

## a WeEkly Journal 0f practical information, art, science, mecilanics, ciemistry, and manufactures


THE CENTENNIAL EXHIBITION..--THE CAMPBELL PRINT ING PRESS.
About 200 feet west of Machinery Hall, upon a command ing eminence, is situated the building illustrated on pag 391, volume XXXIV, which has been erected by the Camp bell Printing Press Company, at their own expense. On on floor of the building are ten of the diferent styles of print ing machines manufactured by this company, the most no ticeable 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 duily newspaper per hour: a figure which will be readily comprehended when reduced to 500 sheets per minute, or 8 per second: and, as they are printed on both sides, it is equal to $16 \frac{8}{8}$ 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 sile of the machine, where it is cut, folded, and counted, which latter operation is recorded on the registe shown just above the pile of paper on the front.
When the rotary press of Richard M. Hoe was the ac knowledged fastest press of the world, the paper was print ed on one side only; it needed a second feeding through to perfect it, and required as many feedels 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 newspape printing press.

NEW YORK JULY 22, 1876.
$\left[\begin{array}{l}\text { e3. } 20 \text { 10ER AnNum } \\ \text { POSTAGE YREIAID. }\end{array}\right]$
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 pro ductions of Limoges and other French towns, the materia 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 sub stance has been encountered; but it should be borne in mind that such will not answer for fine goods of the kind where with our potters hope successfuly to compete agains foreign manufactures, at least until some one discovers an excessively cheap and perfect method of purification. It i cheaper to import the English clay, a fact obvious when it is considered that the merest admixture of ocularly imper ceptible 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 ye 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 estab ished We are indelted to Mr. Moritz J. Cobschiltz th owner of a large portion of the tract, for samples of the mawial, and for information relative to the mines. The kaolin is of a pure white, blue, white and pink quality, and appear sometimes naked to the eye, and sometimes in pockets 60 to 0 feet deep. Mr, Dobschütz states that there is ever 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 itrate of silver which serves for the metallization is dis solved in wood spirit, by which means a thorough impreg nation of the object is oltainable. After maceration (mor or less) the object is dried through rapid agitaticn, but while still moist it is submitted to a saturated solution of mmonia gas, and thus is formed a double nitrate of silve 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 min utes. By this method, the auithor says, he has obtained regular layer of copper on leaves, flowers, insects, etc.


THE CAMPBELL PERFECTING PRINTING AND FOLDING PRESS.

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## ESTABLIBHED 1846.

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IV. LESSONSIN MECII

 VII. NATURAL HISTORY, ETC. -Duration of the Sense


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## a sensible celebration --what was done in new YORE CITY.

The people have very good cause to congratulate themselves over the very sensible manner in which the Centen nial 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 re joicing 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 na tion-unless we mingled ideas of Guy Fawkes' day, derived from the mother country, in a very uncomplimentary man ner with our national holiday-we were ever induced to
adopt the fire cracker as a symbol of joy, must remain a 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 spe cies of amusement of which the annoyance of others and the end
Those who can recall the illuminations of New York city during the war, after Union victories, or her magnificent outlurst 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 wrek pust the dry goods stures 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.
For
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 tal low 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 ew, 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 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 Broadway and across the central point, the lofty buildings
On Union Square, the which surround it were outlined with myriads of bril liantly colored lanterns; while just before midnight a pro cession of some fifteen thousand men, carrying torches, paraded the principal streets. At midnight the vast con course 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 al the charches, 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 a the metropolis, New York welcomed the advent of a new century.

## DO NOT GET COOL-HEALTH HINTS FOR THE BEASON.

" Is this paper out of its senses?" we can hear the reade exclaim, as he casts a wrathful glance at the vagrant mer cury, rambling among the nineties. "Do not get cool, when the sun is scorching and there is no breeze, and the pave ments are almost red hot?"
Haston slowly, good reader. We do not object to reírigera tion of oneself when it is done sensibly, but the trouble is that the majority of persols throw common sense aside with their heavy undergarments. 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 a ninety, and infinitely more difficult then to get rid of them,
nless 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 debili tated. We recently met with some of those axiomatie say ings of the late Dr. W. W. Hall (who recently died a victim a mady a . $W$. Hall ( F . a imely W have not room for the mely. We hat pressed into a paragraph will serve our purposes. If on
any occasion, he says, you find yourself the least bit noticea any occasion, he says, you find yourself the least bit noticea-
bly cool, or notice the very slightest disposition to a chill running along the back, as you value health and life, beg: brisk walk instantaneously, and keep at it until perspira tion begins to return: this will seldom fail to ward off summer cold, which is more dangerous than a cold taken in winter to all persons having the slightest tenaency to con umption. If you have walking and riding to do, ride first ecause if you walk you may get overheated; and then, when ou 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 neumonia.
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 ver low degree is much less harmful and more grateful; but if cy cold water be taken, safety lies only in drinking slowly Take oue swallow at a time, remove the glass from the lips and count twenty slowly before taking another. It is sur prising how little water will quench the thrst when thu rank. Soda water is a favorite leeverage, and bears about he same relation to cool spring water as candy does to read. It does not slake the thirst as well as water, and, be. des, 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 depres ion, don't attempt to raise your spirits by drinking ice water, however thirsty. A cup of hot tea may be wisely aken by most persons, but does not agree with all. The eat 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, unti trength begins to be imparted to the systen.
Never take a nap in the daytime uncovered. Many lie down for a few moments, merely to gain a brief rest, with ut 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 pre vents 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 erson prevent this, as we have said, and at the same time bviate the disagreeable feeling of dampness felt when inen, especially, is next the skin. All garments worn during the day should be removed at night and thoroughly ired and dried. All changes from a heavy to a lighte clothing in summer should be made at the first dressing in the morning. It is safer to wear too much clothes than to ittle, especially for children, invalids, and old people.
We will relax our negative advice in one case, and the only in a metaphorical sense: in other words, in hot weathe 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 dea that this terrible malady is due to the concentration of the sun's rays on the head. Persons are frequently struck, as is terned, in the night, but are more apt to be so late in he afternoon, when the system is depressed by the heat and ervous exhaustion. The way to avoid sunstroke is to orde ne's doings so that vitality shall not be lowered, and the conditions favorable to the disease superinduced. A sun stroke, if not fatal, leaves the patient less able to endur mental or physical work ever after, and requires from him constant care against pulmonary disease or a second visita ion. Avoid worrying the brain and an undue exposure to the sun, and, more important still, do not depress the sys em and lower the bodily temperature by the use of miscalle stimulating " alcoholic drinks. To sum up all in one sen ence: Do nothing to lower the normal bodily temperature No matter how hot the weather, the temperature of the healthy body is invariable at $98^{\circ}$. Cooling below this is no efrigeration but depression, no matter how it is produced and depression means loss of vitality, proclivity to disease nd death.
Since the alove was written, a report of the sanitary com nittee 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 specially between the hours of 11 o'clock in the mornin 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 bsorbs heat) and put inside of $i t$, on the head, a wet clot a large green leaf; frequently lift the hat from the head nd see that the cloth is wet. Do not check perspiration, but rink 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 ho 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 work immediately, lie down in a shady and cool place, apply
cold cloths to and pour cold water over head and neck. If 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 ict wrapped in a towel or other cloth. If there is no ice a 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 inhala ammonia for a few seconds, or give him a tea spoonful of aromatic spirits of ammonia (hartshorn) in tw 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 un derstood by the engineer to mean a palatable wholesome
water, not insipid like rain water, and not foul by the recep water, not insipid like rain water, and not foul by the recep-
tion of that class of impurities which endanger the individ tion of that class of impurities which endanger the individ
ual health. Unpolluted water, as we have explained in a ual health. Unpolluted water, as we have explained in
previous article, is tasteless, inodorous, possesses a neutral or faintly alkaline reaction, rarely contains in $1,000,000 \mathrm{lbs}$ more than $\frac{1}{2} \mathrm{lb}$. of carbon and $\frac{1}{10} \mathrm{lb}$. 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 tem perature. The chief causes of pollution are found in the re fuse fluids from factories and in animal sewage. By a re cent 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 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. Cot ton 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 fac that an average factory, of 250 hands, sends out some
$600,000,000$ gallons of foul water per annum, charged with some $1,446,000 \mathrm{lbs}$. of refuse matter, including $42,560 \mathrm{lbs}$ 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 ar found to be $76 \cdot 2$ per 100,000 parts, and, from Turkey red dy works, $105 \%$ parts. Linen and jute bleacheries discharge caustic soda, lye, waste chloride of lime liquor, waste sul phuric acid liquor, and waste carbonate of soda and soap li quor. Works for dyeing linen and jute contribute polluting liquids essentially the same as those produced in the calic industry. Silk works discharge comparatively small quan tities of dyes and gums. Papermakers contribute refus from the dusting process, lime refuse from the treatment of soda, alkaline waste liquors from the boiling process, the in soluble part of bleaching powders, the waste bleaching liquo (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 pape 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 con sists of pollution by cinders, scorix, 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 of pollution contributed by any of the metal industries.
The waste contents of acid baths render river water unfit 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 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 al owed to go into the streams.
The effect upon fish of a number of leading and potent polluting substances, oocurring as manufacturing refuse, was the subject of elaborate experiments in Scotland some years ago. The information thus obtained was of great
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 $1410 \sigma$ for minnows, or $\overline{7} \frac{1}{0} \sigma$ for goldfish, caused death. sulphate of copper was the most virulent metallic salt, strong fish dying in water which contained only in oro $\overline{\text { od }}$
part. Other substances proved fatal, as follows: Sulphate part. Other substances proved fatal, as follows: Sulphate
of iron and of alum,


 potash, $\frac{1}{30 \frac{1}{0} \sigma}$; foundry coke, ${ }_{14} \frac{1}{\pi}$; furnace cinders, $\frac{1}{14} \overline{0}$ coal tar, | 15 |
| :---: |
| 10 |

