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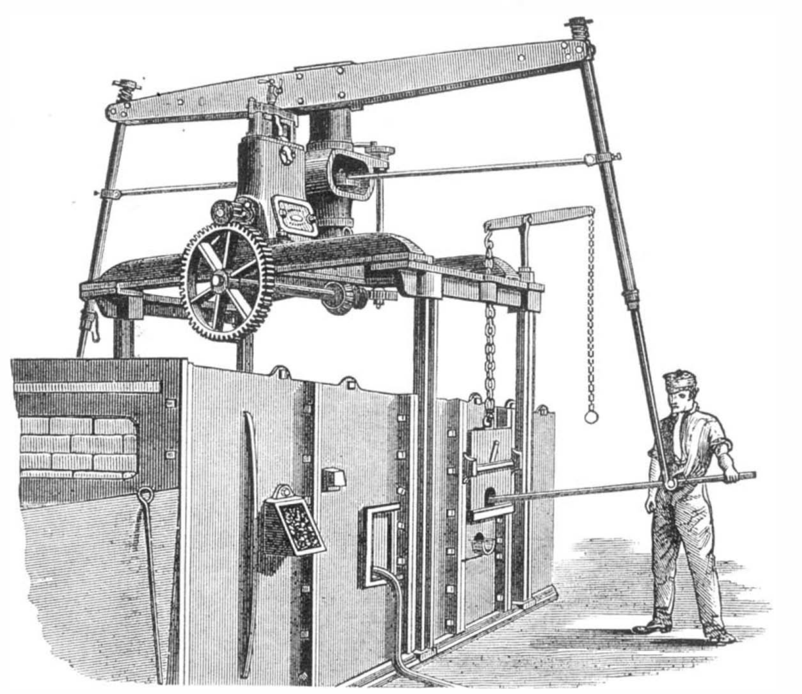
PUDDLING MACHINERY.

We illustrate herewith a rabbling machine for puddling iron, which can be used in conjunction with any of the known furnaces in puddling, and is now almost exclusively used in the Cleveland district, in England, being fixed over the ordinary furnaces. The machine and engine [Clough's patent three-cylinder] are attached to a substantial bedplate, supported on four double-headed rails, or by other means, over the furnace, the latter having a door at each side for charging and withdrawing the bloom when puddled. From each end of a wrought iron beam are suspended two tubes, to which are imparted a vibrating motion from a crank plate working in the column of the machine. These tubes have at the lower end a double hook, on which the rabbles hang, and the latter, in addition to receiving the vibrating motion of the tubes, also have imparted to them a radial motion from the ends of the wrought iron beam. The rabbles thus operate in two directions, and puddle the iron over the whole surface of the furnace bed. The usual charge for a furnace is about 14 cwt., but considerably larger charges have been successfully dealt with.

The consumption of coal is about 14 cwt. to the ton of bars made, and much less fettling is required. The men have easier work and get out a much greater weight in less time than by ordinary hand labor. Considerably over one hundred of these machines have been sold during the past year, and they are acknowledged by those whose opinion should carry weight, to solve in a most satisfactory manner the problem of mechanical puddling. Special care has been taken to have all the working parts as far as practicable protected from dust, as it is well known what grinding effects the dust and ashes from puddling furnaces have upon machinery.



CLOUGH & CO.'S PUDDLING MACHINE.

BRAYTON'S HYDROCARBON MOTOR.

It will be remembered that not long ago we illustrated and described the above-named invention in its then most improved form. Of late, however, the construction of the machine has undergone considerable modifications ; and, as will be seen in the annexed engraving, its construction has been materially simplified. In order to appreciate the nature of this in many respects remarkable motor, which, through its utilization of the gases due to the sudden combustion of oil, may be started or stopped almost immediately, which requires no continuous fire and therefore no furnace, which in brief, costs nothing while not actually in operation, it will be well briefly to review its history as an invention. Thus we shall best exhibit the connection between the present and prior types of machine.

In the first engine made by the inventor, Mr. George B. Brayton, a well known engineer who has devoted a quarter of a century to this especial subject, separate charges of hydrocarbon were exploded, the force acting on a free piston to compress air, which in turn expanded upon the crank piston. Sub sequently a rack and reversible catch or pawl held the piston, and the vacuum was used in connection with the air pressure. Five engines were built on this principle, only however, to be abandoned when the idea occurred that an explosive mixture could be burned without explosion by utilizing the principle embodied in the Davy Safety Lamp. On reducing this plan to practice, another difficulty was met in the production of a vapor compound which has a tendency to condense under high pressure ; and the effect of the varying temperatures upon the evaporation was a further trouble. The substitution of coal gas for liquid hydrocarbon obviated the trouble ; and, after nineteen years of labor, the inventor found himself possessed of an efficient gas engine, which he patented in 1872, and which subsequently satisfactorily underwent tests made by eminent engineers in this city.

Mr. Brayton now resumed his studies on the oil engine, and after two years he devised a motor wherein a combustible compound is formed by mechanical means, which can (he claims) be used successfully regardless of pressure or temperature. Then followed an improvement in extending the water circulation through the piston, so that the power can be applied to both sides of the same, thus doubling the capacity of the engine. Latterly, the principles have been extended to engines of large dimensions, and thus the oil motor has been developed, so to speak, into a position wherein it may enter into full competition with the steam engine. Although it may never do all that steam has done, it is but just to add that it can do that which never has been accomplished while using steam, namely, that, through the invention, a hundred horse power engine may be almost instantly set in motion by igniting a small burner with a match.

The principles upon which the engine operates are as follows : A small pump feeds the necessary quantity of petroleum into a chamber containing a fibrous substance. An air pump forces through the fibrous compound, which is situated close to the cylinder, the quantity of compressed air necessary to the combustion of the petroleum. The air, in passing through the fiber saturated with petroleum, becomes mixed with the hydrocarbon; and from the combustion of the compound, the expansive force which operates the engine is generated. A small independent pipe keeps a current of air passing through the fiber, and thus continuous combustion is secured. To prevent the combustion of the fiber and the petroleum therein contained, there is, between them and the cylinder bore, a perforated plate which acts upon the principle of the Davy lamp, and thus completely isolates the combustion which takes place in the cylinder. This combustion can only occur as the hydrocarbon and air enter the cylinder; and since this is accomplished gradually, the combustion is gradual, answering exactly to the admission of so much steam. The engine is so constructed as to cut off the supply of hydrocarbon and air at a definite point of the stroke; and the remainder of the stroke is completed from the expanding force of the products of combustion, thus securing the economy due to working expansively. The action of the engine is, therefore, substantially the same as that of an ordinary cut-off steam engine. To keep an equable ratio between the power of the engine and the amount of its load, a pressure diaphragm is provided; while by a very simple arrangement, the supply of oil can be increased or diminished to suit the demands of the duty.

Instead of having guide bars and crosshead guides to guide the piston rods, a novel and simple device is used, as will be seen by referring to our engraving, in which A is the engine cylinder, B is the air pump, and C is a lever connected to the engine and pump pistons. The bottom of this lever is a section of a circle struck off the centre of the piston-rod crosshead journal. As a consequence, the bottom of the lever, C, rolls along a pathway, while still keeping the center of the top crosshead parallel at every point of the stroke, with the pathway, which, being true with the bore of the cylinder, produces a parallel motion without any of the friction due to a sliding motion. The direction in which the fly-wheel revolves is *from* the cylinder (looking at the top of the fly-wheel); and thus the whole tendency due to the angularity of the connecting rod is to keep the lever down upon the pathway on the bed-plate.

The first double-acting petroleum engine made by Mr. Brayton ran in Machinery Hall during the Centennial Exhibition. It was entered as a 10-horse engine, but proved upon a friction brake test to give 12½ actual horse power. The 10-horse engine here illustrated contains many advantages over, and im-

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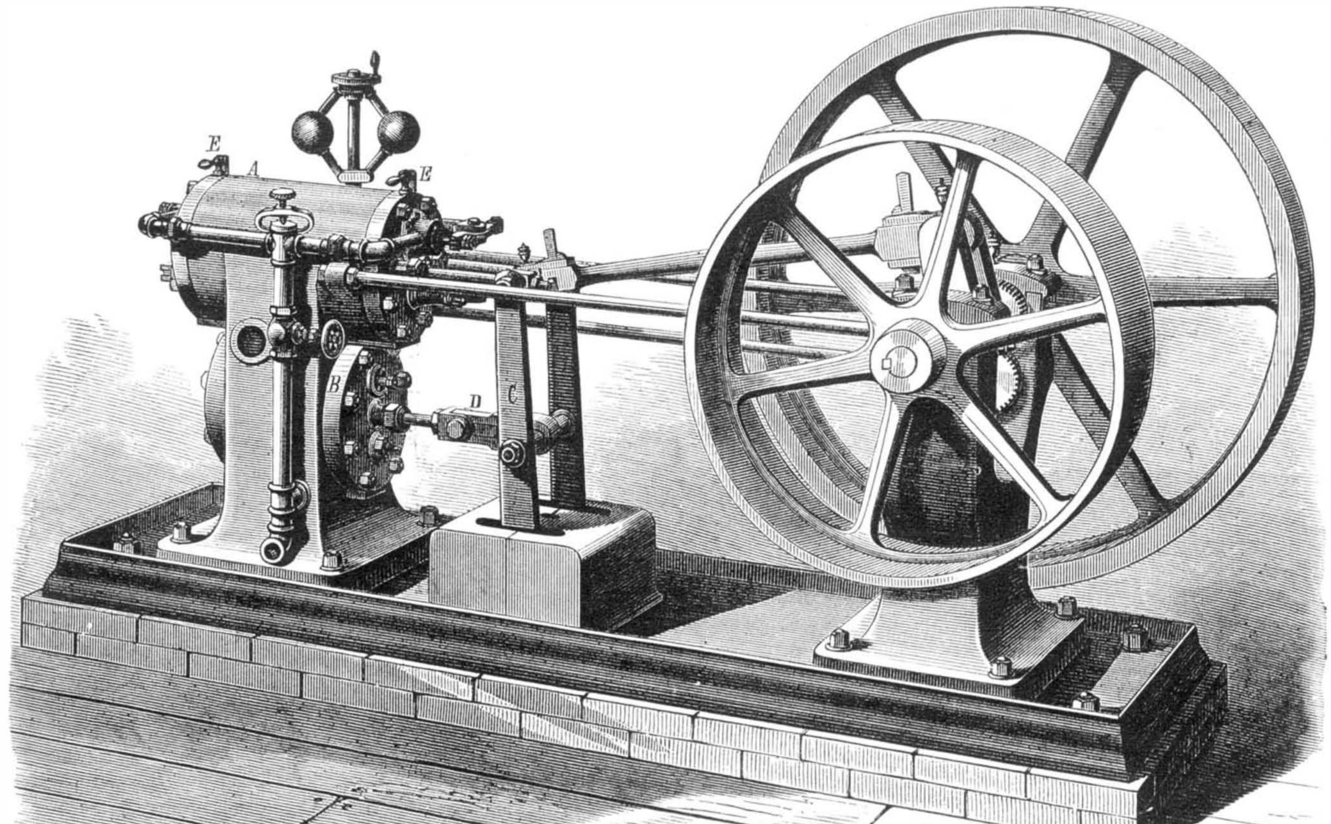

BRAYTON'S HYDROCARBON ENGINE.

Scientific American.

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No. 54.

For the Week ending January 13, 1877.

PHYSICIANS AS PATENTEES.

We have seldom seen a prettier illustration of professional prejudice than appears in a late number of the *Medical Record*. Speaking of the ingenuity of American physicians the *Record* remarks that scarcely a day passes without some new design for the alleviation or cure of disease being submitted to the instrument maker, who first takes good care to charge the designer a round sum for making it, and then goes on to manufacture and sell the article at an immense profit to himself.

Against this one-sided arrangement, the *Record* protests mildly, and raises the question whether the profession could not arrange with the trade to allow the inventor some return for his work, while the manufacturer retained the exclusive right of patenting and selling the article invented and adopted. "This plan," the *Record* observes, "would save the dignity of the profession; and though not so remunerative as the holding of a patent, it would nevertheless give a physician some pecuniary recompense for the outlay of his time and means and the labor of his brain."

This solicitude for the dignity of the profession seems to us rather far-fetched. The logic of the *Record's* position appears to be something of this sort:

First: It is the duty of medical men to give the world unreservedly the benefit of all professional inventions and discoveries they may make. Second: To take out a patent is to retain a proprietary interest in the invention patented. Therefore it is an undignified and unprofessional thing to patent a medical or surgical invention. But a physician may surreptitiously derive a pecuniary benefit from such an invention, or rather from the sale of it, provided he can persuade a manufacturer to allow it to him! For our part we think that this indirect way of getting one's due is infinitely less dignified than the straightforward matter-of-fact way provided by the law. The prejudice against retaining a personal interest in anything pertaining to the profession—a pecuniary interest, we mean—no doubt had a highly honorable origin; but when it is allowed to react, as it clearly does, to the injury of the profession, it becomes anything but a virtue.

No physician objects to the copyright of a medical book—nor does any one imagine that the dignity of the profession is in any way lowered by the circumstance that many of its members add largely to their income by such means. On the contrary, it would be easy to show that copyright has greatly helped to raise the profession in usefulness and in the estimation of men. It serves as a powerful inducement for the preparation of medical works, and, when completed, assures their publication. Without the protection which copyright offers to both author and publisher, it would be quite impossible to get the more costly and valuable of such professional contributions printed at all; and without the prospect of printing there would be little encouragement to undertake their preparation. What the dignity of the profession would have been without its literature we need not attempt to say.

What the profession has lost, in refusing to take advantage equally of the privileges and benefits of patent rights, it is impossible to estimate. There is not another line of manufacturing business in so unsatisfactory a condition, all things considered, as the making and selling of medical and surgical appliances not patented. Most admirable work is done, but it is done in the most expensive manner. Articles which might be cheaply made by machinery, and should be widely used, are turned out slowly and dearly by hand; the price reacts upon the demand; patients suffer for lack of mechanical aids which they or their physicians cannot afford to buy; and the profession loses in both usefulness and dignity in consequence.

The free gift which the profession intends to make of professional inventions thus results only in making such articles so costly as to restrict their use. The motive is honorable, but the practice conflicts with the conditions of trade to such a degree that it defeats its own end and purpose. Lacking the protection which a patent gives, the maker of any new medical appliance can have no object in making its merits known, or in spending money on machinery for its cheaper or more rapid production; so he meets the limited absolute demand in his own slow and costly way, and charges a profit which helps still more to lessen the demand. As a further result, the mass of medical practitioners are but poorly equipped with professional aids, and the general efficiency of the profession is less than it might be and should be.

The cure of these grave evils hinges, we believe, on the adoption of more business-like and practical views touching this matter by the profession as a whole. The moment physicians and surgeons abandon their prejudice against patents, and act like other people, the business of the professional instrument maker will take on a much more satisfactory aspect. Protected in his work, he would have some inducement to improve its methods. The first result would be to cheapen the products and so encourage their more general use. Enlarged demand would react upon the price, and that again upon the employment of such professional aids, to the natural increase of the intelligence and efficiency of the profession.

Further, invention begets invention; and whatever is done to increase the use of improved professional means and appliances increases also, the probability of still other improvements. The inventor's royalty steps in to encourage the good work, and to secure the preservation of valuable suggestions and devices now commonly lost to the profession. The benefit that would ultimately accrue to the profession from and through this line of advancement is quite incalculable.

THE OBLIGATIONS OF SCIENCE TO GOETHE.

The great German poet Goethe, is generally more appreciated by students of German literature than by scientists for the simple reason that most of his literary labors were at once understood, while his scientific labors, in which he was half a century in advance of his contemporaries, are only just beginning to be valued; and even now, the large majority of people have no idea of their high importance. He went forward with such great steps that he was soon far ahead of his time, and contemporary philosophers were utterly unable to keep pace with him, a misfortune which he himself felt and acknowledged!

Goethe approached the grand problems of nature not as an unimpassioned investigator, but as an inspired poet, and the wonderful generalizations which he made in metaphysics, in botanical and zoological anatomy, in embryology and comparative anatomy, were the basis of the modern theory of evolution. These theories sprang from his intensely poetical conception of the necessary unity of nature, and have now been generally acknowledged and accepted. Metaphysics he reformed entirely, by proving that in fact there is no such thing as a metaphysical universe, no nature above the visible nature; and therefore, to Goethe, metaphysics proper did not exist. He saw that matter without mind was as unthinkable as mind without matter; and he was the first who attacked the *dualismus* which treated mind and material nature, essence and phenomenon, or whatever else they may be called, as opposing principles. He held that in place of being distinct, they form an inseparable unit. Neither matter nor spirit can exist alone; but everything is both in one; and it is evident that it is just as erroneous to call natural objects materialisms as it would be to call them spiritualisms. Nor can any one call this view of the universe atheism, as it acknowledges a God grander and nearer to man than the hypothetical *deus ex machina* of the ancient creeds.

There was recently published a letter from Goethe to Jacobi, in which the writer says: "Why some good people want a God existing outside of the universe is what I do not understand. Does not God exist in the universe, everywhere in the universe? If he does not exist everywhere, entirely and undivided (because the whole universe is a manifestation of His, to us, visible form) then does He exist nowhere. Outside of the universe, there is no space; space comes only to existence as an abstraction when a universe is evolved. A limited personality does not fit an infinite being, which must be the highest, living, active unit: not *in* all things, as if there could be anything outside of Him, but *by* all things, which appear only as perceptible conceptions to the observing faculties of material beings."

In regard to Goethe's labors in special branches of the natural sciences, we must first consider a principle which he insisted on in all his works, namely: That "a bad hypothesis is better than none at all." Professor Huxley endorses this, and adds: "It forces the mind into lines of thought, in which it is more profitable to go wrong than to stand still." One of Goethe's most celebrated works in the natural sciences is his "Metamorphoses of Plants," first published in 1790. In this work he attempted to prove that there was one fundamental organ, by the infinitely manifold transformation of which the whole world of the vegetable forms was evolved. This fundamental organ he thought he had found in the leaf; but if he had been a microscopist he would have gone farther back, and recognized the cell as the organic cause of the leaf. Applying the same reasoning to the cell development, he would have done as we, enlightened by his example, do now; he would have looked for the primary form or type, or other name by which the originating germ may be called.

Goethe's next great labor was his famous theory of the skulls of man and the other mammalia, that they are only modifications or differentiations of vertebræ of the spinal column, being composed of similar parts. This idea, further developed and applied to other parts, is of the utmost importance, and has effected a reform in comparative anatomy, or, rather, has elevated it to be one of the most solidly founded sciences. To have proved the unity of type of two objects so different in appearance as a vertebra and a skull, and afterwards of other objects, was to have made an immensely progressive step.

Goethe also proved that certain differences between the osseous systems of man and the lower mammalia, which had been insisted on before his time, did not exist in the embryos, and only appeared during and after growth.

It is evident that what Goethe called metamorphosis, is identical with what we call evolution. Witness the following expression: "The triumph of metamorphosis is shown when this theory teaches how simple organization begets families, how families split up into races, and races into various types, with an infinity of individualities. Nature cannot rest, nor preserve what she produces, but her actions go on *ad infinitum*."

COLOR MUSIC.

A correspondent sends us an essay on the analogies between sound and color, describing a new instrument (which he terms a color organ), which displays lights of various colors, claimed to be harmonious with the music produced. An analogy is traced between arrangement of the colors of the spectrum and that of the notes of the minor scale. Our correspondent thinks that color music might be produced by the arrangement of colored lights, and that such an addition would prove valuable in the presentation of operas, or even in connection with church music.

The analogy that really exists between sound and color is, that both are the products of vibrations which the brain, in accordance with their velocity, translates into one or the other impression. Viewing the physical characteristics, we may proceed a step further, and admit that there exist harmonies and discords between colors, as between sounds; and that in this respect a finely painted picture may be as gratifying as a finely written musical composition. Still further, we may concede that there is such a thing as sound painting; but here the analogy grows weak, for a trained perception is needed to interpret the meaning of sounds which express ideas. Still, it is, and always has been, a motive of composers to make music present pictures or thoughts to the mind's eye, as clearly as a painting conveys ideas to the physical senses. But the composer's motive merely offers the bare idea which the hearer clothes to suit himself; and in no instance can it be urged that any musical writer ever wrote a note to express the sensation of blue or green; although, to listen to early pastoral music is to have the idea of blue sky and green fields brought uppermost in one's mind.

There are, however, the clearest scientific objections to the many repeated attempts to demonstrate the analogy which our correspondent suggests. The deepest musical tone perceptible to the ear is caused by about 30 single vibrations per second, the highest by about 24,000. Beyond the latter limit there is silence, or a sensation of pain to the ear. In music, the range is from 32 to about 4,000 vibrations, or about seven octaves. Comparing these figures with those indicating the vibrations of the color sensation, we shall at once perceive the dissimilarity. Thus, the extreme red of the spectrum shows 407 trillions, and the extreme violet 793 trillions. Now, the upper octave of a given note has just double the number of vibrations; and, therefore, our sensations of color do not correspond to a single octave, else the extreme violet would show 814 instead of 793 trillions. We can, of course, see light showing 814 trillions of vibrations, but the color sensation is exceedingly weak and indefinable.

Again, if several notes are sounded simultaneously, we do not hear a sound of medium pitch, but a chord, which is not easily mistaken for a simple sound. A practised ear can easily analyze this consonance into its components; and a skilled musician can readily follow any instrument or voice even in a full orchestra or chorus. A noise, instead of a musical sound, is only heard when the vibrations take place without any regularity, or when a number of sounds burst upon the ear simultaneously and without any regard to law. But when several colors act on the retina, we see no elementary color, but a hue composed of several simple colors, while several musical tones sounded simultaneously do not blend, but remain perfectly distinct to the ear. No eye is capable of recognizing the elements which compose such a mixed color. The artist may know that such and such colors produce another hue; but he cannot see the components in the mixture. The most practised colorist the world ever saw would be utterly incapable of deciding whether a gray upon a rotating disk were mixed from white and black, from yellow and blue, or from purple and green. If there existed a complete analogy between the two classes of sensation, every mass of sound would resolve itself into a confused noise, and all polyphonous music would be impossible.

