 37 PARK ROW, NEW YORK.

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

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VOLUME XXXV., No. 4. [NEW SERIES.] *Thirty-first Year.*

NEW YORK, SATURDAY, JULY 22, 1876.

Contents.

(Illustrated articles are marked with an asterisk.)

THE SCIENTIFIC AMERICAN SUPPLEMENT.

Vol. II., No. 30.

For the Week ending July 22, 1876.

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A SENSIBLE CELEBRATION—WHAT WAS DONE IN NEW YORK CITY.

The people have very good cause to congratulate themselves over the very sensible manner in which the Centennial anniversary was celebrated. In this city—and the same appears to have been the case generally elsewhere—the tendency to abandon the Chinese method of signifying rejoicing by hideous noises of fire crackers, torpedoes, pistols, and similar ear-splitting contrivances, and to substitute therefor the silent but more eloquent display of banners, flags, and illuminated lanterns was plainly manifest. By what process of election, during the early history of the nation—unless we mingled ideas of Guy Fawkes' day, derived from the mother country, in a very uncomplimentary manner with our national holiday—we were ever induced to adopt the fire cracker as a symbol of joy, must remain a mystery. Suffice it, however, that the popular predilection for the noise nuisance is on the wane; and we may hope, in each recurring holiday, to see the inherent taste of our people exemplified by new and beautiful decorations, and all classes gratified, instead of a few finding pleasure in a species of amusement of which the annoyance of others and the endangering of life and property are the too common results.

Those who can recall the illuminations of New York city during the war, after Union victories, or her magnificent outburst of patriotism, demonstrated by draping almost every edifice in bunting, shortly after the rebellion broke out, say that even these demonstrations were exceeded in grandeur by the display made recently in New York. For weeks past the dry goods stores have been filled with national flags by the million. It would seem as if manufacturers of cotton goods and delaines have, of late, made nothing but the stars and stripes, or red, white, and blue fabrics. For the first time we saw an innovation in the shape of American flags of bunting, 9 and 10 feet in length, and also smaller silk ones, entirely printed on a single piece. It certainly is a curious fact that, during the immense demand for flags in the war time, no one produced them in this way, and that, with the exception of the cheaply printed affairs for children, there were no flags made except those sewn together piece by piece.

Foreseeing the prospective demand for lanterns and lights, for illuminating purposes, a variety of ingenious contrivances were devised. There were lanterns made of pasteboard, in flower pot shape, with holes covered over with colored paper in fanciful designs. Inside of these, instead of a candle, was a little cup, full of a composition of tallow and wax, in which a wick floated. The cup had a long handle, and was made of tin or other cheap metal. The light emitted was equal to that of two or three candles, and the contrivance was far more safe than the latter. Another form of lantern was a large black box which fitted on the window sill. Each box had three or four colored disks let in apertures in it, so that a house, having boxes at all the windows, looked as if in each window there were balls or globes of colored fire. We noticed two or three ingenious devices for holding flagstaffs at an angle in windows, which were quite new, and which met with a ready sale.

Not only on the great thoroughfares, but even in the most unfrequented streets, up in the windows of crowded tenements, on the roofs of street cars, on the heads of horses, on vehicles, on apple stands, on nearly everything, the national colours appeared. Whether it was only a penny paper print of the flag fastened to the dirty walls of some rookery, or the magnificent designs worked in embroidery on the elegant mansions in the fashionable quarter, the patriotic feeling was everywhere manifest. On the night of July 3 came the culmination. From river to river, from Harlem to the Battery, New York fairly blazed. High up on the topmost pinnacle of the great Western Union Telegraph building, an electric light threw its beams far up Broadway and across the rivers to Brooklyn and New Jersey. On Union Square, the central point, the lofty buildings which surround it were outlined with myriads of brilliantly colored lanterns; while just before midnight a procession of some fifteen thousand men, carrying torches, paraded the principal streets. At midnight the vast concourse had gathered in Union Square; and as the hour was reached, the thunder of a heavy gun from one of the forts in the harbor pealed over the city. At that instant a myriad of rockets shot up from the square. The chimes in all the churches, the steam whistles of the factories, the cannon in the forts burst forth in a chorus of rejoicing. The music of the national air was played by the united bands of a dozen regiments, the hundreds of members of the choral societies and the vast crowd of spectators joined in the anthem; and thus, with a celebration worthy of herself as the metropolis, New York welcomed the advent of a new century.

DO NOT GET COOL—HEALTH HINTS FOR THE SEASON.

"Is this paper out of its senses?" we can hear the reader exclaim, as he casts a wrathful glance at the vagrant mercury, rambling among the nineties. "Do not get cool, when the sun is scorching and there is no breeze, and the pavements are almost red hot?"

Hasten slowly, good reader. We do not object to refrigeration of oneself when it is done sensibly, but the trouble is that the majority of persons throw common sense aside with their heavy under garments. There is a prevalent, though none the less stupid, notion that colds, and pleurisy, and pneumonia, and like maladies are peculiar only to winter and early spring, but the facts are that it is slightly easier if anything to incur these diseases with the thermometer at ninety, and infinitely more difficult then to get rid of them, unless dealt with promptly. Therefore we believe that "don't get cool" is sound advice, for it is better to endure the heat while well than to endure it while sick and debilitated. We recently met with some of those axiomatic sayings of the late Dr. W. W. Hall (who recently died a victim to a malady against the contraction of which he most persistently warned others), written many years ago, but always timely. We have not room for all, but the substance compressed into a paragraph will serve our purposes. If on any occasion, he says, you find yourself the least bit noticeably cool, or notice the very slightest disposition to a chill running along the back, as you value health and life, begin a brisk walk instantaneously, and keep at it until perspiration begins to return: this will seldom fail to ward off a summer cold, which is more dangerous than a cold taken in winter to all persons having the slightest tendency to consumption. If you have walking and riding to do, ride first, because if you walk you may get overheated; and then, when you ride, you may be exposed to a draft of air likely to be followed by a chill, a cold, pleurisy, or lung fever, which is pneumonia.

Not a summer passes but that the papers report numerous deaths from drinking ice water by overheated people. For purposes of quenching the thirst, water not cooled to a very low degree is much less harmful and more grateful; but if icy cold water be taken, safety lies only in drinking slowly. Take one swallow at a time, remove the glass from the lips, and count twenty slowly before taking another. It is surprising how little water will quench the thirst when thus drunk. Soda water is a favorite beverage, and bears about the same relation to cool spring water as candy does to bread. It does not slake the thirst as well as water, and, besides, one is apt to drink too much of it.

When you reach home after a day's work, tired and weak perhaps with an undefinable feeling of lassitude or depression, don't attempt to raise your spirits by drinking ice water, however thirsty. A cup of hot tea may be wisely taken by most persons, but does not agree with all. The heat is of more value than the tea itself, but both combined act beneficially on most persons. The degree of debility and downward progress of the system is arrested by the warmth of the water and the stimulating quality of the tea, until strength begins to be imparted to the system.

Never take a nap in the daytime uncovered. Many lie down for a few moments, merely to gain a brief rest, without intending to go to sleep. Too often, however, on waking up, a chilly feeling admonishes one that he has taken cold, which may be the precursor of serious illness.

Both comfort and cleanliness are subserved by wearing woolen gauze next the skin. Furthermore, this fabric prevents the sudden cooling of the body and absorbs the perspiration. Colds are caused by the temperature being too suddenly lowered. Woolen fabrics worn next to the person prevent this, as we have said, and at the same time obviate the disagreeable feeling of dampness felt when linen, especially, is next the skin. All garments worn during the day should be removed at night and thoroughly aired and dried. All changes from a heavy to a lighter clothing in summer should be made at the first dressing in the morning. It is safer to wear too much clothes than too little, especially for children, invalids, and old people.

We will relax our negative advice in one case, and then only in a metaphorical sense: in other words, in hot weather keep cool, don't worry. Persons who allow themselves to become mentally exhausted, by anxiety or strain of any kind, are particularly liable to sunstroke. It is a foolish popular idea that this terrible malady is due to the concentration of the sun's rays on the head. Persons are frequently struck, as it is termed, in the night, but are more apt to be so late in the afternoon, when the system is depressed by the heat and nervous exhaustion. The way to avoid sunstroke is to order one's doings so that vitality shall not be lowered, and the conditions favorable to the disease superinduced. A sunstroke, if not fatal, leaves the patient less able to endure mental or physical work ever after, and requires from him constant care against pulmonary disease or a second visitation. Avoid worrying the brain and an undue exposure to the sun, and, more important still, do not depress the system and lower the bodily temperature by the use of miscalled "stimulating" alcoholic drinks. To sum up all in one sentence: Do nothing to lower the normal bodily temperature. No matter how hot the weather, the temperature of the healthy body is invariable at 98°. Cooling below this is not refrigeration but depression, no matter how it is produced; and depression means loss of vitality, proclivity to disease, and death.

Since the above was written, a report of the sanitary committee of the Board of Health of this city has been made, in which it is said: "Sunstroke is caused by excessive heat, and especially if the weather is 'muggy.' It is more apt to occur on the second, third, or fourth day of a heated term than on the first. Loss of sleep, worry, excitement, close sleeping rooms, debility, and abuse of stimulants predispose. It is much more apt to attack those working in the sun, and especially between the hours of 11 o'clock in the morning and 4 in the afternoon. On hot days wear thin clothing. Have as cool sleeping rooms as possible. Avoid loss of sleep and all unnecessary fatigue. If working in doors and where there is artificial heat, see that the room is well ventilated.

"If working in the sun wear a light hat (not black, as it absorbs heat) and put inside of it, on the head, a wet cloth or a large green leaf; frequently lift the hat from the head and see that the cloth is wet. Do not check perspiration, but drink what water you need to keep it up, as perspiration prevents the body from being overheated. Have, wherever possible, an additional shade, as a thin umbrella when walk ing, a canvas or board cover when working in the sun. When much fatigued, do not go to work, or be excused from work, especially after 11 o'clock in the morning on very hot days, especially if the work is in the sun. If a feeling of fatigue, dizziness, headache, or exhaustion occurs, cease work immediately, lie down in a shady and cool place, apply cold cloths to and pour cold water over head and neck. If any one is overcome by the heat, give the person cool drinks of water or cold black tea or cold coffee, if able to swallow. If the skin is hot and dry, sponge with or pour cold water over the body and limbs, and apply to the head pounded ice wrapped in a towel or other cloth. If there is no ice at hand, keep a cold cloth on the head, and pour cold water on it as well as on the body.

"If the person is pale, and very faint, and his pulse feeble, let him inhale ammonia for a few seconds, or give him a teaspoonful of aromatic spirits of ammonia (hartshorn) in two tablespoonfuls of water with a little sugar."

SOME SOURCES OF BAD WATER.

There is no such thing as pure water, neither at the sources nor anywhere else, except in a laboratory. Pure water, therefore, or good water, in ordinary parlance, is understood by the engineer to mean a palatable wholesome water, not insipid like rain water, and not foul by the reception of that class of impurities which endanger the individual health. Unpolluted water, as we have explained in a previous article, is tasteless, inodorous, possesses a neutral or faintly alkaline reaction, rarely contains in 1,000,000 lbs. more than $\frac{1}{2}$ lb. of carbon and $\frac{1}{10}$ lb. of nitrogen in the form of organic matter, and is incapable of putrefaction, even when kept for some time in close vessels at a summer temperature. The chief causes of pollution are found in the refuse fluids from factories and in animal sewage. By a recent law in Massachusetts, the Board of Health of that State was required to investigate the pollution of rivers, estuaries, and ponds, by such drainage and sewage. And in the seventh annual report of that body we find a valuable and complete record, in which are included detailed descriptions of industrial refuse, which now, as our industries expand, threatens greatly to impair the purity of our water sources, and so react unfavorably upon the public health.

Than some of the liquids for which there is no utilization, and which are allowed to contaminate running streams, it is difficult to imagine anything more nauseously filthy. To make thirty tuns of woolen cloth, for example, over eighty-six tuns of matter composed of grease and dirt from the raw wool, urine, oil, glue, pigs' dung, pigs' blood, urine (second use), soda, common salt, soap, fullers' earth, dyestuffs, and alum are discharged into the nearest water courses. Cotton manufacture involves the pollution of large volumes of water, partly by mineral, but chiefly by organic matters. Nearly the whole of madder dyestuff is waste. We may gain some idea of the extent of the pollution from the fact that an average factory, of 250 hands, sends out some 600,000,000 gallons of foul water per annum, charged with some 1,446,000 lbs. of refuse matter, including 42,560 lbs. of arsenate of soda, containing 833 lbs. of metallic arsenic. All the chemicals used find their way into the stream. From calico dye and print works, the total impurities are found to be 76·2 per 100,000 parts, and, from Turkey red dye works, 105·7 parts. Linen and jute bleacheries discharge caustic soda, lye, waste chloride of lime liquor, waste sulphuric acid liquor, and waste carbonate of soda and soap liquor. Works for dyeing linen and jute contribute polluting liquids essentially the same as those produced in the calico industry. Silk works discharge comparatively small quantities of dyes and gums. Papermakers contribute refuse from the dusting process, lime refuse from the treatment of soda, alkaline waste liquors from the boiling process, the insoluble part of bleaching powders, the waste bleaching liquor if used in excess and without due caution), and the drainage of the making machines. Next to the fouling of water by the washing of filthy rags, the discharge into rivers of the soda liquor in which esparto has been boiled is the most formidable source of pollution from paper mills.

In comparison with the damage which is inflicted upon river waters by the sewage of towns and by drainage of textile fabric factories, the damage caused by the metal trades, with one or two exceptions, is quite insignificant. It consists of pollution by cinders, scoriæ, and furnace ashes, by acids, and by metallic salts. Iron works pollute streams in an insignificant degree by the water used for cooling the rolls, which becomes charged with tar or coarse grease from the bearings. The waste liquors discharged from wire and galvanizing works are the most intense and noxious sources of pollution contributed by any of the metal industries. The waste contents of acid baths render river water unfit for the support of fish life, and the free acid corrodes the cement and loosens the brickwork of sewers. In some tin plate works, the sheet iron, previous to receiving its coating of tin, is pickled repeatedly in dilute sulphuric acid; but the waste liquor, instead of being discharged as formerly into the neighboring stream, is concentrated in shallow leaden evaporators, until, on cooling, it deposits a copious supply of crystals of green copperas, which is sold at a small profit. The mother liquor from these crystals is fortified with fresh sulphuric acid, and used over and over again, none being allowed to go into the streams.

The effect upon fish of a number of leading and potent polluting substances, occurring as manufacturing refuse, was the subject of elaborate experiments in Scotland some years ago. The information thus obtained was of great value, as showing the degree of dilution at which the noxious matters prove fatal or are within safe limits. Goldfish and minnows were employed, the one species for its tenacity of life, the other on account of its delicate vitality. It appeared that, of nitric and sulphuric acid, one part in fifty thousand of water killed the fish. Carbolic acid was found peculiarly destructive; and tannic acid, in the proportion of $\frac{1}{14000}$ for minnows, or $\frac{1}{1000}$ for goldfish, caused death. Sulphate of copper was the most virulent metallic salt, a strong fish dying in water which contained only $\frac{1}{100000}$ part. Other substances proved fatal, as follows: Sulphate of iron and of alum, $\frac{1}{10000}$; acetate of lead, $\frac{1}{4000}$; chloride of lime (saturated solution), $\frac{1}{16000}$; chlorine (saturated solution), $\frac{1}{1400}$; iodine, $\frac{1}{70000}$; bromine, $\frac{1}{35000}$; caustic potash, $\frac{1}{38000}$; foundry coke, $\frac{1}{140}$; furnace cinders, $\frac{1}{140}$; coal tar, $\frac{1}{8750}$.

The most deadly of all contaminations is sewage, and this is now believed by chemists to be all but indestructible, being only rendered insensible in the water by being diluted with at least 100 times its volume of good water. Ordinarily, the human stomach is apparently unaffected by water exposed to a considerable measure of impurities; but it becomes fearfully sensitive to the same waters during the prevalence of an epidemic. This was conclusively shown to be the case during the terrible cholera visitations in London in 1849 and 1854. It may be added that the evil effects of much polluted water, as compared with water but little polluted, which become so palpable during epidemics, cannot cease to exist, except in degree, when no epidemic prevails. Accordingly as the river waters are cleansed from the impurities which now are expected to hide themselves there, the general health of all living things depending on them and using them must benefited.

THE CENTENNIAL EXPOSITION.

The ceremonies at Philadelphia on July 4 partook of a national character, and in this respect they must be distinguished from the local celebrations which took place in every city, town, and village in the country. Although not occurring on the Centennial grounds, they were, nevertheless, a part of the great scheme whereby we emphasize our rejoicing over the completion of the first century of national existence, and they therefore must be chronicled with the history of the Exposition.

The military parade which preceded the ceremonial included representative militia regiments and companies from the different States, the U. S. Corps of Cadets, detachments of sailors and marines, and civilian societies, making a display fully in keeping with the importance of the occasion. At a comparatively early hour, Independence Square, where the grand stand had been erected, became thronged; and when the formal proceedings commenced, the crowd was estimated at over 100,000 people. On the platform was grouped an array of distinguished men, such as has rarely before been seen. The Vice-President of the United States, in the absence of President Grant, presided. About him were the Emperor of Brazil, the Crown Prince of Sweden, Governor Hayes of Ohio, and the Governors of several other States, General Sherman, Count Rochambeau, besides the Foreign Centennial Commissions, the Diplomatic Body, and other dignitaries. The orchestra opened the proceedings by performing the grand overture composed for the occasion, which was followed by prayer by Bishop Stevens, of Pennsylvania. The hymn of welcome to all nations, by Dr. O. W. Holmes, was then sung. The most impressive episode of all succeeded. The Vice President's announcement of what was to come was not audible to the vast crowd; but when the Mayor of Philadelphia stepped upon the rostrum, holding aloft a faded yellow piece of parchment enclosed in a simple frame, the cheer which arose attested the recognition by the people of the original Declaration of Independence. The scene of enthusiasm which the production of the immortal document elicited baffles description. The applause became a mighty roar, the infection spread to the sedate dignitaries on the platform, and all rose to their feet and joined in the tremendous ovation. None cheered more lustily or swung his hat more vigorously than did His Majesty Dom Pedro II. Again and again the acclamations burst forth, until at last, through sheer weariness of its makers, the noise died away. Then Mr. Richard Henry Lee, grandson of the mover of the Declaration in the Centennial Congress, received the document, and in a clear voice read it. The Brazilian hymn, composed in honor and by order of Dom Pedro, was next rendered by the orchestra and chorus, and its repetition was demanded by the people. A superb ode, by far the finest lyric production which the Centennial year has brought forth, was recited by its author, Mr. Bayard Taylor, and received with storms of applause. Lastly followed Hon. William M. Evart's oration, a noble address, a shade too purely intellectual in character, perhaps, for the average thought, but none the less brilliant, masterly, and able. Its nature is such as to forbid abstraction; but the keynote of all was that the Declaration created what was declared, the independence of a new nation. The oration terminated the formal proceedings at Independence Square.

On the Exposition grounds, the Catholic temperance fountain and the Humboldt monument were dedicated with appropriate ceremonies. The attendance (in all 46,125), was somewhat above the average, a fact remarkable in itself in view of the other attractions in the city. Thousands of visitors from New York and other cities arrived, taking advantage of the holiday, and manfully doing the Exposition, despite the almost intolerable heat of the weather.

The Exposition itself is now running as smoothly as could be desired, and the only discontented people are those foreign exhibitors who are converting the fair into a market by selling their articles. They are required, under present custom house regulations, to pay duties on an entire invoice before a single object pertaining thereto can be delivered to the purchaser, and this regulation they are endeavoring to have abrogated. The encampment of the West Point cadets in the grounds has added a new attraction, and the morning and evening parades are attended by thousands of people

We gave last week a brief account of the

RUSSIAN EXHIBIT

in Machinery Hall. The principal display made by that nation is in the Main Building, and no part of the Exposition will more richly repay careful study. Russia is but little known to Americans by her productions, although accounts of her recent achievements in industry have not been wanting. The opportunity here afforded, of learning something definite regarding the wonderful growth, notably in art itdustries, the taste for which did not exist in 1851, but which now in Russia has reached almost a mania, is therefore of the highest value. It is not extravagant praise to say that the Russian exhibit is superb. The silver work is not excelled in the entire fair. Very curious effects are produced by imitations in white silver of the Russian napkin, with the border worked out in such a faithfully minute manner that the threads can almost be counted. These napkins sometimes form the covers of punch bowls, sometimes appear as if carelessly thrown over salvers; and so exquisite is their workmanship that they might easily be mistaken for real fabrics of linen. A peculiar Russian industry is the manufacture of a variety of articles from stones found in the Ural mountains. Malachite, jasper, and lapis lazuli are the materials mostly used; but there are also articles made of minerals quite unfamiliar in this country, such as labrador, rhodonite, and nephrite. Very beautiful are the bunches of fruits carved from the various stones, the natural colors of which reproduce almost exactly the colors of the natural fruit. We have already, in a previous article, described the magnificent malachite mantelpiece and vases. There are also numerous small tables of the same precious mineral, valued at from $100 to $1,000 each. A unique collection of fabrics come from Circassia, all of which are exquisitely embroidered in silk and in gold and silver. The display of furs is the finest in the Exposition, and some idea of the beauty of the articles may be formed from their cost. A little bunch of sable skins, of the finest quality, is valued at $2,400, a lady's cape of black fox fur is marked $1,400, and a cloak made of the backs of sables is valued at $2,700. Some gold jewelry is exhibited, remarkable for the delicate shadings of color, varying from the lightest straw yellow to brownish red. This is produced, we learn, simply by subjecting the metal to various degrees of heat. A pavilion of graceful form is devoted to the display of rubber goods, an American industry introduced recently in Russia, which has met with remarkable success, the product of the single factory making the goods amounting, it is said, to $5,000,000 in value per year. Some handsome carved work comes from the government school in St. Petersburgh. The most noticeable object is a peasant's chair in black walnut, across the seat of which lies the imitation of a towel made of some white wood. The handles are formed of hatchets. At the back of the seat is a pair of mittens admirably carved, and in the frame appears the characteristic motto in the Russian language: "Go slow and you will go far."

The Russian government is represented by superb collections of minerals and fossils, and of school books, school furniture, and other objects relating to education. Among the other exhibits are pianos, scientific instruments, amber, soap, chemicals, ladies' cloaks of velvet lined with the white hair of the Thibet goat, fans, and umbrellas. There is also a jeweled figure of St. Alexander Nevsky standing in a kind of shrine, which may be purchased for $3,500.