The most deadly of all contaminations is sewage, and thi 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. Ordinari y, the human stomach is apparently unaffected by water exposed to a considerable measure of impurities; but it be comes fearfully sensitive to the same waters during the pre valence of an epidemic. This was conclusively shown to be he case during the terrible cholera visitations in London in 1849 and 1854. It may be added that the evil effects of nuch polluted water, as compared with water but little pol uted, 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 impuri ties which now are expected to hide themselves there, the eneral health of all living things depending on them and asing them must benefited

## THE CENTENNIAL EXPOSITION.

T'he ceremonies at Philadelphia on July 4 partook of a ational character, and in this respect they must be distingished from the local celebrations which took place in very city, town, and village in the country. Although no ocurring on the Centennial grounds, they were, neverthe less, a part of the great scheme whereby we emphasize our
rejoicing over the completion of the first century of national 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 includ d representative militia regiments and companies from th different States, the U. S. Corps of Cadets, detachments of sail ors and marines, and civilian societies, making a display full in keeping with the importance of the occasion. At a compara tively early hour, Independence Square, where the grand stand had been erected, became thronged; and when the formal pro eedings commenced, the crowd was estimated at over 100,00 people. On the platform was grouped an array of distin uished men, such as has rarely before been seen. The Vice President of the United States, in the absence of Presiden Grant, presided. About him were the Emperor of Brazil the Crown Prince of Sweden, Governor Hayes of Ohio, an thie Governors of several other States, General Sherman,
Count Rochambeau, besides the Foreign Centenniul Commis Count Rochambeau, besides the Foreign Centenniul Commis sions, 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 enthus iasm which the production of the immortal document elic ited 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 tremen dous ovation. None cheered more lustily or swung his ha 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 De and in in the Centennial Congress, received the document in honor and by order of he orchestra and chorus, and its repetition was demanded by the people. A superb ode, by far the finest lyric produc ion which the Centennial year has brought forth, was re cited 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 intellec ual 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 ngs 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 ad vantage of the holiday, and manfully doing the Exposition despite the almost intolerable heat of the weather
The Exposition itself is now running as amoothly as could be desired, and the only discontented people are those for eign exhibitors who are converting the fair into a market by
gelling their articles. They are required, under present

解 red to the purchaser and this regulation they are endeavo ng 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 eople.
We gave last week a brief account of the

## russian exhibit

in Machinery Hall. The principal display made by that na ion is in the Main Building, and no part of the Expositio 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 defin te regarding the wonderful growth, notably in art itdus. tries, the taste for which did not exist in 1851, but which now in Russia has reached almost a mania, is therefore of he highest value, It is not extravagant praise to say that he Russian exhibit is superb. The silver work is not ex celled 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 ap pear 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 he Ural mountains. Malachite, jasper, and lapis lazuli are he materials mostly used; but there are also articles made of inerals quite unfamiliar in this country, such as bubhes of rhodonite, and nephrite. Vcry beaus the nat buches of which reproduce almost exactly the colors of the natural 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 o 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 parilion 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 anguage: "Go slow and you will go far.
The Russian government is represented by supert colections of minerals and fossils, and of school books, school furniture, and other objects relating to education. Among he other exhibits are pianos, scientific instruments, amber, soap, chemicais, 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 manufac ture.
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 deter mination 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 134 seconds, and that before break of current signal was $1: 28$ seconds, the mean being 131 seconds.
Tue Society of Arts, Geneva, Switzerland, celebrated the first century of its existence on June 1, 187e,

## IMPROVED STRAY 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 amooth 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, B, 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 de appear. The above described de Fices $\Lambda, B, b, C, c$, and $D$, afte being fitted together in the man ner 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 af ford ample space around the elbow and nozzle for the pazsage of water. The tube, $D$, is tapped for the engagement of a screw-thread ed plug, J, that can be readily re moved whenever it is desired to drain the pump, so as to preven freezing. $K$ and $L$ represent, re spectively, the inlet and discharge orifices of the shell. $M$ and $N$ are, respectively, the suction and discharge pipes, which communicate with the previously described oritices. 0 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, 0 and steam pipe, $P$, are now ap plied, after which steam is turned on, and the apparatus then ope rates in essentially the same man ner as ordinary jet pumps. An economy is claimed by the inven tor 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 im portance 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 Edin burgh 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 innoc the leaf, by the eight millions of peonnual consumption of of the Andes who use it, is thirty millions of pounds After of the Andes who use it, is thir milion of pounds. After ering and drying its leaves, Sir Robert gave an account of ering and drying its leaves, Sir Robert gave an account of
some experiments made upon some of his students and himsome experiments made upon some of his students and him
solation of the water from all the workings; the durability of the shafting; the great diminution in the cost of the sink. ing the shaft; the obviation of any necessity for pumping machinery during the boring and nearly so afterwards; the reater degree of comfort to the miner by the absence of water and the possibility of traversing any number of water evels irrespective of the amount of water they contain.

## -ren

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-cellu. the combustion of trinitro-cellu
lose or gun cotton. A tuft of gun cotton is placed in a large tes glass which tapers to a point be neath, ignited, and covered as quickly as possible with a glas plate. The interior of the glass is immediately filled with the characteristic yellowish red fume of nitrous acid. When gun cot ton is ignited on a piece of mois tened litmus paper, it colors th paper red. It also reddens tinctur of litmus, if burned in a beake glass on the bottom of which i some of the tincture. When burned on a strip of moistened io dide of potassium and starch pa per, gun cotton leaves a dark blue spot. The characteristic test fo nitric acid with brucine can be ob tained by burning the gun corton in a conical test glass, at the bot tom 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 reac tion and exhibits this reaction i placed on a watch glass in con tact with brucine and sulphuric acid.
A curious reaction takes place when an ounce of collodion is 71 mixed with an equal volume of concentrated nitric acid. The re action is very violent, red fume are evolved, heat is generated, and at the conclusion of the reaction nothing remains in the vessel bu cotton, the alcohol and ether be ing totally destroyed or evapora ted. The cotton, which now ap parently possesses a fiber, is no only not explosive but is almos totally incombustible, its characte having been totally changed dur ing the experiment.

## NEW MECHANICAL MOVEMENT

We illustrate herewith a ne Wechanical movement for conver ting a tion. It is adapted for use ups reapers, mowers,sewing machines, pumps, hammers, saws, and simi lar apparatus.

## 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 advise no one to try it until something more was known about it or, at least, not to make use of it without consulting a phy sician. 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 "de livered 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 cer tain that, if the American builders can compete advantage ously with the English in a country like Holland, they will succeed in time, and by patient efforts, in establishing fo 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

The case consists of two circula
The case consists of two circula plates, A, attached to a hoop or flange, B, by which they ar sept at the proper distance apart. To the center of the plates, $A$, is pivoted a shaft, $C$, to one end of which the power i pplied. To the shaft, C , within the case, is rigidly attached three-armed cam, D. To the case are pivoted one, two, o hree blocks, $E$, which are made triangular in their genera orm, and are pivoted at their angle. The third sides of the locks, E, are turned toward the cam, D, and are notohed 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 he notch of said block, strike its other arm, and push it orward, so that each block will receive six distinct im pulses at each revolution of the cam, D.


Motion may be communicated from the block, E, to the objert to be vibrated by an arm, $F$, formed upon the sa'd bock at its pivoted angle, as indicated at the left hand side of the figure, or by connecting rods pivoted to the ends of the rms of said blocks, as indicated by the pins, $G$, at the righ and side of the figure. The device was patented through he Scientific American Patent Agency, May 30, 1876, by Messrs. J. Jordan and George Naylor, of Salt Lake City Mess
$\mathrm{U} . \mathrm{T}$.

## IMPROVED SELP-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 tritting, as all the parts necessury 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 EF, 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.

## 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 receire 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 releasing the jaws. The latter are dovetailed on the inclined
forks, $L$, of the head, to slide forward and backward so as
ened 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 $\mathbf{E}$, resting against the outer corner of the heel of the said arm of the shoe. Then, by moving the han dles 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 $I$ reques 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 sor ghum, and each operator will know when he has boiled it to the consistence or thickness desired; and then it should be stirred in shallow panslike milk pans-over a gentle heat, until it be comes granulated, or "sugared off," as they say in the maple sugar works, when sirup is conver ted to sugar.
" We can give our readers another useful hin for utilizing their surplus water melons. It is this : Last year we saw some Virginia farmer feed water melons to their milch cows, when they came up at night, with very good effect, by in creasing 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 morn ing."

## NEW METHOD OF MOLDING CYLCNDERS.

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 disadvanta ges, this system does not allow of deep tempering, since the mold itself heats very rapidly and does not serve to cool the ylinder cast in it. The method devised by M. A. Tuck, of Donawicz, Austria, says the Bulletin du Musée, And in which Donawicz, Austria, says the Bulletin du Musee, and in which the cooling process as long as is desired, and of carrying the the cooling process as long as is desired, and of carrying the
temper as far into the interior of the cylinder as the sameis temper as far into the interior of the cylind
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 watertight. 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 , of the cylinder, which are not to be tempered, are cast in $c$, of the cylinder, which are not to be tempered, are cast in
molds, $c$ 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 tronnion, $e$. In the same way as the cooling can be regulated by the length of the water circulation, so can is intensity be varied by regulating the temperature of the water used.
to be adjustable for different sized nuts. The disk-headed so as to work the jaws backward and forward.