There is still another difference (which Professor Von Bezold, whose reasoning we are following, in his admirable work on the "Theory of Color," points out). A tone will be perceived as such when only a few of its component vibrations are executed; but if the number of vibrations which reach the ear is too small, a confused impression is the result. Rapid passages on the bass notes of a pianoforte degenerate to a mere rumble; while there is a crystalline sharpness to quick runs on the high notes. In one case, as each note is struck, but a very few vibrations enter the ear; in the other, the vibrations are received by hundreds. With colors the case is different. The impression of a succession of colors can only be produced when the number of vibrations entering the eye from each color exceeds five trillions, and even then it will be quite imperfect, and little more than a glitter. If we paint a color top half of one color and half of another, the two sensations, rapidly produced alternately, are analogous to those of the trill in music. But if such a trill were executed so that each sound should execute the number of vibrations corresponding to the number of vibrations of light, which must enter the eye to produce the effect of alternating colors, the sounds would have to succeed each other in periods measuring at least years.

Returning to the numbers of vibrations corresponding to each color, and constructing with them a scale in accordance with the spectrum, we shall find the same to be very different for the musical scale. In such a scale we cannot illustrate the intervals which are almost involuntarily indicated by the ear in music. Take the fifth, where the vibration numbers are as two to three. A person having a good ear will at once recognize, as discords, variations on either side of the correct proportion. Yet the numbers of vibration of the red of the Fraunhofer line C, and those of the ultramarine blue, a little on the other side of G, likewise bear the same ratio; but it is absolutely impossible, even for the eye of the best colorist, to determine the exact point at which this proportion is reached. So the difference between the octaves in colors is of extraordinary magnitude; while, in music, a note and its octave may easily be confounded by an unpractised ear.

Mr. John Ruskin, in his "Modern Painters," dwells with great elaboration on the principle of gradation in color. He tells us that Nature never uses a color without grading it; that is, never employs flat tints. And he further claims that Turner, whom he considers only inferior to Nature, probably because of his fallible humanity, never painted a square inch of canvas without grading his tint. If we accept this, we are led, according to the theory of musical analogy, to a ludicrous conclusion. Gradation in color must be analogous to the *portamento* in music. The semitone interval of the chromatic scale is but very sparingly employed in music, because it really produces the howl of some wild animal. Therefore, it would follow that if our correspondent had Turner's "Slave Ship" placed before him, and were told to reverse his theory, and translate color into sound, his instrument or chorus would begin a series of hideous howls and whines. A tiled mosaic pavement, consequently, being destitute of gradation, would be the highest possible translation of a musical composition into a composition of colors.

MORE REMARKABLE CLOCKS.

IN a recent number, we referred to a clock without any apparent works, nothing being visible but a transparent dial and a pair of hands. Such clocks are, we are informed, no great novelties, as several of these "mysterious clocks" have been invented, and two were patented in this country previous to that of M. Robert. An informant saw one in Birmingham in 1856, and he remembers reading in the SCIENTIFIC AMERICAN of a similar clock being on exhibition in San Francisco several years ago.

One of the clocks above referred to (that of C. Schwippl, of this city, patented June 21, 1864), differs from M. Robert's clock in having the works in boxes in the centre of the hands. but the patent of C. King, June 16, 1868, shows a clock with the movement concealed in the counterpoise on the end of the hand, like that of M. Robert.

Another style of clock without apparent works was exhibited in a Broadway store some fifteen years ago. It consisted of a heavy ornamental base on which stood a transparent glass column, having a metallic cap on which rested a light round frame surrounding a transparent glass dial of about five inches in diameter, having the usual figures on it, but only one hand, so that it could only point out the hours, or such fractions thereof as could be indicated in the space between two figures.

The works in this clock were probably concealed in the base, and the connection made with the hand by means of a glass rod or tube passing through the centre of the glass column, which rod or tube moved a glass plate at the back of the dial; which, being of the same shape and size as the dial, and the edges of both being concealed by the frame before mentioned, could not be distinguished from the dial plate, and was supposed to be part of it by the ordinary observer. This plate had the hand firmly attached to it, so as to travel with it, and it probably had a metallic ring around it having teeth gearing with a small pinion on the end of the glass rod or tube before referred to, as there was sufficient room in the frame of the dial and the cap of the column to conceal both teeth and pinion.

As there appeared to be no connection between the base and cap supporting the frame of the dial, excepting the plain transparent glass column, and nothing but the figures and a small, ordinary hand on the equally transparent dial, this was truly a "mysterious clock" to most people, but the above is probably the explanation of the mystery.

A third style of mysterious clock was exhibited in Cortlandt street, in this city, a short time since. This consisted of what appeared to be an ordinary French clock contained in a base, supporting a bronze figure with an outstretched arm, from which hung the pendulum There appeared to be no connection whatever between the pendulum and the works, and the question: How is the pendulum kept in motion? was a puzzle that baffled some of the best mechanicians and horologists in the city. Many different theories were advanced to account for the continued movement, such as the application of a blast of air acting on the ball, electricity, magnetism, etc., all of which were denied by the exhibitor; but the real explanation was probably as follows: The figure itself, instead of being stationary on the base, as it appeared to be, was fixed on the top of a vertical shaft, concealed in the base and connected with the movement in such a manner as to give the figure a turning motion sufficient to swing the pendulum, but so small as to be imperceptible to an ordinary observer.

Among other curious clocks we may mention that patented by T. A. Davis, January 15, 1846, which had neither weight nor springs to drive it. Instead of using the cord to hang a weight on in the usual manner, the clock was suspended by it and the weight of the clock itself became the driving power.

A patent was granted by the Assembly of Connecticut, in 1783, for a clock to wind itself up by means of air, which was probably on the same plan as that patented by C. B. Hoard, April 3, 1860, in which the warm air escaping from a room through a ventilating fan or windwheel wound up a spring or weight.

Several attempts have been made to drive clocks by the expansion and contraction of mercury or metallic rods caused by the variation of temperature between day and night. One was exhibited by Coxe in London, in 1827, driven by the expansion of mercury, and the expansion of metallic rods for the same purpose and by the same means is proposed in the patent of Washburne, July 4, 1865.

A recent patent (E. Stockwell, March 2, 1876), shows a safe with a "time lock," in which the clock work is wound up by the opening and closing of the door of the safe, and the apparatus is provided with a device to prevent overwinding, no matter how many times the door may be opened after the spring is properly wound. This is something on the same principle as a French invention we saw some years since, in which the opening of the door of a wardrobe or bookcase wound up the spring of a clock connected with it, and of the watch which is wound up by the opening of the case to see the time.

Almost every one has heard of the wonders of the great clock at Strasburg, its automaton figures, etc; but few know that it has a sphere showing the precession of the equinoxes. This sphere turns once in 25,920 years! at least, we were informed so, but could not then spare the time required to wait and verify the statement.

THE RESIGNATION OF THE COMMISSIONER OF PATENTS.

Judge R. H. Duell has resigned the Commissionership of Patents, his resignation taking effect on January 1. He leaves the position through motives similar to those which have influenced many of his predecessors, namely, to engage in the private practice of patent law, having completed arrangements, it is said, whereby he connects himself with a law firm of this city. Judge Duell's administration has been marked by much ability; and in the last annual report of the Secretary of the Interior it is stated that, during the year which he has been in charge, the income of the Patent Office has been greater and the expenses less than in any previous year in the history of the office.

Although Judge Duell explicitly states that he has had his present course in contemplation for several months, his resignation will be by many regarded as untimely, in view of the irregularities recently discovered among his subordinates. In some cases, false names appeared on the pay rolls, which were explained to be those of draughtswomen who objected to being known as Government employees; and in others, drawings given out to be made as piece work were sublet by those to whom they were entrusted to other parties. This was irregular; but, it it stated, in no case did it involve loss to the government. The objectionable practices appear to have been promptly checked by an order from the Commissioner, on his attention being publicly called to them.

Among the names of persons suggested for the Commissionership, are those of Congressman Hoskins, of New York, Mr. W. H. Doolittle, and Mr. R. L. B. Clark, Chairman of the Appeal Board of the Patent Office. It is highly important that the person selected for this very responsible position shall possess considerable legal knowledge, and be well informed on matters pertaining to the present state of the arts and of inventions, and also well versed in the practical workings of the Patent Office itself. These requirements, we think, would all be fulfilled by Mr. Clark, whom we have no doubt would make an excellent Commissioner. He is an old and experienced employee of the Patent Office, where he has attained high rank.

Since the above was in type, we learn that our old friend and former associate on the SCIENTIFIC AMERICAN, Salem H. Wales, Esq., is strongly advocated for the Commissionership. For more than one year Mr. Wales occupied the position of President of the Department of Parks, and subsequently and now for over three years has been the official head of the Department of Docks of this city. In discharging the difficult duties of both of these highly responsible positions, he has exhibited rare executive ability. In both he has been called upon to direct engineering work of magnitude, to govern the expenditure of large sums, to interpret laws, many intricate and perplexing, yet involving interests, both public and private, of the highest importance. Through his extended experience in these varied and onerous requirements, he has acquired a breadth and class of knowledge which render him exceptionally well fitted for filling the Commissionership in a manner acceptable to inventors and to the country at large.

Osmose Plan for Blisters.

The removal of infilteration of the skin is easily accomplished, according to M. Ungerer, by osmose. He had occasion to prove this lately in having to treat an extensive scald on the hand, which resulted in a large and exceedingly painful swelling without wounds. Cold water treatment for 12 hours did not relieve the swelling in the least, and the pain was almost unbearable when the hand was removed from the water only a few seconds. He, therefore made a diffusion experiment, dipping the hand in a saturated salt solution, and the success was surprising. Though the salt solution had not the temperature of the ice water, the pain diminished almost immediately, and in 4 hours blister and pain were both entirely gone. The hand next day differed from the other only by a very slight swelling and redness.

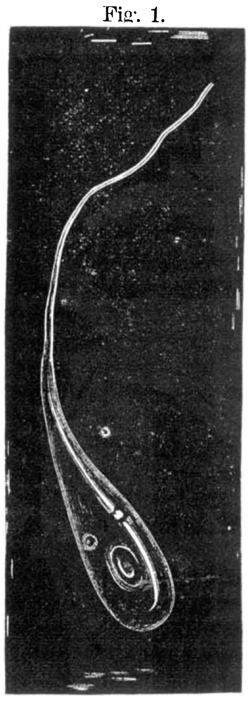
Neptune the Most Distant Planet.

After a long continued labor, M. Leverrier has at length, with the theory of Neptune and Uranus, completed the study of all the members of the solar system. The author's chief object was to decide the question whether there is an ultra-Neptunian planet, which might be detected, as Neptune was, by the perturbations produced by it on planets already known. The conclusion is negative; there is nothing indi cating the existence of a body outside of Neptune

TEMPERED GLASS.

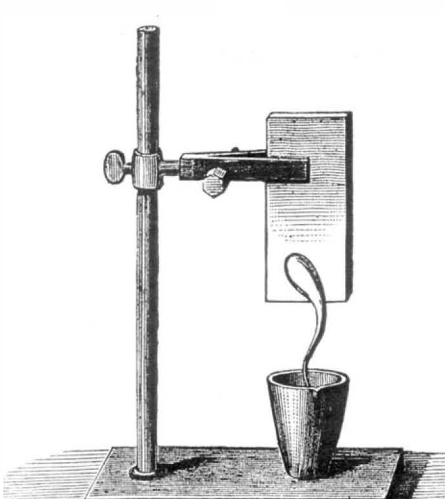
[Our readers are familiar with the practice of hardening steel to a degree in excess of the requirements, and then reducing it the exact degree of softness which will give the required flexibility and toughness. The latter process is called tempering; and the absence of brittleness and the durability of the steel when in use is properly called its temper. In the following article, however (which we translate from *La Nature*) the noun temper is used as the equivalent of the French noun *trempe*, which properly signifies the hardening and not the reducing process; but it adequately gives the meaning of the word, if this explanation be borne in mind.—EDS.]

Fig. 1.



A substance is said to be tempered when, after having been heated, it is suddenly cooled. Ordinarily this result is obtained by plunging it while hot into a cold liquid; and the degree of temper is proportionate to the heat of the object and also to the rapidity and extent of the cooling. The effects thus produced may be partially or wholly removed by annealing. This operation, the inverse of tempering, consists in reheating the tempered material and then cooling it slowly. If it is reheated to the temperature to which it had previously been raised, no trace of temper remains; if it is brought to a lower temperature during a shorter time, the effects of tempering are only lessened. The remarkable properties possessed by tempered steel are well known; but generally, it is not so well understood that other bodies, such as phosphorus, sulphur, certain alloys, etc., experience on being tempered interesting modifications, some of which have been utilized in the arts.

Fig. 2.



The tempering of glass and the curious properties thus acquired by that substance was first studied during the seventeenth century, when "Batavian tears," or "Prince Rupert's drops" were first produced. These objects are now frequently made in glass works, as curiosities, and are retained by allowing melted glass to drop or extend slowly from the end of a rod into a vessel of cold water. The piece

Fig. 3.

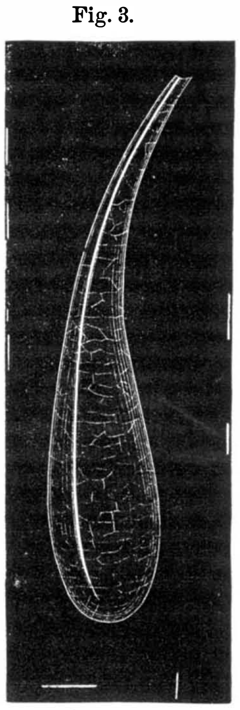
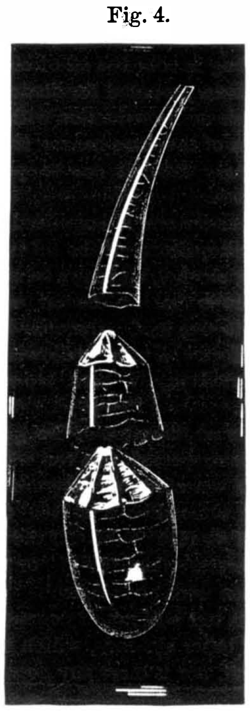


Fig. 4.



which assumes a tear or drop shape, as shown in Fig. 1, is, on cooling, broken from the rod. The curious feature about these tears is that, while they will resist the blow of a hammer on their thick portion, the breaking off of a small piece of the tail causes them at once to fly into a myriad of fragments. It has hitherto been supposed, in order to account for the above, that the exterior of the glass cooled first, and solidified, while the material within, cooling more slowly,

Fig. 5.

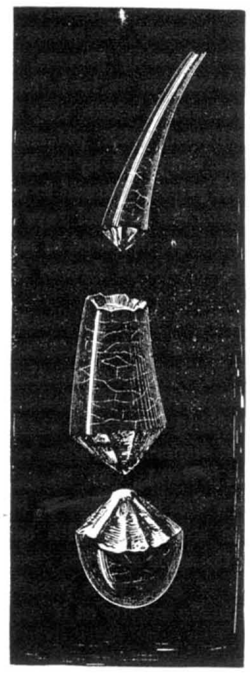
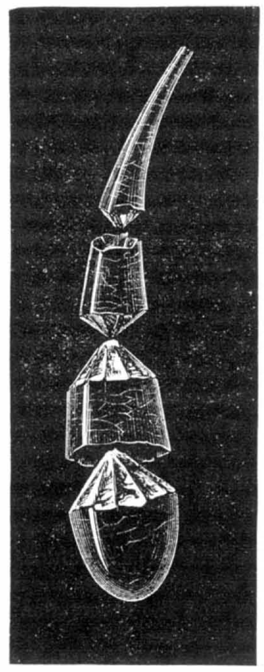
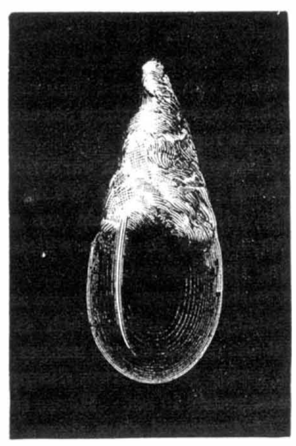


Fig. 6.



was prevented by its rigid envelope from contracting, and hence remained in a state of fixed dilatation. Consequently, according to this theory, on breaking the outer envelope, the

Fig. 7.



unstable equilibrium of the interior molecules would result in their disaggregation.

The investigations of M. Victor de Luynes, however, tend

Fig. 8.

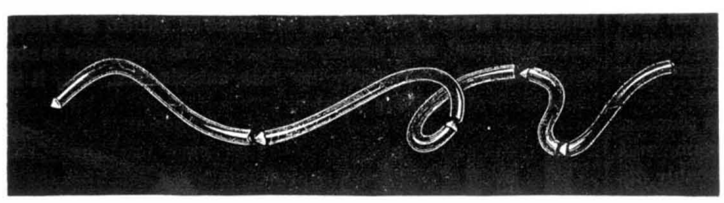


Fig. 9.

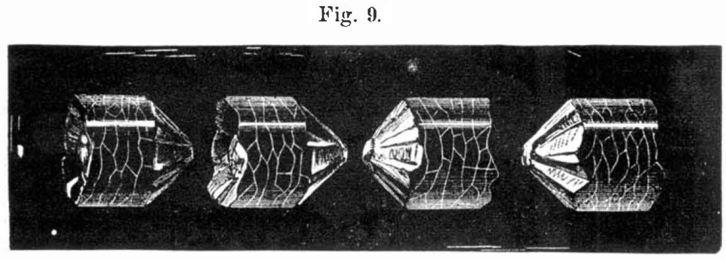
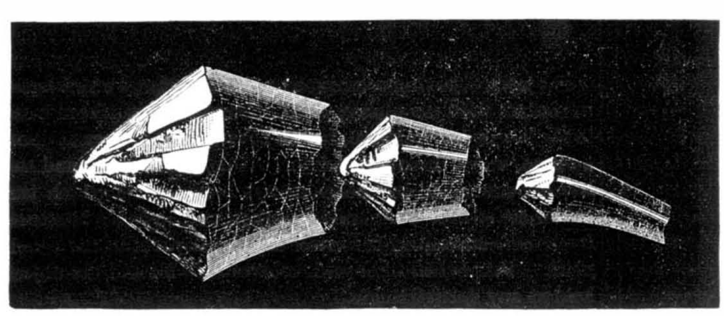


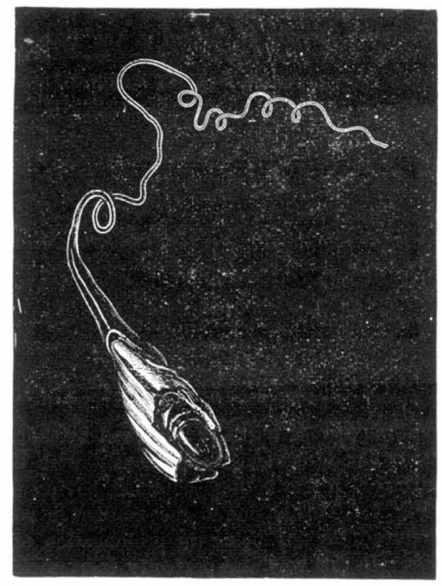
Fig. 10.



to show that the effects noted are due principally to a particular state of the exterior layers of the tears, and that the interior of the mass plays only a secondary part in the phenomenon. The experimental proofs are as follows: A tear is so suspended above a platinum vase of hydrofluoric acid that only the extremity of the tail enters the liquid. As the latter eats away the glass, the drop is lowered, and in this way it is found that it is possible entirely to dissolve away the tail without determining an explosion; but when the neck (that is to say, the point of divergence of the pear-like form) of the tear is reached, equilibrium is always disturbed. Reciprocally, on introducing the large end into the acid, the layers of glass are successively eaten away, and the tear becomes completely dissolved, leaving only the tail and the point of origin, or neck, as before.

These two experiments prove, first, that the stability of the tear depends especially on the existence of the parts of the glass which constitute the origin of the neck, and that, as regards these parts, so long as they are kept intact, all the exterior layers of the tear may be removed without determining explosion. Hence it follows that the said layers are not necessary to the maintenence of equilibrium. By gradually destroying the enlarged portion by hydrofluoric acid the tear is reduced to a nucleus. If several rather large tears be thus treated, and if the action of the acid be arrested at different periods for each, nuclei of different sizes are obtained, of which the explosive properties vary

Fig. 11.

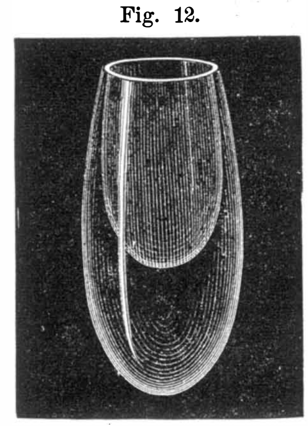


in intensity. When the tear is thick enough an inert nucleus is reached, which breaks under a shock like ordinary glass.

The tear made in the manner above described may be considered as formed by the superposition of unequally tempered and hence unequally dilated layers of glass. This dilatation of the exterior layers by the temper produces a bending or flexure analogous to that obtained by compressing the tear in the direction of its axis so as to expand it transversely. Supposing a section to be made in the tear in a plane passing through the axis, the glass in the exterior layers, which M. de Luynes terms the active ones, would be in the same state as in a plate of glass submitted to flexure; the exterior parts being dilated, the interior parts compressed, and the two being separated by a neutral stratum where the glass remains in its natural state. In the tear, the flexion would be carried to its maximum, or, in other words, the conditions would be the same as if the plate of glass were bent so that its extremities touched. All the layers extended or compressed by flexion unite at the neck of the tear; and for this reason it will be seen that, upon the unimpaired existence of the neck depends the stability of the tear; and also that, on destroying the said neck, the active layers, by virtue of the elasticity developed by the flexure are free to exercise their spring-like action to regain equilibrium, and in so doing to destroy the whole tear. If, on the contrary, the exterior layers are slowly dissolved, the neck being preserved, the layers which remain are maintained by the resistance of the interior layers, and equilibrium is not upset.

If the unequal flexions, due to the inequality of temper of the exterior layers, determine rupture by their elasticity when per-

Fig. 12.