In Agricultural Hall the Russian display well represents the farming industries of the empire. There are grains of all kinds in sacks with glass covers and in sheaves, flax, wool, and dried fruits, canned goods, biscuits, wines, liquors, and so on through a long catalogue. The agricultural implements consist only of a mower, a thrasher, and a few fanning mills. Russia also makes an admirable exhibit in the Shoe and Leather Building, showing shoe and upper leathers, kid boots, shoes, gloves, etc., all of fine manufacture.

For a long time it was supposed that Russia would make no display at all; but when her government concluded to participate, it evinced prompt energy and liberality. A commission appointed at the eleventh hour made a list of the articles wanted and of the manufacturers who produced the best of each kind. The government undertook the payment of freight and insurance to and from Philadelphia, and of all expenses of installation. Thus, in a remarkably short space of time, a thoroughly good and, in some respects, exceedingly brilliant exhibit was organized.

Longitude by Telegraph.

The *Philosophical Magazine* has an article on the determination of the longitude of Cairo, from Greenwich, by the exchange of telegraph signals, by Captain C. Orde Brown. The actual experiments were between Porthcurnow and Alexandria, the whole series of cables being joined direct. The total length of cable was 3,222 nautical miles; 40 Menotti cells were used, although signals were read with 12 cells. The mean loss of time before the signal or make of circuit was visible was 1·34 seconds, and that before break of current signal was 1·28 seconds, the mean being 1·31 seconds.

THE Society of Arts, Geneva, Switzerland, celebrated the first century of its existence on June 1, 1876.

IMPROVED STEAM JET PUMP.

It has been customary to cast the nozzle of the above named pumps in one piece with the shell of the pump: but, owing to the peculiar shape and internal position of the nozzle, it has been found to be a difficult matter to impart a smooth finish there. An undue amount of friction is thus opposed to the passage of steam and water through the pump, which impairs the efficiency of the device.

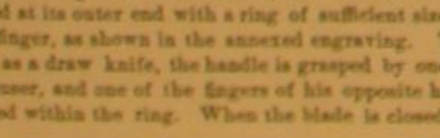
The device herewith illustrated is mainly intended to overcome the difficulty. A, Fig. 1, represents an ordinary elbow, such as is used with gas and steam fittings, and s.id elbow has the nozzle or jet pipe, P, screwed into it, as shown in Fig. 2. This nozzle is furnished with an ajutage, *b*, of a bore adapted to the capacity of the pump. Projecting horizontally from this elbow is a short pipe, C. Radiating from said elbow is the tube, D, whose office will presently appear. The above described devices A, B, *b*, C, *c*, and D, after being fitted together in the manner shown in Fig. 1, are then placed in a suitable mold, and the shell cast around them, after which the core is removed and the body of the pump is complete.

By referring to Fig. 1, it will be seen that the shell is composed essentially of an enlargement, E, and a neck, F, the enlargement being chambered out so as to afford ample space around the elbow and nozzle for the passage of water. The tube, D, is tapped for the engagement of a screw-threaded plug, J, that can be readily removed whenever it is desired to drain the pump, so as to prevent freezing. K and L represent, respectively, the inlet and discharge orifices of the shell. M and N are, respectively, the suction and discharge pipes, which communicate with the previously described orifices. O is an ordinary coupling that unites the projecting end of the pipe, C, with the steam pipe, P. The body, EF, with its unclosed nozzle, ABC, is ready for use almost as soon as it is taken from the mold. The coupling, O, and steam pipe, P, are now applied, after which steam is turned on, and the apparatus then operates in essentially the same manner as ordinary jet pumps. An economy is claimed by the inventor to result from the unimpeded flow of steam within the nozzle, formed of A and B, and of water around the same, which cannot be obtained when the parts, A and B, are rough castings.

The invention was patented March 7, 1876, by Mr. Hanson P. Tenant, of Newcastle, Ind.

COMBINED POCKET AND DRAW KNIFE.

An ingenious device, patented February 29, 1876, by Mr. John W. Pierce, of New Bedford, Mass., is a tool which may be used for a draw knife, and for all purposes required of an ordinary pocket or clasp knife. It consists in a clasp knife, having one or more blades, one of which latter is provided at its outer end with a ring of sufficient size to admit the finger, as shown in the annexed engraving. To use the tool as a draw knife, the handle is grasped by one hand of the user, and one of the fingers of his opposite hand is inserted within the ring. When the blade is closed, the ring



will extend beyond the butt of the handle, and afford a convenient means whereby the knife may be suspended from the person.

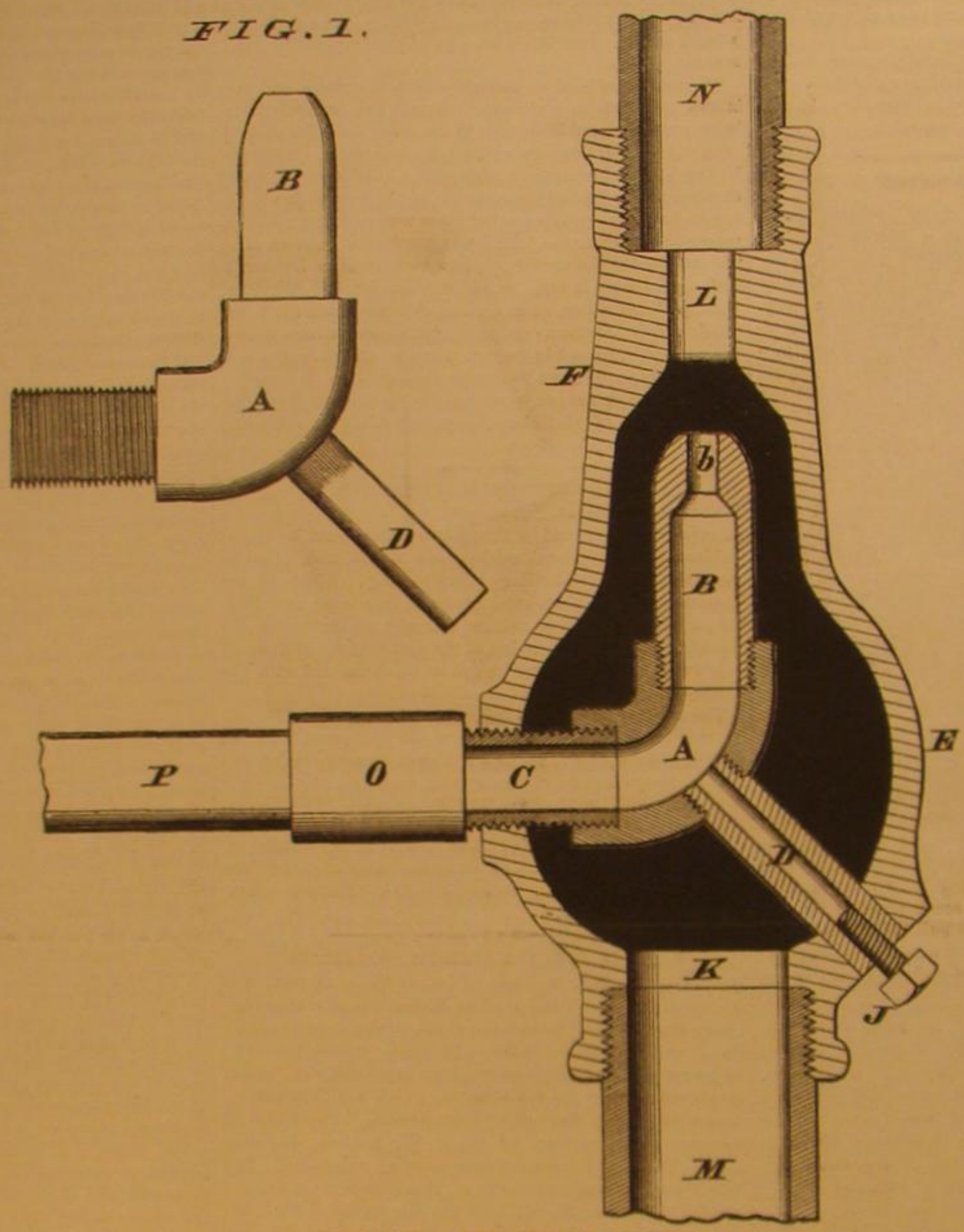
Bessemer Steel in France.

In an action brought by Mr. Bessemer against M. Schneider, of Creusot, a decision was given by the Court of Appeal against the plaintiff on April 28 last. "This decision," says the *Bulletin of the Committee of French Forges*, "extinguishes the claims of Mr. Bessemer, and is of extreme importance for the whole of the French trade. Had the claims of Mr. Bessemer been recognized, this recognition would have affected every maker of steel except M. Schneider." Bessemer steel is at present a cheap article in France, and this decision will not increase the price.

The Coca Leaf.

Sir Robert Christison showed recently, before the Edinburgh Botanical Society, that diversity of opinion had existed among chroniclers and travelers in regard to the effects of coca upon those who chew it; for, while most of them considered that it possessed wonderful powers of sustaining strength under prolonged fatigue without food, some thought its use pernicious and dangerous, others, not only innocuous, but beneficial to health. The annual consumption of the leaf, by the eight millions of people along the Cordilleras of the Andes who use it, is thirty millions of pounds. After giving a description of the coca plant, and the method of gathering and drying its leaves, Sir Robert gave an account of some experiments made upon some of his students and himself, in which he had found that it was both a preventive of

FIG. 1.



TENANT'S STEAM JET PUMP.

fatigue and a restorative of strength after severe bodily exertion, and that it had no reactionary effect upon the system. In regard to the use of coca as a medicine, he advised no one to try it until something more was known about it, or, at least, not to make use of it without consulting a physician. He had succeeded in extracting a liquor from the leaf, as a more satisfactory mode of administration than chewing the leaf; but he had not been able to ascertain whether this retained all the properties of the article. A similar *liqueur de coca* was to be had in Paris.—*Medical and Surgical Reporter.*

American Engines vs. English Engines in Holland.

The majority of pumping engines hitherto employed in Holland, for elevating water, have been furnished by English builders, who have practically had a monopoly in this respect of the Dutch market. They now find formidable rivals in American manufacturers. "The Fitchburg (Mass.) Steam Engine Company," says the *Moniteur Industriel Belge*," delivered its first machine in Holland six months ago, and has recently delivered its eighth engine in Amsterdam."

"This shows," continues our contemporary, "that with perseverance, profitable results may be attained, and it is certain that, if the American builders can compete advantageously with the English in a country like Holland, they will succeed in time, and by patient efforts, in establishing for themselves outlets of trade in every European market."

Deep Mining.

At a recent meeting of the American Institute of Mining Engineers, Philadelphia, M. Julian Déby, of Belgium, read a paper on the process of sinking deep shafts. The difficulty to be surmounted in sinking mining shafts below the water level is to get a tubing strong enough to sustain the outside pressure. M. Chaudron, a Belgian engineer, finally solved it by constructing a tube of cast iron in sections with flanges, each section being thoroughly tested with hydraulic pressure. The advantages of this system are the complete isolation of the water from all the workings; the durability of the shafting; the great diminution in the cost of the sinking the shaft; the obviation of any necessity for pumping machinery during the boring and nearly so afterwards; the greater degree of comfort to the miner by the absence of water and the possibility of traversing any number of water levels irrespective of the amount of water they contain.

Lecture Experiments with Gun Cotton.

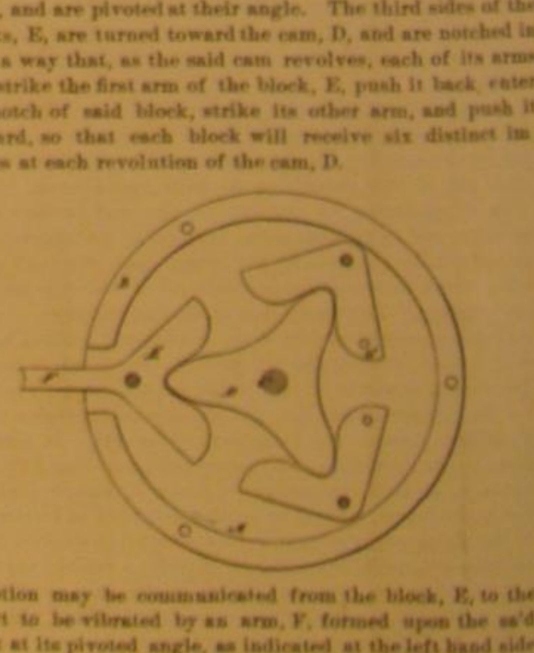
Dr. A. Vogel describes several methods of proving that nitrous and nitric acids are among the gaseous products of the combustion of trinitro-cellulose or gun cotton. A tuft of gun cotton is placed in a large test glass which tapers to a point beneath, ignited, and covered as quickly as possible with a glass plate. The interior of the glass is immediately filled with the characteristic yellowish red fumes of nitrous acid. When gun cotton is ignited on a piece of moistened litmus paper, it colors the paper red. It also reddens tincture of litmus, if burned in a beaker glass on the bottom of which is some of the tincture. When burned on a strip of moistened iodide of potassium and starch paper, gun cotton leaves a dark blue spot. The characteristic test for nitric acid with brucine can be obtained by burning the gun cotton in a conical test glass, at the bottom of which are a few drops of water, and covering with a glass plate. The water at the bottom of the glass has a strongly acid reaction and exhibits this reaction if placed on a watch glass in contact with brucine and sulphuric acid.

A curious reaction takes place when an ounce of collodion is mixed with an equal volume of concentrated nitric acid. The reaction is very violent, red fumes are evolved, heat is generated, and at the conclusion of the reaction nothing remains in the vessel but cotton, the alcohol and ether being totally destroyed or evaporated. The cotton, which now apparently possesses a fiber, is not only not explosive but is almost totally incombustible, its character having been totally changed during the experiment.

NEW MECHANICAL MOVEMENT.

We illustrate herewith a new mechanical movement for converting a rotary into a vibratory motion. It is adapted for use upon reapers, mowers, sewing machines, pumps, hammers, saws, and similar apparatus.

The case consists of two circular plates, A, attached to a hoop or flange, B, by which they are kept at the proper distance apart. To the center of the plates, A, is pivoted a shaft, C, to one end of which the power is applied. To the shaft, C, within the case, is rigidly attached a three-armed cam, D. To the case are pivoted one, two, or three blocks, E, which are made triangular in their general form, and are pivoted at their angle. The third sides of the blocks, E, are turned toward the cam, D, and are notched in such a way that, as the said cam revolves, each of its arms will strike the first arm of the block, E, push it back, enter the notch of said block, strike its other arm, and push it forward, so that each block will receive six distinct impulses at each revolution of the cam, D.

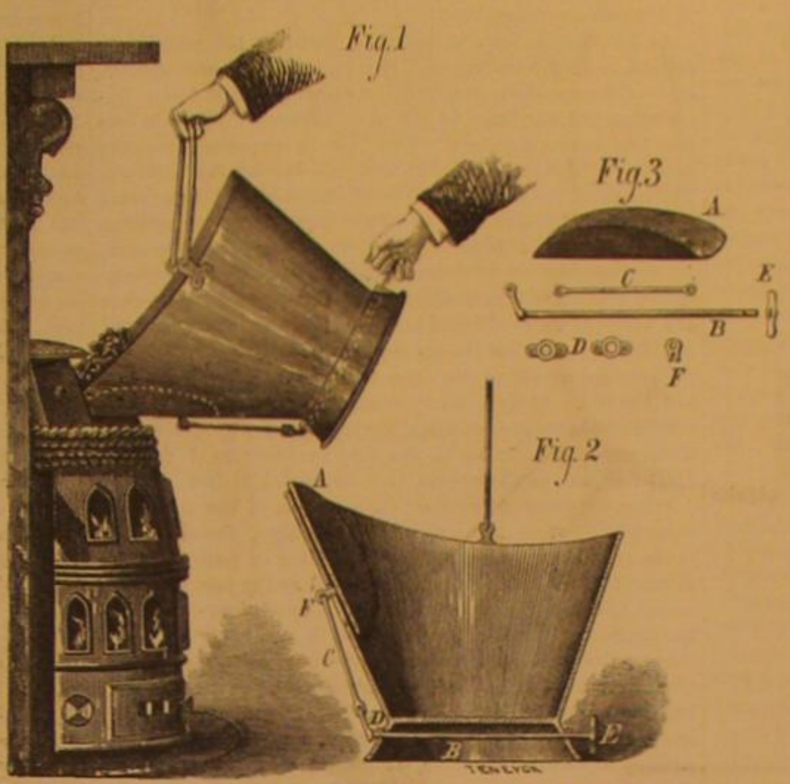


Motion may be communicated from the block, E, to the object to be vibrated by an arm, F, formed upon the said block at its pivoted angle, as indicated at the left hand side of the figure, or by connecting rods pivoted to the ends of the arms of said blocks, as indicated by the pins, G, at the right hand side of the figure. The device was patented through the Scientific American Patent Agency, May 30, 1876, by Messrs. J. Jordan and George Naylor, of Salt Lake City, U. T.

IMPROVED SELF-DISCHARGING COAL HOD.

We illustrate herewith an improvement in coal hods, designed to facilitate the discharge of coal into the stove, and to obviate the clumsy and awkward exertion with which every one is familiar. A rock shaft, B, is journaled in bearing plates, D, below the bottom of the hod, and is provided with a handle, E, in the rear and a crank in front. This crank is connected through the rod, C, with an eye, F, which latter passes through a narrow slot in the hod, and is riveted to a sliding shovel, A. By tilting the hod and twisting or rocking the shaft, B, to and fro, as in Fig. 1, the shovel, A, slides back and forth under the coal, and discharges it smoothly and uniformly into the stove without spilling. The additional cost to a hod is but trifling, as all the parts necessary to fit up an ordinary hod are shown in Fig. 3, namely, a shovel, A, formed of one half pound of No. 17 sheet iron, and one half pound of malleable iron castings, B C D E F, costing in all about ten cents. The invention is a cheap, simple, useful, and apparently practical one. It adds but imperceptibly to the weight of a hod, and does not interfere with the holding capacity of the same. It is attachable to any of the hods in use, and does not destroy the utility of the hod even if the devices bec me broken. It avoids battering the end of the hod, and dispenses with the rear handle. It does not soil the hands while operating the hod, and its attachment to the hod involves no change in the shape of the latter which would prejudice its popularity.

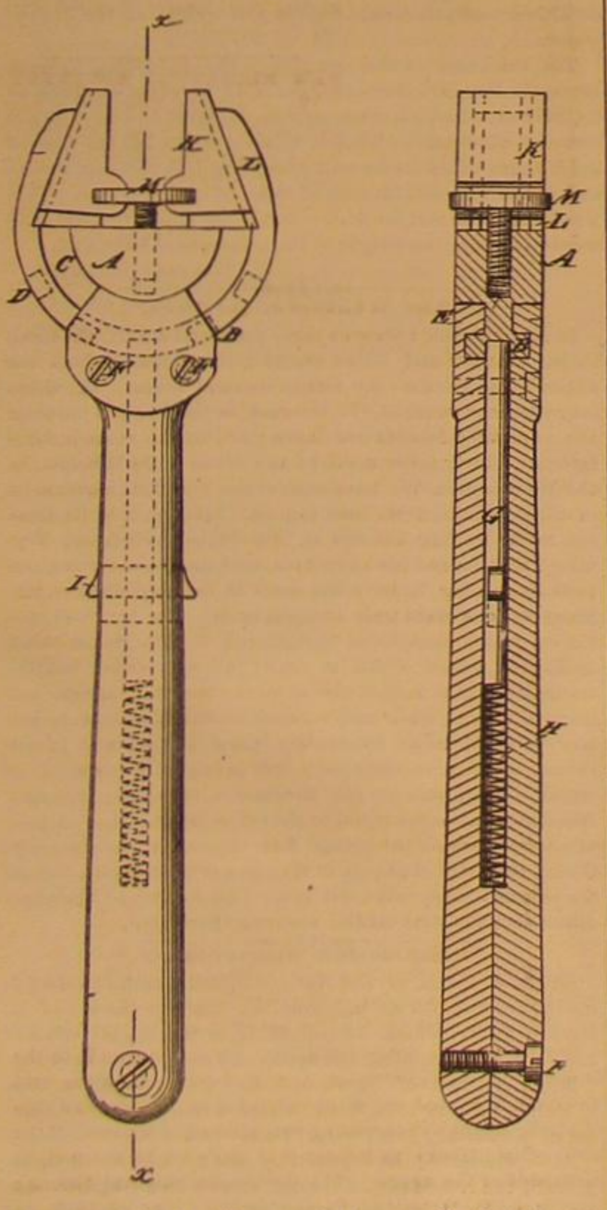
Patented through the Scientific American Patent Agency, February 9, 1875, and March 16, 1875, by Edward W. Byrn, 309 C street, N. W., Washington, D. C. Correspondence is solicited with manufacturers with a view to effecting a sale or manufacturing on royalty.



BYRN'S SELF-DISCHARGING COAL HOD.

IMPROVED WRENCH.

Mr. Wilbur J. Squire, of East Haddam, Conn., has patented (March 14, 1876) through the Scientific American Patent Agency, a novel form of wrench, engravings of which are given herewith. The jaw head, A, is constructed with a circular base, B, and a circular groove, C, on each side, also with pin holes, D, in the base. The handle is made in two parts longitudinally, which are grooved to receive the base and have a curved flange, E, to fit in the grooves of the head and secure it when the parts are fastened by screws, F. The parts of the handle are also grooved to receive the stop pin, G, and the spring, H, which are used for fastening the jaw head. These are notched to let the thumb studs, I, project sufficiently to pull the pin back for releasing the jaws. The latter are dovetailed on the inclined forks, L, of the head, to slide forward and backward so as



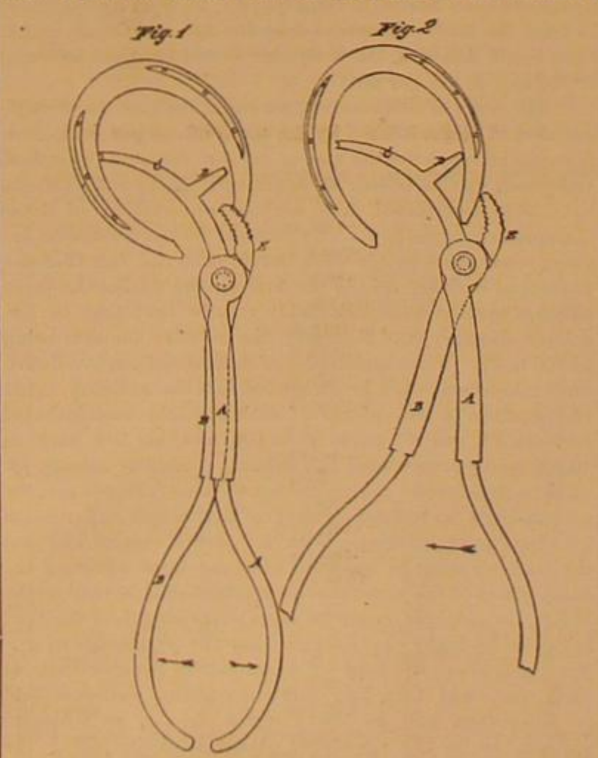
to be adjustable for different sized nuts. The disk-headed crew, M, is notched in the jaws and screwed in the head so as to work the jaws backward and forward.