BYRN'S SELF-DISCHARGING COAL HOD.
BYR SEIP
number of cases have been reported in which water alone proved sufficient to relieve paroxysms of pain for a short ime, it would seem that our knowledge of the effects of ypodermic medication is by no means complete, and tha York Medical Journal.

## IMPROVED TOOL FOR BENDING HORSESHOES.

Mr. William Ray, of Poplar Post, Ohio, has invented tool forstraightening 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 pinch ers. 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 curved inward, and has teeth formed upon both its iuner is curved inward, and has teeth formed upon both its iuner and outer sides, to cause it to take a firmer hold upon the
end or heel of the shoe. In 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 secos:d 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 he straight-

Tijections of Carbolic acid in Fhoumatism. Injections of carbolic acid have been used with benefit 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 used at each injection in the neighborhood of the affected joint, and the results, though not permanent, are sufficied to relieve the patient temporarily. In regard to this apecies f medication patient temporarily. In regard to this specie oes the the contref come from the water of the solution, or fre

## 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 the intimate relations of the atmosphere to health and climate are assuming daily a more universally acknowl dged importance.

A little more than half a century ago, Lord Cavendish be stowed 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 entitely inadequate, he finally settled upon the number 20.833 , as expressing the average. The best $m$ ?an 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 tains, of diffusion and changes of temperature, the homogetains, of diffusion and changes of temperature, the homoge-
neous mixture of the constituents of the atmosphere is never perfectly achieved.* The difficulty is better understood perfectly achieved.* The difficulty is better understood
when the vast quantities of matter involved are considered, 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 $11 \cdot 67085$ trillions of lbs., or, making allowance for the space occupied by the land above the sea level, $11 \times 10^{18}$, that is, 11 trillions of lbs. A little closer approximation can be obtained by using the most recent determina tions of the earth's dimensions. These are as follows :

|  | Polar radus in feet. |
| :--- | :---: |
| Equatorial radius in |  |
| Bessel. $\ldots \ldots \ldots 20,853,662$ | $20,923,596$ |
| Airy. . . . . . . . $20,853,810$ | $20,823,713$ |
| 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 $41,839,044$ feet. Taking Clarke's figures as a basis, the volume of the earth is $38,239 \cdot 43 \times 10^{18}$ cubic feet. By comlining the results given above, we obtain $41,707,268$ feet for 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 $38113 \cdot 3084 \times 10^{18}$, or trillions cubic feet: if a sphere, to $38178.1 \times 10^{18}$ cubic feet which is $64.79 \times 10^{18}$ 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 $259,356 \cdot 52$ millions of cubic
miles, its surface 196.68 millions of square miles, or $5483 \cdot 1 \mathrm{x}$ miles, its surface $196 \cdot 68$ millions of square miles, or $5483 \cdot 1 \mathrm{x}$
$10^{12}$ square feet, or $7895 \cdot 68$ billions square inches. Multiplying this figure by the average pressure the atmosphere exerts at $32^{\circ}$ Fah. on every square inch of surface at the level of the sea, or $14 \cdot 7304$ pounds avoirdupois, we have a result not widely different from that given by Hers
namely : $11.63065 \times 10^{18}$ pounds, or $5192.5523 \times 10^{12}$ tuns.
If we assume that the weight of the atmosphere proximately $11 \times 10^{18} \mathrm{lbs}$., 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 :

|  |  |  | Mean Elevation. |  |
| :---: | :---: | :---: | :---: | :---: |
| Surface of | $\substack{\text { Area in } \\ \text { miles } \\ \text { square }}$ | $\Lambda 8$ calcu- lated | $\begin{gathered} \Lambda 8 \text { spread } \\ \text { over ntire } \\ \text { continental } \\ \text { area } \end{gathered}$ | $\begin{gathered} \text { As spread } \\ \text { over earth's } \\ \text { surface } \end{gathered}$ |
| Europe | ${ }^{3} 5 \mathrm{~F}$ millions |  | 5 | 11.93 |
| Sorth America | , | 1,718 | ${ }_{2 \times 11} 17$ | ${ }_{75} 75038$ |
| Africa | ${ }_{3}^{11} 3$ | 1,600 50 | ${ }^{360} 78.7$ | ${ }^{93} 7.553$ |
| ${ }_{\text {L }}$ Ausid | 51. |  | 1110.6it |  |
| Warth |  |  |  | 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 lbs., the corresponding weight of that portion of atmosphere is $8.61475 \times 10^{18} \mathrm{lbs}$. 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 $2.89067 \times 10^{18} \mathrm{lbs}$.
11.50542 trillions of lbs., then, is the total. Or, in the 11.50542 trillions of lbs., then, is the total. Or, in the second place, the entire surface of the globe, at a mean ele-
vation above sea level of 288 feet, may be multiplied by the vation above sea level of 288 feet, may be multiplied by the
mean pressure at that altitude. This, at a barometric hight mean pressure at that altitude. This, at a barometric hight
of $29 \cdot 672$ inches, is 14.5631 lbs . The result is 11.503461 tril-

lions of lbs., very slightly differing from that given above. The weight of a cubic foot of air at standard pressure and emperature being 0.080066 lb ., we get from the weights pre iously found $142.64 \times 10^{18}$ cubic feet or $142 \cdot 6166 \times 10^{18}$ cubi is fest understood by calculating the thickness of the envelope 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 o the atmosphere. A simple way of arriving at the thickness is by finding the relativehights 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 $10,513 \frac{1}{2}$, and the corresponding hight of the atmosphere is 6,214 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. Luricating 288 feet from 26,214 , the difference, 25,926 , is less than the former numbers. This is to be expected from the ncrease of density as we go towards the earth's surface The mean of the three values is 25,985 feet, and represent very nearly the actual hight of the atmosphere of uniform
density. This is 415 feet less than five miles. The very careul experiments made to determine the earth's density have hown that its weight cannot be very far from $5 \cdot 56$ times tha f a globe of water of equal bulk, and this would be $5900 \cdot 8681$ rillions of tuns. As the atmosphere weighs $5134 \cdot 5$ billions of tuns, the weight of the latter is to that of the former, as o $1,149,000$. Their relative volumes are as 1 to 267. If the elative 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 $16 \cdot 35$ feet
When we come to calculate the amounts of the many va ious 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 ctual variations in composition of the specimens of air ana yzed, 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 car-
bon 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 combus tion and evaporation, or set free by the agency of decay and putrefaction. It is only through its great complexity of 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 f oxygen in the atmosphere rarely exceeds $21 \cdot 1$ per cent o within extremely narrow limits; and if the oxygen either within extremely narrow limits; and if the oxygen either ex-
ceeds 20.99 per cent, or faces below 20.9 per cent, there is eason to look for accidental circumstances modifying the average composition. This was strikingly shown by the
100 analyses of the air of Paris made by Régnault, the oxy 100 analyses of the air of Paris made by Régnault, the oxy
gen percentage varying from 20.913 to $20 \cdot 999$,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 20.908 and 20.998 per cent.

It may seem of little consequence that the amount of oxy en should be diminished by one tenth of one per cent, and it would be, were not the loss in oxygen replaced by other ad generally less beneficial ingredients. Many curious fact chave been ascertained from a close observation of these
changes in composition. The younger De Saussure, who de voted 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 De cember, January, and February, the relative amounts being
as 100 to 77 . From multitudes of determinations continued as 100 to 77. From multitudes of determinations continued during fourteen years, he concluded that the ordinary rang of variations in the volume of carbonic acid was inclute
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 ap plies to the extreme multiplication of these carbonic acid de erminations as to those of oxygen: that single experiment the analyses must be repeated until the laws affecting the the analyses must be repeated until the laws affecting the What, for example, could be more surprising than the fact, ndicated by many experiments, that the percentage of $c: r$ bonic acid about the tops of mountains is greater than a heir 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, ausing a down rush from the upper strata, the percentage of oxygen at the earth's surface may temporarily undergo an acrease much beyond the average
One of the principal sources of the increase of carbonic acid in the a tmosphere is the process of respiration by ani mals. If the number of respirations by ar adult be reckoned
at 15 per minute, and an average amount of 32 cubic inches of air is expired, containing $4 \frac{1}{2}$ per cent of carbonic acid, of air is expired, containing $4 \frac{1}{2}$ 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 glove would annually increase the volume of carbonic acid $7,3 \times 0,000,000,000$ cubic feet, and diminish the oxygen by the same amount. This again would at least be doubled by the espiration 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 de composed 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 $27 \cdot 28$ per cent or $851 \cdot 870$ millions of tuns of carbon. The computed rea of the coal measures on the earth's surface is 260,00 quare 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 atmospher would be doubled by burning this amount of coal annually for 4,500 years. The totalamount of coal is 4.83 billions o uns, which, if burnt, would increase the amount of carbonic acid in the atmosphere four and a half times, or raise its per centage to $0 \cdot 18$. This percentage is smaller than is fre quently 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 er 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 portion of the earth's bulk is made up of carbonaceous de posits. The whole annual production of coal would mak 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 o fairly blacken it. The entire bulk of the coal measures ven when estimated at double the available amount $c$ coal now known, probably does not exceed 450 billions of cubic feet, which would form a layer about an inch thick ver the earth's surface.
But a vast amount of carbonic acid is locked up in the arth's strata, combined with various bases, more especially lime and magnesia, forming immense deposits of limestone nd dolomite. If this carbonic acid at one time formed a portion of the atmosphere, its bulk must have been prodicious. A very thin stratum of carbonate of lime, when de posited, would yield as much carbonic acid as the atmos phere at present contains. It would require but a thin pellie, a whitewash of 0.136 inch in thickness over the whol urface of the globe. A similar layer of pure limestone, 28.37 feet in depth, would double the weight of the atmos 28.37 f f
phere.
The

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 feetmay 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.