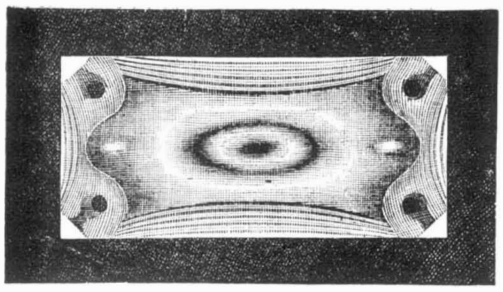


mitted to detach themselves the molecules of glass of each layer should be displaced in inverse direction, according as the rupture takes place from the tail or from the large end; and hence there should result a difference in the arrangement of said molecules after the rupture. The central portions of a transverse section which belong to slightly tempered layers should not become displaced, while, with the molecules of the outer highly tempered strata, the reverse should be true. Hence after rupture, a trundcate cone should be produced, the summit of which should be directed either to the tail or to the large end, according as the empered layers had been set at liberty from one or the other other extremity.

In order to verify this, a tear was half inclosed in plaster, as in Fig. 2. The tail was attacked with hydrofluoric acid, and the large end was cut with a saw. After rupture, the fragments were held in place by the plaster, and their position and form could thus be conveniently studied. The tear usually remains as in Fig. 3, and on separating the fragments it is found to be composed of numerous truncated cones mutually imbedded. Fig. 4 shows a tear, the tail of which has been destroyed by acid. The summits of the cones are turned in the direction of the tail. In Fig. 5 the tear has been cut at the large end, and the summits are turned in the opposite direction to that noted in the preceding case. Finally, in Fig. 6 is shown a tear sawn through the middle, in which the summits are directed in opposite directions on each side of the point of division.

There are various other facts which tend to confirm the mode of structure already attributed to the Batavian tears

Fig. 13.

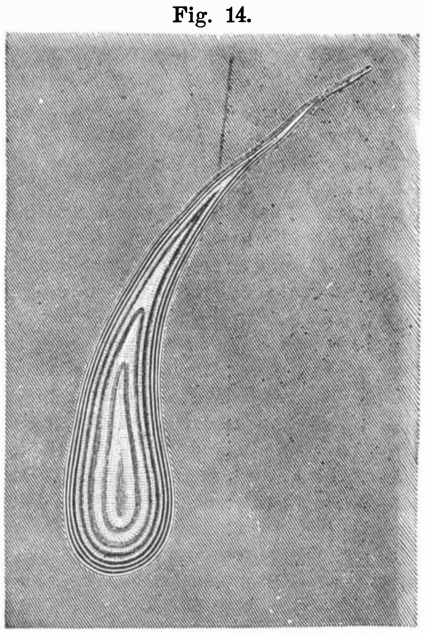


Thus, when the tear is partially attacked by the acid, the tail sometimes disaggregates simultaneously with the layers near the surface. A tear is then obtained having the form shown in Fig. 7. This is due to the manner in which the drop is produced, the tail being the prolongation of the exterior layers. In this way also perfectly inert nuclei may be obtained.

Cylindrical rods of tempered glass present phenomena similar to those shown by the tears. On heating a rod at one end it often breaks along its entire length, exhibiting a conical needle-like fracture. If more or less thick threads of molten glass be dropped in water, after the manner described for making tears, they solidify in spirals sometimes very long, sometimes greatly twisted. These threads possess very high tension, due to the temper of the superficial strata, so that, by attacking the spirals or twisted tubes with acid at one portion of their thickness, they explode like Batavian tears. On imbedding the tubes in plaster and cutting them in the middle, to the right and left of the cut will be observed the conical disposition of scales, placed in contrary directions, as shown in Figs. 8 and 9.

When the tempered threads are very fine, they are then very strongly twisted; and it suffices to plunge one extremity in hydrochloric acid to determine immediate explosion. When masses of glass are drawn out to produce cylindrical rods, there remain at the extremities pear-shaped pieces, resembling large tears and weighing perhaps 2 lbs. each. When separated from the blowpipe these fragments break on cooling, like tears cut at the large end, and present the conical fracture with the summits directed to the large extremity, as shown in Fig. 10. A piece of one of these huge tears, which had accidentally become broken, showed a curious phenomenon. On being pressed between the fingers, it became suddenly heated to about 80° Fah., the heat being probably disengaged at the moment of rupture. In Fig. 11 is represented

Fig. 14.



a tear of crown glass, broken partially at the moment of solidification. It shows the lamellar structure described very clearly.

The properties of tempered glass may be noted in any glass object which, after being highly heated, is rapidly cooled in the air. The "philosophic phial," which glass blowers often make at the extremity of their blowpipes, in order to test the quality of the glass, is an instance in point. After examination, the object, Fig. 12, is carelessly thrown on the ground, and left to cool. It will bear quite a strong blow delivered on its outside, but the dropping of any hard body into it causes it to burst into countless pieces.

The properties hitherto noted in Batavian tears, may be found in tempered glass, and they are present in degree proportional to the temper. If, however, the glass is but partially tempered, it is no longer possible to determine the degree thereof by rupture. Recourse must then be had to another characteristic presented by all tempered glass, without regard to the intensity of temper; namely, the action of the glass upon polarized light. The tempering process, by producing in the glass changes of elasticity in various directions, causes phenomena of double refraction which may be determined by the coloration manifested with polarized light. If a rectangular plate of glass, tempered by cooling in the air, is placed between two nicol prisms (turned to extinction), there are obtained, by causing the parallel rays to traverse the glass, very brilliant colorations, disposed as represented in Fig. 13. The form of these colored figures depends on that of the plate.

When objects in tempered glass are not cut with parallel faces, the direct observation of the figures under polarized light becomes more difficult. The following elegant method of observation has, however, been proposed by M. Mascart. As ordinary glass and liquid carbolic acid have very nearly the same degrees of refrangibility and dispersion, a glass rod plunged in the acid becomes almost invisible. M. Mascart puts the masses of tempered glass which he desires to observe into glass vessels with parallel sides, filled with carbolic acid. The conditions are then the same as if the vessel and its contents were one solid block of glass with parallel sides, and the observation may be made exactly as if such were the case.

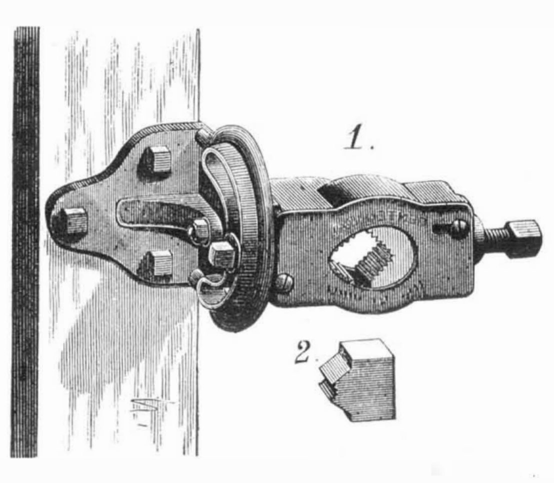
We may now subject the Batavian tear to the test of polarized light; but in order to interpret the indications which we shall obtain, another experiment will be necessary. A flat, rule-shaped piece of glass is inserted in a vise. When placed between two nicol prisms, it produces no phenomenon. Now the screw is turned down, and the glass is bent. As the flexion proceeds under the influence of the polarized light, a black band is first seen in the middle of the rule; then the edges become colored, and then numerous colored bands appear. Relax the screw; these phenomena disappear, and the normal state is regained.

We next place a Batavian tear in carbolic acid in a vessel having parallel faces. When the whole is subjected to polarized light, Fig. 14, colored bands are seen around the contour of the tear, similar to those which we previously obtained by bending the glass rule.

Thus optics prove that temper produces analogous effects to those due to mechanical action, such as flexions; with this difference, that the effects due to temper are permanent, while those which result from flexion disappear as soon as the producing cause ceases to act. Hence the study of the optical properties of tempered glass shows that it is in the same state as glass submitted to bending; and thus we reach a similar conclusion to that already based on the fracture of the glass.

THE CENTENNIAL PIPE VISE.

The principal novel features in the new pipe vise herewith illustrated are the jaws, which are made of chilled cast iron, instead of steel, as is usually the case. The appliance is not only rendered less costly by this substitution, but, it is claimed, is much more durable.



The jaws, 2, having corrugated or fluted surfaces which come in contact with the pipe or other object held, are placed loose in the box or jaw holder, 1; and a cover which swings as upon a hinge, keeps them in position. The bench plate and the box are connected by means of two bolts, one of which is a center or swivel bolt, and the other, at a suitable distance from the said center, traverses the circular slot in the bench plate. This, when tightened, secures the vise and the object held at any desired angle.

Among the other advantages claimed is the trifling expense of repair, the cost of a new set of jaws being less than one third that of repairing steel ones. By simply opening the box cover, one or both of the jaws may be removed and new ones substituted. This is the work of a moment, and the vise is rendered as good as new. The simplicity of construction is obvious from the illustration.

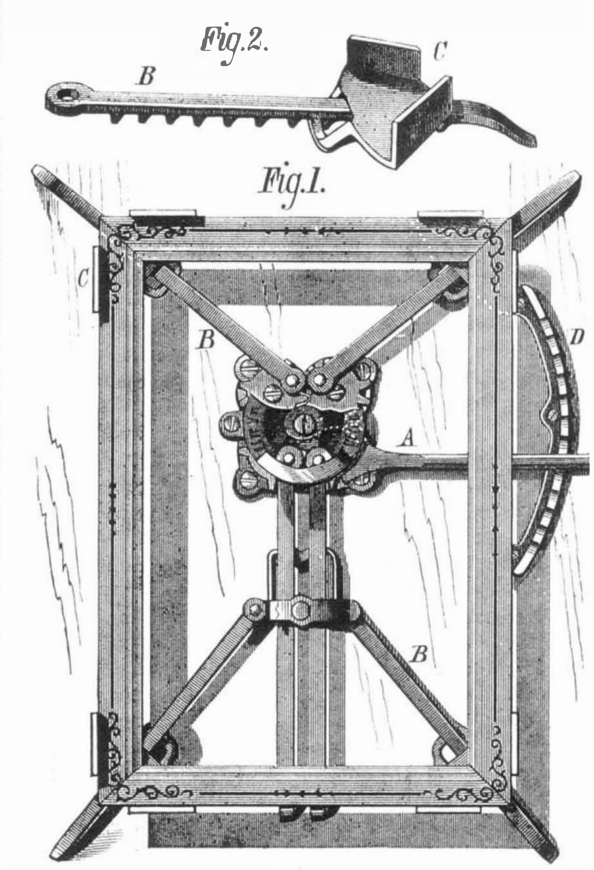
For further particulars address the Exeter Machine Works, William Burlingame, agent, Exeter, N. H., or 140 Congress street, Boston, Mass.

A NEW water and grease proof paper is obtained by saturating paper with a liquid prepared by dissolving shellac at a moderate heat in a saturated solution of borax.

WIETING'S IMPROVED FRAME CLAMP.

We illustrate herewith a new and convenient device for clamping picture and looking-glass frames, sashes, boxes, and other work secured together at the corners by glue or nails, etc. It may also be used for holding pieces of joinery of different shape during the setting of the glue or cement.

To the bench or bedpiece is attached a metal plate, on which four lugs are cast. One lug serves as a bearing for a toothed segmental lever, A, and the others form pivots for cog-wheels, which intermesh with the segment on the lever and with each other, so as to form a connected train of gearing. On the upper sides of each of the wheels and the lever are pins, which serve as pivots for the clamping rods or stretchers, B, Fig. 2. Lastly, over the wheel a cap (broken away in Fig. 1) is secured.



The stretchers, B, are formed with lugs on their under faces, and their outer ends are bent down so as to keep the rods horizontal. On these stretchers are placed shoes, C, which are readily adjustable thereupon by the engagement of the loops on said shoes with the lugs on the stretchers. These shoes are formed with ears at right angles to each other, with an intermediate space so as to allow the ends of the corners of the frame to project beyond them. The ears are covered with leather, felt, or paper, to prevent marring the frame.

To operate the machinery, it is simply necessary to adjust the shoes, C, on the stretchers in accordance with the size of the frame, each shoe being set in relatively the same position, so as to secure a perfect square or rectangular frame. The pieces composing the frame, having glue put on their ends, are laid in their relative positions; the lever is slightly drawn, when the corners can be properly adjusted, and the lever drawn as tight as may be, and locked by the rack, D, when the frame may be nailed without danger of displacement.

Patented May 16, 1876. Machines or territory can be had by applying to A. Wieting, Fort Plain, N. Y.

To Distinguish Bitter Almond Oil from Nitro-Benzol.

When benzol from coal tar is treated with strong nitric acid, it is converted into, nitro-benzol, a substance closely resembling in odor the oil of bitter almonds. Several methods have been proposed for distinguishing the two, one of which depends on its reduction with nascent hydrogen. The result in case of the nitro-benzol is aniline, but the test is an exceedingly difficult one to perform, except by experienced chemists.

An easier one is suggested in Wittner's *Seifenfabrikation*. A small quantity of the oil is dissolved in 8 or 10 parts of strong alcohol, adding a solution of caustic potassa equal in volume to that of the oil used, and then evaporating the mass to one half. Genuine bitter almond oil, when treated thus, forms a clear yellowish liquid, while nitro benzol is converted into a hard brown mass, over which is a clear liquid.

If an adulteration of the genuine oil with some artificial kind is suspected, this test will not suffice; but the adulteration is detected by determining the boiling point. Oil of bitter almond boils at 180° C. (356° Fah.,) and nitro-benzol at 213° C. (415° Fah.). If the oil to be tested boils at a higher temperature than 180° C., or 356° Fah., it indicates an adulteration with nitro-benzol.

This test will not of course, distinguish the new artificial oil of bitter almonds, which has the same composition as the natural, nor is there any necessity for distinguishing it.

DYEING BLUE GREY ON GAUZE.—For 22 lbs. stuff, take through a water containing 17 ozs. sulphuric acid, and rinse well; and then, at 176° Fah., through a fresh beck of 3¼ ozs. nigrosin and 2 lbs. 3 ozs. alum, and dry.

Continued from first page.

provements upon, the one exhibited. It has been stated that the chemical constitution of petroleum shows it to be, as a fuel, 25 per cent. superior to all other fuels. In the Brayton engine the whole products of combustion are contained in the working cylinder, thus, it is claimed, utilizing to the utmost extent the theoretical value of the fuel. In this connection, however, it may be said that, since petroleum, if consumed to practical completion, leaves a mineral residue, the combustion in this case not carried to its final limit, there remaining in the cylinder a comparatively heavy oil, which prevents the formation of a solid deposit, and which serves at the same time for lubrication. The engine is substantially and well built, and has, as will be seen, but few parts, the working parts being accessible and all under the eye of the engineer.

For further particulars address the Pennsylvania Ready Moter Company, 132 North Third street, Philadelphia, Pa.

Communications.

Binocular Vision.

To the Editor of the Scientific American:

In the SCIENTIFIC AMERICAN of November 25, I notice an article giving the history of the stereoscope; and having never seen in print any other theory of binocular vision than that contained in the article, I conclude that scientific men accept these ideas as correct. Until it can be ascertained that a person who never saw with but one eye does not see things in relief, the theory of Sir Charles Wheatstone, that a superposition of one image on another is necessary, cannot be proven. If any one closes one eye, the relief view of objects is not affected. But in this case it may be said that it is caused by the experience of previous observations. In viewing objects at a distance there is a convergence of the vision, which allows only one focussed point to be seen at a time, but each eye sees a different image as the object is viewed from two different points about two and a half inches apart, yet only one object is seen. When I was a boy I often amused myself in observing objects passing by the corn crib. If the slats are two and a half inches wide and nailed vertically, leaving spaces about one and a half inches, an object (such as a man plowing, passing in front at some distance, say a quarter of a mile) will present a very amusing and instructive spectacle to any one placed inside the crib at about eight or ten feet from the slats. The width of the slat prevents him from converging his vision. Sometimes the horses will be a great distance ahead of the plowman; in a moment the man will be at the horses' tails, then the horses will appear to have very long bodies. It is not necessary that the lenses be prismatic.

More than twenty years ago I made two stereoscopes with common lenses of six inches focus, placed two and a half inches apart from center to center, with their axes parallel. The images were pasted on the cards so that any two corresponding points were exactly two and a half inches distant. The effect was equal to, if not better than, that produced by prismatic lenses. I think the parallel vision is nearer the truth, as the rays of vision, from a base line of only two and a half inches (the distance of the eyes apart), are very nearly parallel. It seems that the small difference in the images has much to do with the unity and relief.

As this subject has been handled by men of great acumen, I feel diffidence in approaching it, but never having seen or heard of a steorscope made with ordinary lenses placed with parallel axes, this may be the means of further investigations by persons having more time, and being more competent, than your correspondent. JOHN H. HEYSER.

Hagerstown, Md.

A Cigar Box Telegraph.

To the Editor of the Scientific American:

Having seen a description of Bailey's system of sea telegraphy in your SUPPLEMENT, No. 7, I recalled some experiments in that line made by myself some years ago. The manner of making the signals, though not new perhaps, was entirely original with me, and would probably interest many of your readers. The system was used at night only, and was managed in this way: A small kerosene lamp was inclosed in an ordinary cigar box, which had an opening cut through the top for the lamp chimney, and several small holes through the bottom to admit air. On the side of the box, just at the height of the flame, was cut a round opening, about four inches in diameter, and covered with glass, to keep out the wind. A shutter of suitable size to cover this opening, was then fastened to the box, by a single screw at the bottom, so that the shutter could be vibrated to or from the opening, like an inverted pendulum. A small stop was put on one side to prevent the shutter from passing the opening; while a knob near the screw served as a handle to vibrate the shutter. A light spring kept the shutter closed, so that no light was visible. My brother, who lived just one mile distant, possessed a similar box and lamp, which we used almost every night. The usual Morse code was used, and the dots and dashes were distinguished from each other by the duration of the flash. To open the shutter and close it immediately represented a dot; to open and close slowly, —say to keep it open about half a second—represented a dash.

A little practice soon enabled any one to read or transmit a message almost as rapidly as by the electro-magnetic system. At the distance of a mile the light of the small lamp, seen through the opening of the cigar box, looked like a tiny spark, but was distinct and certain. With an instrument on this principle, having a powerful lamp and reflector, I believe that messages could be easily transmitted a distance of ten miles in clear weather. Any boy can easily make and use a contrivance of this sort to amuse and instruct himself during the long winter evenings. T. C. HARRIS.

Sassafras Fork, N. C.

Solid-Ended Connecting Rods.

To the Editor of the Scientific American:

It would seem that a connecting rod forged in one piece, with simply an opening in its ends for the reception of its brasses, would commend itself both for locomotive and stationary engines wherever it could be applied, as superior to the complex and costly combination of strap, gibs, and keys usually employed.

I am not aware of a single instance in our American practice where such a rod is used for the main connection of a locomotive; but solid-ended rods are used occasionally for parallel rods, and stationary engine builders are beginning to appreciate them. A good sample of such a rod was seen on the Brown engine in the saw mill at the Centennial Fair. This engine, by the way, was one of the finest on exhibition; its design, proportion, fit, and finish being excellent.

A, Fig. 1, is a side and end view of the crank end of the rod, slightly modified to adapt it to locomotive use, the one on the Brown Engine having semi-circular ends. The opening for the reception of the brasses, B, must, of course be wide enough to let the collar of the wrist, C, through it as shown; the brasses have flanges only on their inner ends, so that the rod, A, may be slipped upon them after they are placed upon the wrist. The wedge, D, may then be put in, and the steel binding plate, E, slid in to place, as shown at E, in the end view. Fig. 2 shows this plate detached from the side view; a small binder is applied at *x*, to keep the plate in its place. The wear of the brasses is followed up by the screw, F, and wedge, D; and when the wedge has reached the extent of its range, it may be returned to the position shown, and a thin steel backer inserted behind one or both brasses as the cese may require; this process of adjustment may of course be repeated until the brasses are worn out.

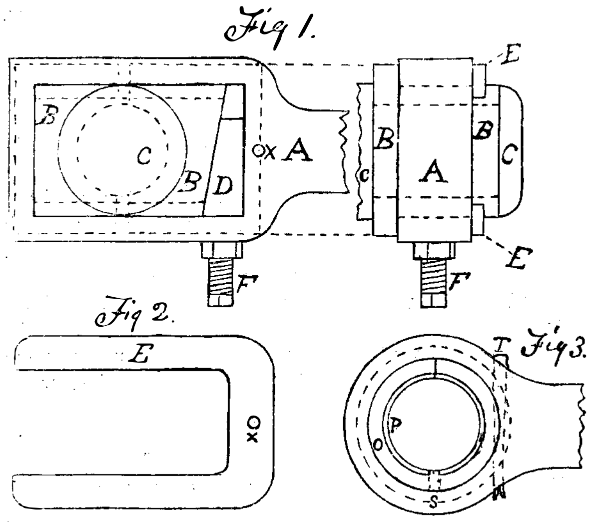


Fig. 3 shows a good substantial form for the ends of parallel rods; the outer ring, O, must be large enough to let the collar of the wrist pass easily through the eye in the rod; the ring, P, is simply a lining of hard composition, to take the wear of the wrist and to be renewed occasionally when worn out; the outer ring being secured by a taper pin, T, split at its lower end as shown. The inner ring is kept from turning by a dowel, S. The rings, being in halves, may be first placed upon the wrist, and then the rod slipped upon them, as explained above. F. G. WOODWARD.

Worcester, Mass.

Boiler Explosions.

To the Editor of the Scientific American:

It is very generally conceded by scientific and practical men that the most common, if not the sole cause of boiler explosions is the allowing the water to become so low that the boiler is overheated, and then while it is in this condition introducing a large amount of water, which, coming in contact with the highly heated iron, is almost instantly transformed into steam, thereby straining the boiler to the bursting point.

Attention should be directed to the other side of the question: the prevention of boiler explosions. Lack of water being the cause of explosions, it is self-evident that a sufficiency of that element would prevent them. The care of keeping up this supply of water rests upon the engineer in charge of the boiler; and engineers are, as a rule, men who have just sufficient education to feed their vanity. They are not educated men, but are a little better informed than their fellows. Their employers, almost invariably, place a large amount of confidence in them. This confidence, taken in connection with their limited education, leads them to feel a superiority to those with whom they come into contact. In many cases it is impossible to tell them anything, for they know all things, as they think, and their evidence is the fact of their employers asking their advice. If an explosion occurs, and you ask the engineer his opinion of the cause, he does not know, he has no theory; but one thing he is positive of: The boiler was full of water a few minutes before the catastrophe occurred; and here he is at variance with all scientific men and the public generally. Such are the men by whom boiler explosions are to be prevented.