Injections of Carbolic Acid in Rheumatism.

Injections of carbolic acid have been used with benefit to relieve the pain of acute rheumatism, by a hospital surgeon, Dr. A. Scharpringer. The method is similar to that practised at St. Francis' Hospital, and consists in using an aqueous solution, containing from three to five per cent of the acid. About twenty minims of this solution are used at each injection in the neighborhood of the affected joint, and the results, though not permanent, are sufficient to relieve the patient temporarily. In regard to this species of medication an important question arises, and it is this: Does the relief come from the water of the solution, or from the contained acid? When it is remembered that a large number of cases have been reported in which water alone proved sufficient to relieve paroxysms of pain for a short time, it would seem that our knowledge of the effects of hypodermic medication is by no means complete, and that further observations are necessary in this direction.—*New York Medical Journal.*

IMPROVED TOOL FOR BENDING HORSESHOES.

Mr. William Ray, of Poplar Post, Ohio, has invented a tool for straightening and bending horseshoes, of which Fig. 1 is a side view, shown in position for straightening a shoe. Fig. 2 is a side view of the same, shown in position for bending a shoe. A and B are the two handles of the tool, which are pivoted together in a manner similar to a pair of pinchers. Upon the forward end of the handle, A, is formed a



long jaw, C, which is curved outward, and its end is notched to cause it to take a firmer hold upon the edge of the shoe. Upon the middle part of the inner or convex side of the jaw, C, is formed a short arm, D, projecting at right angles, or nearly at right angles, with the jaw, C. Upon the forward end of the other handle, B, is formed a short jaw, E, which is curved inward, and has teeth formed upon both its inner and outer sides, to cause it to take a firmer hold upon the end or heel of the shoe.

In use the tool is placed between the ends of the shoe, with the end of the long jaw, C, resting against the inner edge of the shoe between the first and second nails, or thereabout, and the short jaw, E, resting against the inner corner of the end of the shoe, as shown in Fig. 1. Then, by drawing the handles, A B, apart, the shoe will be straightened or spread. To bend the shoe, the long jaw, C, is placed within the shoe, with the end of the arm, D, resting against the arm of the shoe to be drawn inward or bent, and with the short jaw, E, resting against the outer corner of the heel of the said arm of the shoe. Then, by moving the handles toward the heel of the other arm of the shoe, the said shoe will be bent or contracted.

Water Melons.

Mr. George R. McKee, of Georgia, writes as follows:

"We do not market more than one third of the melons that we can produce, the balance being virtually wasted. It is with a view to utilizing this wasted crop that I request the subject continued."

To this, the *Maryland Farmer* replies:

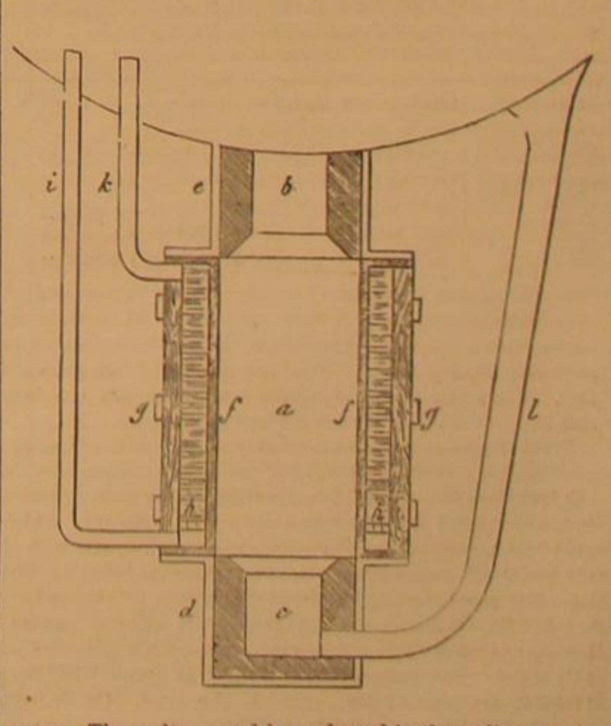
"There has been so little done in this direction, and so little experience had, that we can only give our own operations. We peeled off the rind, took out the seeds, and then crushed the melons in a cider press, squeezing out the juice; then boiled and evaporated it, in the same way as we do the sap of maple or the juice of the sorghum, and each operator will know when he has boiled it to the consistence or thickness desired; and then it should be stirred in shallow pans—like milk pans—over a gentle heat, until it becomes granulated, or "sugared off," as they say in the maple sugar works, when sirup is converted to sugar.

"We can give our readers another useful hint for utilizing their surplus water melons. It is this: Last year we saw some Virginia farmers feed water melons to their milch cows, when they came up at night, with very good effect, by increasing the quantity and improving the quality of their milk. In other instances we have seen the good results of feeding cows sound water melons; after standing in the stall or yard over night, they eat melons with avidity in the morning."

NEW METHOD OF MOLDING CYLINDERS.

The method ordinarily employed for hardening the surface of cast iron cylinders consists in casting them in iron molds with thick sides. Besides possessing a large number of other disadvantages, this system does not allow of deep tempering, since the mold itself heats very rapidly and does not serve to cool the cylinder cast in it. The method devised by M. A. Tuck, of Donawicz, Austria, says the *Bulletin du Musée*, and in which water is employed to cool the cylinder, allows of continuing the cooling process as long as is desired, and of carrying the temper as far into the interior of the cylinder as the same is generally possible by outside refrigeration.

This result is obtained by a circulation of water outside the mold. The shell, *f f*, or rather the part of the same which surrounds the body, *a*, of the cylinder to be tempered, has double sides, so as to receive the water; the trunnions, *b*, have single sides. The interior envelope, that is to say, the real mold, *f* is of thick boiler plate. Its joints are welded, and it is provided with strong welded rings of wrought iron. This mold is placed vertically and surrounded by a cylindrical cover of wood, *g*, the heads of which are made water-tight. As shown in the engraving, the tube, *i*, leads the water into the lower part of the mold, and the water enters by the openings, *h*, becomes heated, rises, circulating between the envelope, *f*, and the wooden wrapper, and leaves by the tube *k*, at the upper portion. The trunnions, *b* and *c*, of the cylinder, which are not to be tempered, are cast in molds, *e* and *d*, and in earth, placed with great care so as to prevent any possible contact of the molten iron with the



water. The molten metal is conducted in the ordinary manner by a conduit, *l*, which terminates at the lower portion of the lower trunnion, *c*. In the same way as the cooling can be regulated by the length of the water circulation, so can its intensity be varied by regulating the temperature of the water used.

[For the Scientific American.]

FACTS AND FIGURES CONCERNING THE EARTH AND ITS ATMOSPHERE.

It has recently been to me a matter of surprise that there are no published analyses of the atmosphere in the United States, or indeed in America, by an American. It is not that any notable difference is observable in the composition of American air, as compared with that of Europe, but because the intimate relations of the atmosphere to health and climate are assuming daily a more universally acknowledged importance.

A little more than half a century ago, Lord Cavendish bestowed his unsurpassed experimental skill upon the problem, to the extent of making five hundred determinations of the percentage of oxygen. With methods which now appear entirely inadequate, he finally settled upon the number 20·833, as expressing the average. The best mean result of the present day is 20·95, a little more than one tenth of one per cent over the number obtained by Cavendish. And yet Lord Cavendish could not satisfy himself that his experiments showed any difference between the air in London and in the country. Sufficient is now known to render it probable that the air in no two contiguous places is precisely the same. With all the mighty apparatus of winds and mountains, of diffusion and changes of temperature, the homogeneous mixture of the constituents of the atmosphere is never perfectly achieved.* The difficulty is better understood when the vast quantities of matter involved are considered, quantities not adequately realized when hundredths of one per cent only are discussed in the analytical results. I could not lay my hand upon these figures in a convenient form; and after calculating them from the best data available, the thought occurred of giving them a permanent form.

In his "Meteorology," Sir John Herschel states that, if the diameter of our globe be taken as 7,926 miles, the weight of the atmosphere is 11·67085 trillions of lbs., or, making allowance for the space occupied by the land above the sea level, 11x10^{12}, that is, 11 trillions of lbs. A little closer approximation can be obtained by using the most recent determinations of the earth's dimensions. These are as follows:

	Polar radius in feet.	Equatorial radius in feet.
Bessel..........	20,853,662	20,923,596
Airy............	20,853,810	20,923,713
Clarke..........	20,852,429	20,923,171

According to the last named authority, the equator also is elliptical, its major axis being 41,852,700, and minor axis 41,839,944 feet. Taking Clarke's figures as a basis, the volume of the earth is 38,239·43x10^{18} cubic feet. By combining the results given above, we obtain 41,707,268 feet for a mean polar, and 41,846,980 for a mean equatorial diameter, and for the earth's mean diameter 41,777,124 feet or 7912·36 miles. If the earth's volume be calculated as a spheroid, on the former supposition, it amounts to 38113·3084x10^{18}, or trillions cubic feet: if a sphere, to 38178·1x10^{18} cubic feet which is 64·79x10^{18} cubic feet in excess over the former somewhat more exact calculation. Accepting the latter number, however, as sufficiently correct for our purpose and much more convenient in the following calculations, we obtain for the volume of the earth 259,356·52 millions of cubic miles, its surface 196·68 millions of square miles, or 5483·1x10^{12} square feet, or 7895·68 billions square inches. Multiplying this figure by the average pressure the atmosphere exerts at 32° Fah. on every square inch of surface at the level of the sea, or 14·7304 pounds avoirdupois, we have a result not widely different from that given by Herschel, namely: 11·63065x10^{12} pounds, or 5192·5523x10^{12} tuns.

If we assume that the weight of the atmosphere is approximately 11x10^{12} lbs., the weight of that portion of it displaced by the elevation of the continents is 630,658 billions of lbs. In fact it is not so much; it is 125,238 billions lbs. This calculation is readily made by recurring to the mean hights, obtained by Humboldt and other eminent geographers, for the elevation of the continents above sea level. We shall have, putting the results in tabular form:

Surface of	Area in square miles	Mean Elevation. As calculated	As spread over entire continental area	As spread over earth's surface
Europe	3·5 millions	670 feet	45·98 feet	11·923 feet
Asia	17 "	1,150 "	393·38 "	99·402 "
North America / South America	15 "	748 "	291·17 "	75·506 "
Africa	11·5 "	1,600 "	300·78 "	93·551 "
Australia	3 "	500 "	29·41 "	7·627 "
Land	31 "		1110·67 "	
Water	145·68 "			
Earth	196·68 "			288·008 "

It will be seen from the above that if the excess of land in America above sea level were spread over 51 millions of square miles, the mean elevation of the continents would be increased 291 feet, and, if over the surface of the globe, 75 feet. The mean elevation of the continents is 1,111 feet, and that of the entire earth's surface 288 feet.

From these figures, we can readily obtain quite a close approximation to the true weight of the earth's atmosphere. In the first place the weight of that portion resting upon the sea is found and added to that resting upon the continents, which give us a correct total. The pressure on each square inch of the sea, at 32° and at mean barometric pressure, being 14·7304 lbs., the corresponding weight of that portion of atmosphere is 8·61475x10^{12} lbs. At 1110·67 feet of altitude the barometer stands at 28·755 inches and represents a pressure of 14·119 lbs. The corresponding weight is 2·89067x10^{12} lbs.; 11·50542 trillions of lbs., then, is the total. Or, in the second place, the entire surface of the globe, at a mean elevation above sea level of 288 feet, may be multiplied by the mean pressure at that altitude. This, at a barometric hight of 29·672 inches, is 14·5631 lbs. The result is 11·503461 trillions of lbs., very slightly differing from that given above.

The weight of a cubic foot of air at standard pressure and temperature being 0·080066 lb., we get from the weights previously found 142·64x10^{18} cubic feet or 142·6166x10^{18} cubic feet for the entire volume of the atmosphere. This result is best understood by calculating the thickness of the envelope which such an atmosphere would form around the globe. It would be either 25,982 or 25,978 feet, according as the former or latter number is taken as representing the true volume of the atmosphere. A simple way of arriving at the thickness is by finding the relative hights of a column of mercury and a column of air at mean temperature and pressure. These would evidently be as the relative weights, which are as 1 to 10,513¼, and the corresponding hight of the atmosphere is 26,214 feet above sea level.

At an altitude of 288 feet, the hight of the barometric column is 29·672 inches, and the hight of the atmosphere, above the mean elevation of the continents, 25,996 feet. Lubricating 288 feet from 26,214, the difference, 25,926, is less than the former numbers. This is to be expected from the increase of density as we go towards the earth's surface. The mean of the three values is 25,985 feet, and represents very nearly the actual hight of the atmosphere of *uniform* density. This is 415 feet less than five miles. The very careful experiments made to determine the earth's density have shown that its weight cannot be very far from 5·56 times that of a globe of water of equal bulk, and this would be 5900·8681 trillions of tuns. As the atmosphere weighs 5134·5 billions of tuns, the weight of the latter is to that of the former, as 1 to 1,149,000. Their relative volumes are as 1 to 267. If the relative weights and volumes are represented by circles, the diameters of the circles in the first case are as 1 foot to 1,071 feet, and in the second, as 1 foot to 16·35 feet.

When we come to calculate the amounts of the many various bodies which make up the atmosphere, the variations in the results of the observers, depending in part upon the different methods of analysis employed and in part upon the actual variations in composition of the specimens of air analyzed, present us with a long array of figures to choose from. Besides the four principal constituents of the atmosphere, there are various compounds of nitrogen and oxygen, of carbon and hydrogen, of nitrogen and hydrogen, of hydrogen and sulphur, of hydrogen, nitrogen, and sulphur, to say nothing of salts of chlorine, sulphuric acid, nitrates, etc., diffused throughout the atmosphere by processes of combustion and evaporation, or set free by the agency of decay and putrefaction. It is only through its great complexity of composition that the atmosphere is qualified to discharge the multitude of services required of it by the vegetable and animal kingdoms, and in the general economy of the globe. We may fairly assume, from the vast accumulation of the results obtained by many eminent analysts, that the volume of oxygen in the atmosphere rarely exceeds 21·1 per cent or falls below 20·1. But the range of variation actually falls within extremely narrow limits; and if the oxygen either exceeds 20·99 per cent, or faces below 20·9 per cent, there is reason to look for accidental circumstances modifying the average composition. This was strikingly shown by the 100 analyses of the air of Paris made by Regnault, the oxygen percentage varying from 20·913 to 20·999, giving a mean of 20·96. Of 9 specimens of air from the neighborhood of Lyons, 30 from Berlin, 10 from Madrid, 23 from Switzerland 15 from the Mediterranean, 5 from the Atlantic Ocean, and 3 from South America, the extremes were comprised between 20·908 and 20·998 per cent.

It may seem of little consequence that the amount of oxygen should be diminished by one tenth of one per cent, and it would be, were not the loss in oxygen replaced by other and generally less beneficial ingredients. Many curious facts have been ascertained from a close observation of these changes in composition. The younger De Saussure, who devoted many years to this work, established the fact that the amount of carbonic acid in the atmosphere during the three summer months was considerably greater than that in December, January, and February, the relative amounts being as 100 to 77. From multitudes of determinations continued during fourteen years, he concluded that the ordinary range of variations in the volume of carbonic acid was included between 6·2 and 3·7 parts in 10,000, and that 4·9 parts in 10,000 fairly represented the mean. A similar remark applies to the extreme multiplication of these carbonic acid determinations as to those of oxygen: that single experiments are often quite at variance with the general results, and that the analyses must be repeated until the laws affecting the composition of the atmosphere are established beyond doubt. What, for example, could be more surprising than the fact, indicated by many experiments, that the percentage of carbonic acid about the tops of mountains is greater than at their feet: and this, too, notwithstanding carbonic acid is more than half as heavy again as air, so powerful appears to be the agency of plants in decomposing the carbonic acid near the surface of the ground and replacing it by a corresponding amount of oxygen? The solution of carbonic acid and its precipitation upon the ground dissolved in rain likewise assists its removal. During calm weather the atmosphere appears to contain more carbonic acid at night than in the day; but when disturbed by violent winds, causing a down rush from the upper strata, the percentage of oxygen at the earth's surface may temporarily undergo an increase much beyond the average.

One of the principal sources of the increase of carbonic acid in the atmosphere is the process of respiration by animals. If the number of respirations by an adult be reckoned at 15 per minute, and an average amount of 32 cubic inches of air is expired, containing 4½ per cent of carbonic acid, there is thrown into the atmosphere daily by each individual about 20 cubic feet of this gas. The population of the globe would annually increase the volume of carbonic acid 7,300,000,000,000 cubic feet, and diminish the oxygen by the same amount. This again would at least be doubled by the respiration of the lower animals and by the agencies of decay and combustion. The volume of the atmosphere is 968,870,000 cubic miles; and of this, if four hundredths of one per cent be taken as the average volume of carbonic acid, 387,510 cubic miles consist of the latter. If 20·96 per cent is the mean for oxygen, it amounts to 203,076,600 cubic miles. About 100 cubic miles of carbonic acid are annually added to the atmosphere, at which rate the amount of carbonic acid would be doubled in 3,731 years and all the oxygen consumed in two million years, were not the carbonic acid decomposed by vegetation in an inverse proportion. The weight of a cubic foot of carbonic acid is a little more than one tenth of a pound, and of a cubic mile about eighty and a half million of tuns. The total amount of carbonic acid in the atmosphere is three billion tuns, containing 27·28 per cent or 851·870 millions of tuns of carbon. The computed area of the coal measures on the earth's surface is 260,000 square miles, with a present annual production of 250,000,000 tuns of coal. If 75 per cent of this coal is estimated as carbon, the amount of carbonic acid in the atmosphere would be doubled by burning this amount of coal annually for 4,500 years. The total amount of coal is 4·83 billions of tuns, which, if burnt, would increase the amount of carbonic acid in the atmosphere four and a half times, or raise its percentage to 0·18. This percentage is smaller than is frequently present in the air of crowded rooms like theaters, and which people endure, at least for some time, without serious consequences. If all the coal of the carbonaceous era were formerly a part of the atmosphere, the earth need not necessarily have been untenantable by air-breathing animals. These results appear surprising until we reflect how small a portion of the earth's bulk is made up of carbonaceous deposits. The whole annual production of coal would make a bar 12 feet square passing from east to west through the earth's center. But if spread over the earth, it would amount to 0·015 cubic inch for each square yard of surface, hardly enough, when rubbed over a square yard of drawing paper, to fairly blacken it. The entire bulk of the coal measures, even when estimated at double the available amount of coal now known, probably does not exceed 450 billions of cubic feet, which would form a layer about an inch thick over the earth's surface.

But a vast amount of carbonic acid is locked up in the earth's strata, combined with various bases, more especially lime and magnesia, forming immense deposits of limestone and dolomite. If this carbonic acid at one time formed a portion of the atmosphere, its bulk must have been prodigious. A very thin stratum of carbonate of lime, when deposited, would yield as much carbonic acid as the atmosphere at present contains. It would require but a thin pellicle, a whitewash of 0·136 inch in thickness over the whole surface of the globe. A similar layer of pure limestone, 28·37 feet in depth, would double the weight of the atmosphere.

The thickness of the stratified rocks extending upward from the Potsdam formation probably averages as much as 38,500 feet, of which three eighths or 14,500 feet may be put down as limestone. This is equivalent to 140 millions of cubic miles of limestone rock, weighing 1·55 trillions of tuns and containing 682 billions of tuns of carbonic acid. This would be to the weight of the earth itself as 1 to 8,652, and would increase the weight of the atmosphere 133 times.

ALBERT R. LEEDS.

* In general the constitution of the atmosphere is regarded as constant, because, after the removal of its carbonic acid and water, the proportion between the oxygen and nitrogen is almost invariable.

The Wonders of the Deep.

In her scientific cruise of three years and a half, the Challenger steamed and sailed 68,930 miles, crossing both the Atlantic and Pacific—the former several times. The deepest soundings were 4,575 fathoms, in the Pacific, between the Admiralty Islands and Japan; and in the Atlantic 3,875 fathoms, ninety miles north of the island of St. Thomas, in the West Indies. We have noticed the principal movements of the expedition from time to time. Its return to England has revived public interest in the work of Professor Wyville Thomson and his associates, and many interesting details concerning it have appeared in the English journals. Many curious crabs were brought home. One very odd specimen, which came to the surface only at night, is described as having a head which is nearly all eye, and a body so transparent as to render visible all the nerves, muscles, and internal organs, while another more lobster-like creature had no eyes at all. Near Amsterdam Island, in the South Indian Ocean, the ship encountered a belt of gigantic seaweed, of which single plants are said to attain a length of a thousand feet and a thickness equal to that of a man's body. A gale of snow, to which the vessel was exposed in the Antarctic Ocean, consisted of exquisite star-like crystals which burned the skin as if they were red hot. The history of the expedition abounds with similar unique experiences.

Indelible Ink without Silver.

Mr. A. J. Foose, of Del Norte, Colorado, sends us the following formula for an indelible ink without the use of nitrate of silver, which, he maintains, is thoroughly efficient and capable of resisting the action of freezing and thawing:

No. 1. Extract of logwood, 1 lb.; water, 1 gallon. No. 2: Sulph. prot. of iron, 4 ozs.; water, 4 ozs. No. 3. Sulphuret of potassium, ½ oz.; water, 2 ozs.

After dissolving the logwood by boiling, add No. 3 to No. 2, until the iron assumes a black color; then add this compound to No. 1, and boil a few minutes. Add cyanuret of potassium, ¼ oz., which fixes the color. For ink, add gum and alcohol; for dyes, add grease.