## The wonders or the Deep.

In her scientific cruise of threeyears and a half, the Chal lenger 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 Atlanicic 3,875 fathoms, ninety miles north of the island of St. Thomas, in athoms, ninety miles north of the island of Sti. momas, in of the expedition from time to time. Its return to England
on has revived public interest in the work of Professor Wy ville Thomson and his associates, and many interesting de tails concerning it have appeared in the English journals. Many curious crabs were brought home. One very odd spe cimen, 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 ('cean, the ship encountered a belt of gigantic seaweed, of which single plants are said to attain a length of a thousana 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 expe. dition abounds with similar unique experiences.

## Indelible Ink without silver.

Mr. A. J. Foose, of Del Norte, Colorado, sends us the folowing 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 : Sulph. prot. of iron, 4 ozs.; water, 4 ozs. No. 3. Sulphu ret of potassium, $\ddagger$ 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, $\frac{1}{2}$ oz., which fixes the color. For ink, add gum potassium, $\frac{1}{2}$ oz., which fixes the
and alcohol ; for dyes, add grease.

## PRACTICAL MECHANISM．

by Joshua rose
Skcond $\overline{\text { SEries－Number VII．}}$
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 is a back view of a face plate o which work may be held lyy 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 turn－ ing tools from touching the metal of the face plate．It supports the work （being nearly of the same size）when equired，and obviates the necessit 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 there－ fore 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 ly 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 chuck so strengthened will require truing frequently on ac count of the strains to which its fibers will be subjected from the unequal expansion or contraction of its component parts． Fig． 50 shows the back of a chuck strengthened by the bat tens，A A A


Another method of making a chuck is shown in Fio． 53. It is considered superior to the former from its greater abili－ ty to resist outward strains in every direction，while the strains to which it must necessarily be subject，from varia－ tions of temperature and hamidity，are less than in the for mer．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 fol lows：Procuring two bars for the back，say $4 \times 2$ 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 check－

ing．We next fasten these bars together by gluing and s：rewing them at the center，driving the screws tightly home while the glue is warm．Upon the cross thus formed，we superpose the seginents shown in the front view of Fig． 53 ， at B B B；these may be of almost any thickness，say from to $1 \frac{1}{8}$ 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 thechuck will of course depend upon the number of arms and their depths；and unless the chuck is very substantial，a difficul－
ty will be experienced in turning，on account of the tr emor
A chuck having the middle of iron and the outside of wood supported by arms，is shown in Fig． 54


In shops where the size of the work necessitates the em ployment of chucks of so large a diameter，a special lathe is 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 suf ficiently high rate of speed．In such cases．the arrange ment shown in Fig． 55 is an excellent one．A represents athe head bolted firmly to two uprights，B B，which are

firmly fixed to the joists，$C$ ，and to the flooring at $D$ ，righ over and upon the joists supporting the flooring，or else upon eams provided for the purpose．By this means the wor 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 ， ill admit，a movable tripod re
eing 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 tap－ ping hole． | Sizeacross facets of head or nut． | Depth of head or nut． |
| :---: | :---: | :---: | :---: | :---: |
| $\pm$ | 20 | 0185 | $\frac{1}{2}$ | $\frac{1}{1}$ |
| －3 ${ }^{16}$ | 18 | $0 \cdot 240$ | $\frac{19}{3}$ | $\frac{5}{16}$ |
| $\frac{8}{8}$ | 16 | $0 \cdot 294$ | $\frac{11}{16}$ | 죵 |
| $1{ }^{\frac{2}{6}}$ | 14 | 0.344 | $\frac{25}{36}$ | ${ }^{\frac{7}{16}}$ |
| $\frac{1}{2}$ | 13 | $0 \cdot 400$ | $\frac{8}{8}$ | I |
| $\frac{9}{16}$ | 12 | $0 \cdot 454$ | $\frac{3}{3} \frac{1}{2}$ | 19 |
| 兵 | 11 | $0 \cdot 507$ | $1 \frac{1}{16}$ |  |
| 9 | 10 | 0.620 | 14 |  |
| $\frac{3}{8}$ | 9 | 0.731 | $1 \frac{7}{16}$ | $\frac{7}{8}$ |
| 1 | 8 | 0.837 | $1 \frac{1}{8}$ | 1 |
| 118 | 7 | 0.940 | 113 | 11 |
| 11 | 7 | 1.065 | 2 | 14 |
| 188 | 6 | $1 \cdot 160$ | $2 \frac{3}{16}$ | 14 |
| $1{ }^{17}$ | 6 | $1 \cdot 284$ | $2{ }^{3}$ | $1 \frac{1}{2}$ |
| 1 15 | 51 | $1 \cdot 389$ | $2{ }_{7}{ }^{6}$ | 1䨐 |
| 1星 | 5 | $1 \cdot 490$ | 29 | 1年 |
| 178 | 5 | 1.615 | $21 \frac{5}{8}$ | 17 |
| 2 | 4 t | 1.712 | 3t | 2 |
| 24 | 4 d | 1.962 | 3t | 24 |
| 21. | 4 | $2 \cdot 175$ | 37 | $2 \frac{1}{2}$ |
| $2{ }^{\text {星 }}$ | 4 | $2 \cdot 425$ | 4 | $2 \frac{3}{4}$ |
| 3 | $3 \underline{1}$ | $2 \cdot 628$ | 4 ${ }^{\text {g }}$ | 3 |
| 34 | 32 | $2 \cdot 878$ | 5 | 34 |
| $3 \underline{1}$ | 34 | 3•100 | 5 年 | 31 |
| 3星 | 3 | $3 \cdot 317$ | 5 | 3星 |
| 4 | 3 | $3 \cdot 566$ | 68 | 4 |

cast inon work the taping holes may for sizes
inch and less，be drilled to well clear the given sizes．
The two thousandth locomotive was recently completed the London \＆Northwestern Railway Company＇s works t 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 SHELLIS． The invention herewith illustrated is a new anvil f

 The invention herewith illustrated is a new anvil forpaper 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 sin gle 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 lim－ ited 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 disengaping old caps．Fig． 4 is the cup or socket of the shellin which the anvil and firing cu 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 explo sion 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 mall 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 fred from two cartridge cases，and that the latter are still intact，also that one hundred and four caps have been ex－ ploded on the shell without causing any deterioration．
Patented March 14，1876．The patent is for sale．For fur ther 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 Herclld as follows：

| Minutes． | Yald． | Harvard． | minutes． | Yale． | Harvard． |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | 35 | 12. | 33 | 37 |
| 2. | ． 34 | $35 \pm$ | 13. | 33 |  |
| 3. |  | 35 | 14 | 33 | 40 |
| 4. |  | 35 | 15. | 33 | ：36 |
| 5. |  | 35 | 16. | 33 | 37 |
| 6 | 33 | － | 17. |  | 40 |
| 7. | 33 | － | 18．．． |  | － |
|  | ． 33 | 35 | 19．． |  | － |
| 9. | ． 33 | － | 20．．． |  | 85 |
| 10. | ． 34 | 36 | 21．． | 33 |  |
| 11. | ． 32 | － | 22. |  |  |

The average age of the Yale crew was $23 \cdot 7$ years，hight $69 \cdot 3$ inches，chest 40.2 inches，weight 158.8 lbs ．The aver－ age age of the Harvard crew was $21 \cdot 2$ y

Messrs．Ogden \＆Carpenter，of 409 East 33d street New York city，state that the steam jet plan，to assist com－ bustion，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 powe 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 enery wheals, 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 diamerer desired, while a speed of from 1,080 to 1,800 revolutions is all that is required The diamoud tonl, $A$, 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 diame ter of the bearing, to be prepared, and this the apppe can place on the spindle, adjust the latter, and screw down the diamoud 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 pivotat $H$. The brass is thus adjusted in such a manner that, despite the adjusted in such a manner that, despite the
imperfections in molding, it is ground acimperfections in molding, it is ground ac-
curately with the least removal of metal. curately with the least removal of metal.
The chuck, C , fits into planed guides on The chuck, C, fits into planed guides on
th itable, 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. Thereis 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 Ta . nite Company, Stroudsburg, Pa.

## IMPROVED SAW GUMMING MACHINE.

 In the accompanying engraving we il. lustrate a new application of that univer. sally 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 renjered 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 ssrew, 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

THE TANITE COMPANY'S CAR BOX GRINDER.


DENSMORE'S SAW-GUMMING MACHINE. in from it should le to the stated, is previously adjusted to the proper an F , and the tooth by rotating the arm partially in the block, , 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 gradu ally 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, A pril 4, 1876. For fur ther particulars, address the Tanite Com pany, Stroudsburg. Pa .