The Government has made several attempts to suppress these calamities. On the rivers, it is necessary for all boats to carry a low-water alarm connected with each boiler; and this precaution has reduced the number of explosions to a considerable extent. On land, there has been established in several places a system of inspection. Scientific practical men, who thoroughly understand this business, are employed to examine all boilers, and, in case they prove good, to give certificates to that effect; if otherwise, to have them repaired. This system of inspection has been of great advantage, especially as a means of arriving at the true cause of explosions. It has proved that the bursting of a defective boiler will produce little or no damage; that it is the exploding, the tearing asunder of a sound, well-made boiler, that sends forth the terror and destruction. It has also proved that the inspection of a boiler will not prevent it from exploding, and that such a process will not prevent the engineer from allowing the water to become dangerously low in the boiler. Some other course will therefore have to be taken, and I suggest the use of automatic water regulators and low-water alarms. I will venture to say, that there are over fifteen thousand boilers in Pennsylvania alone, yet, without a doubt, not the one-tenth part of them are using either of these safety arrangements. This is not caused by the expense, for very few owners of boilers would complain against the expense of any thing to secure safety. A very significant fact is that the greater part of the safety arrangements in use in this State are in the oil regions, and this is because there, very frequently, the owners themselves have charge of the boilers. The difficulty is that you go to the proprietor to get permission to attach an alarm to his boiler, he will very likely, in fact almost always, direct you to the engineer, or he will consult that dignitary of himself in regard to it. Of course the engineer gives a decided refusal to have anything to do with it. He knows what the machine is for, and condemns it without an examination. He would not be carrying out human nature, if he did otherwise. You insult him; you wound his vanity, by proposing such a thing as putting up an apparatus to perform the work better than he has been doing it; a machine to give out an alarm and inform against him, when not tending to his duties. You imply a probability of the boiler exploding, which, he thinks, so long as he has charge of it, there is not the least possible danger of. He gives his opinion to the proprietor, and it is taken as correct. The engineer's excuse for disliking these appliances, is that they get out of order. If any one will examine them, and their principle, he will find that they are exceedingly simple, and there is no likelihood of their getting out of order.

Are we to be subjected to the dangers of these explosions and the terrible risk of life incurred on account of the ignorance and vanity of the men who have charge of the boilers? Is is not criminal to neglect any means for the prevention of such disasters? This is a question of public interest, and should be decided by the people, or their representatives. I should like to see something done in this direction, and I am certain that there are hundreds of others who would like to see the same. E. G. A.

Monticello, Pa.

The First Steamboat on the Mississippi.

To the Editor of the Scientific American:

Happening to stop at a bookstall in New York city some years ago, I picked up a tattered duodecimo volume entitled "The Navigator," printed for Cramer, Spear and Eichbaum, by Robert Ferguson & Co., of Pittsburgh, Pa., *anno* 1814. It purported to be "an accurate guide, containing directions for navigating the Monongahela, Alleghaney, Ohio, and Mississippi rivers, with an ample account of these much admired waters, from the head of the former to the mouth of the latter; and a concise description of their towns, villages, harbors, settlements, etc., with maps of the Ohio and Mississippi." The quaintness of the title, and a desire to see what was known at that day of the great Father of Waters, upon whose banks I was preparing to fix my home, induced me to invest a half dollar in the book.

"There is," says the author, or editor (whom I take to be Mr. Zadoc Cramer, as his name appears as the "proprietor of the enterprise,") "now on foot a new mode of navigating our western waters, particularly the Ohio and Mississippi rivers. This is with boats propelled by the power of steam. The plan has been carried into successful operation on the Hudson river, at New York, and on the Deleware, between Newcastle and Burlington. It has been stated that the boat on the Hudson goes at the rate of four miles an hour against wind and tide, on her route between New York and Albany, and frequently with 500 passengers on board. From these successful experiments, there can be but little doubt of the plan succeeding on our Western waters, and proving of immense advantage to the commerse of our country. A Mr. Roosewalt, a gentleman of enterprise, who is acting, it is said, in conjunction with Messrs. Fulton and Livingston of New York, has a boat of this kind now (1810) on the stocks at Pittsburgh, of 138 feet keel, calculated for 300 or 400 tons burthen. And there is one building at Frankfort, Kentucky, by citizens who will no doubt push the enterprise. It will be indeed a novel sight, and pleasing as novel, to see a huge boat working her way up the windings of the Ohio without the appearance of sail, oar, pole, or any manual labor about her—moving within the secrets of her own wonderful mechanism, and propelled by power undiscoverable."

Whether the citizens of Frankfort, Ky., ever "pushed their enterprise" to a successful completion, and sent their boat out to astonish the natives, is not related by our author;

but in a foot note to the edition of 1814, he says: "This steamboat (the one built by Roosewalt, in connection with Fulton and Livingston), called the New Orleans, was launched in March, 1811, descended the Ohio and Mississippi, and landed at Natchez in December, 1811, where she took in loading and passengers for the first time, and passed on to New Orleans, in which route she has been successfully employed ever since. Her accommodations are good and her passengers numerous—seldom less from Natches than from 10 to 20 at $18 per head; and when she starts from New Orleans, generally from 30 to 50, and sometimes as many as 80 passengers, at $25 each to Natchez."

The writer further states that the New Orleans had up to that time (1814) cleared over $20,000, over and above all expenses, the interest on the investment included! The cost of building is not stated; but the owners are said to have estimated the value of their "experiment" at $40,000. The writer of the note goes on to say: "The steamboat goes up in from seven to eight days from New Orleans to Natchez, and descends in two or three, stopping several times for freight and passengers. She stays at the extreme of her journey (New Orleans and Natchez), from four to five days, to discharge and take in loading. It is thought, however, by pushing her, she is capable and ought to make the trip every three weeks throughout the year, in which case her gains would be considerable more than stated; 3 weeks to each trip being 17 trips a year, four more than she performed last year."

In those days, Americans were nothing if not patriotic, and consequently we are not surprised at finding our author commenting thus upon the achievement: "When we reflect that England has had the use of steam power for upwards of one hundred years, and that it was left to Americans to apply its force to the propelling of boats against wind, tide, and the most powerful currents of our rivers, we cannot but rejoice and believe that America possesses that happy kind of superior genius, willing to embrace all the better parts of the old, and capacitated to invent new, principles."

There are other extracts that I might make which would astonish and instruct your readers. Captain Eads' plan of jetties is here proposed and urged by our author, years before Eads was born, as the only way to deepen the mouth of the river. In advance of the bulk of geologists, he boldly throws away the antiquated notions of the age of the world, and declares: "When I survey this immense work performed by the hand of Nature, I cannot accord with the views of the philosophers who are pleased to figure out the infantile state of our world. * * * On the contrary, we must grant it an incalculable antiquity!" Pretty well said for 1814! F. L. J.

Osceola, Ark.

Aeronautics.

To the Editor of the Scientific American:

Your comprehensive editorial article published under date of December 2, 1876, seems to embody the latest suggestions in regard to the subject of aeronautics. The substitution of a machine sustained by mechanical force, instead of by a buoyant gas, is a mark of progress, since a car sustained by gas is, from its large size, in proportion to its carrying capacity, necessarily unwieldy, and at the mercy of the element it is proposed to navigate. That a heavy body can be sustained by mechanical force is evidenced by the flight of birds. That a heavy body can be sustained by continual circular fan motion is evidenced by the toy tin fan, which, when a certain velocity is given it, overcomes the pressure of its weight, rises, and continues to rise as long as that circular motion is, through its own momentum, kept up; and could the velocity with which it starts be maintained by some power within itself, it would be clearly self-sustaining.

The results of the experiments of the Aeronautical Society of Great Britain, noticed in the above mentioned article, afford a very satisfactory starting point from which to calculate the amount of nominal horse-power required to raise and keep supported a certain number of pounds weight. These experiments show that a plane, whose surface measures one square foot, held at an angle of 15°, against a current of air having a velocity of twenty-five miles per hour, will sustain a weight of 1½ lbs., while the direct pressure, necessary to hold the plate against the current, is ⅓ of a lb.

Assuming the result to be sufficiently accurate for purposes of experiment, the number of lbs. weight a nominal horse-power will sustain can be readily calculated. A plane at rest, and a wind velocity of twenty-five miles per hour, is equivalent to forcing a plane against still air at a speed of twenty-five miles per hour. The horse-power required to maintain a pressure of ⅓ lb., at a speed of twenty-five miles per hour, would be equal to that number of lbs. (⅓), multiplied by the number of feet a minute which it moves (2,200), and the result divided by 33,000, which will give a result of 1/45 horse-power as the power required to sustain 1½ lbs., or 1/67.5 horse-power to the pound, which is one (1) nominal horse-power to every 67½ lbs., of weight sustained.

Twenty horse-power would sustain theoretically a weight of 1,350 lbs., but, practically, probably only about 1,000 lbs., and would require two fans each 33⅓ feet in diameter, moving at a speed of 35 revolutions a minute, which, with the faces at an angle 15°, would represent a wind velocity of twenty-five miles per hour. As a proof of the power required to drive two such fans at the speed named, we have only to reverse the process and call them wind wheels and calculate the power to be derived from them, with a wind velocity equal to that produced by their motion, twenty-five miles per hour, the result will be very close to twenty horse-power.

From these figures can be seen the enormous amount of power required to be developed by apparatus which must not weigh complete—with supplies for keeping up the power driver for managing the craft, and passengers or freight—a greater number of lbs. than 67½ lbs., (practically 50 lbs.) to every horse-power such apparatus is capable of developing and maintaining. This proportion of power to weight is largely in excess of that which can be produced by any motor at present manufactured, although the steam fire engine boiler comes nearest, for furnishing the most power with the least weight. Until a motor can be devised which shall cover the required demands aerial navigation will probably remain a practical impossibility, but, given these requirements, there is every reason to believe this seemingly difficult problem can be successfully solved. In the past twenty years manufacturers of steam engines and boilers have been, each year, getting more steaming capacity and power within less space and with less weight. It is not particularly visionary to suggest that it may be in the range of possibility to make such advances in future as have been made in the past and produce a motor which shall fulfil the requirements of aerial travel.

Meriden, Conn. CHARLES E. DAYTON.

A Renewal of the Lactometer War.

As a general rule, when learned doctors disagree, they fight out their differences in ponderous pamphlets and periodicals, and occasionally in the lecture room, among their compeers in learning. The general public rarely pays much attention to such warfare; first, because it believes that truth is mighty and will prevail; and secondly, because the subject matter of the controversy too often soars far above the average intellect. Recently, however, a great battle, wherein the public is materially interested, has been waged in a court room; and for several days two sets of learned chemists, armed with lactometers, retorts, flasks, and libraries of authorities, have each endeavored to impress one weary judge and twelve tired jurymen with the profundity of the ignorance of their respective opponents, and the accuracy of their own views.

The case was the People against Schrumpf. Schrumpf sold milk which the Board of Health's lactometer said was watered. Schrumpf was indicted, convicted, fined, and committed to durance vile for ten days. Such, we should explain, was the proceeding which cloaked the real case of Doremus against Lactometer, which was but a repetition of the conflict waged in the courts last spring, wherein the above much abused instrument came off, as it did this time, victorious. President Chandler appeared, as before, as champion of the lactometer, and his opinions were corroborated by many other of our most prominent chemists who have made milk an especial study. Dr. Doremus prosecuted the instrument as of old, and he also had a very respectable support.

We cannot spare space to review the enormous mass of conflicting evidence presented, nor shall we attempt to reconcile the faults or frauds alleged by one side to exist in the instruments of the other. The gist of the whole business is more easily stated. It is a fact, which we have often explained, that the specific gravity of milk may be lowered by adding either water or cream, and its density may be increased by removing the cream. Although cream is lighter than milk, it is heavier than water; and hence the addition of cream has much less effect than that of an equal amount of water; so that although the lactometer does not detect skimmed milk, it does detect the admixture of any considerable quantity of water. Now, after the most careful experiments, the Board of Health has placed the standard of pure milk at the lowest possible point, namely, specific gravity 1·029; in order that honest dealers may have every protection, and in milk of that specific gravity the lactometer is made to float at the 100° mark. If, therefore, a greater density is shown, then the milk may have been skimmed or slightly watered; if a less density is exhibited, then either water or cream has been added; and it becomes a question of probability, which no one will think much over before deciding, whether the dealer has added water or cream. The lactometer, therefore, does not and is not claimed to decide the actual value of the milk, but it does serve to indicate any considerable amount of dilution; and this view, in which the best experts agree, is now reinforced by opinions of intelligent parties. The lactometer will therefore continue to be, as it has been all along in this city, a terror to dishonest milkmen and a valuable safeguard for the community.

Enamels for Culinary Vessels.

For enamelling cast and wrought iron vessels, the following is the method and materials most generally employed: 100 lbs. calcined and ground flints, and 50 lbs. borax, calcined and finely ground, are intimately mixed, fused, and gradually cooled. Of this 40 lbs. are mixed with 5 lbs. of potter's clay, and ground in water to a pasty mass. The vessel, first thoroughly cleansed by means of very dilute sulphuric acid and scouring with sand, is lined with a coating of this about ⅙ of an inch thick, and left for it to harden in a warm room. A new coating is next added, prepared from 125 lbs. of white glass, free from lead; 25 lbs. borax; 20 lbs. soda in crystals, which have been pulverized and fused together; ground, cooled in water, and dried. To 45 lbs. of this, 1 lb. of soda is added, the whole mixed in hot water, dried and finely powdered. A portion of this is sifted over the other coating while it is still moist, and the vessel is then dried in an oven at the temperature of boiling water, (212° Fah.) The vessel is then heated in a stove or muffler till the glaze appears. It is then taken out and more glaze powder is dusted on the glazed surface already in fusion. This enamel resists perfectly the action of dilute mineral and vegetable acids and alkalies, and does not crack or scale off from the metal.

In Germany and France the following process has lately came into use—more especially for enamelling copper culinary vessels: 12 parts (by weight) white flor spar; 12 parts gypsum, and 1 part borax, are finely powdered, ground together and fused perfectly in a crucible; when cold, this mass is again carefully ground to powder, made into a uniform paste with water, laid upon the clean metallic surfaces, dried and fused. This also gives a beautiful alabaster surface for ornamental purposes.

Moses Refuted.

The subjoined ludicrous production, from the New York *Times*, is one of the best burlesques on the "scientific method" that have come under our notice. The hit at geologists who construct elaborate theories on exceedingly frail suppositions might well be extended to some learned professors in other branches of science, who have reared wonderful but unsubstantial fabrics of apparent fact solely from the "scientific (?) uses of their imaginations."

"A new and violent blow has just been struck at the Mosaic account of creation by the discovery of an extremely important fossil in a coffee sack at Baltimore. In the center of this sack was found the skull of a monkey. There can be no doubt as to the facts. The coffee was of the variety called Rio, and the skull was perfectly preserved. Let us dwell for a little upon the meaning of this discovery as interpreted by the principles of geology. The coffee sack was 12 (say 12½) inches in diameter, and 4 feet in height. The skull, which lay in the middle of it, was therefore 2 feet below the surface. To suppose that it was violently forced into the sack, after the latter was full, would be eminently unscientific. No one imagines that the fossil birds of the Old Red Sandstone dug down into that locality through the superincumbent strata. Nothing is more universally conceded than that fossils are always found where they belong. The animals whose remains we find in the rocks of the paleozoic, the meso-Gothic, and the Syro-Phœnician strata, belong, respectively, to those several systems. The fossil monkey skull was, therefore, deposited in the coffee sack when the latter was half full, and the 2 feet of coffee which rested upon it was a subsequent deposit. Now, it follows from this premise that monkeys existed during the early part of the Rio coffee period. It is the opinion of most geologists that the Rio coffee period succeeded the tertiary period, and immediately preceded the present period. Now, no tertiary monkeys have yet been found; but the Baltimore discovery shows that monkeys existed as early as the middle of the Rio coffee period, a date far earlier than any which has hitherto been assigned to them.

"We are now in a position to inquire what is the least period of time which must have elapsed since the skull of the Baltimore monkey was the property of a live and active simian. The answer to this question must be sought by ascertaining the rate at which coffee is deposited. It is the opinion of Mr. Huxley, based upon a long and careful examination of over three hundred garbage boxes, that coffee is deposited in a ground condition at the rate of an inch in a thousand centuries, but the deposition of unground coffee is almost infinitely slower. He has placed bags, coffee-mills, and other receptacles in secluded places, and left them for months at a time, without finding the slightest traces of coffee in them. Although Huxley does not hazard a guess at the rate of deposition of unground Rio coffee, Professor Tyndall does not hesitate to say that it is at least as slow as the rate of deposition of tomato cans. Let us suppose, as we are abundantly justified in doing, that 30,000,000 of years would be required to bring about the deposition of a stratum of tomato cans one foot thick all over the surface of the globe, an equally long period must certainly have elapsed while a foot of underground coffee was accumulating over the skull of the Baltimore monkey. We thus ascertain that the monkey in question yielded up his particular variety of ghosts and became a fossil fully 30,000,000 of years ago. Probably even this enormous period of time is much less than the actual period which has elapsed since that monkey's decease; and we may consider ourselves safe in assigning to his skull the age of 50,000,000 years, besides a few odd months.

"In the light of this amazing revelation, what becomes of Moses and his 6,000 years? It will hardly escape notice that he nowhere mentions Rio coffee. Obviously, this omission is due to the fact that he knew nothing of it. But if he was unacquainted with one of the most recent formations, how can we suppose that he knew anything about the elder rocks—the metamorphic and stereoscopic stratas? And yet it is this man, ignorant of the plainest facts of geology, and of its very simplest strata, who boldly assumes to tell us all about the creation!"

A Sinister Result of the Centennial.

While it is much more agreeable to believe that our Centennial Exposition has been attended with none but beneficial results, the fact cannot be ignored that one unfortunate consequence is just now strongly obtruding itself. To the unsettled state of politics is undoubtedly owing the check which all have remarked in the rapid recovery of business from the stagnation of the past three years; but to that cause alone cannot be laid the unusual financial stringency which prevails at the present time, most especially in agricultural districts. Reports from many sections of the country state that failures to meet obligations, among the farmers, were never so frequent; while business with that usually thrifty class of the population has rarely been more dull. It looks very much as if the people, possibly relying on the favorable indications (which appeared during the summer) of a brisk fall and winter trade, had invested their savings in Centennial excursions, and now find themselves compelled to retrench, or, in many cases, driven to the worse result of failing in their payments. There is one consolation in the fact that the money has not gone out of the country; and although the movement may remain sluggish till the new Administration is settled upon, a general revival of business will undoubtedly come in the spring.

Stearin from Fats.

Much attention has been attracted by our recent articles on the manufacture of artificial butter, and many of our correspondents have experimented on the separation of the constituents of fatty matters. The entire separation of the stearin from the fats is, however, a difficulty with some of them, and for their benefit, and that of others, we will give descriptions of the several methods in use.

The first is the saponification of the neutral fat with lime-water and steam, or with aluminate of soda, sold under the name of *natrona* or refined saponifier. Another method is by treatment with dilute and strong sulphuric acid and steam, at a high temperature. The third method is by chloride of zinc, and by dry decomposition and distillation with superheated steam alone. Perhaps the process most commonly employed on a small scale is that of the saponification with lime or aluminate of soda. Heat (in a large, lead-lined wooden vat or tub) the fat and water in the proportion of about 10 lbs. fat to 2 gallons water, by means of steam circulating through a coil of leaden pipes in the bottom of the vat. When all the tallow is melted, add 1¼ gallons lime water containing 1¼ lbs. of lime (about 14 per cent. of the weight of tallow). Heat constantly nearly to the boiling point, with constant stirring, for from 6 to 8 hours. Run off the yellow glycerin solution, add 1¾ gallons dilute sulphuric acid at 12° Baumé (=1.086 specific gravity, containing 30 per cent. of sulphuric acid, H_2SO_4) to the lime soap; stir, and heat as before until the reaction is complete, shut off steam, let the whole stand to settle, draw off the fatty acids from the top into similar smaller vats, add diluted sulphuric acid and heat, draw off the fatty acids, and wash repeatedly with hot water. The quantity of fatty acids obtainable from 100 lbs. good tallow are about 94.8 lbs. The average of solid fatty acids is about 45.9 per cent.

Let the washed acids stand for some time in a fused state to eliminate all mechanically adhering water, then allow to solidify by cooling. Press out the liquid oleic acid in an hydraulic press; then put the cake in a more powerful press, and subject to pressure again; after this, it is pressed again, as before, but between warm plates. It is then fused, cast in large porcelain-lined iron moulds, of about 5 lbs. capacity each, and set by to crystallize. This is accomplished in 12 hours in winter; but in summer it requires twice the time. The crystallized cakes are placed in bags of horsehair, between plates of iron or zinc, in a hydraulic press capable of exerting immense pressure. The cakes are once more subjected to pressure in a press placed horizontally, the plates inclosing the cake being heated in this case by steam; this removes the last trace of oleic acid. The stearic acid is then melted together with dilute oil of vitriol (3° Baumé, 1.02 specific gravity), washed with water containing oxalic acid, and cast into slabs for the candle maker.

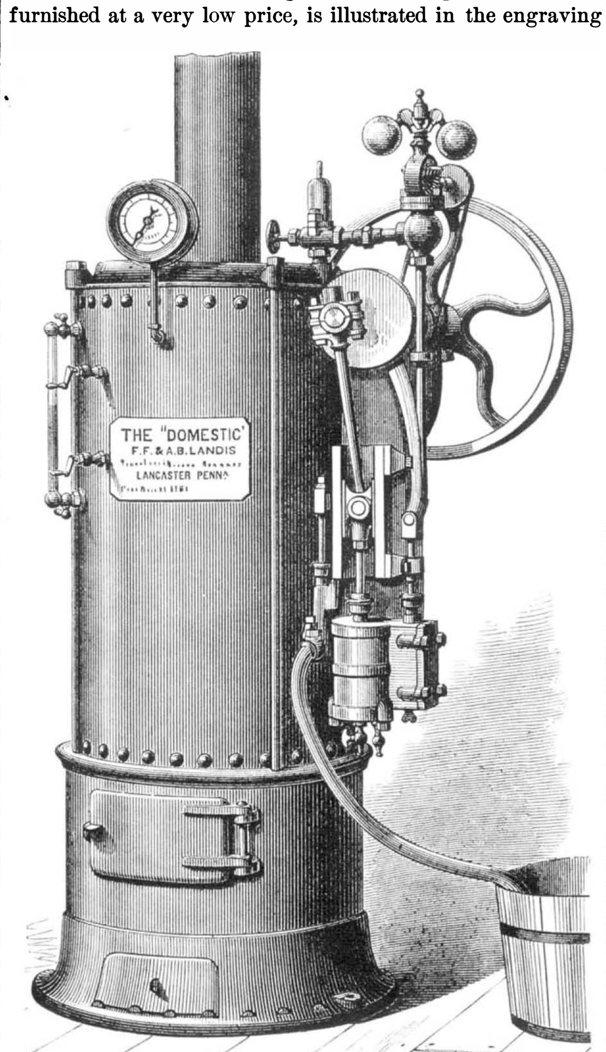
THE TANITE COMPANY'S NEW PLANER KNIFE AND STOVE PLATE GRINDERS.