PRACTICAL MECHANISM.

BY JOSHUA ROSE.

SECOND SERIES—Number VII

PATTERN MAKING.

From the appliances for turning work between the centers, we pass to those for holding work independent of the back center of the lathe by means of chucks, the name by which such appliances are generally known.

Fig. 51.

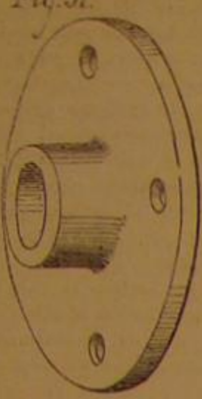
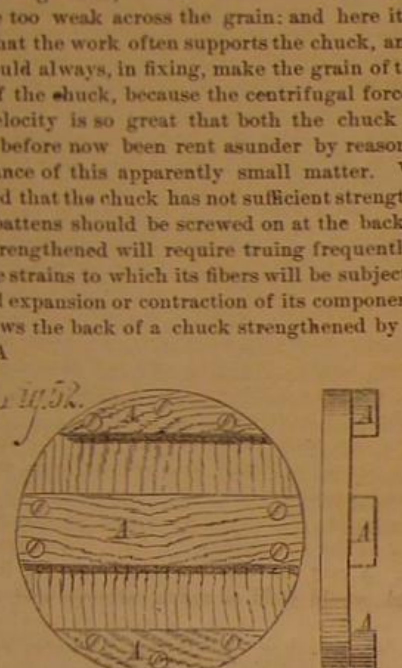


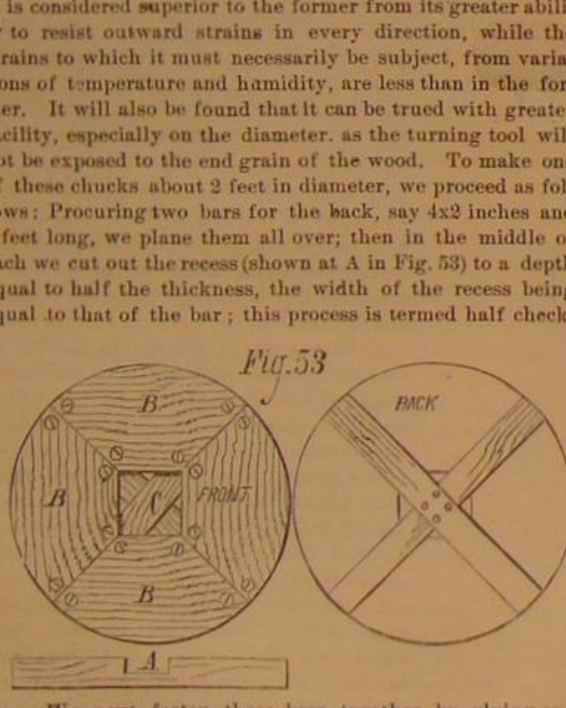
Fig. 51 is a back view of a face plate, to which work may be held by screws; the usual method, however, is to screw to the face plate a disk of wood, and then to true the wood across the face and on the diameter. The work is then fixed to the new surface thus obtained. Many good purposes are served by the intervention of the disk of wood (or chuck, as it is usually termed) between the metal plate and the work. For instance, it is a guard which effectually prevents the turning tools from touching the metal of the face plate. It supports the work (being nearly of the same size) when required, and obviates the necessity of having more than three or four face plates of metal. Its surface is readily made to conform to the shape of the work, and furthermore it is very readily trued up. When we have to deal with large sizes, a mere disk of wood will not serve, as it will be too weak across the grain: and here it may be remarked that the work often supports the chuck, and therefore we should always, in fixing, make the grain of the work cross that of the chuck, because the centrifugal force due to the high velocity is so great that both the chuck and the work have before now been rent asunder by reason of the non-observance of this apparently small matter. When it is considered that the chuck has not sufficient strength across the grain, battens should be screwed on at the back; but a chuck so strengthened will require truing frequently on account of the strains to which its fibers will be subjected from the unequal expansion or contraction of its component parts. Fig. 52 shows the back of a chuck strengthened by the battens, A A A

Fig. 52.



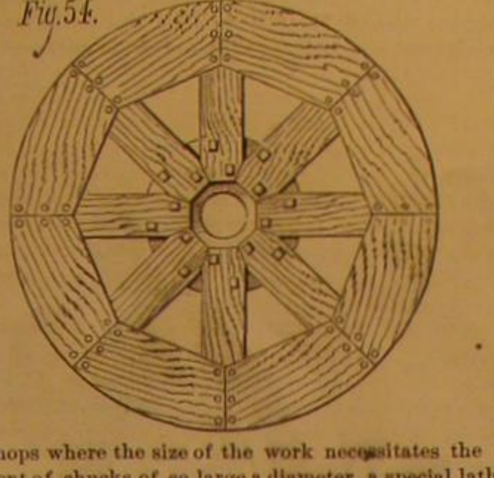
Another method of making a chuck is shown in Fig. 53. It is considered superior to the former from its greater ability to resist outward strains in every direction, while the strains to which it must necessarily be subject, from variations of temperature and humidity, are less than in the former. It will also be found that it can be trued with greater facility, especially on the diameter, as the turning tool will not be exposed to the end grain of the wood. To make one of these chucks about 2 feet in diameter, we proceed as follows: Procuring two bars for the back, say 4x2 inches and 2 feet long, we plane them all over; then in the middle of each we cut out the recess (shown at A in Fig. 53) to a depth equal to half the thickness, the width of the recess being equal to that of the bar; this process is termed half checking.

Fig. 53



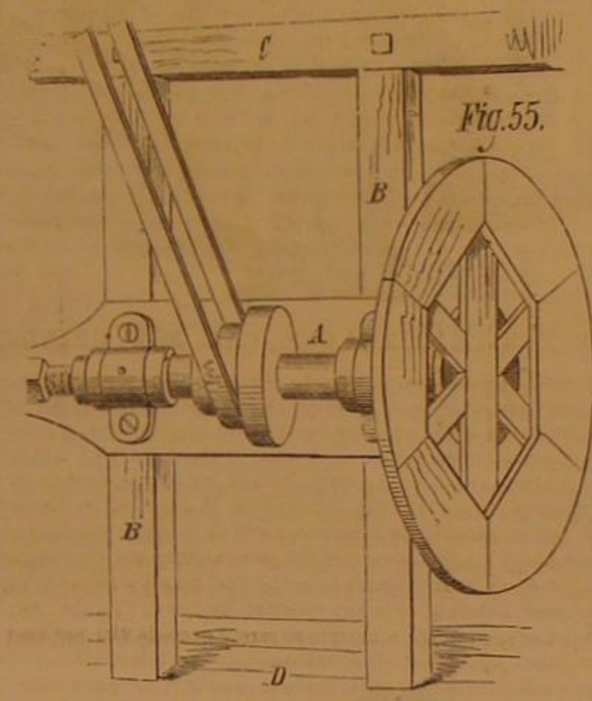
We next fasten these bars together by gluing and screwing them at the center, driving the screws tightly home while the glue is warm. Upon the cross thus formed, we superpose the segments shown in the front view of Fig. 53, at B B B; these may be of almost any thickness, say from ½ to 1½ inches. They should be planed on the back and should not extend to the center, but leave an open space (as shown in Fig. 53, at C) of about 4 or 5 inches. This opening can be filled, if desired, by screwing on a square piece. If the segments were carried to the center, they would be too weak to bear a screw near that point; and again in large chucks, we very seldom require to use the part about the center. Chucks of very large size, that is to say, from 4 feet upwards, will require more support than is afforded by the four arms of the cross. Three bars can be put together, so as to give six arms, which will answer probably for a 6 or 7 feet chuck. For still larger sizes, it is necessary to cast a strong circular plate to form the middle of the chuck, and to then bolt the requisite number of arms to it. This strength of the chuck will of course depend upon the number of arms and their depths; and unless the chuck is very substantial, a difficulty will be experienced in turning, on account of the tremor. A chuck having the middle of iron and the outside of wood, supported by arms, is shown in Fig. 54.

Fig. 54.



In shops where the size of the work necessitates the employment of chucks of so large a diameter, a special lathe is of great advantage, because a lathe having an elevated bed is so tremulous and shaky; while those having large solid heads are too cumbersome, and are not belted to run at a sufficiently high rate of speed. In such cases, the arrangement shown in Fig. 55 is an excellent one. A represents a lathe head bolted firmly to two uprights, B B, which are

Fig. 55.



firmly fixed to the joists, C, and to the flooring at D, right over and upon the joists supporting the flooring, or else upon beams provided for the purpose. By this means the work may, if the lathe head is fixed midway upon the posts, B B, be as large as the space between the ceiling and the flooring will admit, a movable tripod rest, such as shown in Fig. 47, being employed for a tool rest.

Proportions of Bolts and Nuts.

In reply to several of our correspondents, we give below a table of the standard sizes for the heads of bolts and of nuts, including the pitches of the threads and size of tapping holes:

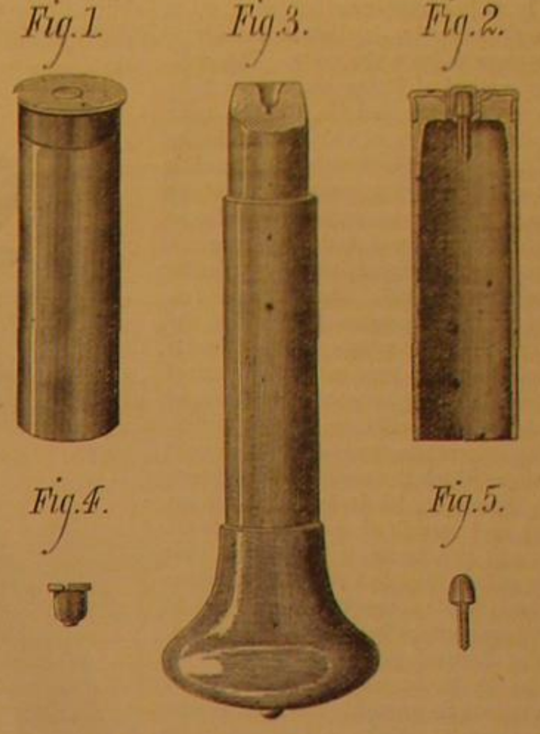
Diameter of bolt.	Threads per inch.	Size of tapping hole.	Size across facets of head or nut.	Depth of head or nut.
¼	20	0·185	½	¼
5/16	18	0·240	19/32	5/16
⅜	16	0·294	11/16	⅜
7/16	14	0·344	25/32	7/16
½	13	0·400	⅞	½
9/16	12	0·454	31/32	9/16
⅝	11	0·507	1 1/16	⅝
¾	10	0·620	1¼	¾
⅞	9	0·731	1 7/16	⅞
1	8	0·837	1⅝	1
1⅛	7	0·940	1 13/16	1⅛
1¼	7	1·065	2	1¼
1⅜	6	1·160	2 3/16	1⅜
1½	6	1·284	2⅜	1½
1⅝	5½	1·389	2 9/16	1⅝
1¾	5	1·490	2¾	1¾
1⅞	5	1·615	2 15/16	1⅞
2	4½	1·712	3⅛	2
2¼	4½	1·962	3½	2¼
2½	4	2·175	3⅞	2½
2¾	4	2·425	4¼	2¾
3	3½	2·628	4⅝	3
3¼	3½	2·878	5	3¼
3½	3¼	3·100	5⅜	3½
3¾	3	3·317	5¾	3¾
4	3	3·566	6⅛	4

For cast iron work, the tapping holes may, for sizes of 1 inch and less, be drilled to well clear the given sizes.

THE two thousandth locomotive was recently completed at the London & Northwestern Railway Company's works at Crewe, England. The occasion was celebrated by giving a holiday and a day's pay to all the workmen, some 6,000 in number, and a banquet, which was attended by the directors of the company, at which were exhibited specimens of the different classes of engines used on the road.

IMPROVED ANVIL FOR PAPER CARTRIDGE SHELLS.

The invention herewith illustrated is a new anvil for paper cartridge shells, by means of which it appears that a



large number of charges may be fired from one and the same shell without injury thereto. We are informed that a single shell has been used in firing forty-two shots, and that one hundred and four caps exploded on a shell have not caused any deterioration. Each cartridge case, therefore, lasting for so many charges, the sportsman can, with a limited number of them, change his charges to suit different kinds of game, and thus be relieved from transporting a large number of cartridges of varying sizes. Fig. 1 is a perspective view of the ordinary paper shell. Fig. 2 is a sectional view of the same with the improved anvil attached, Fig. 3 is a device for disengaging old caps. Fig. 4 is the cup or socket of the shell in which the anvil and firing cup is held, and Fig. 5 is a detached view of the anvil. The anvil is of brass, iron, or steel, in a single piece. Its head is somewhat larger than its stem, and is made slightly conical in form, to receive thereupon the cap for the explosion of the charge contained in the shell. There is a narrow groove made across the head of the anvil and continued down one side and to the end of the stem. Through this groove the fire is conveyed in a straight line to the charge, causing the same to explode without injuring the case. The groove, it will be observed, extends entirely across the top of the anvil head, so that a large surface for the passage of the flame is afforded. The device shown in Fig. 3 may be made of wood or any other suitable material. Its stem is small enough to be inserted readily in the paper shell, and at the end there is a socket, the bottom of which receives the point of the anvil, keeping it in a central position while it is being pushed outward from the shell. This disengages the old cap and leaves the anvil ready for a new one.

From a certificate submitted by the inventor and signed by several well known professional sportsmen, the statement of the inventor is confirmed that forty-two shots have been fired from two cartridge cases, and that the latter are still intact, also that one hundred and four caps have been exploded on the shell without causing any deterioration.

Patented March 14, 1876. The patent is for sale. For further particulars, apply to the patentee, Mr. J. Saget, 198 Chartres street, New Orleans, La.

American University Boat Races.

The first university race ever rowed in America in eight-oared shells took place between representative crews from Yale and Harvard on the Connecticut river, at Springfield, Mass. June 30, 1876. Length of course, 4 miles. Won by the Yale crew in 22 minutes and 2 seconds, Harvard coming in 31 seconds, or 13 lengths, astern. The number of strokes made per minute of the respective crews is given by the New York *Herald* as follows:

Minutes.	Yale.	Harvard.	Minutes.	Yale.	Harvard.
1	34	35	12	33	37
2	34	35½	13	33	—
3	34	35	14	33	40
4	33	35	15	33	36
5	33	35	16	33	37
6	33	—	17	32	40
7	33	—	18	33	—
8	33	35	19	33	—
9	33	—	20	33	35½
10	34	36	21	33	—
11	32	—	22	—	—

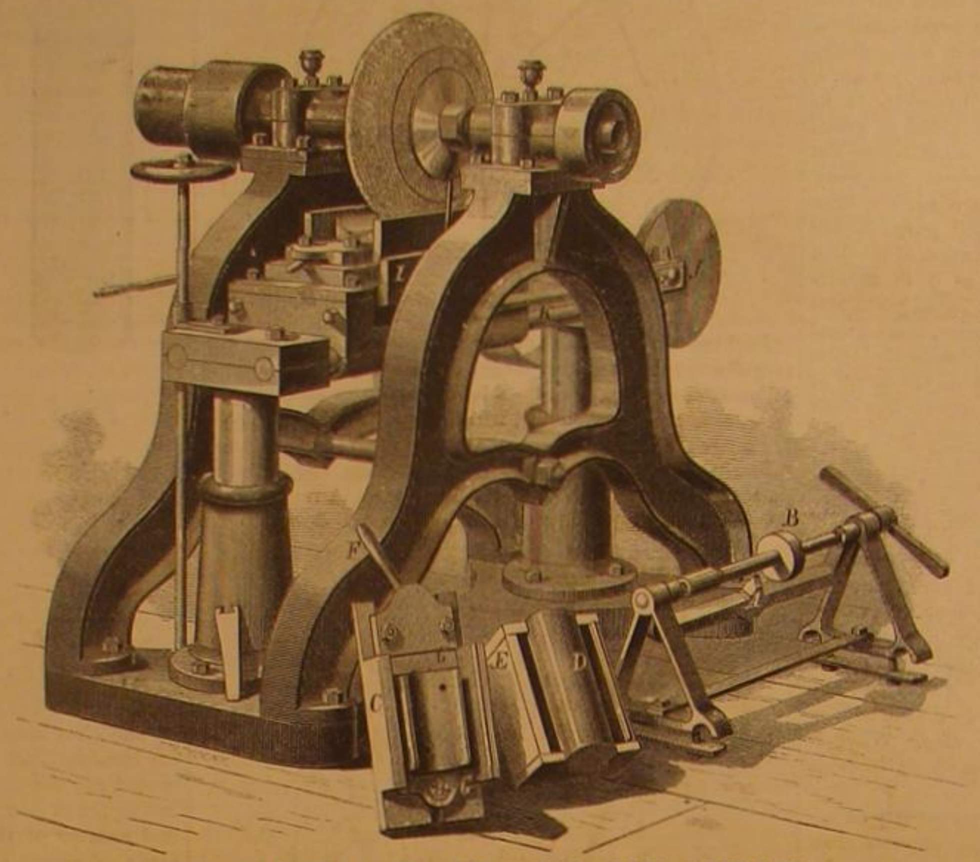
The average age of the Yale crew was 23·7 years, hight 69·3 inches, chest 40·2 inches, weight 158·8 lbs. The average age of the Harvard crew was 21·2 years, hight 68·8 inches, chest 39·7 inches, weight 159·14 lbs.

MESSRS. OGDEN & CARPENTER, of 409 East 33d street, New York city, state that the steam jet plan, to assist combustion, described by us on page 18, current volume, has been in use at their establishment for more than four years with success.

IMPROVED CAR BOX GRINDER.

The use of car brasses, entirely unfitted and rough from the sand, results in great wear of axles and of the brasses, in hot brasses, and the delays and accidents entailed thereby, in an immense consumption of oil and cotton waste, and in such excessive friction as greatly to increase the power necessary to draw the train. The ordinary method of fitting car brasses is by the use of lathe and file, and the work requires the labor of a skilled mechanic.

The machine herewith illustrated is not only expected to supersede the above named tools for the purpose, but also to render the accurate fitting of brasses a cheap process, requiring no particular experience or skill. The principal feature of the apparatus is found in the emery wheels, which are originally turned and then kept true by a patented diamond tool, the latter being so arranged that it is impossible to turn by it anything except the geometrically correct circle to which the master mechanic sets it. Wheels of 20 inches diameter are used; and though they should be worn down to the flange, it is claimed that they will still grind the full diameter desired, while a speed of from 1,080 to 1,800 revolutions is all that is required.



THE TANITE COMPANY'S CAR BOX GRINDER.

The diamond tool, A, is shown in its frame, in the engraving, detached from the apparatus proper. The tool, it will be observed, swings on a center in its frame, and can be adjusted to any arc. Once set, it can only turn the prescribed arc with accuracy. In order to avoid the necessity of the foreman having to set the tool, a gage is also furnished. This consists of a spindle adjustable with a nut in such a way that its two points rest in the centers on which the diamond tool revolves. It is only necessary for a disk, B, turned accurately to the diameter of the bearing, to be prepared, and this the apprentice can place on the spindle, adjust the latter, and screw down the diamond tool until it touches the periphery of the disk. A nut is then fastened on the diamond tool, and the frame is lifted on the ways beneath the wheel, when the moving of the handle turns the face of the wheel to the exact circle desired.

To adjust the brass in the chuck, C, it is first set on the axle, D. The chuck is then placed on frame, E, in such a way that the Vs fit. Handle, F, then moves a cam that clamps the brass between the jaws, G, one set of which swing on a pivot at H. The brass is thus adjusted in such a manner that, despite the imperfections in molding, it is ground accurately with the least removal of metal. The chuck, C, fits into planed guides on the table, I, and is thus brought in exact line with the motion of the wheel. The crank, J, serves to move the table to and fro on the rods, K, and the table also rises and falls on planed ways, being pressed up by springs. The hand wheel gives vertical adjustment to the whole bed by means of a chain beneath it. There is a pulley by which a suction fan, to remove dust, etc., may be driven. The machine is claimed to be capable of fitting from 150 to 500 car brasses per day

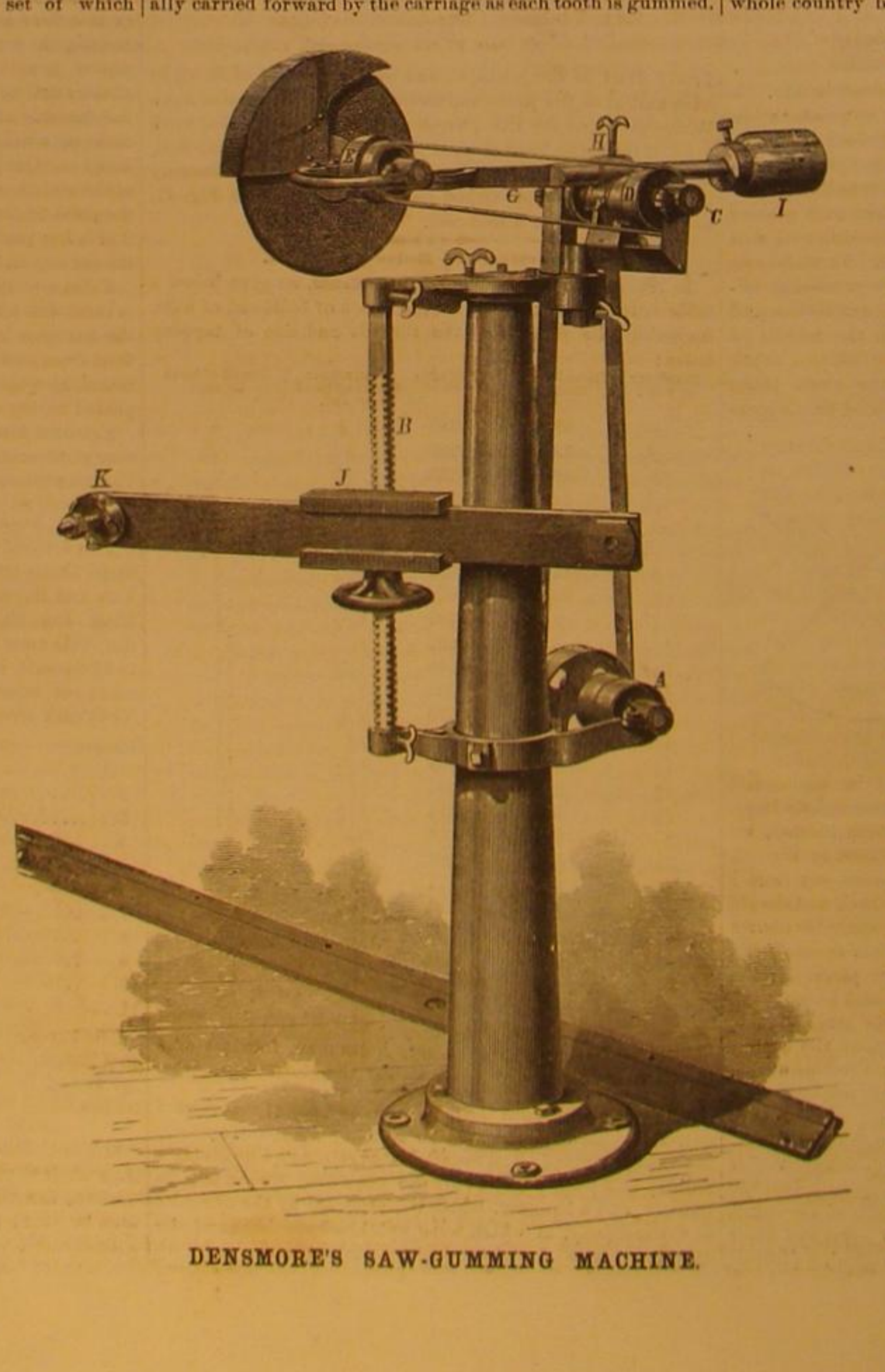
For further information, address the Tanite Company, Stroudsburg, Pa.