The Soap Mines of California.
The rock soap mine is situated in the lower mountains or foothills of the coast range in Ventura ccunt $f$, 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 an 1 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 nine. 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 hearing along in its feartul strength huge lould ers 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 trailleading to stock is then adjusted so as to bring it to a proper hight by the soap mine, traveled only ly the safe pack mule and hardy means of the justed so as to bring it to a proper hight by miner. The rock resembles chalk or lime. At the southern
miner. The rock resembles chalk or lime. At the southern
extremity is an extensive deposit, veined, marbled, and par ticolored, resembling C'astile 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 ocks 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 hottom of the ocean; for on the highest mountain tops can be found nearly perfec sea shells and various specimens of marin matter.-San. Benventura (Cal.) Reporter.
Prizem for Temperance Investigations. The French Temperance Society submit the following questions, to be answered be fore January 1, 1878. For the best and most complete reply to the first a prize of $\$ 400$ is offered, to the second, $\$ 200$. Arti cles must be written in French, and sen with author's name sealed in a packet, with distinctive device, addressed to Dr. Lunier secretary of the society, 6 Rue de l'Univer site, Paris.

1. Determine, by the aid of clinical ob servation and experiment, the differences which (from the point of view of effects on the organization, the two being admin istered with equal alcoholic doses) exist be tween natural wines and brandies on one hand, and on the other wines fabricated or simply troated with alcohols of purely in dustrial 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 ab sinthe, such as the essence of aniseed, fennel, tansy, and analogous plants, aug ments 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. The: 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 resemblance if the outlines were drawn
in the colors of the object; but in this in the colors of the object; but in this
respect the artist must please his fancy respect the artist must please his fancy
When the outlines are dry, color and shade When the outlines are dry, color and shade
the figures; but observe to temper the col ors with strong white varnish.

INFLUENCE OF CEEMICAL FERTILIZERS ON PQTATOES 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 whea 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 with out manure, the vield was re presented by 11.
Applying these experiments to the potato and the vine, Professor Ville, in his recent volume, shows the astonishing ef fects of potassa. On the potato fects of potassa. On the potato
(see $\mathrm{Fi}_{\text {h }}$. 1), his complete ferti (see Fif. 1), his complete ferti
lizer, when used, gave a vield of lizer, when used, gave a vield of
35,200 lbs. per 2.5 acres (A,Fig. 1); a like area yielded $25,960 \mathrm{lbs}$ (B), nitrogenized matter being absent ; and with phosphate absent, the yield was 32,780 lhs (C). When the potassa was re moved, these figures fell to 16,590 lbs. (D). With lime al). sent, the yield determined was 29,700 lbs. (E), and with no ma nure at all (F), $7,700 \mathrm{lbs}$.
On the vine (see Fig. 2) the influence of potassa was still 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 $2 \cdot 5$ acres, or 2,534 gallons of juice ; without nitro gen, 13,640 lbs. and 1,320 gallons; without phosphate, 16,060 and 1,531 gallons; without lime, $17,160 \mathrm{lbs}$. and 1,636 gallons ; without potassa and without any manure (remaining diagrams, Fig. 2), no erop.
M. Ville affirms that, potassa being dominant in the potato the abseuce 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 Americin 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 plant; 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 ornamantal marsh and aquatic plants should poss sess.

## MOLTIPLYING PLANTS.

The simple method of propagation by layering is usually adopted for all low.growing or slender plants, those which cannot roadily 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 ex tremity remains above the ground. The carnation is easily propagated in this way. Select the outward, strongest, and lowest shoots for ward, strongest, and lowest shoots for
the purpose. Trim off a few of the the purpose. Trim off a few of the
under leaves, and shorten the top ones under leaves, and shorten the top ones
even, with a knife ; then cut a slit in a 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 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 $d$ ppth of one inch, pressing the e:rth over it gently. Water immediately, and in dry weathergivelight watering every evening. This is best done in a cloudy day. In about two months the layer will be well rooted. Carna tions and all kinds of pinks should be layered in June o July.
Propagation by cuttings is a very popular and expeditious mode, and one which, like division and layering, exactly re-
produces 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 readils multiplied by leaf cottings nias and gloxinias are readily multiplied by leaf cuttings, the fully developed leaf being inserted in a sandy compost. four inches 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. Lo belias and fuchsias will root freely if severad between th

Fig. 1.


Fig. 2.
 to cost.
$21,000,000,000$ cubic yards of water a year, for irrigation or motive power. If the whole of this water were used forthe 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

## On Salicin.

There is acenmulating 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 anti. malarial 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 tem perature in fever, the dose
should be about two scruples. 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 : C'ommon salt 12 parts, iron in powder 5 parts. Mix and add : Muriatic acid 5 parts, salicin 1 part. He obtains a solu licin 1 part. He obtains a solu
ble, odorless crystalline sub ble, odorless crystalline sub
stance, somewhat styptic and
joints, anywhere in fact; while geraniums will frequently rot off unless trimmed below a joint.-The American Garden.

## The firand 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 Nar-


THE BOG BEAN.


THE BOG ARUM. bonne, which is the shorter course by about 40 miles. This canal will enable English ships, bound for the Mediterranean or the Fast, to save from 800 to $\mathbf{9 0 0}$ 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 emplorment. All that is needed is to show the bitter to the taste, to which he gives the name natrium mu riaticum ferruginosuon salicinatum, a cheap and efficient tonic, anti-zymotic, and febrifuge.—Medical and Surgical Reporter

## The Frankin 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 interest, have been placed in the room: 1. Franklin's electrical machine. This instrument is doubtless the one und the great philopher in making his wonderful experiments in the sciance 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 0 . Evans, about 1804, and is described in Galloway's work on the steam engine, page 101, Iondon, $182 \%$. 4. Working model of a steam engine built by M. W. Baldwin, and presented by him to the Institute, about 1832.

Oll Pipe Linem.
The total mileage of iron pipe used in the oil region is piaced 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 All Relief, Sandy \& Milton, United, Grant, Pennsylvania Transportation, American
Transfer \& Conduit. The principal area 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 thes as the quantity of pipe in and the cost and laying to be 30 cents per foot, it appears that $\$ 2,682000$ is invested in pipes alone. The cost of pumps, tanks,
etc., will swell this to double the

## public that a good return may be expected. The French ${ }^{\text {amount. }}$

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

Metropolitan Underground Railway, London.-The total number of passengers carried over the Metropolitan, on Wt. John's Wood, and Hammersmith and City Railways, on Whit Monday last, was 243,077.

## the optics of photograpiy.

## Lroturi delivered at the btivens institute of technology, by

 Pargident henky mortonThe 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 necossarily affects every other branch, insomuch that it is impossible to study one and exclude the rest. We can not become proficient in physics without a knowledge of chemistry, nor in chemistry without a knowledge of phy sics. 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 per manent, 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 pects as to be worth 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 origihave been vanquished. This problem and its solution origi-
nated and now constitutes the science of photographic optics or the optics of photography.

being bent towards the perpendicular ; while on leaving it only to $\mathrm{F}^{\prime}$. Con versely, rays starting from $\mathrm{F}^{\prime}$ will emerge again and passing into the air, it will be bent as much away parallel. Now, if we put the other half of the lens on from the perpendicular, and will consequently emerge pa rallel to its original direction.
This principle was beautifully shown by projecting an ar row 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 again, rays starting from $\mathrm{F}^{\prime}$ will converge at $f^{\prime}$, just as far on the other side of the lens. It is evident, moreover, that, the further the source of rays is removed from $F^{\prime}$, in the direction $F^{\prime} Y$, 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, $F^{\prime \prime \prime}$, corresponds to $f^{\prime \prime}$. Conversely, rays proceeding from $f^{\prime \prime}$ will diverge so much that the lens can bring them to a focus only at $F^{\prime \prime}$ 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 ob jects 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 wher they need it most, and a com pensation 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 refran-
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 cande, A B; so that if a screen were place.
would obtain a reversed image of the candle.

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

Passing now from this general statement to the principles some kinds of glass possess a greater power of dispersion, 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 paral the point, fign in the lel rays not dran in thiga, bed on equally by the opposite surfaces of the lens; and the would be bent less and less the more we approached the mid
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 , 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 pro-
cess, and are brought to a focus at F . Either lens alone cess, and are brought to a ocus at $F$. Either lens alone
would produc; a chromatic aberration; but placed together
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 tha


$y$ las 3 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 low er half a denser medium. The ray, $A B$, is bent in the direc tion, $B G$. The amount of this bending or refraction varie 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
dle of the lens, because the angle decreases more and more. The point, $F$, is called the focus, a word meaning fireplace 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
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 0 are cut off, with the exception of those passing through the opening. Without the stop, the outer rays, $0 a$, would diverge considerably on both sides of the focal point cut by the screen, $B$ focal point cut by the screen, $B$ the position, $A$ or the the position, A or C, the curva ture of the resulting image would become very appreciable. With the stop, however, the screen could be moved anywhere between $\Lambda$ 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 pas through it. Som of these pas there is greater converging power there is greater converging power,
and are consequently brought to and are consequently brought to a nearer focus than those passing
through the middle. This cirthrough the middle. This cir cumstance 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 con sequently obliged by the dia phragm, 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 concaveside 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, AB and CD, 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 follow ing drawings: In Fig. 12, let A B represent two plano-con vex lenses, exactly alike, and so placed that their outer sur faces form parts of an imaginary sphere, A B C D. Then, neglecting refraction for a moment, it is evident that a bun dle of rays, $r r$, which the aperture of the diaphragm, $\mathrm{D} D$, allows to pass through both lenses, will be affected only by the little lenses, $\mathrm{L}, \mathrm{L}^{\prime}$, 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, $r^{\prime} r^{\prime}$, passing through the edges of the lenses, A B and C D, will be affected only by the two prisms, $P$ and $P^{\prime}$, which will countersct 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 water into the watch glass, when the image came out with
surprising distinctness. The applause which followed this