The Tanite Company's "Automatic Planer Knife Grinder," illustrated in Fig. 1, is made in three sizes: No. 1 for 24 inch, No. 2 for 36 inch, and No. 3 for 48 inch knives. This company claims to be the first to conceive and bring into use the cup wheel, by which the unequal concave grinding, caused by the wear of wheel when used on its face or edge, is avoided. In this machine, the knife is ground with a straight bevel with no change until the wheel is worn out. This apparatus stands about 2 feet 11 inches high to top of wheel, and is 3 feet wide, No. 1 being 3 feet 3 inches, and No. 3, 5 feet 8 inches, long. It has a 1¼ inches steel arbor fitted with self-oiling boxes, with 3½ inches bearings; and it runs, we are informed, perfectly steadily when the wheel is making 1,500 revolutions per minute. It grinds smoothly, leaving no chatter marks upon the knife. Owing to their peculiar process of manufacture, the Tanite Company are enabled to furnish wheels that cut rapidly and with a very small degree of heat. The stove plate machine, which is represented in Fig. 2 is designed to meet the needs of stove manufacturers. It weighs about 720 lbs. The top of table, when horizontal, is 2 feet 9 inches from floor, and in area measures 24½ by 41½ inches; the front end of table can be elevated by means of a hand wheel and screw, so as to obtain, in combination with a cone wheel, any desired angle. The arbor is made of 1¾ inches steel, and has two bearings, one 6 inches, the other 8¼ inches, long; and by means of the rack, pinion, and lever, it can be raised 6 inches if desired. The overhead work is very complete, the hangers having adjustable self-oiling boxes.

Both of these machines are of excellent workmanship, and of strong and durable material. For further particulars address the Tanite Company, Stroudsburg, Pa.

THE DOMESTIC STEAM ENGINE.

A new domestic steam engine of 3 horse-power, which is furnished at a very low price, is illustrated in the engraving



herewith given. In construction, this machine embodies many advantageous features. The bed, cylinder, steam-chest, both crank shaft bearings, and the guide lug are all cast in a single piece. The bed is oval in form and hollow, and the portion on which the cylinder is made serves as a feed water heater, wherein the exhaust steam is utilized. In order to protect the crank bearings from heating, due to their proximity to the boiler, they are made of the best Babbitt metal; and a chamber is provided beneath them into which the cold feed water is forced prior to its entering the heater. The chamber also tends to keep the other parts of the engine (except the cylinder, steam chest and heater, which should of course be as hot as possible) in a cool state. The crosshead, connecting rod, eccentric strap, and rod are constructed of cast steel. The crank shaft is of cold rolled iron; the pump barrel, stuffing box, valves, and chambers are of brass, and are disposed so that easy access to the packing may be had. The valves may be reached for repacking and adjustment by slacking one set screw without removing any of the pipes. The tops of the stuffing boxes are cupped so as to prevent water and oil running down over the engine. The piston is a solid casting; and in two grooves in its face are sprung metal rings, turned eccentrically, and larger than the cylinder. This is claimed to form an excellent self-adjusting packing. Lastly, the necessary drain cocks and an efficient governor are provided.

The cylinder diameter is 3 inches; stroke, 4 inches; diameter of fly wheel, 18 inches; and weight, 65 to 70 lbs. At 260 revolutions per minute, and under a pressure of about 100 lbs. of steam, the engine develops (per dynamometer) a little over 3 horse power. It is sold as of 1½ to 2 horse power, with a working speed of 300 revolutions. It may be attached to the boiler by bolts, or to a separate post.

The boiler has a cast iron base, forming fire box and ash pit. There is a fire brick lining which, it is claimed, on becoming heated tends to consume the gas generated. Holes through the smoke bonnet above the tubes are provided, so that the latter can be cleaned without removing the bonnet. Above the bonnet is a circular plate with corresponding apertures, which are, all but one, smaller than those through the smoke bonnet. By turning the plate so that the one large hole is successively brought over the tubes, the latter may be cleaned one at a time. The small holes serve as a damper, admitting cold air into the stack, and so checking the draft, and thus avoiding the necessity of opening the fire door. The boiler has all necessary attachments, and all parts of the engine are duplicated, so that they may be easily replaced.

For further information address the manufacturers, Messrs. F. F. & A. B. Landis, Lancaster, Pa.

Distance Indicator.

This improvement is by Captain Henry Watkin, R. A., being a hydro-clinometer designed for use in coast batteries, having a height of 90 feet and upwards above the sea level. It consists of a piece of wood about 2 feet 6 inches long, 3 inches deep and 1 inch thick. Imbedded in one side is a tube containing colored spirit, there being above the tube a scale graduated for yards. A small telescope is fixed at the top of the instrument at one end, the telescope having cross hairs similar to those in a theodolite. In using the instrument, the end furthest from the observer rests on the top of the box in which it is carried, the end next the observer, and which carries the telescope, being elevated by means of an adjustable brass arm or support. In taking a range all that is necessary is to sight the object and bring the cross hairs to cut the water line. The exact range is then ascertained by reading the figures on the scale at the level of the spirit, which gives it without any calculation whatever. The time required for the operation is about eight seconds, after which the object, if moving, can be continuously followed. After full trial, both at home and abroad, this instrument has been sealed for adoption in the British service.

Fig 1

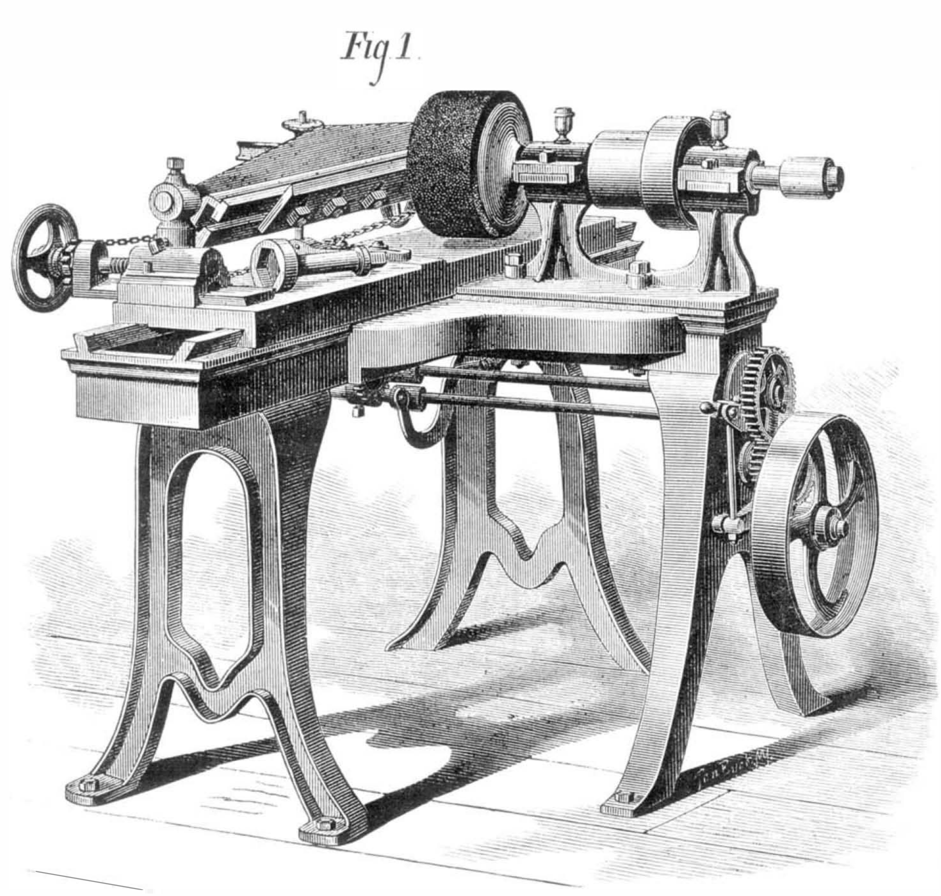
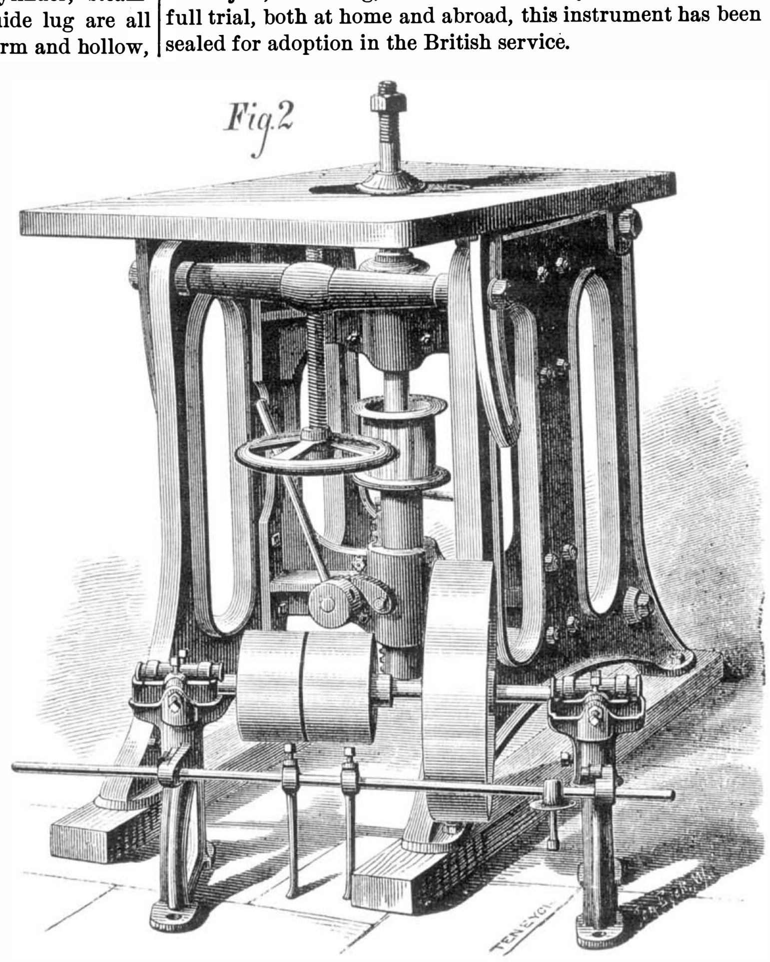


Fig 2



THE TANITE COMPANY'S PLANER KNIFE AND STOVE PLATE GRINDERS

THE HARE AND HER FOES.

Mr. Wolf has represented in the admirable picture (which we select from his work entitled "The Life and Habits of Wild Animals,") a touching episode in the life of one of the most graceful and harmless creatures in the whole list of Nature's works. The hare (*lepus timidus* of Linnæus) has in all ages been a chosen type of speed and timidity; and from the time of the Roman empire till now, the chasing of hares has been a favorite sport. In the pursuit of these creatures, as generally practised now, called coursing, grayhounds are employed, the dogs being matched against each other in couples, and held by their collars to a catch at the end of a leathern strap. When a hare is found, and leaves her form in the grass where she prefers to make her home, after she has started some distance, the dogs are released simultaneously; and away they go with lightning speed, the devotees of the sport riding after them to enjoy the chase, and to see which favorite dog catches the hare. The pursued creature is overmatched in speed, strength and endurance; but she frequently gives the best grayhounds a long run, as she doubles with remarkable facility, turning back on her course so suddenly as to run between the dogs, who shoot far beyond her, being unable to come to a sudden stop. Hares are also hunted in the usual way, with harriers, hounds of a breed possessing speed and keenness of scent.

The eyes of the hare are large and prominent, and its vision extends in all directions at once; its senses of hearing and smell are very acute. Hares generally remain quiet during the day in the form or seat, as it is called, which is generally a depression in the ground in a meadow. In the evening they chase each other and gambol over the fields, and manage to get food enough for the day's support; and the neutral color of the animals so closely resembles that of the soil that they readily escape observation after sunset.

The hare shown in our illustration has been wounded in the foot, perhaps by a stray pellet from a sportsman's gun; and unable to proceed farther, she crouches under a leafless bush. But the whiteness of the snow soon reveals her whereabouts to the pursuing crows; and a few of these strong *omnivora* will soon peck the poor creature to death. The crows depicted are of the hooded variety (*corvus cornix*, Linnæus); they have black heads, forenecks, wings, and tails, with purplish blue and green reflections; the rest of the plumage is ash gray in color, tinged with purple. This crow occurs in all parts of Europe, being common in the north of Scotland; its favorite food is fish and molluscs; and when unable to break the shells of the latter with its beak, it will carry them to a great height and drop them on a rocky spot. Its ordinary flight is slow and regular, and its gait upon the ground remarkably sedate and dignified.

HUNTED DOWN.

Simple Apparatus only Necessary.

We hear so much nowadays about the elaborate outfits of scientific apparatus, wherewith this or that college is provided, while so many ingenious devices, with names ending in "graph," "scope," and "meter," are constantly being invented, that we are half inclined to think that more attention is being paid to the tools than to the work which they are designed to accomplish. Apparatus may be divided into two classes; first, that used for purposes of investigation; and second, that employed to demonstrate the laws of science or the results of investigations to others. In either case, the simpler the tools the better; for in the one the investigator wishes little to hamper him in his pathway toward the result he searches for, and in the other the idea is to impress principles on the mind, and not to burden it with unnecessary details.

The student of the lives of the great inventors and discoverers will find that they almost always preferred the most primitive devices for working out their ideas, and for illustrating their meaning in giving explanations. Faraday's first electrical experiments were conducted on a machine which he himself made with a glass phial; and his lectures to children were models of extemporaneous speaking, illustrated by experiments, made with the simplest materials. His discourses on a candle are admirable disquisitions on heat and combustion. Tyndall, from a piece of ice, evolves a wonderful story. The late Professor Graham offered in himself a still more striking example of how genius of the right sort can work with the very simplest means. A recent biographer says that, "with a glass tube and plug of plaster of Paris, Graham discovered and verified the law of diffusion of gases. With a tobacco pipe, he proved indisputably that air is a mechanical mixture of its constituent gases. With a tambourine and a basin of water, he divided bodies into crystalloids and colloids, and obtained rock crystal and red oxide of iron soluble in water. With a child's India rubber balloon filled with carbonic acid, he separated oxygen from atmospheric air, and established points the importance of which, from a physiological point of view, it is impossible to overrate. And finally, by the expansion of a palladium wire, he did much to prove that hydrogen is a white metal."

Pressing Cotton in Vessels.

A new system has been recently adopted in this city by shippers of cotton which is said to prove thus far successful. The cotton is first pressed in a compressing machine, and bound with iron bands, as is usual with all cotton cargoes. The bales are then put into the ship, side by side, and pressed longitudinally into their places by a patent hydraulic machine. They thus get a pressure both ways, and it is this second pressure that makes the saving of room. The entire cotton cargo thus forms a compact mass in the hold, and its weight is proportionately so much greater than ordinary cotton cargoes that the necessity for ballasting the ship is obviated. It is claimed that about one-fourth more cotton can be packed in vessels' holds by this means than formerly.

Ingenious Advertising.

Visitors to the Centennial will doubtless remember that one of the sewing machine exhibitors in Machinery Hall, whose display occupied a very prominent position on a principal aisle, kept posted, during the continuance of the Exposition, a large sign, inviting all comers, and especially those who owned sewing machines, to inscribe their names in a handsome register. The inducement offered was that, after the close of the Exhibition an elegant sewing machine would be presented to some one of the signers, and all would have equal chances in drawing for the prize. Of course the effect of this was to attract hundreds of people toward this particular exhibitor's display; and thus his goods were brought into especial prominence. But that was merely a secondary object. A very large percentage of those who stopped to read the sign wrote their names, and told the kind of sewing machine they were using. Then a neat certificate was presented in return, which established the signer's claim to one share in the drawing. In this way thousands—perhaps tens of thousands—of names of sewing machine users were obtained. We always found a crowd about the book, often large enough to partially block the passage.

Now that the Centennial is over, the shrewd sewing machine concern is reaping its rich reward, and at the same time is firing hot shot into its competitors. To every individual on that register circulars are sent in which each person is informed that No. 20,561 drew the prize, and that the fair winner is of course "delighted with her good fortune." Then the reader is told that to him or her, and to all other signers on the book, and to them only (there is an air of severe justice and unrelenting discrimination about this), the so-and-so machine will be sold at half price, and in addition the purchaser will be presented with a "Centennial souvenir," in the shape of a set of lithographed figures of the buildings. He is also advised: "If you have an old machine, it will be to your advantage to sell it now, and get the so-and-so." Of course, the recipient of this wise counsel is impressed with the inestimable advantages, which are his merely through his fortunately happening to sign his name during his Centennial visit.

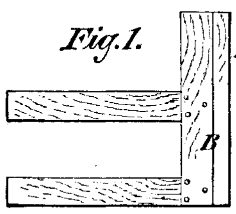
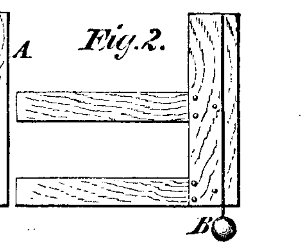
There is a furniture dealer somewhere out West to whom it would be unfair not to give credit while on this subject of ingenious advertising. He issues circulars to all the church sextons, requesting them to send to him, just as soon as they learn of a marriage, the names of the happy pair. On receipt of this information, the agents of the furniture man are hurled upon the innocent and defenceless couple; and on sales being effected a neat percentage goes to the sexton. The same enterprising person prints business cards across marriage licenses, and furnishes them to town clerks; and among the names of other household furniture, the words "cradles" and "children's chairs" are prominently displayed. Some years ago, there was (and probably still is) a custom in some New England towns of tombstone agents appearing at the house of mourning within a few hours after a funeral; and they would, tearfully and in a sympathetic manner, solicit an order for a memorial marble to the "dear departed." While some of the above-described methods of increasing business are perhaps objectionable, they lack the promptitude and persistency of the lightning rod man, who starts when the storm commences, and pervades the whole town before the clouds have dispersed.

A NEW plan for protecting safes is to enclose them in wire netting, so connected with a battery and bell that the division of any portion of the wire ruptures a circuit, and the bell gives the alarm.

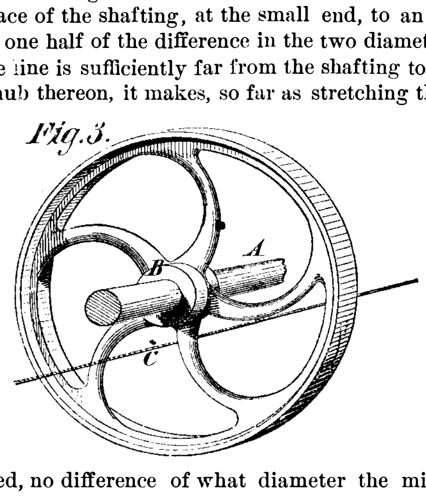
HOW TO ADJUST LINE SHAFTING.

A correspondent asks us for some accurate method of lining shafting, and says that for want of knowledge upon the subject, his shafting runs out of true; and as results, the belts have an unequal tension upon them, the bearing boxes get heated, and the couplings get loose, giving him constant trouble. As we have from time to time received a number of similar communications, we give the following information upon the matter.

There are several methods of lining line shafting, and some of them are found to be decidedly defective in practice. One of the most common of these is that of hanging plumb lines over the shaft, and then streching a line, parallel with the line shaft, but near the floor, and then adjusting the line shaft until the plumb lines are all equidistant from, or have precise and equal contact with, the stretched line, thus accomplishing the horizontal adjustment. This is a crude and troublesome operation for several reasons, among which may be mentioned the fact that it is difficult to measure between such lines when they are long, and that, as the line shaft is moved during adjustment, the plumb lines sway about, involving the necessity of some one to steady them. They are furthermore in the way; and the contact by swaying of a single one with the stretched line interferes with the whole operation. For the vertical adjustment a spirit level alone

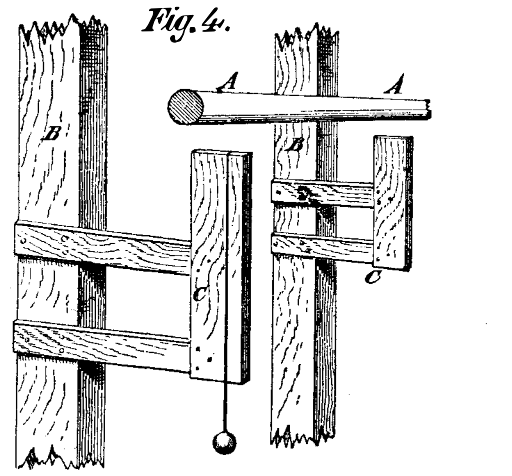
is sometimes employed; and this is objectionable for the reasons, among others, that there is nothing to guide the operator as to whether the part he begins at, and which we will suppose requires to be adjusted, should be lifted at the one end or lowered at the other, in order to make an adjustment suitable to the general line of the shafts. He may it is true first test the whole line of shaft, and make a note of the result arrived at at each testing place, using the notes as a guide to the readiest method of adjustment. It is better, however, in every respect, to adopt the plan here recommended, which is as follows: First prepare a number of rude wooden frames, such as are shown in Fig. 1. They are called targets, and are pieces of wood nailed together, with the outer edge face, A, planed true, and having a line marked parallel with the planed edge and about ¾ inch inside of it. This is intended for use as a guide, in conjunction with the plumb line shown in Fig. 2, attached at B. The next proceeding is to stretch a line parallel with, but vertically below the line of shafting, sufficiently to clear the largest hub upon any of the pulleys on the line of shafting, as shown in Fig. 3, in which A, represents the shafting, B the largest pulley hub, and C the stretched line. In adjusting this line, we have, however, the following considerations: If the whole line of shafting is parallel in diameter, we set the line equidistant from the shafting at each end. If one end of the shafting is of larger diameter, we set the line further from the surface of the shafting, at the small end, to an amount equal to one half of the difference in the two diameters; and since the line is sufficiently far from the shafting to clear the largest hub thereon, it makes, so far as stretching the line is



concerned, no difference of what diameter the middle sections of shafting may be. The line should, however, be set true as indicated by a spirit level.