IMPROVED SAW GUMMING MACHINE.

In the accompanying engraving we illustrate a new application of that universally useful invention, the emery wheel, to the purposes of a saw gummer. The apparatus embodies novel devices, whereby the wheel may be set to any angle and rendered suitable either for gumming saws or for grinding the edges of planer or other knives. The working parts are supported on the crosshead of the strong upright column, as shown. At A are the driving pulleys, journaled between arms on a lower cross piece, in which is also socketed the lower extremity of the elevating screw, B. On the upper crosshead is swiveled a yoke, to which is journaled a shaft, C, carrying pulleys, D. These, as is clear from the engraving, transmit motion from the driving pulleys, A, to the pulley, E, on the emery wheel shaft. The shaft, C, passes through a metallic block, F, which fits loosely upon it, and which is ground off to a point on its under side, to form a bearing for an adjusting screw, not shown. Said block is also bored to receive the arm, G, which supports the grinding wheel. This arm is movable in the block and can be fastened in any desired position by the set screw, H. I is a counterbalance for the wheel. J is a stock, secured in place, as desired, by a set screw not shown, and supported from below by the hand wheel by which it can be elevated and depressed. Said stock has ways for a saw bar or a carriage with clamps for the blade.

The saw disk, in case a circular saw is to be gummed, is attached to the end, K, of the saw bar, and the latter is properly adjusted and fastened to the stock, in such position as to bring the saw teeth properly under the emery wheel. The stock is then adjusted so as to bring it to a proper hight by means of the elevating screw, and the arm, G, is depressed in front until the wheel is in proper position. The wheel, it should be stated, is previously adjusted to the proper angle to the tooth by rotating the arm partially in the block, F, and securing it when the wheel is at suitable inclination. When the apparatus is to be used to gum a straight-edged saw, the blade is confined in a carriage, and the wheel is set in relation thereto, as already described. The saw is gradually carried forward by the carriage as each tooth is gummed. Planer blades are mounted similarly to saw blades, and arm and carriage are so adjusted that the knife edge can be traversed continually along the side of the wheel. The latter can be set by rotating the arm at any angle, in regard to said edge, between a perpendicular and a horizontal position.

Patented by Randolph Densmore, April 4, 1876. For further particulars, address the Tanite Company, Stroudsburg, Pa.



DENSMORE'S SAW-GUMMING MACHINE.

The Soap Mines of California.

The rock soap mine is situated in the lower mountains or foothills of the coast range in Ventura county, five miles from the city of the same name. It was discovered by A. F. Hubbard while prospecting for coal. He accidentally dislodged some that fell into water and dissolved. It being a new experience to see rock dissolve, he gave it his attention, found it soapy, took it home to experiment with, and soon learned its virtues; yet, strange to tell, his family used it for nearly a year before it was given to the public, when Mr. Hubbard associated himself with Messrs. Cronk & Bickford, forming the present company, who are sole proprietors of this wonderful mine. It is accessible only through a cañon leading to and opening upon the beach. The coast line stage road passes the mouth of this cañon, three miles below the mine. This cañon or ravine penetrates one of the wildest possible volcanic regions. A little stream follows its course, an almost "lost cause" in summer, but in winter a raging, rushing torrent, which, after draining immense hights and many a rugged mountain side, finds its way to the ocean, often bearing along in its fearful strength huge boulders and entire trees. Along the side of this ravine, sometimes in the bed of the stream, sometimes high up in its precipitous banks, winds a little trail leading to the soap mine, traveled only by the safe pack mule and hardy miner. The rock resembles chalk or lime. At the southern extremity is an extensive deposit, veined, marbled, and particolored, resembling Castile soap. The ledge at its opening is fifteen to twenty feet wide, and crops out for 2,000 feet, to an unknown depth. The lode is well defined, with wall rocks of hard slate stone, and has, in common with the slate and sandstone strata about it, been thrown up from the depths and turned completely on edge. In its vicinity is a mountain of gypsum, also turned up on edge; indeed, the whole country bears evidence of fearful convulsions, also of some time having lain peacefully at the bottom of the ocean; for on the highest mountain tops can be found nearly perfect sea shells and various specimens of marine matter.—*San Beneventura (Cal.) Reporter.*

Prizes for Temperance Investigations.

The French Temperance Society submits the following questions, to be answered before January 1, 1878. For the best and most complete reply to the first a prize of $400 is offered, to the second, $200. Articles must be written in French, and sent with author's name sealed in a packet, with distinctive device, addressed to Dr. Lunier, secretary of the society, 6 Rue de l'Université, Paris.

1. Determine, by the aid of clinical observation and experiment, the differences which (from the point of view of effects on the organization, the two being administered with equal alcoholic doses) exist between natural wines and brandies on one hand, and on the other wines fabricated or simply treated with alcohols of purely industrial derivation, and brandies of the same origin.

2. Discover by the aid of clinical and experimental observation whether (with equal doses) the addition to alcohol of an aromatic principle other than that of absinthe, such as the essence of aniseed, fennel, tansy, and analogous plants, augments the toxic properties.

Painting Glass for the Magic Lantern.

Draw on paper the size of the glass the subject you mean to paint. Fasten this at each end of the glass with paste, or cement, to prevent it from slipping. Then reverse the glass so as to have the paper underneath, and with some very black paint, mixed with varnish, draw with a fine camel hair pencil very lightly the outlines sketched on the paper which are reflected on the glass. It would add to the resemblance if the outlines were drawn in the colors of the object; but in this respect the artist must please his fancy. When the outlines are dry, color and shade the figures; but observe to temper the colors with strong white varnish.

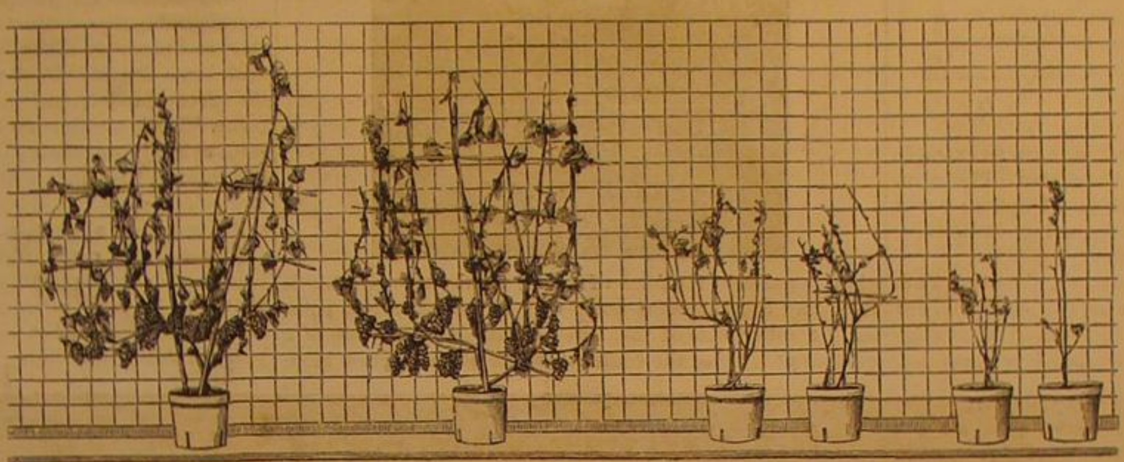
INFLUENCE OF CHEMICAL FERTILIZERS ON POTATOES AND GRAPES.

A second volume on this subject has recently appeared in France, written by Professor Ville, whose early experiments on the effect of various artificial manures attracted so much attention among agriculturists some years ago. In his first book, M. Ville gave a large number of engravings of plants, reproduced from photographs, exhibiting the influence of his so-called complete fertilizer, composed of nitrogenized matter, phosphate of lime, potassa, and lime, and noting the facts that, by the use of this compound, the yield of wheat per acre was more than double that obtained when nitrogenized manure alone was furnished, the ratio being about 46 to 20. When mineral manure alone was employed, the crop fell to 16, and finally, in earth without manure, the yield was represented by 11.

Applying these experiments to the potato and the vine, Professor Ville, in his recent volume, shows the astonishing effects of potassa. On the potato (see Fig. 1), his complete fertilizer, when used, gave a yield of 35,200 lbs. per 2·5 acres (A, Fig. 1); a like area yielded 25,960 lbs. (B), nitrogenized matter being absent; and with phosphate absent, the yield was 32,780 lbs. (C). When the potassa was removed, these figures fell to 16,590 lbs. (D). With lime absent, the yield determined was 29,700 lbs. (E), and with no manure at all (F), 7,700 lbs.

Fig. 1.

Fig. 2.



On the vine (see Fig. 2) the influence of potassa was still more evident. Complete fertilizer (two figures on the left of Fig. 2) caused a yield of 26,400 lbs. per 2·5 acres, or 2,534 gallons of juice; without nitrogen, 13,640 lbs. and 1,320 gallons; without phosphate, 16,060 and 1,531 gallons; without lime, 17,160 lbs. and 1,636 gallons; without potassa and without any manure (remaining diagrams, Fig. 2), no crop.

M. Ville affirms that, potassa being dominant in the potato, the absence of that base coincides with the appearance of the disease, and that vegetables deprived of it become the prey of inferior organisms, fungi, lice, etc.

WATER PLANTS.

An American gentleman recently took some plants of the bog bean (*menyanthes trifoliata*) to England, rightly thinking such a pretty plant worthy of cultivation, and not knowing that it was a native of British as well as American bogs. The bog bean and bog arum, like a number of other plants, had common possession of the two worlds long before the white man had crossed the the Atlantic. Both these plants have something more in common, namely, they are both perfectly hardy, and thrive in boggy and muddy places, margins of lakes, mud banks, etc.; both are dwarf in stature, both have creeping stems that root as they creep, both have distinct and graceful foliage, especially when growing freely in rich ground, and both have beautiful flowers. They are plants which every one who cares for ornamental marsh and aquatic plants should possess.

THE BOG BEAN.

THE BOG ARUM.

MULTIPLYING PLANTS.

The simple method of propagation by layering is usually adopted for all low-growing or slender plants, those which cannot readily be multiplied either by division, cuttings, or seed. The operation is one of the simplest: A branch or stem of the plant is bent down, and pegged or otherwise fastened below the surface of the soil, while its growing extremity remains above the ground. The carnation is easily propagated in this way. Select the outward, strongest, and lowest shoots for the purpose. Trim off a few of the under leaves, and shorten the top ones even, with a knife; then cut a slit in a slanting direction on the under side of the shoot. This slit should be about an inch long, in an upward direction towards the next joint. Loosen the earth and make a small oblong hole one or two inches deep. Lay that part of the stem where the slit is made in the earth, keeping the cut open and placing the head of the layer upright and one or two inches out of the earth. Hold the layer in position by pegging it down with a little forked twig. Now cover to the depth of one inch, pressing the earth over it gently. Water immediately, and in dry weather give light watering every evening. This is best done in a cloudy day. In about two months the layer will be well rooted. Carnations and all kinds of pinks should be layered in June or July.

MULTIPLYING BY LAYERING.

MULTIPLYING BY CUTTINGS.

Propagation by cuttings is a very popular and expeditious mode, and one which, like division and layering, exactly reproduces the parent plant. Nearly all soft wooded plants—such as fuchsias, lobelias, and pelargoniums—are best multiplied from cuttings of the stem; while thick leaved begonias and gloxinias are readily multiplied by leaf cuttings, the fully developed leaf being inserted in a sandy compost. A cutting may vary in size, but it is generally from one to four inches long. It consists of a young shoot taken off the plant with a sharp knife, and afterwards cut off at an acute angle below a joint. This fresh-cut end is to be inserted in the earth if hardy, or in a pot of sandy soil if tender. Lobelias and fuchsias will root freely if severed between the joints, anywhere in fact; while geraniums will frequently rot off unless trimmed below a joint.—*The American Garden.*

The Grand Canal Du Midi.

M. A. Manier has proposed the formation of a maritime canal through France, from the Atlantic Ocean at Bordeaux to the Mediterranean. According to the description which has been published, the Grand Canal is intended to be 300 feet wide at the bottom, 30 feet deep throughout, to flow through Bordeaux, Agen, Toulouse, Carcassonne, Narbonne, and not Cette, but either La Nouvelle or some point still nearer Narbonne, which is the shorter course by about 40 miles. This canal will enable English ships, bound for the Mediterranean or the East, to save from 800 to 900 miles—in fact, it will complement the Suez Canal, and be, with regard to England, the missing link in the great waterway to India. Even when cut between the two nearest practical points, the Grand Canal must still be a very costly undertaking; but the capital and engineering skill are in Paris and London waiting for employment. All that is needed is to show the public that a good return may be expected. The French government will readily enough grant a concession if no guarantee or subvention is asked for. The Grand Canal du Midi will free for ever the South of France from all inundations; it will receive above 12,000,000 tuns of shipping a year; it will enable the owners to dispose of an average of 21,000,000,000 cubic yards of water a year, for irrigation or motive power. If the whole of this water were used for the wants of industry alone, it would give, in the valley of the Garonne alone, four times the power required for the cotton mills of the whole world. Very slight tariffs would procure from these two sources an income which would justify the outlay of a far larger sum than the projected canal is likely to cost.

On Salicin.

There is accumulating evidence for believing that salicin is a most efficient and unjustly neglected remedy. Dr. Maclagan, in the *Lancet*, and Dr. Senator, in the Berlin *Centralblatt*, speak of it as more desirable, in all respects, than salicylic acid, as an internal remedy in the treatment of acute rheumatism, typhus, parametritis, and febrile affections generally. Its antimalarial powers have long been known, and the Confederate surgeons employed it largely during the war. It is cheap, being quoted, at present, at fifty cents an ounce. To reduce the temperature in fever, the dose should be about two scruples. It does not cause any of the unpleasant itching, headache, or gastric troubles that occasionally follow salicylic acid.

Dr. Pavesi, of Mortara, Italy, highly extols the following mixture as an efficient anti-zymotic, and believes it will supplant quinine: Common salt 12 parts, iron in powder 5 parts. Mix and add: Muriatic acid 5 parts, salicin 1 part. He obtains a soluble, odorless crystalline substance, somewhat styptic and bitter to the taste, to which he gives the name *natrium muriaticum ferruginosum salicinatum*, a cheap and efficient tonic, anti-zymotic, and febrifuge.—*Medical and Surgical Reporter*

The Franklin Institute at the Centennial Exhibition.

The Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts, through the kindness of the Centennial commissioners, has opened a reception room at the northwestern end of Machinery Hall, for the use of its members and visitors from abroad, interested in the mechanic arts. The Institute cordially invites all who desire to do so, to visit their room, in which will be found files of the "Journal of the Institute" and other periodicals devoted to industrial sciences. The room is in charge of a committee of thirty members of the Institute, one or more of whom is in attendance to receive visitors and give any information they may desire in reference to the Exhibition. The following objects, of great historical interest, have been placed in the room: 1. Franklin's electrical machine. This instrument is doubtless the one used by the great philosopher in making his wonderful experiments in the science of electricity. Presented to the Institute by Dr. John R. Coxe. 2. Oliver Evans' steam locomotive engine. This interesting model is among the earliest known, having been built about 1804. 3. Oliver Evans' high pressure steam engine. This is the model of an engine built by O. Evans, about 1804, and is described in Galloway's work on the steam engine, page 101, London, 1827. 4. Working model of a steam engine built by M. W. Baldwin, and presented by him to the Institute, about 1832.

Oil Pipe Lines.

The total mileage of iron pipe used in the oil region is placed by good authority at not far from 1,500 miles, some asserting 2,000 miles to be nearer the truth. This is owned by the following pipe line companies Atlantic, Union, Keystone, Antwerp, Relief, Sandy & Milton, United, Grant, Pennsylvania Transportation, American Transfer & Conduit. The principal area of these pipes lies in Butler county, Pa., where the producing districts are far apart, and the farms in some places are covered as by huge spider webs. The Conduit Company has over 100 miles in use, including 48 miles of main pipe, 3 inches in diameter, and 48 miles of connections, of 2 inch pipe. Before a gallon of oil was pumped, this line cost $400,000. Taking 1,500 miles as the quantity of pipe in use, and the cost and laying to be 30 cents per foot, it appears that $2,682 000 is invested in pipes alone. The cost of pumps, tanks, etc., will swell this to double the amount.

METROPOLITAN UNDERGROUND RAILWAY, LONDON.—The total number of passengers carried over the Metropolitan, the St. John's Wood, and Hammersmith and City Railways on Whit Monday last, was 243,077.

THE OPTICS OF PHOTOGRAPHY.

LECTURE DELIVERED AT THE STEVENS INSTITUTE OF TECHNOLOGY, BY PRESIDENT HENRY MORTON.

The material Universe forms one vast system, a whole, in which no part can exist in a state of isolation from the rest. It is impossible to bring any influence to bear upon one of them without affecting everything else. When Newton saw the apple fall, the train of thought suggested to his mind began its effect upon the thought of all succeeding time; while the change produced in the earth's center of gravity by the change of the apple's position affected not only the planets on the very outskirts of our system but even the remotest of the fixed stars. So also every branch of physical science necessarily affects every other branch, insomuch that it is impossible to study one and exclude the rest. We cannot become proficient in physics without a knowledge of chemistry, nor in chemistry without a knowledge of physics. All sciences are mutually indebted to each other, and all profit by discoveries in any one of them.

Fig. 1.

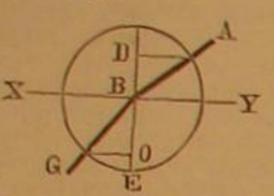
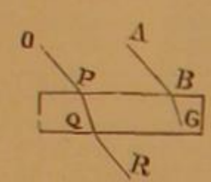


Fig. 2

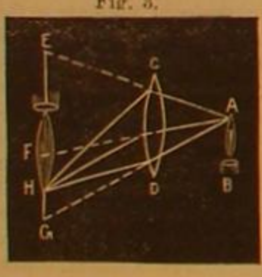


In the subject of the present lecture, we have an example of the interdependence of optics and chemistry. Photography owes perhaps its origin to the science of optics; but it soon made good its indebtedness by originating, in its turn, considerable advances in practical optics.

In the latter half of the fifteenth century, the camera obscura was invented by Baptista Porta, and certainly no one who ever beheld the image produced in this well known instrument could help a feeling of regret that it was not permanent, and a desire to make it so. Thus did the invention of this optical instrument give the first impulse in the direction of photography.

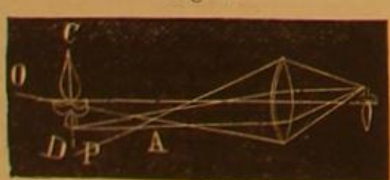
When Daguerre had solved the problem of fixing the image of the camera obscura, his chemical discovery immediately reacted upon optical science. Chemistry called upon optics for the means of producing an image so accurate and perfect in all respects as to be worthy of that permanence, of that immortality which she could confer. This was the great problem in practical optics of the day, as will be readily conceded after an explanation of what was required, what were the difficulties, and how thoroughly they have been vanquished. This problem and its solution originated and now constitutes the science of photographic optics or the optics of photography.

Fig. 3.

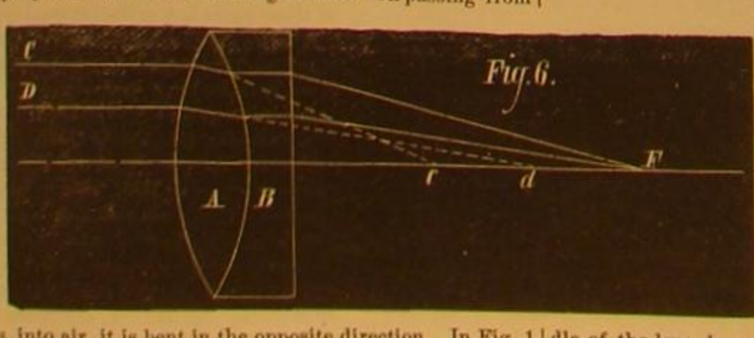


To obtain a proper appreciation of the question, it will be well to begin at the very beginning. When a ray of light passes from a rarer to a denser medium, as for example from

Fig. 5.