Fig. 13.-THE MEGASCOPE
these columns, leaving them to apply the information ther given to their own wants. In deference to the demand fo the rules abstractly stated, and believing that in many in stances a reference to the rule itself rather than to any ap plication of it will serve our correspondents' purpose bette and at the same time relieve our already crowded query col umns, we shall from time to time present a series of usefu facts and formulæ taken from the works of Molesworth Haswell, Nystrom, " Wrinkles and Recipes," and other re liable 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 send ing us queries on any mechanical or engineering subject, answerable by rules or formule, will generally here find th information needed.-EDs.]
Shrinkage of castings, in locomotive cylinders $\frac{1}{16}$ inch in 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 $\frac{5}{5}$ inch in a foot; in lead, same; in copper $\frac{3}{16}$ inch in a oot; in bismuth $\frac{5}{82}$ 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 withou 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 tough ness, place the fragment on a block of cast iron ; if good, $i$ may be driven by a blow of a hammerinto 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, $30^{\circ}$ ordinary soft wood planing machines, $35^{\circ}$; gouges and
plowing machines, $40^{\circ}$; hard wood tool cutters, $50^{\circ}$ to $55^{\circ}$.

The hide of a steer weighs about the eighteenth part, an the tallow the twelfth part, of the living animal.
The buoyancy of a cask in lbs. $=10$ times the capacity n 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 grap otassa and other chemical fertilizers on potato and grap
ines. The most accessible and cheapest form in which po tassa is obtainable is wood ashes, which every country house keeper should carefully collect from the hearth. Mr. Austin P. Nichols, of the Boston Journal of Chemistry, has recentl made some analyses of ashes taken from the hearth, wit the following potassa results

Potassa. . . . . . . . . . .
Carbonate of potassa.
No. $\begin{array}{lll}12.55 & 12.64 & 12.59\end{array}$
Cat 18.38 mixture of hickory and bech. The results show the of mixture of hickory and beech. The results show the amoun pure potassa tained; but the absolute alkali power and value as repre sented are best cial potassa held in the ashes. One hundred lbs. held 19.8 lbs. of alkaline salts, soluble in water, and consequently, $i$ we estimate the value of commercial potassa at eight cent 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 potass value to each bushel of fifty-thre cents. The ordinary ashes, suc 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 her adopted, we have found to be about forty-two cents per bushel From these results it is clear tha the farmer had better retain his ashes for farm use than to sel them at the price usually obtaine from soap peddlers. Besides the potassa salts, ashes contain impor tant amounts of phosphoric acid soluble silica, etc., which ad greatly to their value as fertili ing material. It is safe to say that every bushel of true wood ashe which a farmer produces upo his hearth is worth to him, fo farm use, forty cents in gold. It is, therefore, very poor husbandry to sell them for twenty cents th bushel, as many do. We valu ashes so highly that offers fo them are rejected, no matter wha 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 plan food, and at cheaper rates than in any other mixtures. W have used this combination for many successive seasons, with most satisfactory results. We confidently expect tha he German potassa products will before long stop the con sumption of wood ashes in the manufacture of American potassas, and it will be a happy day for our agricultura 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, o 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.

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United Staten Circuit Courto-Southern District of
New York.


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## Zecent samericau and toreigm qeatents.

## new mechanical and engineering inventions

IMPROVED PRINTER'S GAILLEY.
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 cor-
rections without scaling off type. It consists of an adjustable cross bar that is applied by hinged or buckle joints to the side of the galles, to be readily folded out of the way or locked to the
type. When it is desired tolock the type for taking a proof, 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 ocking bar is brought against the type, and the knuckie or hingeu 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 scal-
ing off of types, which forms an objectionable feature of the locking off of types, which forms an objectionab

IMPROVED STOVE PIPE JOINT.
James L. Loring, Dallas center, Iowa, assignor to himself, Fortunatus Hubbard, and Judson Purinton, of same place.- This is an inproved stove pipe Joint that forms a solid and tirm connection
of the pipes, so that they cannot be pulled apart or pushed togeof the pipes, so that they cannot be pulled apart or pushed toge-
ther, 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 shank nearly of the width of the slots.
mphoved balanced slide valith
Joln 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 diaphragin takes the upward pressure of the steam, and has sufficient movement to allow the ralve to be pressed by the down pressure in said chamber steann-
tight on the seat. The area of the chamber is sufficiently larger tight on the seat. The area of the chamber is sufficiently larger
than that on the under side of the valve subject to liftifg pressure to keep the valve tight

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imphoted weigh scale
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Alanson Carpenter, Angola, Ind.. assignor to himself and Joseph smith, sume place.-This invention relates to an improved weigh pressure of steam in a boiler ; and it consists of a sliding post connected by a bottom crosshead and lever rods with weighted ehow levers ha
or box.
tMPROVED SEIF-CLOSING HATCHWAY.
samuel W. Bell, Burgettstown, Pa.-This is a hatchway door. It is opened automa cally by a tapering elevator, made in rections,
hinged together and folding, and closed by springs or weights, in the manner specifler.
improved manufactlere of bugt anll shor nolds, bic AND IMPROVED SCREW-THREADED laN HIDE SHOE PEGS. George V. Shettield, New York city, assignor to sheffield Screw Dists 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 rre scretwed into corresponding screw-tapped holes in the parts to be united.
ture of the threaded pegs, in which the skins or hides ture of the threaded pegs, in which the skins or hides, as they
come from the animals, are spread on boards placed over a bed o common salt in a retort, and subjected them to the uction of the salt heated to about $90^{\circ}$ for a sufficient length of time to petrify and harden them. Practicable screws are made from the string cut from the hides, the winth being about the same as the thickness of the skin, so as to make them square.
mpROVED CAK COLPLING;

George W. Johnson, Princeton, assignor of one half his right to
Francis W. Hauss, Gibson county, Ind. - This consists of a hook 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.
mproved compensating pendeley
Fritz Willman, La Salle, Ill.-The pendulun ball is suspended by tion, and a lever, the lever being tixed in the rod of least expan sion for a fulcrum, and having the more expansible rod connected to one end, and the ball to the other end, so that when the rodsex pand the ball will be raised, and it will be lowered when they contract. The amount of variation or compensation is varied hy shift ing the lever along the rod in which it is suspended.

MiPROVED FILE Shield
William Murray, Vicksburg, Miss.-This invention consists of coupling joints and pipes for quickly erecting frames for scatiolds, and for supporting plates to protect flremen from the heat of burning buildink, the object being to enable them to approach
closer to $\boldsymbol{a}$ burning building, and to afford protection to other husildings by heing set up berween them and the huildings on fire

IMPKOVED LOCK AND KEY
John J. Portuguez, New York city.-This is an improved lock fo safes, doors, and other places where two parts are to be secured to
gether, so constructed that it cannot be opened by any other in strument than the key made expressly tor it. The mechanism which embodies several novel and ingenious devices, cannot be explained without the aid of drawings.

MPROVED SMOKE JACK.
John B. Deeds and David A. Bridwell, Terre Haute, Ind.--Thi consists of a flue or jack with movable and balanced hood and out-
side ventilators. The movable hood adjusts itself automatically by a surrounding conical rim, with drip holes, to the top of the 10 omotive smoke stack

MPROVED HOSF PIPE COUPLING.
Thomas Loftus, Sacramento, Cal., assigner of one half his right to Benjamin Bullard, Jr., same place.-The coupling is formed by an exteriorly threaded and flanged tube, and two interior
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 ou
one of the boring bits and bucket sections and substitutiny pronged bit of peculiar form, with a shorter bucket section, bowl ders of larger size may be taken out than can he with othe ders of
augers.

NEE CHEMICAL AND MISCELLANEOUS INVENTIONS.
mproved 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 The said weight being uttached cock arm, opens the stopcock and allows the water to pasa to the water wheel.

## MPROVED MICROSCOPE.

George Wale, Firview, N. J.-This is an inproved microscope distance which the object glass may be adjusted to greater or lese thrown out of its accurate vertical position, and by which th greater or lesser intensity of the light may be regulated and set to various conditions of the object. The invention consists, first, o the mechanism for the minute vertical adjustment of the objec glass; secondly, of the adjustable ring frame and socket : and IMPROVED PHOTOGRAPIIC PIATEE.
Frederick H. Powell and Philip Lehnen,Auburn, N.Y.-This consists in an improved plate forphotugraphs or signs made of water-
proof paper, having a coat of paint on the back, and one or more proof 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 onc or more layers or haking japan or varnish, and then baking ach final eont to hardness to obtain the required finish
mproved birial, apparite
Lewfis H. Shular, Crawfordsville, Ind.-A deep, strong box, with cosed top, open side, and dumping bottom, is mounted on truck heels to move sidewise. The bottom may be opened and closed by a crank shaft. Cruacs are provided for lowering the coffin by
chains and a erank shaft, aud ure pivnted to the ends of the box inside of the cruening to swing out on the grave, and to close in fo protection when the box is shut up. The shaft has a ratchet and pawl torholding the coffin when required. After the coffin is lowcred, the box is moved along over it on the track for dumping the arth in.
mprotell voltale belit
Alexander M. Dye, Elkhart City, ill.-The platesure secured to felt band by olinching them over the eilges und also by a band ottom fastening.
improvein whigh scales
Robert H. C. Hhea, Uniontown, Ky.-These scales are adapted for being carriod 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 cn a fulcrum or flange bent down from the tray or scale beam. The weigh ing beam is lougitudinally slotted for the sliding weight, having ends for attaching smaller weights.
improfed combined meanthe a di funnel.
Frank H. Winston, Evansville, Wis.--This invention consists in a liquid is running from the measure.