We may now proceed to erect the targets as follows: The planed edge, A, in Fig. 1, is brought true with the stretched line and is adjusted so that the plumb line, B, in Fig. 2, will stand true with the line or mark, B, in Fig. 1. When so adjusted, the target is nailed to the post carrying the shafting hanger. In performing this nailing, two nails may be slightly inserted so as to sustain the target, and the adjustment being made by tapping the target with the hammer, the nails may be driven home, the operator taking care that driving the nails does not alter the adjustment. In Fig. 4, A A represents the line of shafting, B B, two of the hanger posts, and C C, two of the adjusted targets.

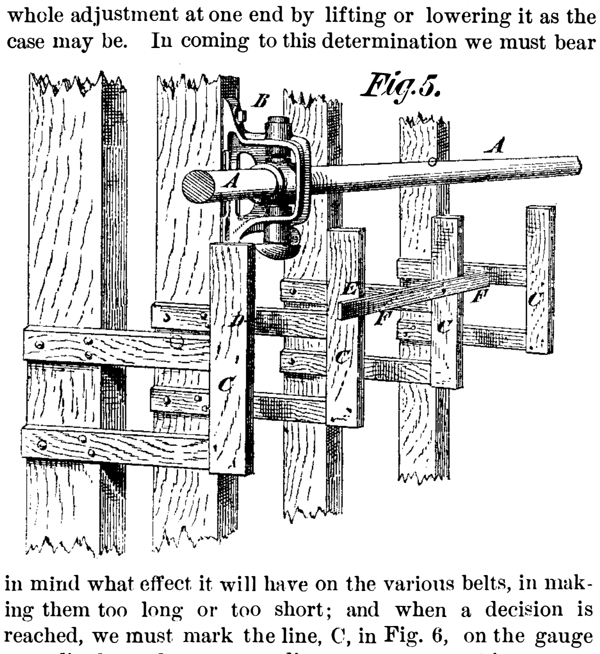
Having adjusted and fixed in the manner above described a target to each of the posts supporting a shafting hanger, we may remove the horizontal stretched line, and take a wooden straight edge long enough to reach from one post to another. Then beginning at one end of the shafting, we place the flat side of the straight edge against the planed edge of two targets at a distance of about 15 inches below the top of shafting; and after leveling the straight edge with a spirit level, we mark (even with the edge of the straight edge) a line on the planed edge of each target; and we then move the straight edge to the next pair of targets, and place edge even with the mark already made on the second target. We then level the straight edge with a spirit level, and mark a line on the third target, combining until we have marked a straight and horizontally level line across all the targets, the operation being shown in Fig. 5, in which A A represents the line of shafting, B B, the hangers, and C C, the targets. D represents the line on the first target, and E, the line on second. F is the straight edge, levelled ready to form a guide whereby the line, D, or target, may be carried forward, level and straight, to target 3, and so on across all the targets. The line thus marked is the standard whereby the shafting is to be adjusted vertically; and for the purpose of this adjustment, we must take a piece of wood or a square such as is shown in Fig. 6, the edges, A and B, being true and at a right angle to each other. The line D, in Fig. 5, marked across the targets being 15 inches below the center line of the shaft at the end from which it was started, we make a mark upon our piece of wood the line C, in Fig. 6, 15 inches from the edge, A (as denoted by the dotted line in Fig. 6); and it is evident that we have only to adjust our shaft for vertical



height so that, the gauge (shown in Fig. 6) being applied as shown in Fig. 7, the shaft will be set exactly true, when the mark, C, on the piece of wood comes exactly fair with the lines, D, marked on the targets.

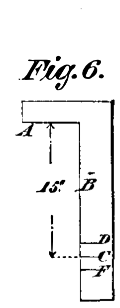
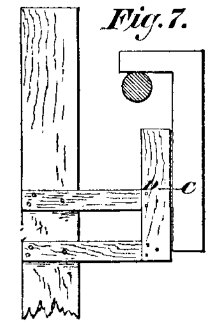
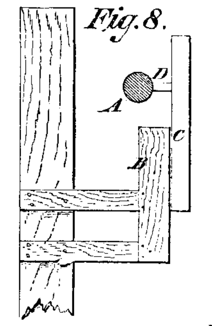
For horizontal adjustment, all we have to do is to place a straight edge along the planed face of the target, and adjust the shaft equidistant from the straight edge, as shown in Fig. 8, in which A is the shaft, B the target, C the straight edge referred to, and D a gauge. If, then, we apply the straight edge and wood gauge at every target, and make the above described adjustment, the whole line of shafting will be set level and true.

There are several points, however, during the latter part of the process at which consideration is required. Thus, after the horizontal line, marked on the targets by the straight edge and used for the vertical adjustment, has been struck on all the targets, the distance from the center of the shafting to that line should be measured at each end of the shafting; and if it is found to be equal, we may proceed with the adjustment; but if, on the other hand, it is not found to be equal, we must determine whether it will be well to lift one end of the shaft and lower the other, or make the whole adjustment at one end by lifting or lowering it as the case may be. In coming to this determination we must bear



in mind what effect it will have on the various belts, in making them too long or too short; and when a decision is reached, we must mark the line, C, in Fig. 6, on the gauge accordingly, and not at the distance represented in our example by the 15 inches.

The method of adjustment thus pursued possesses the advantage that it shows how much the whole line of shafting is out of true before any adjustment is made and that without entailing any great trouble in ascertaining it; so that, in making the adjustment, the operator acts intelligently and does not commence at one end utterly ignorant of where the adjustment is going to lead him to when he arrives at the other. Then, again, it is a very correct method, nor does it make any difference if the shafting has sections of different diameters or not; for in that case, we have but to measure the diameter of the shafting, and mark the adjusting line, represented in our example by C, in Fig. 6, accordingly, and when the adjustment is completed, the center line of the whole length of the line of shafting will be true and level. This is not necessarily the case, if the diameter of the shafting varies and a spirit level if used directly upon the shafting itself. In further explanation, however, it may be well to illustrate the method of applying the gauge shown in Fig. 6, and the straight edge, C, and gauge, D, shown in Fig. 8, in cases where there are in the same line sections of shafting of different diameters. Suppose, then, that the line of shafting in our example has a mid section of 2¼ inches diameter, and is 2 inches at one, and 2½ inches in diameter at the other end. All we have to do is to mark on the guage, shown in Fig. 6, two extra lines, denoted in Fig. 6 by D and E. If the line, C, was at the proper distance from A, for the section of 2¼ diameter, then the line, D, will be at the proper distance for the section of 2 inches, and E at the proper distance for the section of 2½ inches diameter: the distance between C and D,

and also between C and E, being ⅛ inch, in other words, hale the amount of the difference in diameters. In like manner for the horizontal adjustment, the gauge piece shown at D in Fig. 8, would require when measuring the 2¼ inches section, to be ⅛ inch shorter than for the 2 inches section, while for the 2½ inches section would require to be ⅛ inch shorter than that used for the 2¼ inches section, the difference again being one half the amount of the variation in the respective diameters. Thus the whole process is simple, easy of accomplishment, and very accurate.

If the line of shafting is suspended from the posts of a ceiling instead of from uprights, the method of procedure is the same, the forms of the targets being varied to suit the conditions. The process only requires that the faced edges of the targets shall all stand plumb and true with the stretched line. It will be noted that the plumb lines (shown on the target in Fig. 2, at B) are provided simply as guides whereby to set the targets, and are put at about ¾ inch inside of the planed edge so as to be out of the way of the stretched line. It is of no consequence how long the stretched line is since its sag does not in any manner disturb the correct adjustment

Bewitched Engineers.

It is luckily not often that we learn of such an exhibition of silly superstition as the performance of one Latimer has lately evoked from the Civil Engineers' Club of the Northwest, in Chicago. Latimer is not an every-day seventh son of a seventh son, born under an eclipse, who restores lost articles and predicts marriages (with photograph of future spouse), and who invites you to send one dollar and a lock of your hair—ladies half price. He is a specialist in the business, and devotes himself exclusively to the divining rod branch. The club recently had a collective interview with him. After working himself into a proper clairvoyant state, he lucidly explained that "from every substance in nature, there are thrown out emanations at an angle of 45°, and that according to the affinity between such emanations and a substance on the rod, so will the latter be more or less influenced." With a perspicuity unusual in oracular utterances, he added that "the moving force is magnetism;" and that when he insulates himself, there is no movement in the rod.

So vastly was the club impressed with the superhuman information it had received (doubtless free, in consideration of the advertising of the *séance* in the club's organ, the Chicago *Engineering News*, whence we quote *verbatim*) that the members "became so absorbed in the fascinating occupation of wandering gravely about the room with forked twigs in their hands, sometimes advancing, and sometimes retreating; but always with eyes closely fixed on the mysterious rod which each clutched with all the strength of his fingers, that a formal adjournment was forgotten, and the meeting finally broke up as train time approached. A committee, however, was appointed to arrange for a series of complete tests by which the most skeptical might be convinced that a new and valuable scientific fact awaited only investigation to become recognized and utilized."

There is evidently a good opening for sane civil engineers in Chicago.

A Toad-Eating Fly.

Nature, among those occasional odd freaks wherein she seems to overturn her own laws, often reverses in the strangest manner the conditions of destroyer and prey. Toads, it is well known, live on insects, and for this reason are valuable aids to gardeners and farmers in protecting their crops. Lately there has been discovered an insect which lives on toads, and which afflicts those reptiles in a way that suggests the concentrated revenge of the whole insect class. It deposits its eggs on the eyes of the toads; and the *larvæ*, in the form of minute white worms, devour not only these organs, but the nose end jaws of the unfortunate batrachian. Curiously enough, the toads do not seem to suffer, but continue their usual habits apparently undisturbed. The name *lucilia bufonivora* has been given the fly.

THE LOUISVILLE WATER WORKS.

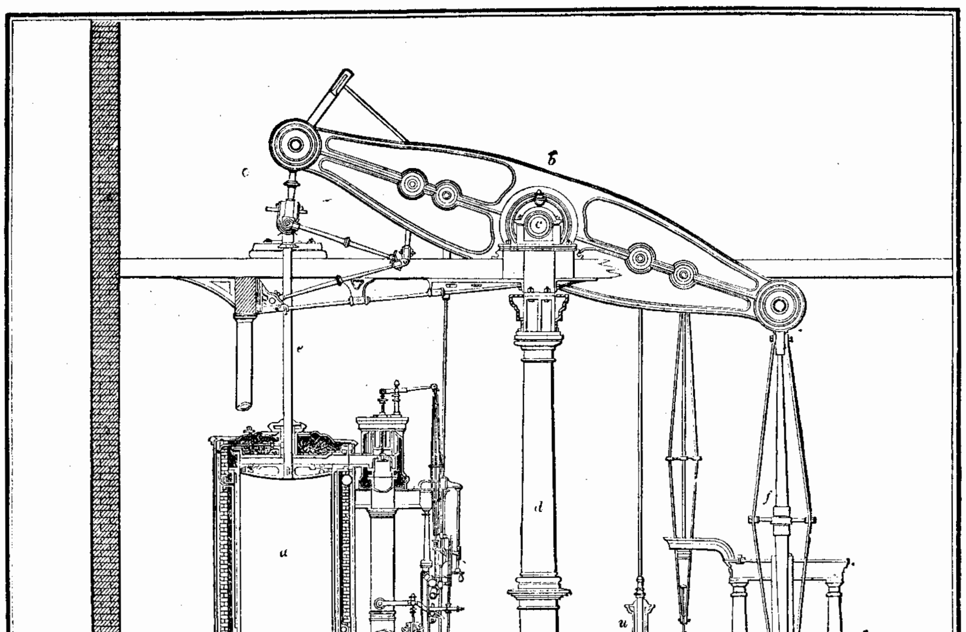
The large pumping engines of the city water works of Louisville, Ky., are on the Cornish plan. They are exactly alike, each working a single-acting lift and force plunger pump. The dimensions of the principal parts of the engines and pumps are as follows, namely: Steam cylinder, *a*, 70 inches diameter, stroke of steam piston 10 feet. The beam, *b*, for each engine is double; the two members, 3 feet 5 inches apart from center to center, are each 31 feet 10 inches long between end centers, 6 feet 9 inches deep in the middle, with 3 inch thickness of web, and 9 inches width of center rib and outside flanges; the cylinder and pump ends of the beam are equal in length; each pair of beams weighs 42 tuns. The beam vibrates on a main center or shaft, *c*, 20 inches diam. eter, 9 feet 8 inches long, with journals 15 inches diameter. and 19½ inches bearing. The plummer blocks, for the beam center of both engines, rest in pedestals bolted to a massive cast iron entablature, which (extending transversely across the house and into the brick walls) is supported by four Tuscan columns, *d*, of cast iron, standing on and anchored to the beam wall, by means of arched cast iron bedplates, built in the masonry. The piston rods are guided by parallel motions, and the pump connecting rods by crossheads and slides; piston rods, *e*, 6¼ inches diameter and 16 feet long each; pump connecting rods, *f*, 8 inches diameter and 28 feet long each.

The pump barrels are 36 inches in diameter each, plungers 36 inches diameter, with stroke same as steam piston, 10 feet. The extreme lift of the pumps, when the river is at its lowest stage, is 21 feet 10 inches. The pumps are connected with the standpipe by two lines of 40 inch, flanged pipes, provided each with a stop gate near the standpipe. The pump valves, *h h*, are of the kind known as Harvey and West's double belt valve. The pumps and pump mains to the standpipe have a circular water way of 40 inches diameter throughout, thus admitting the introduction of pump barrels 40 inches in diameter, and increasing the present pump capacity 23 per cent whenever the consumption of water will demand a greater supply than at present provided for.

The metal (cast iron) of the pumps and pump mains is from 2 to 3 inches in thickness, varying as the forms vary from the cylindrical to the oval or rectangular. All the joints are made with lead by means of flanges and bolts; the flanges are from 2½ to 3 inches thick, and from 4 to 6 inches wide, with 1¼ inch bolts.

Each engine is provided with a battery of three single flue Cornish boilers. The performance of the engines has been very satisfactory. The highest daily duty (calculated by the Cornish method) was 48,363,344 lbs. of water raised 1 foot high per 100 lbs. coal; the highest monthly average was 35,957,629 lbs., and the yearly average duty 30,217,865 lbs. Cost of the engines and connections complete, $117,753.64.

The cataract, *m*, is in the vault, *n*; the condenser and air pump are in the well below the main floor, *o*, of the engine house, *p* is the cistern, *r* condenser, *s* bucket of air pump, *t* hot well. *w* is the induction waterpipe at the foot of the pump stock, *v* the eduction main, *u* the feed pump.



PUMPING-ENGINE, LOUISVILLE WATER-WORKS.

(*Theodore R. Scowden, Engineer.*)

Constructive Use of Wood.

The main stay of constructive woodwork is the mortise and tenon. A piece of woodwork which can be put together without glue, nails, or screws, and serves its purpose, is an ideal work of construction; but this is not always possible. Another principle of construction is that every piece of wood should be so placed that it can swell or shrink without injuring itself, or displacing any other piece. This is maintained in an ordinary panelled door, provided no mouldings are inserted. Still another principle is that mitre-joints should be avoided, whether for moulded work or not, for the reason that shrinkage causes all mitres to open. No piece of wood should be used unless the straight grain of the wood can be seen through its full length in one place. Inserted mouldings should be avoided as far as possible; and all mouldings for panel-work should be worked on the styles and rails. It is a general principle, observed in the best mediæval joinery, that all mouldings on rails which are horizontal should butt against the styles; and that styles should be either plain, or should have mouldings stopped before reaching the joints with the rails. In practice all rail mouldings may be worked the whole length of the stuff used; and, if muntins (which are the middle styles) are used, the mouldings may be cut away to the square wood before the mortise is cut which is to receive the tenon of the muntin. Thus the mouldings will butt against the square sides of the muntin. All the parts for a door thus made can now be got out by machinery, and the door will be fully constructive in every sense of the word. There is no obstacle to this in the way of cost. The dovetail is a constructive device; and the dowel is admissible in places as a substitute for the mortise and tenon. Tongue and grooving is a legitimate device, both for ends and sides of boards. Bevelling the edges of the pieces thus joined is better than beading. The best way to construct large panels is to make them of narrow strips, tongue and grooved, and bevelled at the joining edges. Such panels will never "draw." The shrinkage will be divided between all the joints. Solid table-tops should never be fastened with glue or screws, but should be secured with buttons fastened to the under side of the top, which travel in grooves cut in the framework to allow for expansion and shrinkage. These are but few of the principles to be observed in doing the best woodwork.

In all kinds of lumber, the heart should be rejected. All boards cut on a radius from the center to the periphery of a tree will remain true, while all others have a tendency to warp or check. The first are called "quarter-sawn." It is a peculiarity of oak that the best grain is found in quarter-sawn boards. It is only in these that the "silver-grain" is seen. This consists of a ribbon of very hard substance which grows out from the center of the tree. It is for this reason that oak is the most enduring wood: it has a grain two ways. All woods check in the direction of a radius from the center. Quarter-sawn oak cannot check.—*Andrews' Guide to Church-Furnishing.*

TO MAKE a good varnish for gun barrels, take shellac 1 1-2 ozs., dragon's blood 3 drachms, rectified spirit 1 quart. Apply after the barrels are browned.

NEW YORK ACADEMY OF SCIENCES.

The regular monthly meeting of the chemical section of this society was held at their rooms, 64 Madison avenue, on December 11, Dr. J. S. Newberry, President, in the chair. Professor A. R. Leeds, of the Stevens Institute of Technology, read a paper entitled

A NEW TEST REACTION OF ZINC.

While testing before the blowpipe a new mineral from the Franklin zinc mines of New Jersey, Professor Leeds discovered that the reaction for zinc, when this metal is present in silicates in minute quantities, is much more easily obtained by the use of fused sodic chloride of sodium than with sodic carbonate. This is due to the greater volatility of zinc chloride over the oxide. The green color with cobalt was not readily obtained unless the assay itself were moistened with cobalt instead of the coating. It will be noticed that the number of blowpipe reagents is gradually increasing, and the tests are becoming more satisfactory and delicate.

NOTES ON THE ULTIMATE ANALYSIS OF CRUDE PETROLEUM

was the title of a paper by Professor S. F. Peckham, read by Professor Leeds, Chairman of the chemical section. The author stated his troubles in obtaining satisfactory results by combustion of crude petroleum with oxygen and oxide of copper, and how he overcame them. Instead of using the ordinary bulb for holding and weighing the liquid, he used a glass tube drawn out into capillary tubes at both ends, so that the liquid could be drawn up into it without being heated. The oil was placed in a platinum boat, and over it a brush of asbestos, which had been soaked in nitrate of copper and ignited, and thus covered with oxide of copper. Oxygen gas was employed in the combustion. Care is necessary to avoid violent explosions.

INDIUM IN AMERICAN BLENDES.

A paper on this subject, by Professor H. B. Cornwall, of Princeton, was also read by the Chairman of the section. The author has devoted much attention to the spectroscopic examination of American blendes for indium, and in several cases his labors have been crowned with success. In the *American Chemist* for January, 1873, he mentions several blendes then examined, in one of which, that from Roxbury, he found a considerable quantity of this new metal. In the present paper, he mentions several others in which traces of it have been detected, especially some from the far west

Professor A. R. Leeds read a paper on the

CHEMICAL LITHOLOGY OF THE ADIRONDACKS,

and exhibited polished specimens of rock brought from the summit of Mount Marcy. The chemical study of the composition of rocks is a tedious and laborious one and Dr. Leeds and his assistants deserve great credit for their persevering labors, although the details are not such as to be of popular interest. Among other analyses reported was a quantitative one of basalt, in which eleven constituents were determined, including titanium.

The following papers were read by title: "Descriptions of New Noctuæ, with remarks on the variations of larval forms in the group," by A. R. Grote, of Buffalo, and "An Index to the Literature of Titanium, from 1789 to 1876," by E. J. Hallock, of Columbia College.

The section on mineralogy met at the School of Mines, in 49th street, on December 18. Professor T. Egleston read a paper on the

SMELTING OF NATIVE COPPER

at Lake Superior. Dr. Bolton and Mr. Julian gave a sketch of a mineralogical tour in Western North Carolina, accompanied by the exhibition of a great number of specimens.

ON December 29 ult., a terrible accident happened on the Lake Shore and Michigan Southern Railroad. The train fell through an iron bridge near Ashtabula, Ohio, the cars falling 75 feet. There were 175 persons on the train, of whom between 30 and 40 were killed outright. The wrecked train, as usual, caught fire, and the cars, etc., were totally destroyed.

FOR a cement for fixing metal letters to glass windows, take copal varnish 15, drying oil 5, turpentine 3, oil of turpentine 2, liquefied glue 5 parts. Melt in a water bath, and add dry slaked lime 10 parts.

Salicylic Acid in the Household.

Dr. Von Heyden gives the following directions for using this newly introduced antiseptic in the preservation of food, and for other purposes in domestic economy :

1. Raw meat: It frequently happens, especially in the warm season, that meat which is otherwise faultless emits an unpleasant smell on boiling. This is often the case with certain kinds of meat, like tongues, etc., which contain readily decomposing particles of fat and blood. This is easily remedied by laying the meat, before cooking, in warm water which contains from half to one teaspoonful of salicylic acid to the quart; or by putting a little acid in the water in which it is boiled.

To protect meat from spoiling for a few days either of the following methods may be employed: Place it in water containing from ½ to 1 teaspoonful of acid in a quart of water; or rub it with dry salicylic acid, especially near the bone and fat. The manner of keeping it, as well as the previous cleansing, is as usual. Although raw meat, when treated with salicylic acid, loses its fine red color on the surface, it suffers no change within. The meat also cooks soft in a short time. It is also advantageous to add 1½ teaspoonful of the acid to a quart of brine used in pickling meats.