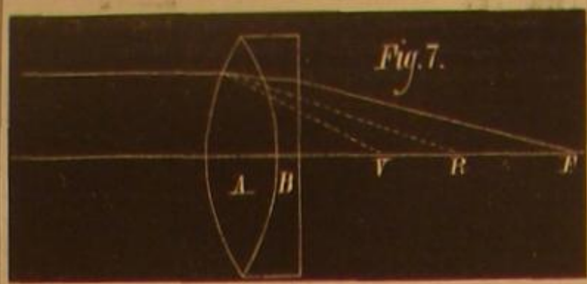


air into glass, its course is changed by being bent towards the line perpendicular to the entering surface. On passing from

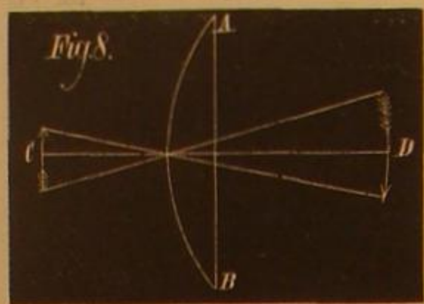


glass into air, it is bent in the opposite direction. In Fig. 1 the upper half of the circle, above X Y, is a rarer and the lower half a denser medium. The ray, A B, is bent in the direction, B G. The amount of this bending or refraction varies with the nature of the substances employed, and is found by dividing the sine of the angle of incidence by the sine of the angle of refraction. In Fig. 2, let Q G be a bar of glass; then the ray, O P, will be deflected on entering the prism by being bent towards the perpendicular; while on leaving it again and passing into the air, it will be bent as much away from the perpendicular, and will consequently emerge parallel to its original direction.

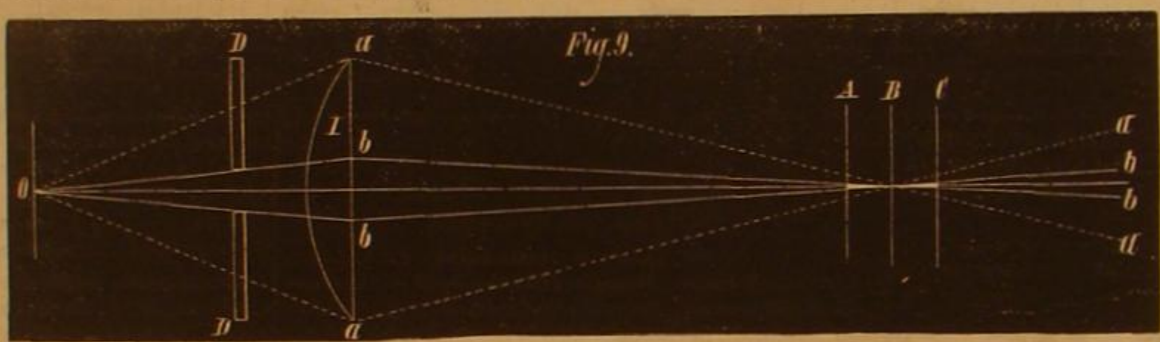
This principle was *beautifully* shown by projecting an arrow on the screen and then interposing a bar of glass be-



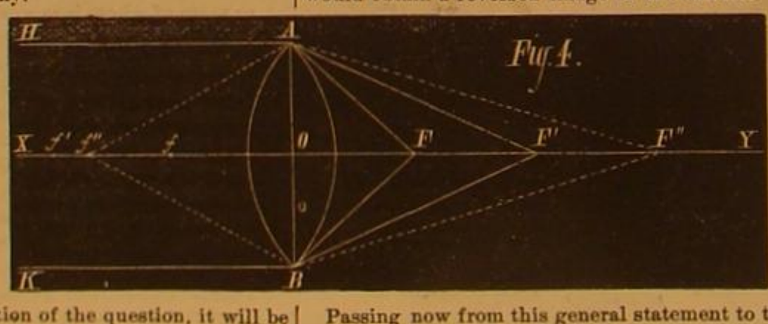
tween a part of it and the rays. The result was that, where the rays were intercepted by the glass, the arrow was *broken* and the broken piece stood either above or below the rest, according to the inclination of the glass. Now if the intercepting



glass is made in the form of a lens, all the rays striking it from any one luminous point will be refracted to a point on the other side of the lens, because it is made up of a number of prisms, the angles of whose surfaces grow more



acute as we pass from the center to the ends, C and D, Fig. 3. In this figure we have three out of many rays striking the lens from A; by carefully constructing the passage of these rays, it is found that they will all meet in the point, H. The same can be shown with any other point of the candle, A B; so that if a screen were placed at E G, we would obtain a reversed image of the candle.



Passing now from this general statement to the principles involved, we find that parallel rays, falling on an ordinary glass lens having both surfaces of the same curvature, will meet in the center of curvature on the other side of the lens. Thus, in Fig. 4, the rays, H A, K B, will be refracted to the point, F. The same would be true for any other parallel rays not drawn in the figure, because they would be acted on equally by the opposite surfaces of the lens; and they would be bent less and less the more we approached the middle of the lens, because the angle decreases more and more. The point, F, is called the focus, a word meaning fireplace. Conversely all rays, starting from F, would emerge parallel on the other side of the lens.

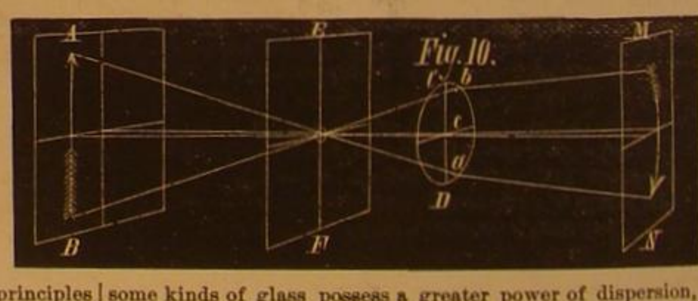
If now we suppose the lens split in half in the direction, A O B, and one half removed, its converging power would evidently be reduced one half; in other words, the focus will be twice as far off, and the rays, H A, K B, will now be bent only to F'. Conversely, rays starting from F' will emerge parallel. Now, if we put the other half of the lens on again, rays starting from F' will converge at *f'*, just as far on the other side of the lens. It is evident, moreover, that, the further the source of rays is removed from F', in the direction F' Y, the *less their divergence*, and the easier it is for the lens to make them converge on the other side. Hence the further we put the source of light from the lens on one side, the nearer the lens will its rays be brought to a focus on the other side. Thus the point, F'', corresponds to *f''*. Conversely, rays proceeding from *f''* will diverge so much that the lens can bring them to a focus only at F''. Two points having such relations to *each other are called* conjugate foci.

To illustrate this, the lecturer had a lens and a burning candle on the stage. Placing the candle at a proper distance from the lens, an image of it was produced on the screen. When the candle was then brought nearer the lens, it was found necessary to move the lens further from the screen to *get an image*; and when the candle was further removed from the lens, the latter had to be placed near the screen. It was also observed that, the nearer the candle was to the lens, the larger the image produced.

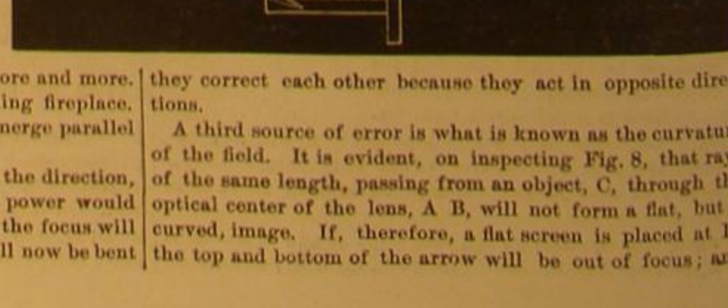
Unfortunately it is impossible, even with the most skillful workmanship, to construct spherical lenses, which bring objects to a perfectly sharp focus. This is especially the case with large lenses. Thus rays coming from the bottom of the inverted object, in Fig. 5, will not all meet in the same point. Those passing through points near the center will meet at D; those passing through the ends will come to A; and intermediate rays will assume positions between these two points, so that a blurred image results. This error is called spherical aberration.

This defect is corrected by joining to our double convex lens another having one surface concave and the other plane, as in Fig. 6. The refraction is greatest near the points of the lens, A, because the angle between its two surfaces is greatest there; on adding the lens, B, however, which acts in the contrary direction, the rays are lifted up most near the ends of the lens, just where they need it most, and a compensation is thus effected. By the use of the lens, A, alone, the ray, C, would pass to *c*, and the ray, D, to *d*; on adding the lens, B, however, both will converge at F.

Another source of error lies in the fact that the rays of light are of different refrangibility; so that the red rays will pass to one, and the violet to the other, end of a band called the spectrum, in which the other colors occupy intermediate positions. Now, as these different rays possess different photographic power, we would obtain an image of varying intensity. This is called chromatic aberration. To correct this defect, a similar arrangement is employed as in the case of spherical aberration. It has been found that

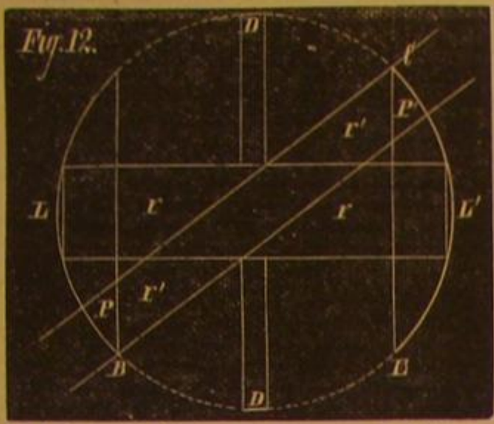


some kinds of glass possess a greater power of dispersion, that is, of separating the rays of different colors, than others. Taking advantage of this property, the lens, B, Fig 7, is made of heavy lead glass, having a high dispersing power. With the lens, A, alone, the ray, S, would have been separated into a series of colors stretching from V to R; but on passing through B, they undergo a reversing process, and are brought to a focus at F. Either lens alone would produce a chromatic aberration; but placed together



they correct each other because they act in opposite directions.

A third source of error is what is known as the curvature of the field. It is evident, on inspecting Fig. 8, that rays of the same length, passing from an object, C, through the optical center of the lens, A B, will not form a flat, but a curved, image. If, therefore, a flat screen is placed at D, the top and bottom of the arrow will be out of focus; and if the screen is properly placed for the top and bottom of the arrow, the middle will be out of focus. The different parts of the image evidently do not lie in the same plane; and to correct this error, the same device will have to be employed as in photographing at the same time objects lying in several different planes more or less distant from each other. In other words, we must produce what is known as



"depth of focus." This is necessary even in taking a portrait, where the nose and the ears of the sitter, for example, would come to a focus at different distances from the lens.

The depth of focus is increased by means of the diaphragm or stop, an ingenious contrivance, shown at D D, in Fig. 9, by which all rays coming from an object at O are cut off, with the exception of those passing through the opening. Without the stop, the outer rays, O *a*, would diverge considerably on both sides of the focal point cut by the screen, B; and if this screen were moved to the position, A or C, the curvature of the resulting image would become very appreciable. With the stop, however, the screen could be moved anywhere between A and C, and a tolerably sharp image produced.

It is not possible, however, by the use of the diaphragm alone to correct the curvature of the field entirely. The effect of the diaphragm is really to divide the lens into as many little lenses as there are pencils of light passing through it. Some of these pass through the ends of the lens where there is greater converging power, and are consequently brought to a nearer focus than those passing through the middle. This circumstance of itself would tend to produce a distortion. This is shown in Fig. 10, where the parts of the arrow, A B, not lying in the axis of the lens, C D (and consequently obliged by the diaphragm, E F, to pass through the ends of the lens, at *a* and *b*), are brought to a focus nearer the lens than the middle points.

It has been found by experience that a convergent meniscus lens provided with a stop and placed with its concave side toward the object to be photographed, will produce the least amount of curvature of the field. When the convex side is turned towards the object, a greater curve is produced in the opposite direction. Hence, by combining two such meniscuses, and placing a diaphragm between them at the proper relative distance from the lenses, this fault is entirely overcome. These and other considerations, which would take us too far, led Mr. Zentmayer, of Philadelphia, to invent his celebrated lens, a representation of which is given in Fig. 11. Here we have two meniscuses, A B and C D, with a stop, S S, nearer the smaller one. The lenses are made of the same kind of glass, and yet counteract each other's errors so well as to produce a very perfect instrument. The leading principles will be better understood from the following drawings: In Fig. 12, let A B represent two plano-convex lenses, exactly alike, and so placed that their outer surfaces form parts of an imaginary sphere, A B C D. Then, neglecting refraction for a moment, it is evident that a bundle of rays, *r r*, which the aperture of the diaphragm, D D, allows to pass through both lenses, will be affected only by the little lenses, L, L′, and two blocks of glass having parallel surfaces. Hence, we will get only the insignificant amount of spherical and chromatic aberration due to two minute lenses. The rays, *r′ r′*, passing through the edges of the lenses, A B and C D, will be affected only by the two prisms, P and P′, which will counteract each other, being exactly equal and opposite. For the reason already stated, and on account of the refraction of the rays, the diaphragm is not placed in the center, but a little to one side. This instrument has a most remarkable depth of focus, and produces most excellent results.

To show that any refracting medium, water for example, could become a lens when made into the proper shape, the lecturer placed a watch glass in the path of the rays coming from a vertical lantern containing a slide of a fine piece of statuary. Nothing was visible on the screen, until he poured water into the watch glass, when the image came out with surprising distinctness. The applause which followed this striking experiment sufficed to agitate the water, disturbing the shape of the lens and destroying the image, which did not perfectly reappear until the water came to rest.

One of the most astonishing effects that a lens is capable of producing was shown by the aid of an instrument called the megascope, represented in Fig. 13. This is nothing more than a dark box, having a lens in front and illuminated inside with an oxycalcium light falling on a sheet of white paper in the rear of the box. When the hand is held as close to the light as it can be without burning it, an immense image in natural colors and startling relief is produced on the screen. The huge proportions of this mammoth hand produced a ludicrous effect when compared with the hand of an assistant standing near the screen. Other objects, such as a plaster cast, a mother of pearl shell, an apple cut in half, and the works of a watch, were then shown with splendid effect. The images of these objects are so large that it is difficult to keep them in focus in all their parts. The lecturer concluded by exhibiting a number of photographs upon the screen, pointing out their artistic excellence and defects in accordance with the principles laid down. C. F. K.

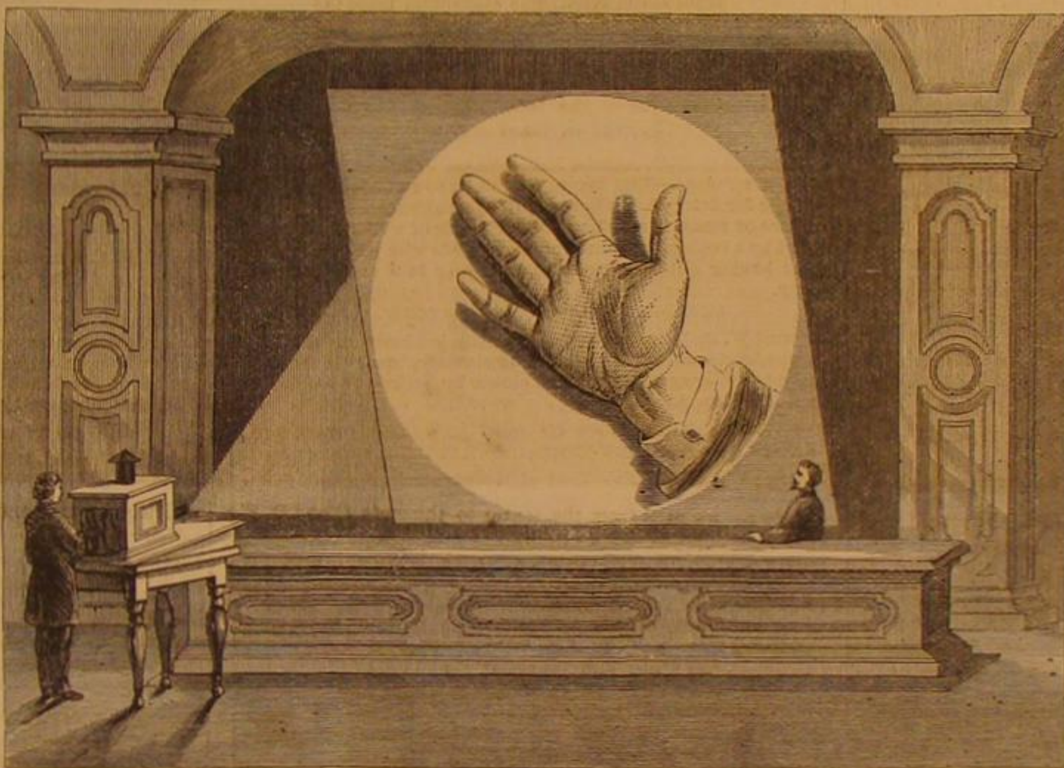


Fig. 13.—THE MEGASCOPE.

Facts and Simple Formulæ for Mechanics, Farmers, and Engineers.

[We are constantly receiving letters, asking for simple rules for various engineering and mechanical operations. Frequently the writers send us merely the problem, requesting us to apply the rule and publish the solution. In order to avoid repetition, it is our custom to refer correspondents, presenting analogous cases, to those already published in these columns, leaving them to apply the information there given to their own wants. In deference to the demand for the rules abstractly stated, and believing that in many instances a reference to the rule itself rather than to any application of it will serve our correspondents' purpose better and at the same time relieve our already crowded query columns, we shall from time to time present a series of useful facts and formulæ taken from the works of Molesworth, Haswell, Nystrom, "Wrinkles and Recipes," and other reliable sources, in place of our usual collection of recipes. Brief and simple rules, which are the results of the experience of any of our readers, we shall be glad to receive for publication in this connection; and correspondents sending us queries on any mechanical or engineering subject, answerable by rules or formulæ, will generally here find the information needed.—EDS.]

Shrinkage of castings, in locomotive cylinders $\frac{1}{16}$ inch in a foot; in pipes $\frac{1}{8}$ inch in a foot; girders, beams, etc., $\frac{1}{8}$ inch in 15 inches; engine beams, connecting rods, etc., $\frac{1}{8}$ inch in 16; thin brass $\frac{1}{8}$ inch in 9; thick brass $\frac{1}{8}$ inch in 10; in zinc $\frac{5}{16}$ inch in a foot; in lead, same; in copper $\frac{3}{16}$ inch in a foot; in bismuth $\frac{5}{32}$ inch in a foot; in tin $\frac{1}{4}$ inch in a foot.

To test iron and steel: Nitric acid will produce a black spot on steel; the darker the spot, the harder the steel. Iron, on the contrary, remains bright if touched with nitric acid. Good steel in its soft state has a curved fracture and a uniform gray luster; in its hard state, a dull silvery uniform white. Cracks, threads, or sparkling particles denote bad quality. Good steel will not bear a white heat without falling to pieces, and will crumble under the hammer at a bright red heat; while at a middling heat it may be drawn out under the hammer to a fine point. To test the toughness, place the fragment on a block of cast iron; if good, it may be driven by a blow of a hammer into the iron; if poor, it will be crushed under the blow.

Main shafting in woodworking shops should run at 300 revolutions per minute. Mortising machines, 250 to 300 strokes per minute; stroke 6 to 9 inches. Sharpening angle for machine cutters, adzing soft wood across the grain, 30°; ordinary soft wood planing machines, 35°; gouges and plowing machines, 40°; hard wood tool cutters, 50° to 55°.

The hide of a steer weighs about the eighteenth part, and the tallow the twelfth part, of the living animal.

The buoyancy of a cask in lbs. = 10 times the capacity in gallons *minus* the weight of the cask itself.

A square of slate or slating is 100 superficial feet. The lap of slates varies from 2 to 4 inches. The pitch of a slate roof should not be less than 1 inch in hight to 4 inches in length.

Wood Ashes.

On another page we publish illustrations of the effects of potassa and other chemical fertilizers on potato and grape vines. The most accessible and cheapest form in which potassa is obtainable is wood ashes, which every country housekeeper should carefully collect from the hearth. Mr. Austin P. Nichols, of the Boston *Journal of Chemistry*, has recently made some analyses of ashes taken from the hearth, with the following potassa results:

	No. 1.	No. 2.	Mean.
Potassa..................	12·55	12·64	12·59
Carbonate of potassa......	18·38	18·55	18·48

"The wood from which the ashes came consisted of a mixture of hickory and beech. The results show the amount of pure potassa and carbonate of potassa which the ashes contained; but the absolute alkali power and value as represented are best shown in the amount of crude or commercial potassa held in the ashes. One hundred lbs. held 19·85 lbs. of alkaline salts, soluble in water, and consequently, if we estimate the value of commercial potassa at eight cents per pound, we have a cash potassa value in these ashes of $8.60 in each 100 lbs. A bushel of dry ashes weighs about 34 lbs.; this would give a potassa value to each bushel of fifty-three cents. The ordinary ashes, such as are collected in the country by soap boilers, are usually not so rich in alkaline constituents. The mean potassa value of these ashes, estimated upon the value here adopted, we have found to be about forty-two cents per bushel. From these results it is clear that the farmer had better retain his ashes for farm use than to sell them at the price usually obtained from soap peddlers. Besides the potassa salts, ashes contain important amounts of phosphoric acid, soluble silica, etc., which add greatly to their value as fertilizing material. It is safe to say that every bushel of true wood ashes which a farmer produces upon his hearth is worth to him, for farm use, forty cents in gold. It is, therefore, very poor husbandry to sell them for twenty cents the bushel, as many do. We value ashes so highly that offers for them are rejected, no matter what they may be.

"In the mixture of raw bone meal and ashes, recommended by us ten years ago, we get quite all the valuable constituents of plant food, and at cheaper rates than in any other mixtures. We have used this combination for many successive seasons, with most satisfactory results. We confidently expect that the German potassa products will before long stop the consumption of wood ashes in the manufacture of American potassas, and it will be a happy day for our agricultural industry, if the products of our wood fires are turned in the direction of the farm."

RED INK.—The following recipe for a beautiful red ink is given by Metra, of Paris: Dissolve 25 parts, by weight, of saffranin in 500 parts warm glycerin, then stir in carefully 500 parts alcohol and an equal quantity of acetic acid. It is then diluted with 9,000 parts water, in which is dissolved a little gum arabic.

Inventions Patented in England by Americans.

[Compiled from the Commissioners of Patents' Journal.]

From May 26 to June 7, 1876, inclusive.