IMPROVED BREECH-LOADING FIKL; ARM
John A. Heckenbach, Kenosha, Wis.-Thisconsists of a movable in a simple way, br means of which the plate can be readil taken ott for making smooth and bright with emery paper, and ca be tightened up when the parts become loose trom wear, withou xpense, and also without tools. The plate also allows of using impizoved ba'til for treatingi uron.
Curistian Ziegenheim, Allegheny, Pa.-This is a compound for reating iron preparatory to uniting it with steel by casting th teel on the ron, consisting of sal soda, caustic soda. borax, lime and water.
imphoved ice ciream freezer.
Edward (i. Wheeler, Moblle, Ala.-This consists of an ice can surounding the cream basket, both of which are inside of an oute revolve with it being supported on its pivot so as to tur eally. The clevice is so connected to the beater shaft that, although only artially flled with ice, it can be made to freeze a full can of cream bshifting it up along the cresum bucket, after freezing the lowe portion.

IMPROVED PROIECTILE FOR ORDNANCE
John G. Butler, New York city.-By means of this invention the abot of a projectile may be applied in the shape of a compara ively delicate flanged ring, whereby the weight is not only greatl reduced, bat much strength is adaea, since the sabot is secured to he projectile so much nearer to its periphery. A reduction of th requently 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 foun tain atachment, ng at the under side of the elongated wings.

NEW WOODWORKING AND HOUSE AND CARRIAGE
BUILDING INVENTIONS.
implooved sanh balance.
James Waddell, Mamaroneck, N. Y.-This is an improved sash holder, by which the upper sash may be readily opened and close ashes may be secured in closed position. The cordsare conneoted with the top and front of the upper sash, and then passed over pulleys arranged on the top of the lower sush.

## NEW AGRICULTURAL INVENTIONS.

improved fence post.
Frederick Sulter, De Witt, Iowa.-This consists of a slotted me tallic tube with a wooden core, to which the wire-supporting ste les are fastenod. A top staple and wire retain a prot MPROVED HARROW
William Taylor, st. Louisville, Ohio.-This harrow is so con structed that it will readily adjust itself to irregularities in the pass obstructions, and to clear it of rubbish. It has longitudinall hinged seotions.

## Tusintss aud Eersomal.

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 33.-R. G. B. will And directions for bronzing iron
castings on p. 28, vol. 31.-C. w.. Jr., can provor-

 coarse sugar with a quart of thour paste-- F. F.,
G. M. Č. \& 1 3., J. M., C. C., J. H. G.., and many
 dustrial and scientitic subjects. should address the
booksellers who advertise in our columns, all of booksellers who advertise in our conlumns,
whom arc trustworthy firms, for catalopues.
(1) F. M. J. sars: I want to convey water
1,000 feet fromit hydrant beforc it can be used. Which is the most practicable way, to be uas 1,000
feet of pipe and conect an engine to the end, or Yeet of pipe and connect an engine to the end, or
connect the engine close to the hydrant, and the connect the engine close to the hydrant, and the
bose to the end of the pipe and play through the hose to the end of the pipe and play through the
pipe and hose? $A$, The itrst method would be a stream.
(2) A. S. asks: How are photographs put
upon glass and made transparent, so as to be colored on the thack with oil colors? A. The face of the picture is covered liferally with starch paste
and laid upon clean glasy. Then, with a smooth, and laid uppn clean glass. Then, with a smooth,
hard edge, the paperisrubbed upon the back from hard edge, the paperis rubbed upon thc back from
the center to the edge until aill 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 different names for the same thing.
(4) A. F. I. asks: How high can water be
(aised with an ordinary well pump by using check valves, say 10 or 12 feet apart? A. If, as we un-
derstand you, you mean to force the water up, the derstand you, you mean to force the water up, the
hight is only limited by the power applied, and the tis only limited by the
the strength of the apparatus
(5) W. L. P. usks: 1. In what proportion should the best Portand cement be mixed with
ceean sharp sund. for coating the outside of a ciean sharp sumd. fro coating the outside of a
stone or brick building? A. One measure of cement powder to thrce measures of dry sand. 2 , How many square feet will a barrel of cement
mixed with sand cover: A. One barrel of ce ment and three of sand will make $31 /$ harrels of
mortar, which will cover about 4.100 square feet mortar, which will cover about 4.1.10) square feet
of brick wall, or about 40 squares, to a thickness or hrick wall, or about to souares, to a thicknes
of $\psi_{4}$ or an inch. 3. should it be put on in oue or coat put on immediately a fter it, before the fira cout has set. The permanence of stucco on th exterior walls of $\mathfrak{a}$ building depends generally more upon the stability of the surface that re-
ceives it than upon the stucco itself. The latter can absorb water und sive it olt without injury
but if into the brick, it is upt to freeze in winter and fracture the face of the wall. IT harden and fill the pores of the brick, spread a thin wash of ce-
ment over the wall $n$ nd scrape it off first, before putting on the principal coat. 4. Could an ordinry house plasterer put it on sarisfactorily: A
(6) E. M. B. asks: Will a pump do work as easily wirh a 12 inch column as with a 5 inch, the sime or water valve beiny the same in both cases?
The lift is 150 feet. A. Other things being similar, the pump shoute
the 12 inch pipe
(i) I. V. V. N. asks: The following is a $2 \times 4$ hanes ongine, large enough to drive a boat 20 feet
long and 40 inches beam, with a propeller: A. somewhat larger cylinder would be advishble.
(8) R. B. H. says: I have a small iron cyltrous oxide gas. I have also a regular dental gas ometer that will hold a similiar quantity. How can I compress this nitrous oxide gas into the rinn cylinder, taking it from the gasometer? A.
You will need a compressing pump. Considerahigh degree of compression.
(9) J. R. McC. says: 1. I saw in the Scienment and oll to put on a brick wall, to keep out the moisture. Would water do ns well as oil to mix with the cement, or would the brick bellig 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 ilike
any other pint, with a brush; if your wail hus been alreaty painted, you should use oil and not water. 2. After the cement is applied, cean I paint over the wall with any ordinary puint" A. Yes. (10) J. T. C. asks: A. and B. have an argument about namey of floors in a building two or
more stories high. A. suys the tloor on a level more stories high. A. suys the floor on a level
with the street is the ground floor, and not the frst thoor, but the tloor up one flight of stairs from this ground hoor is the first floor, and up twe with street is the first floor, and way also be called the ground floor, but the floor up one tilight is the second floor, and vo 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 Hoor in London and the rez de chanueée in Paris correspond to our first Hoor; and the frst
story in Londonand premier itage in Paris valent to our second floor. In London they some-
 thing.
(11). I. J. asks: A. says that glue can be
disosolved in alcobol without applying heat prodisoolved in alcobol without applying heat, pro-
viding the spirit be of the proper strenkth: says it cannot be done with alcohol alone. A. B
(12)
(12) (. . H. W. asks: Is carbonic arid bene
fcial to the stonneh A . In many cuses it te (13) (C. E. R. says: 1 have seen articles represent somed wood han pressed molde, represent curved wood, and intended for orna-
mentation on furniture. Can you tell me how theyare made: A. The composition you mention is probably that made from shwdust and
clue You state that paper pulp can be hardened by treatment with chloride of zinc. Can you give ne
fuller dircetions' A. We believe the fuller directions? A. We believe the anhydrous
chloride of zinc is employed. together with the chloride of zinc is employ.
(14) J. H. S. asks: How much cinc, used s s a preventive of scale, is rezuired for a 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
areafraid to depress their gun below angle in fring 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 Gold leaf is principally employed for this pur pose, also other foils. An amalgam of copper and mercury hay also been used with yood results.
You should have stated more explicitly what particular variety of cement you had reference to (17) T. P. H. asks: Can marsh grass be
utilized in the manufacture of paper? A. The utilized in the manufacture of paper? A. The
material, we believe, has been used for this purmaterial, we belifeve, has been used for this pus
pose before. If it can be eoonomically harvested, dried, and freighted, and occurs in suffcien
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 b more easily raised when in motion than at rest (the upper stone being the runner) by the regula ting screw, is not credited. Can you explain? A.
A simple test could be made by attuching a spring balance t.
Of what material must a barometer be made in order to be entirely reliable? A. Mercury baro neters are regarded as the most accurate. do you find the diameter of $a$ ring: A. Divide imes the area by the circumference.
(19) W. M. nays: I have a gummy Huid which contains by the test considerable iron in solution. The density is about $15^{\circ}$ Baume. Can A. Iron in solution may he precipitated by heat ing it with nitric acid, and then adding ammonia. (20) L. H. E. asks. How cun I make a and pliable? A. A good mixture for making and keeping leather flexible consists of 1 pint boile linseed oil, 2 , ozs. beeswax, 1 oz. Bur Bundy pitch,
and 2 ozs. turpentine. nelted together over $A$ alo, (21.
. H. C. N. asks: How caul I make gold thicken with callined red ocher, and reduce to the turpentine. On water color or distemper work use isinglass size, mixed with finely ground yellow ocher.
(22) H. B. usks: If a buttle be partly filled with water and an uir pump applied to the top be pumped out, leaving a perfect vacuum in the bottle: It is understood that the hottle shall he
colosed ai:tight.
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 arop it into the current, it will move down th are lighter. I say it is because the particles have a larger surface in proportion to their weight, to
be acted upmn by the water. Which isright?
(24)
(24) U. H. asks: 1. Would an engine with two oscillating cylinders, क\% inch in diameter and of 114 nch stroke, he powerful enough to run a
seroll sawing machine to saw pine 1 inch thick? A. The engines will answer. 2 . Of what size should the boiler he, to run with spirit lamp, an 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 tind alcohol a very cxpensive form of fuel, even if you succeed in usin, It at all.
 meter to register more gas than really goes
through it: A. It would be very easy to make neter that would do this.
(26) F. C. R. Jr. asks: 1 . If $a$ ball is thrown strike the hand with the same force that it left it with? A. No. 2. Why not? A. On account the resistance of the air.
(27) S. G. asks: How many feet of water hot 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, mul-
tiply this by 550 , and divide the product of the velocity of the water in feet pcr second
in lls.
ise
(28) F. O. R. suys: 1 have steel springs taining 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 hent of the steam will injure the temper?
will it corrode them: A. If the springs are kept Will it corrode them: A. If the spring are kept
bright, they will prove quite durable. To prevent
ore or silver.
(29) J. W. N. asks: Which wheel, of a the ground in rounding a curve, with nothing on the axle, the wheels being drum rapidly? A. We are not
level.
(30) J. J. asks: 1 . What power is gained on every additional inch on the face of an 18 inche diameter pulley, say from 8 inches to 7,8 , etc.?
A. As we understand your question, if you double the face, you can expect to transmitt about double the power. ${ }^{2}$. What is the best thing to put on a tightly stretched, it would he advisable to use a
wider belt. 3. Is a six ply belt as liable to slip an wider belt. 3. Is a six ply belt as liable to slip an
a four ply: A. Yes, other things heing the sume.
(31) D. P. A. asks: What weight will a 2
inch jack screw raise and sustain? The screw has inch jack screw raise and sustain? The screw has
2 threuds to the inch, single thread, and length of nut is $s$ inches. A. If you do not take friction pressure applied, as the distance passed over in a given time by the point of application of the pressure is to the didstance passed over in the sume
time by the point of application of the weight. time by the point of application of the weight.
Practically this result fled by friction : how much can best he usce
(32) O. 1. 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 $30^{\circ}$, at a on form and construction of fan blowers that is safer to answer such questions by experiment.