2. Pure cow's milk: The addition of ½ to 1 teaspoonful to a quart (or about ½ to 1 gramme *per liter*) of dry crystallized acid—not in aqueous solution—prevents curdling for 36 hours longer than otherwise, and yet it retains the property of yielding cream and butter perfectly.

3. Butter: If butter be worked with water containing one teaspoonful of acid to the quart, and kept in such water, or packed in cloths soaked in an aqueous solution of the acid, it keeps much longer. Even butter which has began to be rancid can be improved by carefully washing with salicylic water, 2 or 3 teaspoonfuls to the quart, and washing in clean water.

4. Preserved fruits: Cherries, currrants, raspberries, plums, apricots, and peaches may, as experience has proved, be very advantageously treated in the following manner: The fruit is placed in a preserve jar, with not a very wide mouth, layers of fruit alternating with layers of sugar, but no water; and strewing over it a pinch of salicylic acid (½ gramme to the kilogramme, or 3½ grains to the lb.), and covering the jar with parchment paper which has been softened in salicylic acid solution, and then boiling as usual in a water bath. Bilberries, or blueberries, are better boiled without sugar, allowed to cool, and put into narrow-mouthed bottles (some crystals of salicylic acid being strewed over them), corked and sealed. Fruit preserved in this way has kept well for two seasons. Others have recommended covering the fruit in the jar with a close-fitting strip of blotting paper, which has been saturated with a solution of salicylic acid in rum.

For cucumber pickles, and those put up with vinegar and sugar, a corresponding process is recommended; the acid being boiled in the vinegar, and when cold poured over the pickles. For salted cucumbers, salicylic acid is put in the water during the boiling (½ to 1 teaspoonful to 1 quart), and otherwise treated as usual. It is also recommended to sprinkle salicylic acid in the barrel on the surface of the pickles.

5. Boiled vegetables: An equally small amount of dry salicylic acid may be added to these to prevent their spoiling.

6. For disinfecting and purifying the air and walls of closed rooms, salicylic acid may be evaporated on a hot sheet of iron or tin.

7. Vessels, corks, etc., which have a disagreeable odor or taste, will be rendered perfectly sweet by washing with a solution of salicylic acid, a fact that deserves special attention.

The best method of preparing these salicylic acid solutions is to put 2 or 3 teaspoonfuls of acid in a quart of water, heat rapidly to boiling, and let cool. What separates on cooling is an excess of pure acid, which may be kept for subsequent use, or it may be well stirred up and used in suspension when more of the acid is wanted than will go into solution.

In this connection we may add that the purest form of salicylic acid is that obtained by dialysis, as it is impossible to remove all the tarry and resinous matter by recrystallization.

What's in a Name?

We recently published a description of an ingenious lantern improvement by President Henry Morton, of the Stevens Institute, which was reproduced by the *English Mechanic* as the discovery of Mr. Henry Norton. We also described the new resonant alloy invented by Professor Silliman, of Yale College, which our cotemporary also publishes, but credits the invention to Mr. Lilliman, of New Haven, Conn.

An Improved Indian Ink.

Most of the black Indian ink met with in commerce possess this disadvantage, that it blots when a damp is brush passed over it; or, as draughtsmen say, "it does not stand." The addition of alum does but little good; but G. Reisenbichler states that bichromate of potash accomplishes the object by rendering insoluble the glue which the ink contains, and thus making the ink permanent. Such an ink Reisenbichler calls "Harttusche," or "hard Indian ink." The bichromate of potash is not colorless; on the contrary, it possesses a deep yellow (almost red) color, but does not at all injure the shade of the ink, as 1 per cent. of it in a very fine powder, intimately mixed with the ink, which has already been mixed with glue and dried again, is sufficient. The salt must always be mixed with the ink in a dry state; otherwise the ink might lose its friability in water.

A drawing which has been made with this ink in the dark, or by artificial light, must be exposed to sunlight for a few minutes, which renders the bichromated glue insoluble in water. Draughtsmen who cannot provide themselves with such ink make use of a dilute solution of bichromate of potash in rubbing up the ink. There is no danger of the yellow salt penetrating the paper, if the ink is thick enough.

DYEING DEEP ROSE.—This color is dyed in the beck in which cochineal reds have been dyed, adding, for 22 lbs. material, 10½ ozs. oxalic acid, 5¼ ozs. tin crystals, and 3½ ozs. cochineal. Boil up, cool, and dye boiling for 30 minutes.

Inventions Patented in England by Americans.

From October 24 to November 20, 1876, inclusive.

ATTACHING GEAR WHEELS.—B. T. Taylor *et al.*, Fall River, Mass.
BALE TIE, ETC.—W. B. Hayden, Columbus, Ohio.
CAR COUPLING.—G. H. Awes, Adrian, Mich.
CAR LAMP.—A. H. Phillippi *et al.*, Reading, Pa.
CASTOR.—L. P. Lawrence, Port Morris, N. J.
EGG BOX.—A. H. Lucas *et al.*, St. Louis, Mo.
ELECTRIC LIGHT BUOY.—P. E. Smith, Scotland Neck, N. C.
ELEVATOR.—B. H. Davis, Foxcroft, Me.
FEEDING PAPER TO PRESSES, ETC.—H. W. Covert, New York city.
FIRE EXTINGUISHER.—H. Conant, Pawtucket, R. I.
GRAIN SCOURER.—The Barnard and Leas Company, Moline, Ill.
IRONING TABLE.—L. P. Lawrence, Port Morris, N. J.
JAR, ETC.—A. Montgomery, New York city.
LAYING PIPES, ETC.—A. O'Neill, Baltimore, Md.
MAGNETIC ENGINE.—E. Weston, Newark, N. J.
MAKING GAS, ETC.—R. D. Bradley, Preston, Md.
MATCH FRAME.—E. B. Beecher, New Haven, Conn.
MOWER AND REAPER.—S. Sweet, Dansville, N. Y.
NAIL FEEDING MACHINE.—J. C. Gould, N. J.
OPENING CANS, ETC.—Meyer *et al.*, New York city.
OPENING CANS, ETC.—S. Poole, Boston, Mass.
PACKING BAGS, ETC.—H. L. Mattison, Oswego, N. Y.
PAPER BAG MACHINE.—E. Stanley *et al.*, Brooklyn.
PERFORATING PAPER.—W. Braidwood *et al.*, Mount Vernon, N. Y.
PIPE JOINT.—A. O'Neill, Baltimore, Md.
PIPE MACHINERY.—J. B. Root, New York city. Three patents.
POTATO DIGGER.—L. A. Aspinwall (of Albany, N. Y.), London, England.
PREPARING WOOD.—N. Wheeler, Bridgeport, Conn.
PRESSING SUGAR.—T. L. Wadsworth, San Francisco, Cal.
PULLEY, ETC.—A. A. Hall *et al.*, Nashville, Tenn.
RAILWAY RAIL.—J. T. Clark, Augusta, Ga.
RAISING WATER.—J. A. Ayres, Hartford, Conn.
RIBBON WIRE, ETC.—J. Fettis, New York city.
SCREW CUTTING.—S. W. Martin, Springfield, Ohio.
SETTING SPRINGS, ETC.—J. S. Passenger *et al.*, Birmingham, Conn.
SHEET METAL PIPES, ETC.—F. Hœltge *et al.*, Cincinnati, Ohio.
SHOVEL.—H. W. Shepard *et al.*, Brooklyn, N. Y.
SMOKE CONSUMING FURNACE.—C. B. Bryant, *et al.*, Stoneham, Mass.
SPEED GOVERNOR.—G. Westnighouse, Jr., Pittsburgh, Pa.
SPRAY APPARATUS.—M. A. Lake *et al.*, Chicago, Ill.
STEAM BOILER, ETC.—J. B. Herreshoff *et al.*, Bristol, R. I.
STORING FUEL, ETC.—E. R. Kerr, Kewanee, Ill.
SUGAR MAKING, ETC.—E. A. Corbin *et al.*, Philadelphia, Pa.
TREATING EXTRACTS, ETC.—W. Adamson, Philadelphia, Pa.
WIRE FENCE, ETC.—W. D. Hunt, Scott, N. Y.
WORKING HIDES, ETC.—A. Fitzhenry, Somerville, Mass.

Recent American and Foreign Patents.

NEW MECHANICAL AND ENGINEERING INVENTIONS.

IMPROVED COTTON GIN FEEDER AND PICKER.

William T. Adams, Rienzi, Miss.—Cotton to be operated upon is placed on an apron, when it is carried forward to the picker, the apron being moved by a crank. The picker being revolved by a belt from the gin, acts upon the cotton as it comes over the roller and delivers it to the gin. The rapidity with which the cotton is fed into the machine may be varied. The picker cylinder has forked and curved teeth.

IMPROVED TIRE UPSETTER.

Morris W. Griffiths, Middle Granville, N. Y.—In using the machine the part of the tire to be upset is heated and is bent inward over the horn of an anvil, more or less, according as the tire is to be shortened. The bent part is then placed upon a plate, and is clamped by rough faced eccentrics. The bend is then hammered out of the tire, when the latter will be shortened.

PULVERIZED FUEL FEEDER FOR SMELTING FURNACES.

William West, of Golden City, assignor of one half his right to Ira S. Elkins, of Denver, Col. Ter.—This is a contrivance for feeding smelting furnaces with coal dust by means of the air blast. A screw conveyer feeds the dust into tubes, from which it drops through the funnel-mouthed pipes into the large blast pipes upon nozzles through which the blasts escape and force it into the furnace.

IMPROVED BOOT AND SHOE CRIMPING APPARATUS.

Henry Lampus, Enon Valley, Pa.—The leather to be crimped is placed under a plate, and it is forced down between other plates by a screw, the distance between the plates being adjustable. The form of the plates not only causes the leather to crimp smoothly and evenly without wrinkles, but the boot made of an upper crimped on this machine is claimed to be not liable to wrinkle in the instep, and is more comfortable to wear than those crimped in the usual way.

IMPROVED LABELING MACHINE.

Jonathan Bigelow, Boston, Mass.—This invention is an improvement in that class of labelling machines or apparatus in which the paste and label are applied to the can as it rolls down an inclined plane, of which the paste bed and label holder form a part. The invention relates to several features for improvement, for which reference must be made to the patent.

NEW MISCELLANEOUS INVENTIONS.

IMPROVED FIRE EXTINGUISHER.

Amzi S. Dodd and Isaac C. Andrews, New York city, assignors to Home Fire Extinguisher Company, of same place.—A bottle containing part of the gas generating ingredients is held in a cage in the upper part of the can, and so disposed that, by screwing down a stem which is attached to a bell which rests above the bottle, the latter is forced down on a projection on the bottom of the cage and broken. The construction is such that it is impossible to break a charged bottle when adjusting it, from forgetting to raise the breaking devices. The second invention consists in ribs formed upon the inner sides of the bars of the cage to receive the ring rib formed upon the outer surface of the bottle, and support said bottle; and in the combination of a stopper with the stem and the bell in such a way that the bottle may drop away from said stopper when forced down through the cage.

IMPROVED PACKAGE BAND.

Owen I. Taylor and Thomas H. Patterson, Saginaw, Mich.—This package band consists of a connecting plate, with two elastic bands attached to it at right angles to each other. The bands hook to the connecting plate after passing around the package in opposite directions.

IMPROVED APPARATUS FOR HANDLING HORSES.

William W. Winegar, Chambersburg, Ill.—This consists of a couple of upright crotches, together with cords and a tightening device therefor, mounted on a cranked axle of a pair of wheels, in such manner that, by adjusting the axle fore and aft under the body and between the legs of the animal, the cords may be arranged so as to confine him in a web in which he can be turned over on side or back, and can be moved about readily on the wheels.

IMPROVED PEW HAT HOLDER.

William H. Hampton, Luray, Va.—This invention consists in applying to the back of pews a wire holder that is capable, by a rotary movement, of placing a gentleman's hat under the seat in front, the hat being thus both out of the way and not at all liable to become soiled or injured. Patented April 18, 1876. See advertisement on another page.

IMPROVED PEA-NUT HEATER.

Jean Espito, New York city.—This consists of a top receptacle with a hinged cover, surrounded at the sides and bottom with a water chamber that is heated by a charcoal furnace in the base or supporting chamber. The charcoal furnace provides the steady heat required for heating the water bath, which again imparts the required heat to the pea-nuts without wilting, browning, or parching the same. They may thereby be kept in the heater for considerable time, and be sold at any moment in a fresh and heated state.

IMPROVED PROCESS OF MAKING BIRCH BEER.

Harvey Decker, Jersey City, N. J.—This process is for making beer from ground birch bark, and it consists in first extracting the strength thereof in hops and water without boiling; secondly, fermenting the liquor obtained with yeast; and, thirdly, in adding malt and sugar, the latter having been previously made to absorb oil of wintergreen.

IMPROVED LIQUID FILTER.

William Maynard, New York city.—This is a combination of the partitions and the screens with each other, and with a case to form a series of filtering and conducting spaces for the passage of the liquid. The construction is such as to enable the apparatus to be quickly and thoroughly cleaned.

IMPROVED STONE PAVEMENT.

John Murphy, Columbus, O.—This consists in laying blocks of stone with interspaces, filled with a composition consisting of pulverized slag, coal tar, fresh lime, sand, and pitch. A pavement laid in this manner is said to be impervious to water and is not acted upon by frost. The composition, being in a measure elastic, renders the pavement easy to travel on, and it also deadens the sound of vehicles passing over it.

COMBINED PENCIL SHARPENER, PROTECTOR AND ERASER.

Andrew Wilson, Providence, R. I.—This is a casting which resembles a human hand grasping a cone, and having the index finger extended. The cone is hollow, and has a section removed from one side. In one edge a knife is secured, for the purpose of sharpening the pencil. The lower end of the cone holds a rounded rubber eraser. The index finger is widened, and in it is secured a knife. The portion of the blade near the cone is made concave for cutting twine. The outer end is intended for cutting paper of different thicknesses. The arm of the casting is bored and threaded for receiving the point of the pencil, which it protects.

NEW WOODWORKING AND HOUSE AND CARRIAGE BUILDING INVENTIONS.

IMPROVED SPRING HINGE.

Lorenz Bommer, Brooklyn, N. Y.—A flange or wing plate is cast in one piece with the ornamental top and bottom buttons of the hinge, and has a fixed pintle socket and detachable top socket, both provided with annular recesses. This dispenses with the separate casting, finishing, and attaching of the buttons, and imparts, by the greater bearing surface on the pintle, a more rigid connection with less friction on the faces or bearings of the seats.

IMPROVED WAGON BRAKE LEVER.

David McGuire, New Gordon, Mo.—This consists in the arrangement of a jointed lever for operating the brake connected with a pawl, that engages with rounded ratchet teeth on a curved bar attached to the side of the wagon. The pull of the brake rod on one part of the lever locks the pawl in the curved bar. The lever automatically unlocks the pawl when it is moved to relieve the brakes.

NEW AGRICULTURAL INVENTIONS.

IMPROVED GATE.

William G. Hughes, Columbia City, Ind.—When the gate is closed its forward end enters the space between the two posts. The latch is placed across this space so that it may engage upon a catch and fasten the gate. By operating a lever a latch may be raised to unfasten the gate.

IMPROVED FEED TROUGH.

James H. Grundy and Thomas H. Carter, Bremen, Ky.—This trough is so constructed as to prevent fowls or other animals than those being fed from having access to the grain, and to prevent the animals being fed from wasting their food by throwing it out of the trough. It is provided with a cover sliding longitudinally, in which is a hole to receive the animal's nose. The cover is provided with suitable stops to limit its movements.

NEW HOUSEHOLD INVENTIONS.

IMPROVED WEATHER STRIP.

John C. Fiester, Reading, Pa., assignor to himself and Jacob Schaaber, of same place.—This weather strip is made from two pieces of wood, one of which is fixed to the door and the other joined to it by a rule joint. Hinge plates are provided at each end and also springs for throwing the removable part down on the door sill. A spring bolt catches and retains the strip as it is raised by passing over the threshold, and is tripped by contact with the door casing as the door is closed.

IMPROVED PADLOCK.

Anthon O. Kruger, Rock Harbor, Mich.—This consists of a pawl connected to the bolt and so held by a spring that it must be pushed by a thumb piece into the path of the key before the latter will engage it, so as to throw back the bolt. The thumb piece is locked by a spring pin inside of the lock, so that it cannot be moved until the spring pin is drawn out b the key. The invention also consists of a secondary bolt, to be worked by a key hole plate and a stud on it, which engages the bolt by a pawl, so as to swing into and out of the position to be engaged with the keyhole plate stud, which must itself be adjusted to a certain position to receive the pawl.

IMPROVED SCREW TAP.

Josiah W. Melvin, Houston, Texas.—This is an expanding tap or reamer having cutters placed in slots in the tapering portion of a mandrel, in which they are capable of being moved longitudinally. They are clamped by a thimble and nut upon the outer side, and a clamping bolt running through the mandrel.

IMPROVED SCREW PROPELLER.

Frank Maynard, North Dorset, Vt.—This is a motor for the propulsion of canal boats. It consists in arranging upon radial arms screw blades that extend inward from the circumference of the wheel through one half or less of the distance from the periphery of the shaft, and in making them of the same pitch at the inner and outer edges. The hoop that surrounds the wheel, as well as the peculiar construction of the hull, it is claimed to throw the water in a line parallel with the shaft.

Artificial Butter.

To the Editor of the Scientific American:

Owing to the receipt of much correspondence concerning my article on artificial butter, which appeared in the SCIENTIFIC AMERICAN SUPPLEMENT, N. Y., Nos. 48 and 49, I wish to state that I own no patent on the process. The only patent held is Mage's, which is owned by the United States Dairy Company, 6 New Churchstreet. All letters, therefore, should be forwarded to that address. The process I described in my article is simply an elaboration of that patented by Mege, and cannot be used without infringing on the United States Dairy Company's patent. HENRY A. MOTT, Jr., E. M., PH. D.

New York City.

Notes & Queries

A. F. will find a recipe for a cement for china on p. 346, vol. 24.—N. T. will find directions for making silicate of soda on p. 225, vol. 23.—F. N. will find directions for getting rid of flesh worms on p. 233, vol. 31.—J. C. will find directions for making laundry bluing on p. 219, vol. 31.—H. T., J. K., B. L., J. H., T. W., J. D., W. R., and others who ask us to recommend books on industrial and scientific subjects, should address the booksellers who advertise in our columns, all of whom are trustworthy firms, for catalogues.

(1) F. W. C. says: I wish to convey hot water 1,000 feet from the heater through an iron pipe. Must the return or circulation pipe be as large as the supply, in order to keep the water hot at the terminus of supply? A. Yes.

1. I notice that in the vacuum chamber of a cold water pump, the water does not fill the chamber. What is it above the water, air or vacuum? A. It is air, and the pump does not draw it off because it is at a higher level. 2. Will the vacuum gauge work as well attached to the bottom? A. The gauge may be placed in any desired position.

(2) F. McL. asks: Is there any instrument by the aid of which a person can see the interior of his own eye? A. We know of none.

(3) C. H. H. asks: In regard to the water wheels at Fairmount Water Works, Philadelphia, does the water, or part of it, after being forced up, run back and act as power to raise more water? A. No.

(4) R. S. says: I have a floor made of alternate strips of black walnut and ash. I have great trouble in keeping it clean; infact, it never really looks clean except immediately after washing. I have oiled it several times with boiled linseed oil, but it collects and holds the dust too much wherever any one walks. Under pianofortes, etc., it retains its brightness and beauty. What is the best substance or oil for me to use? A. Procure a liquid wax at your house painters; this is often applied for this purpose.

(5) A. says: Given a cast iron tank bolted together watertight, and intended to hold pure water. With what shall the inside be painted or covered, in order to effectually prevent rust? The required preparation must be inexpensive and be applied in liquid form. Nothing that will contaminate the water or dissolve, even slowly, will answer, a perfectly waterproof and innocuous preparation is the desideratum. A. Asbestos paint would probably fill most of the conditions required.

(6) A. M. H. says: The four chimneys of my three story brick dwelling did not draw well. This I attributed to the surrounding trees and houses, both of which are considerably higher than my dwelling, and although I had the chimneys well cleaned out to satisfy myself that there was no obstruction in them, I found a good and sufficient remedy only in placing upon each an iron pipe 8 feet high by 7½ inches in diameter. I had the pipes made of galvanized sheet iron and strongly fastened with ½ inch iron rods. But a little while ago, after a two years' use of the pipes, the whole four pipes were swept away by the wind and broken into pieces as if they were pasteboard. Upon examination the pipes appeared to have been almost entirely rusted or eaten away from the inside, while upon the outside they were but a little discolored with rust. Why did they first go from the inside, and is there not some kind of durable paint or covering, not too brittle, that will prevent this? A. The soot upon the inside of the pipes developes an acid which assists in corroding the iron. The only satisfactory remedy is the extension of the brick chimney itself to the height required, and securing the same with iron braces.

(7) J. H. L. says: I claim that water is elastic and can be compressed. A friend claims that water is not elastic. A. Water is slightly compressible.

(8) N. A. asks: Will a fan, such as is used to make blast for melting iron, make more blast by having eight arms or wings than if there are but four? A. It would not necessarily be more effective with eight arms. It would be quite possible to build a fan of four vanes which was more effective than one having eight, and *vice versa*, on account of other considerations.

(9) E. L. asks: Can we change our mill, now driven by three wheels with direct gear, by transmitting power from wheels to one main shaft with quarter twist, and from this shaft with quarter twist to spindles? If the wheels will drive steadily, without any reaction, shall we lose any power by the indirect transmission? A. We think there will be no difficulty in making this change. As, however, you will have two belts and shafts to drive, in addition to the other gearing, the useful effect of your engine will be somewhat diminished.

(10) W. A. C. asks: Do you know of any steam boiler in this country built expressly to use salt water, and if so, has it proved a success? A. All marine boilers may properly be classed under this head. Such boilers are successful as long as they are kept reasonably free from scale. For land boilers, those of the cylindrical form have many advantages, when salt water is to be used, as they can be easily and quickly cleaned.

(11) F. G. asks: How much power will it take to force an inch stream of water through iron pipe 75 rods up a gradual rise or 75 feet, and what kind of pump would you recommend? A. Your question is rather indefinite, for almost any amount of power might be required to force water through the pipe, according to the velocity. We never recommend special manufactures in these columns.