AIR GUN.—I. Johnson *et al.*, Worcester, Mass.
ATMOSPHERIC HAMMER.—J. C. Butterfield, Chicago, Ill.
BANK CHECK, ETC.—J. B. Johnston, New York city.
BEER TAP.—G. C. Driner *et al.*, Brooklyn, N. Y.
BILLIARD BALL.—W. H. Lippincott, Pittsburgh, Pa.
BOILER.—I. Barton, Williamsport, Pa.
BOMB LANCE.—P. Cunningham, Newark, N. J.
BOOT HEEL TRIMMER.—L. Graf, Newark, N. J.
CIGAR LIGHTER.—O. W. Boyden, Newark, N. J., *et al.*
CURTAIN FIXTURE.—C. Buckley *et al.*, Meriden, Conn.
DESK.—W. S. Wooton, Indianapolis, Ind.
ENVELOPE.—H. Burnell, San Francisco, Cal.
FARE REGISTER.—A. Hance *et al.*, New York city.
FIBER DRAWING HEAD.—J. Good, Brooklyn, N. Y.
HARVESTERS.—B. F. Jackson, Pittsfield, Ill.
HECKLING HEMP, ETC.—J. Good, Brooklyn, N. Y.
LOOM.—G. Crompton, Worcester, Mass.
MAKING GAS.—T. S. Stewart, Philadelphia, Pa.
MAKING WOOD SCREWS.—T. J. Sloan, New York city.
MOTIVE ENGINE, ETC.—J. T. Gallup, Greenport, N. Y.
PANTALOONS.—G. R. Eagar, Boston, Mass.
PIPE-CUTTING TOOL.—A. Saunders, Yonkers, N. Y.
POLISHING BUTTONS.—G. P. Warner, Leeds, Mass.
ROCK DRILL.—J. B. Waring, New York city.
ROCK DRILL.—W. W. Dunn (of San Francisco, Cal.), London, England.
SWIMMING APPARATUS.—R. B. Pumphrey, Baltimore, Md.
TREATING REFUSE OIL, ETC.—W. P. Jenney, New York city.
WASHING FABRICS.—J. Brown, Monticello, N. Y.
WASHING WOOL, ETC.—F. G. Sargent, Graniteville Mass

DECISIONS OF THE COURTS.

United States Circuit Court--District of Rhode Island.

THE ATTORNEY GENERAL, UPON THE RELATION OF GEORGE V. HECKER *vs.* THE RUMFORD CHEMICAL WORKS *et al.*

[In Equity.—Before Shepley and Knowles, JJ.:—Decided May 15, 1876.]

This was a proceeding in equity in the name of "George H. Williams as the Attorney General, upon relation of Hecker *vs.* The Rumford Chemical Works *et al.*," the prayer of the bill being to declare void and to cancel and annul certain reissued letters patent, and to enjoin defendants from prosecuting any suit at law or equity for alleged infringements of the same.

A patent for a useful invention is not, under the laws of the United States, a monopoly, in the old sense of the common law.

It more nearly resembles a contract which, under the authority conferred by the constitution, Congress authorizes to be entered into between the Government and the inventor, securing to him, for a limited time, the exclusive enjoyment of the practice of his invention in consideration of the disclosure of his secret to the public, and his relinquishment of his invention to the public at the end of the term.

The practice that obtains in England as to the mode or forms of procedure for the cancellation and annulling letters patent by *scire facias* does not obtain in this country.

No statute of the United States confers or recognizes the existence of any such right, nor can any precedent be found for the suing out of a writ of *scire facias*, or the bringing of a bill in equity to repeal or cancel the patent by the Attorney General, in the name and behalf of the United States, either with or without a relator.

The jurisdiction conferred, by the acts of 1790 and 1793, upon the Federal courts to repeal a patent, and which without express grant it is believed did not inhere in these courts, is nowhere conferred by the acts of 1836 or 1870, or in the Revised Statutes of 1874.

The decisions in the Federal courts sustaining proceedings in equity to vacate letters patent granting lands obtained by fraud, furnish no precedent in case of letters patent for inventions.

"The Attorney General of the United States, as he is Attorney General," has no authority as such and in his own name to file an information, or commence proceedings by bill in equity.

If the court has jurisdiction in cases of this character, the information should be in the name and behalf of the United States, and should be filed by the attorney of the United States, in the district in which the information is filed.

Any other mode of procedure (unless authority is expressly conferred by statute) is neither authorized by law, sanctioned by any precedent, nor supported by the authority of any judicial decision.

[*Causten Browne* and *Charles F. Blake* for the informant.
William M. Evarts, *Clarence A. Seward*, and *Charles S. Bradley* for the defendants.]

Supreme Court of the District of Columbia.

HENRIETTA H. COLE *vs.* JOHN W. KENNEDY AND JOHN E. KENDALL.

[In Equity, No. 4,635. Docket 15.—Before Wylie, J.]

WYLIE, J.:

The reissued letters patent No. 4,319, dated April 25, 1871, declared good and valid, said patent being for improvements in fluting machines granted to H. H. Cole.

The "Knox," "Pee-less," and "Crown" fluting machines are infringements of the Cole patent, as reissued.

[*Charles S. Whitman*, for complainant.
R. Ross Perry, for defendant.]

United States Circuit Court---Northern District of New York.

GEORGE S. NEWELL *et al.* *vs.* GEORGE WEST *et al.*

Where an inventor and patentee entered into a written contract with one of the part owners of the patent, to procure, if possible, an extension of the same, and, under such contract, received a valuable consideration, and, after his death, his wife, as executrix, procured such extension, and conveyed by assignment, duly recorded, such extended patent to the assignees of said part owner, who was a party to the original contract with the inventor and patentee, it was held by Wallace, J., that, upon the resignation of the trust as executrix, and the appointment of an administrator with the will annexed, such administrator could not make a legal assignment of such extended patent so as to vest the same in another and different party than the assignee of the executrix.

[The complainants having filed their bill for a perpetual injunction, and for an accounting, alleging the infringement by defendant of extended letters patent, in which complainants own the exclusive right for the State of New York, the defendants plead thereto that the Union Paper Bag Machine Company is the owner of the patent in exclusion of the complainants. Complainants having taken issue by replication to the plea, the cause now comes on to be heard upon the pleadings and proofs.]

[*Marcus P. Norton*, for complainants.
Horace Binney, for defendants.]

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

HENRY L. DALTON *et al.* *vs.* CHARLES NELSON *et al.*—IN EQUITY.—JANUARY 28, 1876.

Letters patent for an improved steam gage cock were issued to Albert Bisbee, September 18, 1855, were extended for seven years from September 18, 1869, and were reissued on June 14, 1870, to Oscar T. Earle, assignee of Bisbee.

SHIPMAN, J.:

This is a bill in equity, in favor of the owners of the reissued letters patent, to restrain the defendants from an alleged infringement, and for an account. Infringement and the novelty of the invention are denied by the answer.

The alleged invention, which is a compression steam gage cock, was made by Mr. Bisbee in 1853, and consisted, in the language of the specification:

First, in making one of the surfaces that meet to close the water way or steam passage of a piece of galvanized rubber, which is protected from spreading or confined in metal in such manner that but little more than its bearing or acting surface is exposed; and secondly, in making the other surface, which is of metal, in the form of a ring, so that the rubber may be compressed, by the same power, more forcibly than if the metal surface were equal in area to that of the rubber.

Prior to this invention, the opposing surfaces of steam gage cocks had been made of brass or other metal, which was speedily roughened or worn by the dirt or grit in the water. To remedy this difficulty, one of the surfaces was sometimes faced with leather or lead; but the steam soon destroyed the leather, and corroded or cut away the surface of the lead. The joints leaked, and the cocks soon needed repair, whatever material was employed. The use of vulcanized rubber as one of the bearing surfaces overcame these difficulties. Its advantages are briefly explained, by one of the defendants' witnesses, to have been that, "being a rubber or elastic substance, it wouldn't wear and grind, as metal surfaces would; by its elasticity it pressed upon the seat and easily made a tight joint; it has always answered just as well in hot water as cold, while metal surfaces and ground joints in stopcocks will not stand at all in hot water." The Bisbee cock has proved to be of great value. It has superseded the use of pre-existing devices, has met with large sales, and "has answered its purposes perfectly."

The main question in the case is as to the validity of the patent. The defendants have introduced a number of devices, which are claimed to have anticipated the plaintiffs' patent. Of these, the valve patented by Albert Fuller was clearly antedated by the Bisbee invention. In neither one of the other prior inventions or prior publications was vulcanized rubber used as one of the surfaces to close the steam passage. This fact raises the question which was considered by counsel to be the principal one in the case, namely: Is the substitution of vulcanized rubber for cork, leather, or soft metal, by which substitution a substantially perfect gage cock was first produced, the subject matter of a valid patent?

The difficulty which was to be overcome by the patentee was to make a steam gage cock which would not readily leak, and which would resist the action of steam. The result which he attained was the invention of a durable gage cock, which remained tight under various pressures and different degrees of heat, and which did not get out of repair. This result was accomplished by the discovery of the fact that highly vulcanized rubber, in consequence of its elasticity, would not be ground and changed by water containing dirt or grit, and in consequence of its durability and non-corrodible properties, would successfully endure and withstand the power of steam. In the year 1853, the peculiar adaptability of hard rubber to the varied mechanical purposes to which it has since been applied was much less understood than it is at the present time. The invention consisted in the practical application of the discovery by such mechanical means that an efficient gage cock was produced.

An attempt was made to show that this invention had been anticipated by the application of sheets of vulcanized rubber to the edges of the door or plate of manhole of steam engines, and also upon the delivery valves of engines; but the analogy between the edge of a gasket, upon the plate of a manhole, or upon a delivery valve, and one of the opposing surfaces of a compression steam gage cock, which is necessarily opened and closed at frequently recurring intervals, and which should be so constructed as not to become leaky from the constant use to which it is subjected, is so remote that a rubber gasket cannot with propriety be considered an anticipation of Bisbee's invention. The remark of Judge Coltman in Walton *vs.* Potter (4 Scott's N. C., 91), seems to be applicable to this branch of the case.

It appears to me that it (the plaintiff's invention) is a very useful application and adaptation of a substance, the properties and qualities of which, for the purpose, had never been known before, and, therefore, that it was properly the subject of a patent.

Again, the Bisbee invention comes within the principle which was enunciated in Hicks *vs.* Kelley (18 Wall., 673):

The use of one material instead of another in constructing a known machine is, in most cases, so obviously a matter of mere mechanical judgment, and not of invention, that it cannot be called an invention, unless some new and useful result, an increase of efficiency, or a decided saving in the operation, is clearly attained.

Here the substitution does not merely produce the same result in the same way, but produces a new result, differing from the former one so materially that it might almost be said that the difference is one of kind, and not of degree. The improvement was of such marked character that the inference is that the new device must have been the result of invention, thought, experience, and skill, rather than the result of mere mechanical judgment.

The defendants' device is an imitation of the plaintiffs' gage cock, except that, in lieu of the vulcanized rubber, the defendants use the material which was patented by reissued letters patent issued to Nathaniel Jenkins, August 8, 1869; the claim of the patent is for an elastic packing composed of at least four tenths of finely pulverized refractory earthy or stony material, intimately mingled with and held together by rubber, prepared for vulcanizing and then vulcanized, as and for the purpose described.

The defendants have taken the principle or idea of the Bisbee invention, which was the production of a tight steam gage cock, by the use of vulcanized rubber as one of the bearing surfaces, and the same material is used in the same form and shape in which it appears in the Bisbee invention. It is true that other materials are intermingled with the vulcanized rubber, forming one compound but the vulcanized rubber of Bisbee is none the less used because other materials are fused with it. The infringement is manifest.

Let there be a decree for an injunction and an account.

[*S. J. Gordon* for plaintiffs.
Thomas W. Clarke, for defendants.]

Recent American and Foreign Patents.

NEW MECHANICAL AND ENGINEERING INVENTIONS.

IMPROVED PRINTER'S GALLEY.

Henry E. Hanna, Pittsfield, Ill.—This invention is a galley, by which the type may be locked in an instant without sidesticks, quoins, and chase, for taking proofs, and unlocked for making corrections without sealing off type. It consists of an adjustable cross bar that is applied by hinged or buckle joints to the side of the galley, to be readily folded out of the way or locked to the type. When it is desired to lock the type for taking a proof, the locking bar is brought against the type, and the knuckle or hinged frame lowered and extended to its full width, giving a firm and complete locking of the type at a saving of time and labor. As the lower part of the locking bar is first withdrawn from the bottom of the types, while the bar still holds the upper part of the type, the locking bar may be easily released without producing any sealing off of types, which forms an objectionable feature of the locking attachment of galleys heretofore in use.

IMPROVED STOVE PIPE JOINT.

James L. Loring, Dallas center, Iowa, assignor to himself, Fortunatus Hubbard, and Judson Purinton, of same place.—This is an improved stove pipe joint that forms a solid and firm connection of the pipes, so that they cannot be pulled apart or pushed together, while being readily disconnected when required. It consists of recesses at the end of one pipe, in connection with rivets of the other pipe end, the rivets having broad interior heads, and shanks nearly of the width of the slots.

IMPROVED BALANCED SLIDE VALVE.

John Edward Watson, Louisville, Ky.—This invention consists in the improvement of balanced slide valves, by combining a piston, diaphragm, and valve with a seat having port, passages, and channels leading from steam inlet. The diaphragm takes the upward pressure of the steam, and has sufficient movement to allow the valve to be pressed by the down pressure in said chamber steam-tight on the seat. The area of the chamber is sufficiently larger than that on the under side of the valve subject to lifting pressure to keep the valve tight.

IMPROVED WEIGH SCALE.

Alanson Carpenter, Angola, Ind., assignor to himself and Joseph Smith, same place.—This invention relates to an improved weighing scale for determining the weights of substances, and also the pressure of steam in a boiler; and it consists of a sliding post connected by a bottom crosshead and lever rods with weighted elbow levers having outer index arms, swinging in a suitable casing or box.

IMPROVED SELF-CLOSING HATCHWAY.

Samuel W. Bell, Burgettstown, Pa.—This is a hatchway door. It is opened automatically by a tapering elevator, made in sections, hinged together and folding, and closed by springs or weights, in the manner specified.

IMPROVED MANUFACTURE OF BOOT AND SHOE SOLES, ETC., AND IMPROVED SCREW-THREADED RAWHIDE SHOE PEGS.

George V. Sheffield, New York city, assignor to Sheffield Screw Driving Machine Company, same place.—The first invention consists in the method of uniting the soles of boots and shoes, or the parts to be joined together, by means of threaded screws made of petrified rawhide, or other analogous fibrous material, which said screws are screwed into corresponding screw-tapped holes in the parts to be united. The second invention relates to the manufacture of the threaded pegs, in which the skins or hides, as they come from the animals, are spread on boards placed over a bed of common salt in a retort, and subjected them to the action of the salt heated to about 90° for a sufficient length of time to petrify and harden them. Practicable screws are made from the strings cut from the hides, the width being about the same as the thickness of the skin, so as to make them square.

IMPROVED CAR COUPLING.

George W. Johnson, Princeton, assignor of one half his right to Francis W. Hauss, Gibson county, Ind.—This consists of a hook and a catch on each bar, so contrived as to form a double coupler, which connects self-actingly, and is disconnected by a chain or cord from above, or from the side, in such manner as to avoid going between the cars.

IMPROVED COMPENSATING PENDULUM.

Fritz Willman, La Salle, Ill.—The pendulum ball is suspended by two rods of metal, of different powers of expansion and contraction, and a lever, the lever being fixed in the rod of least expansion for a fulcrum, and having the more expansible rod connected to one end, and the ball to the other end, so that when the rods expand the ball will be raised, and it will be lowered when they contract. The amount of variation or compensation is varied by shifting the lever along the rod in which it is suspended.

IMPROVED FIRE SHIELD.

William Murray, Vicksburg, Miss.—This invention consists of coupling joints and pipes for quickly erecting frames for scaffolds, and for supporting plates to protect firemen from the heat of a burning building, the object being to enable them to approach closer to a burning building, and to afford protection to other buildings by being set up between them and the buildings on fire.

IMPROVED LOCK AND KEY.

John J. Portuguez, New York city.—This is an improved lock for safes, doors, and other places where two parts are to be secured together, so constructed that it cannot be opened by any other instrument than the key made expressly for it. The mechanism, which embodies several novel and ingenious devices, cannot be explained without the aid of drawings.

IMPROVED SMOKE JACK.

John B. Deeds and David A. Bridwell, Terre Haute, Ind.—This consists of a flue or jack with movable and balanced hood and outside ventilators. The movable hood adjusts itself automatically by a surrounding conical rim, with drip holes, to the top of the locomotive smoke stack.

IMPROVED HOSE PIPE COUPLING.

Thomas Loftus, Sacramento, Cal., assignor of one half his right to Benjamin Bullard, Jr., same place.—The coupling is formed by an exteriorly threaded and flanged tube, and two interiorly threaded tubes, which screw on the former and clamp the hose.

IMPROVED EARTH AUGER.

Datus N. Root, Parkersburg, Iowa, assignor to Chancy F. Owen, same place.—This consists of a bucket and bits contrived in three equal sections, by which the auger works faster, and by taking out one of the boring bits and bucket sections and substituting a pronged bit of peculiar form, with a shorter bucket section, bowlders of larger size may be taken out than can be with other augers.

NEW CHEMICAL AND MISCELLANEOUS INVENTIONS.

IMPROVED FIRE ALARM AND EXTINGUISHER.

Thomas F. Nevins and John W. Smith, Brooklyn, N. Y.—This invention consists in making water flow through a water wheel whose movement acts upon a bell, whereby an alarm is sounded automatically the moment the water commences to flow. As soon as a fire breaks out and the flame licks a cord, the latter burns and breaks, and a spring throws back the bolt and lets a weight fall. The said weight being attached by a chain to the end of the stopcock arm, opens the stopcock and allows the water to pass to the water wheel.

IMPROVED MICROSCOPE.

George Wale, Fairview, N. J.—This is an improved microscope stand, by which the object glass may be adjusted to greater or less distance from the object without being disturbed in the least, or thrown out of its accurate vertical position, and by which the greater or lesser intensity of the light may be regulated and set to various conditions of the object. The invention consists, first, of the mechanism for the minute vertical adjustment of the object glass; secondly, of the adjustable ring frame and socket; and lastly, of the variable light-admitting aperture of the same.

IMPROVED PHOTOGRAPHIC PLATE.

Frederick H. Powell and Philip Lehnen, Auburn, N.Y.—This consists in an improved plate for photographs or signs made of waterproof paper, having a coat of paint on the back, and one or more coats of baking japan or varnish on the face, and hardened. The process of preparing the paper for photograph and sign plates consists in first waterproofing the paper, then coating the back with a paint, and baking it in an oven till hard, then coating the face with one or more layers of baking japan or varnish, and then baking such final coat to hardness to obtain the required finish.

IMPROVED BURIAL APPARATUS.

Lewis H. Shular, Crawfordsville, Ind.—A deep, strong box, with closed top, open side, and dumping bottom, is mounted on truck wheels to move sidewise. The bottom may be opened and closed by a crank shaft. Cranes are provided for lowering the coffin by chains and a crank shaft, and are pivoted to the ends of the box inside of the opening to swing out on the grave, and to close in for protection when the box is shut up. The shaft has a ratchet and pawl for holding the coffin when required. After the coffin is lowered, the box is moved along over it on the track for dumping the earth in.

IMPROVED VOLTAIC BELT.

Alexander M. Dye, Elkhart City, Ill.—The plates are secured to a felt band by clinching them over the edges and also by a band bottom fastening.

IMPROVED WEIGH SCALES.

Robert H. C. Rhea, Uniontown, Ky.—These scales are adapted for being carried by physicians and druggists in portable folded state, in the pocket. They are made of a longer weighing beam and a shorter tray beam, hinged together and working on a fulcrum or flange bent down from the tray or scale beam. The weighing beam is longitudinally slotted for the sliding weight, having lateral index hands and a guide pin, and provided with pronged ends for attaching smaller weights.

IMPROVED COMBINED MEASURE AND FUNNEL.

Frank H. Winston, Evansville, Wis.—This invention consists in a crooked stopper rod, by which the stopper may be held while the liquid is running from the measure.

IMPROVED BREECH-LOADING FIRE ARM.

John A. Heckenbach, Kenosha, Wis.—This consists of a movable plate in front of the breech block, with a device for tightening it up in a simple way, by means of which the plate can be readily taken off for making smooth and bright with emery paper, and can be tightened up when the parts become loose from wear, without expense, and also without tools. The plate also allows of using stronger pins on which the hammer strikes.

IMPROVED BATH FOR TREATING IRON.

Christian Ziegenheim, Allegheny, Pa.—This is a compound for treating iron preparatory to uniting it with steel by casting the steel on the iron, consisting of sal soda, caustic soda, borax, lime, and water.

IMPROVED ICE CREAM FREEZER.

Edward G. Wheeler, Mobile, Ala.—This consists of an ice can surrounding the cream basket, both of which are inside of an outer can, and suspended from the handles of the beater shaft, so as to revolve with it, being supported on its pivot so as to turn easily. The device is so connected to the beater shaft that, although only partially filled with ice, it can be made to freeze a full can of cream by shifting it up along the cream bucket, after freezing the lower portion.

IMPROVED PROJECTILE FOR ORDNANCE.

John G. Butler, New York city.—By means of this invention the sabot of a projectile may be applied in the shape of a comparatively delicate flanged ring, whereby the weight is not only greatly reduced, but much strength is added, since the sabot is secured to the projectile so much nearer to its periphery. A reduction of the distorting effects of the discharge upon the sabot, whereby it is frequently broken, by presenting a greatly reduced area for the operation of these forces, is also gained.

IMPROVED FOUNTAIN PEN.

Henry H. Perkins, Utica, N. Y.—This invention consists of a fountain attachment, bent of one piece of sheet metal, and attached by elongated wings and spring clasps to the pen, the ink reservoir being at the under side of the elongated wings.

NEW WOODWORKING AND HOUSE AND CARRIAGE BUILDING INVENTIONS.

IMPROVED SASH BALANCE.

James Waddell, Mamaroneck, N. Y.—This is an improved sash holder, by which the upper sash may be readily opened and closed and retained in any position for ventilation, and by which also both sashes may be secured in closed position. The cords are connected with the top and front of the upper sash, and then passed over pulleys arranged on the top of the lower sash.

NEW AGRICULTURAL INVENTIONS.

IMPROVED FENCE POST.

Frederick Sulter, De Witt, Iowa.—This consists of a slotted metallic tube with a wooden core, to which the wire-supporting staples are fastened. A top staple and wire retain a protecting cap, and a bottom staple and wire the inner wooden section.

IMPROVED HARROW.

William Taylor, St. Louisville, Ohio.—This harrow is so constructed that it will readily adjust itself to irregularities in the surface of the ground, and will allow either side to be raised to pass obstructions, and to clear it of rubbish. It has longitudinally hinged sections.