Have you ever published any articles on flying machines? A. We think that everything of imbeen noticed in our columns, and on p. 112, vol 2, you will find a pretty thorough review of th uestion.
(33) H. M. W. says: I see it stated that anticipating a crowd at a new church, they tested 55 lbs. to the square inch. To what hight would they have to pile to accomplish it? A About 1 feet. We think, however, that you did not rea the statement rightly. At all events, we are con fident that no such test was applied inthe case mentioned
(34) (. T. V. asks: I have a ram for for-
cing water to my barn, and it will not run. It has cing 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. up and wi tart it? A. You blould endeavor to find out why the waste valve will not shut. It must be obvious that a thorough examin.
uable than our opinion.
(35) J. W. ( $\therefore$ asks: In No. 13 of the SCl ive un illustration of the steam yacht Black Hawk, and say that salt water is now substitute How is this done, und foaming prevented? A. In changing from fresh to salt water, and vice versch foaming is apt to take place; and until the water in the boiler is changed, it is well to throttle the (36) $A$ combustion somewhat.
(36) A. H. S. asks: What size of boiler will need for a $11 / 2 x 3$ inches engine? What should
be the thickness of iron: With such a boiler what horse power could I develope, running at high speed? A. Your questions are rather indefl will depend upen boiler and theness ions, the pressure of steam, and the design and construc tion of the engine. We have published some gen ral rules on pp. $33, \geqslant 25$, vol. 33 .
(37) J. F. N. says: I wish to make a small propeller to drawa small boat to carry 10 persons, on flat water about $1 / / 2$ feet deep. How can I
build it best? A. Build it on the model of a good owboat that has the reguired capacity and draft. (38) F. M. says: I want to make a cast iro run of as inches bore and 4 feet long. How much netal must 1 bave around the bore at the breech Make the diameter of vent 1 inch, and bore it as to enter breechubout 1 inch from the bottom. But you will be safer if you buy a gun ready
(39) (.. W. M. s ys: In your reply to E. L. you say that if, from a point without the ellipse.
ines be drawn to the foci, the line bisecting the angle thus formed will be normal to the curve o it will if tho point is on the line of the majo or of the minor axis, but not otherwise. In what 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 to this matter. By an oversight, we gave the dyections ior drawing a normal on the assumption never seen a praphical solution of the problem for a point outside the curve. Nearlyall'treatises on conic sections, however, give methods by which the equation of the required normal can be readers will beinterested 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. or 30 feet. \%. 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 coniderable difference, if possible.
(41) J. W. B. suys: 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 16 inches in diameter and 30 inches long, that I have had tested to 270 lbs. pressure. A. In our sure a boiler will stand, we generally give working pressure, with a large factor of safety. In prac-
tice, it is usual to find boilers carrying much higher pressures than would be allowed by our proportions; but we think it best to give value authorities in this country and Europe.
(42) C.. W. J. says: It is contended by some the sunlight and heat may have free access there 0 , the tertilizing properties of the muck are lost by evaporation and absorption of nitrates frow the muck. But to allow the shade to remain over better, and, in fact, the only salvation of the muck bed as a fertilizer; and it is contended tha muek is deposited on the required lands, and that the plants designed to be improved thereby hav to grab, so to speak, for their share, entering int direct contict or contest with the sun. It is also contended that rain is a deposic of nitrates, pre iously taken up as vapor, and, therefore, afte ly as the plant can do it; and up $n$ n the reappear

Are these things so? A. If the muck beds be well covered, there is practically 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 fleld the gain or loss to the vegetation (43) W.
(43) W. E. E. says: I have a lot of black rubber chains, and they have all turned to a gray-
ish 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 goodfor oiling farm machinery? Can the sait be taken out of salt butter so as to make an
oil fit for oiling harness? A. No. Such oil is not uitabie for either purpose
(45) W. J. R. says: By what means can I take iron rust out of marble? A. It is impossi-
ble to do this, without injury to the marble, by ble to do this, without injury to the marble, by
purely chemical means. The best method that we 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 th usual manner. Where the stains are too deep for
such treatment, 1 t would perhaps be better to cover them with a light coating of a mixture of plaster of Paris in a strong solution of water glas
(46) C. T. (t. says: Please give me a recipe for cleaning baryta crystals and stalactites. A.
If the crystals are rcally sulphate of baryta, try steeping them for some hours in hot muriatic acid, containing a very little nitric acid. If the ous clay (ocher),this treatment will completely renove the iron,loaving behind the pure white clay, which may best be removed by mechanical
(47) ('. H. W. says: In soldering tiuware 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 to give the best results? A. About 25 or 30 , 2. Wuuld 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 thin 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 and vicc versa. You say that youl to puil, and vicc versa. You say that you cannot cept 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; 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. Butitake 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 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, generaily correct
(50) D. M. says: As many of your reaclers eem to take an interest in the baroscope of Babinet, of which I sent you a description which has
been published in Wrinkles and Recipcs, allow me to suggest a change which experience has taught me. The use of water in that instrument is subgets foul at the expense of the air conflned 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.

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## mowledges, 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 <br> <br> S. \& S.-J. J. R.-J. G. S.-I. W. H.-E. L. R.-C. G. S.-J.D. T.-P. K.-R.E. M.-W. H. E.-C.

 <br> <br> S. \& S.-J. J. R.-J. G. S.-I. W. H.-E. L. R.-C.G. S.-J.D. T.-P. K.-R.E. M.-W. H. E.-C.}

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    Envelops.-H. Burnell, San Francisco, Cal.
    Fare register.-A. Hancc et al., New York city
    Fiber drawing Head.-J. Good, Brooklyn, N. Y.
    harvister.-B. F. Jackson, Pittsfield, ill.
    Hickling Hemp, etc.-J. Good, Brooklyn, N. .
    Loom.-G. Crompton, Worcester, Mass.
    Maiking Gas.-T. S. Stewart, Philadelpha, Pa.
    Making Wood Screws.-T, J. Sloan, New Yaot
    MAEING Wood SCrews.-T. J. Sloan, New York city.
    Motive Engire, etc.-J. T. Gallup, Greenport, N. Y.
    Motive Enaine, rtc.-J. T. Gallup, Gree
    Pantaloons.-G. R. Eagar, Boston, Mass.
    Pipl-Cutting Tool.-A. Saunders, Yonkers, N. Y.
    polisiing bettons.-G. P. Warner, Leeds, Mass. Roci Drill.-J. B. Waring, New York city.
    ock Drile.-W. W. Dunn (of San Franclisco, Cal.), London, England Triming appabatus.-R. B. Pumphrey, Baitimore, Md. Wabinga Fabrics.-J. Brown, Monticello, N. Y.
    Wabince Wool, etc.-F. G. Sargent, Graniteville Mass