Notes & Queries

C. C. P. will find on p. 203, vol. 34, recipes for colored fires.—H. J. C. should line his vinegar casks with the material described on p. 11, vol. 24. —G. W. S. and other pisciculturists should address Seth Green, Esq., Rochester, N. Y.—S. H. D. will will find a recipe for removing warts on p. 97, vol. 32.—R. G. B. will find directions for bronzing iron castings on p. 283, vol. 31.—C. W., Jr., can proportion the change wheels of his compound gears by the rule given on p. 107, vol. 34.—W. B. can paste paper labels on tin if he mixes a tablespoonful of coarse sugar with a quart of flour paste.—E. F., G. M. C. & B., J. M., C. C., J. H. G., and many others who ask us to recommend books on industrial and scientific subjects, should address the booksellers who advertise in our columns, all of whom are trustworthy firms, for catalogues.

(1) F. M. J. says: I want to convey water 1,000 feet from a hydrant before it can be used. Which is the most practicable way, to lay 1,000 feet of pipe and connect an engine to the end, or connect the engine close to the hydrant, and the hose to the end of the pipe and play through the pipe and hose? A. The first method would be best, if you wish to throw a stream.

(2) A. S. asks: How are photographs put upon glass and made transparent, so as to be colored on the back with oil colors? A. The face of the picture is covered liberally with starch paste and laid upon clean glass. Then, with a smooth, hard edge, the paper is rubbed upon the back from the center to the edge until all of the starch is pressed out from between the picture and glass that can be. After it is dry, castor oil is applied to make it transparent.

(3) E. V. J. asks: What is the difference between sweet oil and olive oil? A. They are different names for the same thing.

(4) A. F. L. asks: How high can water be raised with an ordinary well pump by using check valves, say 10 or 12 feet apart? A. If, as we understand you, you mean to force the water up, the hight is only limited by the power applied, and the strength of the apparatus.

(5) W. L. P. asks: 1. In what proportion should the best Portland cement be mixed with clean sharp sand, for coating the outside of a stone or brick building? A. One measure of cement powder to three measures of dry sand. 2. How many square feet will a barrel of cement mixed with sand cover? A. One barrel of cement and three of sand will make 3½ barrels of mortar, which will cover about 4,000 square feet of brick wall, or about 40 squares, to a thickness of ¾ of an inch. 3. Should it be put on in one or two coats? A. Use one primary coat and a finishing coat put on immediately after it, before the first coat has set. The permanence of stucco on the exterior walls of a building depends generally more upon the stability of the surface that receives it than upon the stucco itself. The latter can absorb water and give it off without injury; but if the water finds its way through the stucco into the brick, it is apt to freeze in winter and fracture the face of the wall. To harden and fill the pores of the brick, spread a thin wash of cement over the wall and scrape it off first, before putting on the principal coat. 4. Could an ordinary house plasterer put it on satisfactorily? A. Yes, if an intelligent man.

(6) E. M. B. asks: Will a pump do work as easily with a 12 inch column as with a 5 inch, the size of water valve being the same in both cases? The lift is 150 feet. A. Other things being similar, the pump should force water more easily through the 12 inch pipe.

(7) J. V. N. asks: The following is a 2 x 4 inches engine, large enough to drive a boat 20 feet long and 40 inches beam, with a propeller? A. A somewhat larger cylinder would be advisable.

(8) R. B. H. says: I have a small iron cylinder, that will hold, compressed, 100 gallons nitrous oxide gas. I have also a regular dental gasometer that will hold a similar quantity. How can I compress this nitrous oxide gas into the iron cylinder, taking it from the gasometer? A. You will need a compressing pump. Considerable apparatus is required for producing such a high degree of compression.

(9) J. R. McC. says: 1. I saw in the SCIENTIFIC AMERICAN a recipe to make a wash of cement and oil to put on a brick wall, to keep out the moisture. Would water do as well as oil to mix with the cement, or would the brick being previously painted be a detriment to the cement adhering to the brick wall? A. A wash of cement and oil is simply a paint, and you can apply it like any other paint, with a brush; if your wall has been already painted, you should use oil and not water. 2. After the cement is applied, can I paint over the wall with any ordinary paint? A. Yes.

(10) J. T. C. asks: A. and B. have an argument about names of floors in a building two or more stories high. A. says the floor on a level with the street is the ground floor, and not the first floor, but the floor up one flight of stairs from this ground floor is the first floor, and up two flights the second. B. contends that the floor level with street is the first floor, and may also be called the ground floor, but the floor up one flight is the second floor, and so on. Which is right? A. B. is right, according to the practice followed in this country; but A. would be right in Europe. The ground floor in London and the *rez de chaussé* in Paris correspond to our first floor; and the first story in London and *premier étage* in Paris are equivalent to our second floor. In London they sometimes say "up one pair," that is, one pair of stairs, and in Paris *au premier*, which means the same thing.

(11) J. J. asks: A. says that glue can be dissolved in alcohol without applying heat, providing the spirit be of the proper strength? B. says it cannot be done with alcohol alone. A. B. is right.

(12) G. H. W. asks: Is carbonic acid beneficial to the stomach? A. In many cases it is.

(13) C. E. R. says: I have seen articles made from some composition pressed in molds, to represent carved wood, and intended for ornamentation on furniture. Can you tell me how they are made? A. The composition you mention is probably that made from sawdust and glue.

You state that paper pulp can be hardened by treatment with chloride of zinc. Can you give me fuller directions? A. We believe the anhydrous chloride of zinc is employed, together with the alumina salt, in the sizing.

(14) J. H. S. asks: How much zinc, used as a preventive of scale, is required for a 30 horse power boiler? A. A piece weighing 2 or 3 lbs. will be sufficient to experiment with.

(15) C. W. N. asks: Why is it that gunners are afraid to depress their guns below a certain angle in firing from a hight? A. For fear that the gun may become unmanageable, and more disastrous to friend than to foe.

(16) A. A. H. asks: How is the material used by dentists for filling teeth prepared? A. Gold leaf is principally employed for this purpose, also other foils. An amalgam of copper and mercury has also been used with good results. You should have stated more explicitly what particular variety of cement you had reference to. Plaster of Paris is not used for this purpose.

(17) T. P. H. asks: Can marsh grass be utilized in the manufacture of paper? A. The material, we believe, has been used for this purpose before. If it can be economically harvested, dried, and freighted, and occurs in sufficiently large quantities, it might prove of some value.

(18) C. W. J. asks: The statement that, in the case of mill rocks, the upper stone may be more easily raised when in motion than at rest (the upper stone being the runner) by the regulating screw, is not credited. Can you explain? A. A simple test could be made by attaching a spring balance to the wheel or lever by which the stone is raised.

Of what material must a barometer be made in order to be entirely reliable? A. Mercury barometers are regarded as the most accurate.

The circumference and area being given, how do you find the diameter of a ring? A. Divide 4 times the area by the circumference.

(19) W. M. says: I have a gummy fluid which contains by the test considerable iron in solution. The density is about 15° Baumé. Can I get rid of the iron so as to avoid the color it gives? A. Iron in solution may be precipitated by heating it with nitric acid, and then adding ammonia.

(20) L. H. E. asks: How can I make a dressing that will keep a leather buggy top soft and pliable? A. A good mixture for making and keeping leather flexible consists of 1 pint boiled linseed oil, 2 ozs. beeswax, 1 oz. Burgundy pitch, and 2 ozs. turpentine, melted together over a slow fire.

(21) H. C. S. asks: How can I make gold size? A. For use on oil colors, take boiled oil and thicken with calcined red ocher, and reduce to the utmost smoothness by grinding. Thin with oil of turpentine. On water color or distemper work, use isinglass size, mixed with finely ground yellow ocher.

(22) H. B. asks: If a bottle be partly filled with water and an air pump applied to the top (the pump not reaching the water), can the water be pumped out, leaving a perfect vacuum in the bottle? It is understood that the bottle shall be closed airtight. A. No

(23) C. S. says: When I drop a large stone into a stream of water, it will sink to the bottom; but if I break that stone into small particles and drop it into the current, it will move down the stream. My friend says it is because the particles are lighter. I say it is because the particles have a larger surface in proportion to their weight, to be acted upon by the water. Which is right? A. You are.

(24) U. H. asks: 1. Would an engine with two oscillating cylinders, ⅝ inch in diameter and of 1¼ inch stroke, be powerful enough to run a scroll sawing machine to saw pine 1 inch thick? A. The engines will answer. 2. Of what size should the boiler be, to run with spirit lamp, and at what pressure should I run it? A. You might use a boiler 10 or 12 inches in diameter, and 18 or 20 inches high. You will find alcohol a very expensive form of fuel, even if you succeed in using it at all.

(25) C. J. L. asks: Is it possible for a gas meter to register more gas than really goes through it? A. It would be very easy to make a meter that would do this.

(26) F. C. R. Jr. asks: 1. If a ball is thrown into the air vertically, will it, on coming down, strike the hand with the same force that it left it with? A. No. 2. Why not? A. On account of the resistance of the air.

(27) S. G. asks: How many feet of water per second is required when passing over an overshot water wheel 24 feet in diameter, utilizing 70 per cent of its effective force, to produce 100 horse power? A. Find how many horse power would be developed, if there were no losses, multiply this by 550, and divide the product by the product of the velocity of the water in feet per second multiplied by the weight of a cubic foot in lbs.

(28) F. O. R. says: I have steel springs from No. 18 to No. 0 in thickness in a vessel containing steam, sometimes up to 100 lbs. pressure. For what length of time do you think the springs will maintain their elasticity? Do you think that the heat of the steam will injure the temper? Will it corrode them? A. If the springs are kept bright, they will prove quite durable. To prevent their corrosion, they might be plated with nickel or silver.

(29) J. W. N. asks: Which wheel, of a pair of ordinary carriage wheels, would lift from the ground in rounding a curve, with nothing on the axle, the wheels being drawn rapidly? A. We are not sure that either would, if the ground were level.

(30) J. J. asks: 1. What power is gained on every additional inch on the face of an 18 inches diameter pulley, say from 6 inches to 7, 8, etc.? A. As we understand your question, if you double the face, you can expect to transmit about double the power. 2. What is the best thing to put on a rubber belt to keep it from slipping? A. If it is tightly stretched, it would be advisable to use a wider belt. 3. Is a six ply belt as liable to slip as a four ply? A. Yes, other things being the same.

(31) D. P. A. asks: What weight will a 2 inch jack screw raise and sustain? The screw has 2 threads to the inch, single thread, and length of nut is 4 inches. A. If you do not take friction into account, the weight raised will be to the pressure applied, as the distance passed over in a given time by the point of application of the pressure is to the distance passed over in the same time by the point of application of the weight. Practically, this result will be considerably modified by friction: how much can best be ascertained by experiment.

(32) O. R. M. asks: What power would be required to run a fan with 30 blades, each 5 feet long x 1 foot wide, set at an angle of 30°, at a speed of 500 per minute? A. So much depends on form and construction of fan blowers that it is safer to answer such questions by experiment.

Have you ever published any articles on flying machines? A. We think that everything of importance in reference to the subject has at least been noticed in our columns, and on p. 112, vol. 32, you will find a pretty thorough review of the question.

(33) H. M. W. says: I see it stated that anticipating a crowd at a new church, they tested the strength thereof (by piling pig iron on it) to 50 lbs. to the square inch. To what hight would they have to pile to accomplish it? A. About 16 feet. We think, however, that you did not read the statement rightly. At all events, we are confident that no such test was applied in the case mentioned.

(34) C. T. V. asks: I have a ram for forcing water to my barn, and it will not run. It has always performed its duty well until this spring. The pipe into flume is tight, and no part broken. The valves are in good order; the shut-off comes up and will not go back. Can you tell what will start it? A. You should endeavor to find out why the waste valve will not shut. It must be obvious that a thorough examination would be more valuable than our opinion.

(35) J. W. C. asks: In No. 13 of the SCIENTIFIC AMERICAN SUPPLEMENT, first page, you give an illustration of the steam yacht Black Hawk, and say that salt water is now substituted to avoid carrying the weight of the fresh water. How is this done, and foaming prevented? A. In changing from fresh to salt water, and *vice versa*, foaming is apt to take place; and until the water in the boiler is changed, it is well to throttle the steam and check combustion somewhat.

(36) A. H. S. asks: What size of boiler will I need for a 1½ x 3 inches engine? What should be the thickness of iron? With such a boiler, what horse power could I develope, running at a high speed? A. Your questions are rather indefinite, as the size of boiler and thickness of iron will depend upon the number of revolutions, the pressure of steam, and the design and construction of the engine. We have published some general rules on pp. 33, 285, vol. 33.

(37) J. F. S. says: I wish to make a small propeller to draw a small boat to carry 10 persons, on flat water about 1½ feet deep. How can I build it best? A. Build it on the model of a good rowboat that has the required capacity and draft.

(38) F. M. says: I want to make a cast iron gun of 3½ inches bore and 4 feet long. How much metal must I have around the bore at the breech? A. Make the thickness at breech about 4 inches. Make the diameter of vent ½ inch, and bore it so as to enter breech about 1 inch from the bottom. But you will be safer if you buy a gun ready made.

(39) C. W. M. says: In your reply to E. L., you say that if, from a point without the ellipse, lines be drawn to the foci, the line bisecting the angle thus formed will be normal to the curve. So it will if the point is on the line of the major or of the minor axis, but not otherwise. In what treatise on the conic sections can be found the method of constructing the normal from a point not on the curve, in the case of either the ellipse, the parabola, or the hyperbola? A. We are obliged to our correspondent for calling attention to this matter. By an oversight, we gave the directions for drawing a normal on the assumption that the given point was on the curve. We have never seen a graphical solution of the problem for a point outside the curve. Nearly all treatises on conic sections, however, give methods by which the equation of the required normal can be obtained, and perhaps some of our mathematical readers will be interested in working out a simple graphical solution.

(40) J. H. H. asks: 1. What is the greatest depth from which a siphon can draw water, from an inclined shaft or a straight shaft, or is there any difference? A. In an inclined shaft, the pipe being longer, there would be more friction in the pipe, and the discharge would not be so great. You will reach the practical limit at a hight of 28 or 30 feet. 2. How much longer should the external end be than the internal end? A. A slight difference of level between the two ends will insure working, provided the discharge is the lower, but of course, in practice, it is well to have a considerable difference, if possible.

(41) J. W. B. says: In regard to thickness of iron for a boiler of 14 inches diameter, 30 inches long, you say that iron will stand 35 lbs. to the square inch safely. I have a cylinder of 18 gage, 16 inches in diameter and 30 inches long, that I have had tested to 270 lbs. pressure. A. In our answers to correspondents in relation to the pressure a boiler will stand, we generally give working pressure, with a large factor of safety. In practice, it is usual to find boilers carrying much higher pressures than would be allowed by our proportions; but we think it best to give values which are sanctioned by the highest engineering authorities in this country and Europe.

(42) C. W. J. says: It is contended by some that to clear the foliage from muck beds, so that the sunlight and heat may have free access thereto, the fertilizing properties of the muck are lost by evaporation and absorption of nitrates from the muck. But to allow the shade to remain over the muck, and to haul therefrom as required, is better, and, in fact, the only salvation of the muck bed as a fertilizer; and it is contended that the evaporation and absorption goes on after the muck is deposited on the required lands, and that the plants designed to be improved thereby have to grab, so to speak, for their share, entering into direct conflict or contest with the sun. It is also contended that rain is a deposit of nitrates, previously taken up as vapor, and, therefore, after a shower, the nitrates are then taken up as rapidly as the plant can do it; and upon the reappearance of sunshine and heat, they are reabsorbed

Are these things so? A. If the muck beds be well covered, there is practically little danger of loss, liable to arise from exposure to direct sunlight. The proportion of nitrates of ammonia in rain water is extremely small, so that in a well manured field the gain or loss to the vegetation from this source would be inappreciable.

(43) W. E. E. says: I have a lot of black rubber chains, and they have all turned to a grayish color. How can I get the color back? A. We could not suggest a remedy without examining the material or learning more precisely under what conditions the change had occurred. It is probable that the articles were not originally of good material.

(44) E. P. B. asks: Is oil made from fresh butter good for oiling farm machinery? Can the salt be taken out of salt butter so as to make an oil fit for oiling harness? A. No. Such oil is not suitable for either purpose.

(45) W. J. R. says: By what means can I take iron rust out of marble? A. It is impossible to do this, without injury to the marble, by purely chemical means. The best method that we can recommend is a uniform abrasion over the stained surface with a stiff steel brush, and, if the work was originally polished, repolishing in the usual manner. Where the stains are too deep for such treatment, it would perhaps be better to cover them with a light coating of a mixture of plaster of Paris in a strong solution of water glass.

(46) C. T. G. says: Please give me a recipe for cleaning baryta crystals and stalactites. A. If the crystals are really sulphate of baryta, try steeping them for some hours in hot muriatic acid, containing a very little nitric acid. If the deposit you wish to remove consists of ferruginous clay (ocher), this treatment will completely remove the iron, leaving behind the pure white clay, which may best be removed by mechanical means.

(47) C. H. W. says: In soldering tinware without a soldering iron, with a candle or lamp, the place to be repaired is first covered with an acid. Can you tell me how that acid is prepared? A. Digest zinc in strong muriatic acid until the acid will dissolve no more of the metal. Decant the clear liquid and bottle for use.

(48) H. M. asks: 1. How many strokes should a fret saw give, to one turn of the crank, to give the best results? A. About 25 or 30. 2. Would a friction wheel covered with india rubber of about 2 inches diameter, to be driven by a larger wheel, have power enough to drive the above saw? The 2 inch wheel is to be connected to the under part of the saw, by a crank pin run in a slot in the lower arm of the saw. A. I think it would, with a good heavy balance wheel, or a driver with a heavy rim. 3. Would it run hard under the above conditions? A. I do not think that it would run hard at all.—J. E. E., of Pa.

(49) E. A. F. says, in reply to J. W. O., who asks whether a horse can draw a vehicle more easily if hitched close to it: Several friends say that the closer a horse is to his load, the easier it is to pull, and *vice versa*. You say that you cannot see why the draft increases with the distance except by the additional weight of chain or rope and friction on the ground, if the rope touches the ground. My experience is that, in drawing a log or any other dead weight from the ground, the closer you get to the weight or object the easier it will move, for the reason that your power is above, getting rid of part of the friction. You may hitch to the forward end of a log and draw all you can, and then change to the hind part of the log, and let one animal be on each side with the weight between them, and they will move the load more easily. Take, for instance, a pair of trucks for hauling logs, and place the skids on one side of the trucks and a log to be loaded and team on the other. You may hitch a chain or rope to the trucks and under the log, and back over the trucks and to the team, which is close to the trucks, and then roll the log on. But take chain enough to reach from 30 to 60 feet, and they will load it easier with the 60 feet of chain or rope. In the last position your weight is above the backs of the animals or above the line of draft; in the first your weight is below. A. In our answer to J. W. O., we understood him to refer to an ordinary vehicle, in which no lifting effect was desired. What you have so well detailed in your letter is, we believe, generally correct.

(50) D. M. says: As many of your readers seem to take an interest in the baroscope of Babinet, of which I sent you a description which has been published in *Wrinkles and Recipes*, allow me to suggest a change which experience has taught me. The use of water in that instrument is subject to great inconvenience. For, as the water gets foul at the expense of the air confined in the bottle, it is necessary to remove the water pretty often. Now this trouble is almost entirely avoided by using, instead of pure water, a mixture of water and whisky in equal quantities.

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

S.—The powder consists of oxide of zinc together with finely ground resin. It would be necessary to make a quantitative analysis in order to determine the proportions of each ingredient.

COMMUNICATIONS RECEIVED.

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

On the Calcifaction of Tubercles. By C. B.
On the Water Grate. By F. G. W.
On a Small Engine. By T. B. R.
On the Vicksburgh Cut-Off. By C. G. D.
On Voracious Fishes. By R. L. S.
On an Indelible Ink. By A. J. F.

Also inquiries and answers from the following: S. & S.—J. J. R.—J. G. S.—I. W. H.—E. L. R.—C. S.—G. S.—J. D. T.—P. K.—R. E. M.—W. H. E.—C. M.

HINTS TO CORRESPONDENTS.

Correspondents whose inquiries fail to appear should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them. The address of the writer should always be given.

Enquiries relating to patents, or to the patentability of inventions, assignments, etc., will not be published here. All such questions, when initials only are given, are thrown into the waste basket, as it would fill half of our paper to print them all; but we generally take pleasure in answering briefly by mail, if the writer's address is given.

Hundreds of inquiries analogous to the following are sent: "Who sells electric bells? Whose is the best parlor organ? Who makes diving apparatus? Whose is the best engine-turning lathe?" All such personal inquiries are printed, as will be observed, in the column of "Business and Personal," which is specially set apart for that purpose, subject to the charge mentioned at the head of that column. Almost any desired information can in this way be expeditiously obtained.

[OFFICIAL]

INDEX OF INVENTIONS

FOR WHICH

Letters Patent of the United States were Granted in the Week Ending

June 20, 1876,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

A complete copy of any patent in the annexed list, including both the specifications and drawings, will be furnished from this office for one dollar. In ordering, please state the number and date of the patent desired, and remit to Munn & Co., 37 Park Row, New York city.

Alarm, burglar, H. F. Green	178,922
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9,345.—MEDAL.—W. Conn, Philadelphia, Pa.
9,346.—STOVE.—J. A. Lawson, Troy, N. Y.
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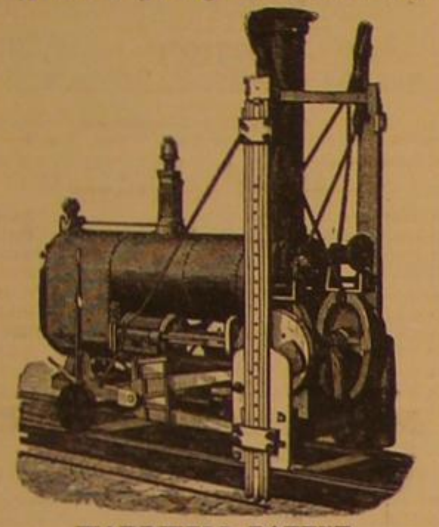

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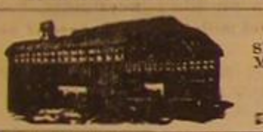

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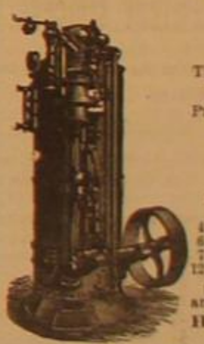

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