(12) R. S. M. says: I want to run a cotton gin and press at a distance of 200 feet from my mill. Which is best, a shaft on ground, or wire rope? A. Either plan will answer very well, and we advise you to employ the one that you can arrange most cheaply.

(13) G. & B. ask: Has the ocean tide ever been used as a motor for driving machinery, otherwise than by water wheels driven by currents, or by the aid of dams and floodgates? A. We have read of propositions to this effect, but do not know of any that have been carried into practice.

(14) J. F. J. asks: How is the level of the sea (I mean the point a surveyor takes in saying that such a place is so far above the level of the sea) obtained? A. Just by taking it. For instance, if the surveyor notes that, at mean low tide, a given reference mark is at a certain elevation above the surface of the water, that becomes fixed, and all elevations can then be referred to mean sea level at any time—without a direct observation—by referring them to the fixed mark, and making the necessary correction.

(15) D. S. says: I am getting a small vertical steam boiler made from No. 20 galvanized sheet iron, I intend to put it on top of a box stove over the pipe hole with a 6 inch flue (that being the size of the pipe). The size of the boiler is 14 x 24 inches, and there will be 4 inches space for water between flue and shell. How much pressure will such a boiler stand? Will the flue stand as much as the shell, or will it collapse? A. The flue is somewhat weaker than the shell. You can carry about 15 lbs. steam. 2. Is there not a way to find the pressure of steam with the safety valve? A. If you buy a safety valve from a reliable maker, you will find it graduated with tolerable accuracy, so that the fall can be adjusted without any calculation. It is not a bad plan, however, to verify the graduation. You will find the manner of doing this fully explained in "Wrinkles and Recipes."

(16) T. M. says: You give Dr. Ferrier's remedy for cold in the head. How often should it be used as snuff? A. If the ailment is really a cold, one application of the preparation will be all that is necessary. It is not advisable to use it constantly for every ache or where neuralgia is suspected.

(17) S. W. asks: Can you tell me how to separate gold from iron when the two are mixed? A. Dissolve the gold in warm *aqua regia* (1 part nitric to 3 parts hydrochloric acid), evaprate nearly to dryness, redissolve in water, and add an excess of strong aqueous solution of sulphate of iron. Boil the liquid and allow to stand in a warm place for an hour. Then decant the clear liquid, gather the precipitate on a filter, wash with hot water, dry, and fuse in a small black lead crucible with a small quantity of anhydrous carbonate of soda. If the directions are closely followed, this will give you a button of the pure metal.

(18) D. asks: What will give a new appearance to old zinc? A. The structure and properties of zinc do not alter by age. You can remove the superficial coating of oxide by means of a little dilute acid and the scratch brush.

(19) W. T. B. asks: Can you give me a recipe for dissolving gutta percha, which is not combustible, and will not cost more than sulphuret of carbon? A. We do not know of such a solvent.

(20) C. E. A. asks: Are wood ashes a benefit to the growth of currant bushes or trees? A. Yes, if not used in excess.

(21) J. P. H. L. says: I have some fine specimens of copper ore. Is there anything that I can put on them that will not change the colors and will prevent their turning green? A. Varnish them with a little purified shellac in alcohol.

(22) W. P. T. says: In answer to H. G. you say that the change of color in hair is due to the loss of the iron salts which are the basis of the dark color. Can the dark brown hair of a young person be prevented from turning white? A. The only remedy that we can suggest is the reinvigoration of the blood by the proper use of animal nourishment and iron tonics. Avoid alcoholic stimulants and do not deprive yourself of needful sleep.

(23) H. L. G. asks: In electroplating, does a current that vibrates do better work than one which does not? A. No.

(24) C. W. W. asks: Of what size and thickness should a boiler be for an engine of 2¼ inches diameter of cylinders, and 4 inches length of stroke? A. Make a vertical one, 20 or 24 inches in diameter, and 3 feet high.

(25) G. A. W. says: I wish to build a propeller launch. I am making an engine 5 x 6 inches; how big a boat will it run at 8 miles an hour? How large should the boiler be, and how large a screw will it require? A. You can have a boat 30 feet long, with a boiler 3 feet in diameter and 4½ feet high. Propeller should be 30 inches in diameter and of 3½ to 4 feet pitch.

(26) F. D. W. asks: Is the following proposition correct? "It is a principle of mechanics that a force acting at right angles to the direction in which a body is moving, does no work, although it may continually and continuously alter the direction in which the body moves. No power, no energy is required to deflect a bullet from its path, provided the deflecting force acts always at right angles to that path." A. It might be true, if the conditions stated were possible; but it is evident that, when the body is deflected, its motion will not be at right angles to the deflecting force.

(27) N. asks: What is a good pickle or dip for copper-plated zinc work, to be used before gilding? A. Use very dilute oil of vitriol.

(28) J. G. W. asks: If the true meridian may not be obtained from the sun? A. Not unless you have true time, and know how much the sun is slow or fast.

(29) J. J. G. asks: Does a side wheel steamboat or propeller draw more water when running than when still? A. Frequently when the boat is in motion the bow is elevated and the stern depressed.

(30) F. C. R. asks: 1. What size of boiler will be large enough to furnish steam for an engine 2 x 4 inches? A. One 20 inches in diameter and 3 feet high. 2. How large a boat will such an engine run at 3 or 4 miles an hour? A. One 15 feet long. 3. What size and pitch of screw will be necessary? A. Use one 18 to 20 inches in diameter and of 3 feet pitch.

(31) H. W. says: In a recent issue of your paper I see that S. N. W. asks who first applied steam power to the propulsion of boats, and is the inventor of steam navigation. You reply "that the Marquis de Jouffroy of France built a steamship some years before Fulton." But Dionis Papin (born August 22, 1647) of Paris, being a Protestant, fled from France after the repeal of the Edict of Nantes and went to England, and from there to Germany, where he was professor at the University of Marburg from 1687 to 1707. During this time he made several inventions, of which the most prominent was the steamship which he built and set to work in Hesse Cassel, on the river Fulda. What has become of the ship is not known.

(32) W. B. F. says: 1. I have an engine of 3 inches bore by 3½ inches stroke, and I would like to know what sized three-bladed propeller I should use, and what horse power of boiler will it take to run a boat with a 25 feet keel, and 8 feet beam, drawing 2 feet of water? A. Use a propeller 24 or 26 inches in diameter, and of 3 feet pitch; and a boiler 28 or 30 inches in diameter and 3½ feet high. 2. What speed would be realized? A. Probably 4 or 5 miles an hour in smooth water. 3. Where could I obtain directions for building such a boat? A. See the directions for building various kinds of boats, in back numbers of the SCIENTIFIC AMERICAN SUPPLEMENT.

(33) G. W. A. says: 1. We are running a 12 x 20 inches engine with a 9 flue boiler 48 inches in diameter, and 20 feet long. The flues are 6 inches in diameter, and the stack is 23 inches in diameter and 40 feet high. She seems to have draft enough, but we cannot keep steam on her. We run her at 100 or 120 revoluttions per minute, driving two 50-saw gins and two 30-inch burrs. The valve is a common slide valve, set with both ends equal with 1-16 in. lead. What is the matter? A. From your account the boiler should steam well if it is clean. Examine it to see if there is much scale in it, and test the engine to see whether there are any serious leaks. 2. Will a 2 inch shaft 100 feet long run two 50-saw gins and one 80-saw gin? A. It would be better to use a larger shaft. 3. Which runs the lightest, belts or iron cogs for driving burrs? A. More of the power applied is generally utilized by belts than by common gear wheels.

(34) B. S. says: I have made an induction coil (Rhumkorff's method), 6 inches long and 3½ inches in diameter. I get a spark from the induced current about 1-16 inch in length and a very severe shock. I would like to put on condensers to increase the spark as much as possible. Please tell me the proper number of sheets of tinfoil to use, their shape and size, and also give directions for connecting them in the main circuit from the battery. A. Thirty or forty square feet of foil will be sufficient. The sheets may be of any size and shape. Connect the condenser up so as to bring its opposite sides on each side of the vibrating break, that is, with contact points of break between its two coatings.

(35) J. H. asks: 1. Does nickel-plating cost as much as silver plating? A. Yes. 2. Does it require to be burnished after plating? A. Yes. 3. Does it require a battery as strong as for silver? A. It requires stronger battery power. 4. What is the best work on nickel plating? A. "Electricity; its Theory, Sources, and Applications," gives all the necessary instructions for nickel plating.

(36) J. T. D. says: Three months ago, I could not hold both ends of the wires from a gravity battery of large size (150 cups): now I can hold them for almost any length of time without feeling much current till I have held it for three or four minutes, and then I do not feel enough to make me let them go. The battery was tested with a galvanometer and proved to be as strong as ever. A. Your hands are probably dry and offer very considerable resistance to the current. When the latter has been allowed to flow a short time it starts perspiration and thus reduces the resistance. It is not difficult to take a continuous current from a battery; one can do this easily and retain hold of the terminal, when frequent interruptions of the circuit would be too severe for the majority of persons.

(37) W. T. N. says: I made a battery of three copper plates, 7 x 8 inches, tacked to slats ¾ inch wide; between these plates were placed two 7 x 8 zincs. The two zincs and the three coppers were then connected with copper slips, and to the combined zincs and the combined coppers were attached the positive and negative wires. The plates were then placed in a common two gallon pail, full of sulphate of copper solution, the slats resting on the edges of the pail. I supposed I had a battery of about 200 inches of zinc surface, and I thought that this ought to produce some signs of magnetization in a bundle of wires (¼ inch in diameter) in a coil of 180 feet 25 wire, and 600 feet of 35. But it did not, nor would it decompose water. The only sign of electricity was the strong salty-bitter taste on placing the poles on the tongue. What was the trouble? A. One hundred feet of No 16 copper wire will give better results with such a battery than all your wire together. It will take two such batteries to decompose water, and the decomposition would probably stop in 20 or 30 minutes.

(38) A. C. L. says: I want to lay a small lead pipe to bring water into my buildings, from a spring 1,600 feet distant, through hard rock, digging nearly all the way. How can we lay the pipe without going deep as ordinarily, but yet protecting it against any danger of freezing. Our idea is to dig a ditch 2 feet deep, fill it with 6 inches of sawdust then lay the pipe, then fill in over that with 12 inches more of sawdust, and then with the dirt taken from the ditch. Will that answer? How is the best way to contruct the well at the spring? A. To give absolute security against freezing in our climate it has been found necessary to lay water pipes five feet below the surface of the ground. In one case the pipes of a good sized city being laid at 3 feet in depth, the water froze and the pipes burst in many places, so that the ground had to be opened again and the pipes relaid at 5 feet in depth. During some winters the frost penetrates the ground very little, but the pipe must be so laid as to be secure in the severest seasons. It is doubtful if the sawdust filling would save it.

(39) G. C. says: My furnace has a chimney 40 feet high; the number of tubes in boiler is 52, their diameter is 1¾ inches; the size of chimney is 14 inches square, inside. I can put the exhaust into the chimney or not, as I wish; but I cannot see any difference between the ways. I carry 60 lbs. pressure, but am short of power. The boiler is good all but firebox, and that is very thin in places. Can I carry any more pressure? A. If your firebox is weak, we advise you not to increase the pressure. From the data sent, we cannot help you much about the boiler. It may be that it steams well, and the engine takes too much steam. This could only be settled by experiment.

(40) J. B. asks: What size of screw wheel will an engine of 2½ inches bore by 5 inches stroke drive, and what size of boat would be suitable? A. You can use a wheel from 22 to 24 inches in diameter, and of 3 feet pitch, and a boat 20 feet long, of 4½ feet beam.

(41) P. H. D. asks: How does the method for finding the true meridian, given in No. 9, vol. 35, differ from that given in Davies' and other works on surveying? A. There was a time when they were right. We have examined some of the earlier as well as later works on surveying, and it appears that they have copied from each other. They have not taken into account the retrograde movement of Polaris of twenty seconds a year. At the present time, Alioth, the first star in the handle of the dipper, is about 25 minutes ahead, while Mizar, the second star, is five minutes behind.

(42) J. R. M. asks: Do the government observers at the signal stations report the actual hight of the mercury in the barometer, or are corrections applied? A. The readings are reduced to the sea level and also to a temperature of 32° Fah. by Guyot's tables. The first 900 feet makes about 1 inch fall in the mercury, so that if a person is 900 feet above sea level, his barometer will read about 1 inch below the signal reports, for that place.

(43) M. J. C. asks: 1. Is there any difficulty in using an object glass two or three inches in diameter as described on p. 283, vol. 35? A. No. Make the focus of the three inch lens 25 feet. 2. Would the instrument you describe be free from color? A. Not wholly. 3. Would not better results be obtained by using an achromatic objective? A. Yes; but it would be far more expensive.

(44) W. M. says, in reply to J. L. A., who asks how to destroy a human tooth, in or out of the mouth: Take the tooth (after it has been removed) and immerse it in muriatic acid for about 12 hours, when it will be dissolved.

(45) W. M. says, in answer to T. P. H.'s inquiry as to how to harden and polish dental plates: They are first vulcanized at 320° for a shorter or longer period according to the constituents of the rubber. Then dressed down with file, scraper, and sand paper, and then polished with prepared chalk and a brush wheel.

(46) R. E. H. says: 1. I have a Rhumkorff coil, with an 8 inch bobbin. It is fitted with a tinfoil condenser, which is connected with the pillar by one wire and the vibratory hammer by the other. The coil will not work while this condenser is attached; but gives a brilliant spark at the contact breaker (using two small Bunsens) when the condenser is removed. Can you suggest a remedy? A. The condenser has evidently become defective; substitute a new one or have the old one repaired. 2. Though a brilliant spark is got at the contact breaker, but a very small one can be got by joining the terminals of the secondary circuit, and I cannot succeed in lighting up some small Geissler's tubes. These terminals will induce a spark from a thin insulated wire or from the knuckles, so that the tension seems considerable. A. An eight inch bobbin will not give a very long spark, but should be sufficient, with a good condenser, to illuminate small Geissler tubes. 3. Should I connect the ends of the secondary coil with thick or thin wire? A. It is not material, either will answer for ordinary purposes.

(47) J. M. asks: 1. By what means does working high steam expansively effect a saving in fuel? A. If the steam is used without expansion, when it is discharged from the cylinder it is capable of doing more work. If now we employ some of this energy, before exhausting, by allowing the steam to expand, it is evident that more work will be obtained by the consumption of a given amount of fuel. 2. Would the supply of a greater quantity of atmospheric air to the furnace of a locomotive be a desideratum? A. No.

(48) C. S. A. asks: Has a noiseless steam ever been invented? A. Many well built steam engines run noiselessly.

Does it make any difference if lightning rods are badly rust eaten in the ground, provided they go deep enough to strike the damp earth? A. No.

How is gas pipe made? A. From flat plates of iron, heated red hot, and drawn through plates till the curvature and lap are made. Then the lap is welded.

In your explanation of the Bessemer steel process, you do not say where the blast comes from. Is it from a stone coal or charcoal fire? A. From a coal fire.

Can there be such a thing as two lines approaching each other and never meeting? A. Yes. See p. 138, vol. 31.

Is the work of tunnelling the North river progressing? A. No.

(49) H. Z. asks: How can I prepare a lithographic stone for Indian ink drawings? A. Rub it with sand, wash well, and then rub with powdered pumice-stone. Then wash again, and polish with a fine piece of pumicestone. The finish thus imparted is unfit for chalk work.

(50) D. S. asks: How is a fine oil finish put on furniture? A. Take boiled linseed oil 1 pint, yellow wax 4 ozs. Melt together, and color with alkanet root to impart a reddish tinge.

(51) J. F. M. asks: Please give me a recipe for a liquid dressing for shoes? A. Take gum arabic 4 ozs., molasses 1½ ozs., good black ink ¼ pint, strong vinegar 2 ozs., spirit of wine 1 oz., sweet oil 1 oz. Dissolve the gum in the ink, add the oil, rub them in a mortar until thoroughly united; then add the vinegar, lastly the spirit.

(52) J. C. B. asks: How can I fasten a thin strip of hard rubber to a similar strip of steel or other metal? A. Make a thin solution of glue, and gradually add pulverized wood ashes till you have a stiff varnish. Use this cement hot.

(53) J. F. G. asks: 1. What proposition in Euclid is known by the name of *pons asinorum*? Some maintain that it was the 5th of book I, namely: The angles at the base of an isosceles triangle are equal, etc., others say that it is the 47th of the same book. "The square on the hypothenuse of a rightangled triangle is equal to the sum of the squares on the other two sides." A. The *pons asinorum* is proposition 5, book I; and the name is given to it by schoolboys, and is supposed to be an allusion to its being the first difficult proposition which the beginner encounters. Proposition 47, book I, is called the Pythagorean theorem, it having been demonstrated by Pythagoras.

(54) F. R. asks: How can I calculate the weight of iron and brass castings from the weight of the wooden patterns? A. Brass castings weigh 17 to 19 times the weight of a pine wood pattern. Iron castings weigh 16 times the same.

(55) A. E. B. asks: How many lbs. to the cubic foot is the maximum that water can float? A. About 62½.

(56) J. B. H. asks: Is there a clock made that winds itself while running? A. No. Such a machine would be a perpetual motion, which is impossible.

(57) I. R. & Co. ask: What is the process for making crocus or composition for polishing, used in nickel plating? A. Crocus is made by putting tin, as pure as possible into a glass vessel, and pour in sufficient nitric acid to cover it. Great heat is evolved, and care must be taken not to inhale the fumes, as they are poisonous. When there is nothing left but a white powder, it should be heated by a Hessian crucible, to drive off the nitric acid.

(58) M. G. A. asks: Where does rattan grow? A. The rattan (*ratan*, Webster) is a sprout from the sugar cane after the cane has been cut.

1. What is the length of the Suez canal? A. About 100 miles. 2. How long was it being built? A. About 10 years. 3. How many locks has it? A. None. The fresh water canal, made for supplying water to the laborers, etc., has locks; we do not know how many.

(59) A. J. asks: Can you give me a recipe for making a black composition in imitation of jet? A. The usual substitute for jet is ebonite or vulcanite, a patented preparation of India rubber.

(60) E. J. F. asks: How is the pattern produced on marbled paper? A. Use finely ground pigments, mixed with water to the consistence of paste. Make a square box about 2 inches deep, large enough to hold an open sheet of your paper. Fill it within ½ inch of the top with a solution of ½ lb. gum tragacanth to 6 quarts water. Strain the solution. Take a long water color brush, and put stripes of the desired pigments on the surface of the gum solution; pass a metal comb through the stripes in a zigzag direction, according to to taste. Dampen the paper, and take 1 sheet of it by two opposite corners, and lay it evenly on the colors, flatten it gently with the hand, lift carefully off, and hang up to dry. When thoroughly dry, polish with a smooth piece of flint.

(61) G. F. E. asks: How can I impart a crystal-looking finish to brass? A. By using a steel scraper or a stick of wood covered with emery paper over the surface. Work it in a circular direction. A slip of Arkansas oilstone, dipped in oil, gives a good effect.

(62) F. D. asks: How can I strip bark from willow twigs, and how can I split the same for making baskets? A. Osier or willow twigs are peeled by soaking them in water till the bark becomes loose, and then stripping them. We believe they are split with a common knife.

(63) N. S., of St. Petersburgh, Russia, asks: 1. How is the rudder of the non-heeling boat represented on p. 287, vol. 35, fixed, so that the after part of the frame does not interfere with it? A. The rudder is fixed to the stern post in the ordinary way. 2. On what theory is the Ocean Queen, shown in the same illustration, built? A. All the information we have on this subject is in the article and illustration.

(64) J. W. S. asks: Is tragacanth mucilage used for any purpose other than by shoemakers and druggists for pasting on labels? A. Yes. It is employed by water color artists, ink manufacturers, manufacturing chemists, and pharmaceutists, and is used extensively in the preparation of mucilage.

1. Can you give me the specific gravities of wax, paraffin, lard, and tallow, at their melting points? A. No, but they are all considerably less than that of water. 2. How can I cast paraffin in a metal mold? A. Coat the mold with a film of olive oil and the paraffin may be readily removed without heating. We think you will experience no difficulty in removing the cast from the mold as you suggest, but in this case the outlines may possibly not be quite so sharp as when removed, after cooling, from the oiled mold.

(65) A. B. T. says: Please inform me how to prepare picture canvas, so that it shall be pliable? A. The canvas cannot be well prepared by amateurs. The materials employed are whiting and glue size.

(66) H. J. asks: In your issue of December 2 is a recipe for hot waterproof cement, in which soluble acid and chromate of lime is to be used. I have been to several drug stores for the chromate of lime, but no one seems to know what it is. Is there any mistake? A. The chromate of lime is a by-product from the manufacture of the chromates of potassa, lead, etc. It may be formed by dissolving one part of lime (caustic) and four parts of chromic acid (by weight) in the smallest possible quantity of pure hot water, decanting the solution and allowing to cool slowly. Under these circumstances the pure salt will crystallize out; or boil the lime with 5 parts of bichromate of potassa dissolved in water, decant the liquid, and dissolve the residue in two parts of chromic acid in water as before. You can obtain this salt by writing to one of the large dealers in laboratory chemicals and utensils in this, or other large cities. There is no mistake in the recipe.

(67) M. D. asks: Why must a smoothing iron be hot to iron clothes? A. To expel the moisture from the starch and convert it into a stiff glaze.

(68) A. A. M. asks: In what solution can I put a beef tongue for a short time, to peel the skin without cooking, and which is not injurious to the meat or the health? A. This cannot be accomplished.

(69) J. D. says: I have some glass curtain pins or knobs in my room; they are hollow, and coated with mercury in the inside. One of them was exposed to the sun and it has lost its brilliancy and reflective power. Was it the heat of the sun that destroyed it? If so, at what degree of heat did it do it? A. If the air in contact with the amalgam was at all contaminated by the products of combustion, which contain sulphurous acid or the exhalations from drain pipes or sewers, the continued heating of the mercury by the direct sunlight might easily determine the gradual formation of the gray film of suboxide or sulphide as the case might be. 2. If a mirror is placed in the sun will the heat destroy it? A. In pure air, sunlight or heat below 600° Fah. has no effect on pure mercury.

(70) H. Y., Jr., asks: Does chewing tobacco have any effect in reducing the flesh and weight of the human body, or does it otherwise make a man thin and soft? A. Yes, especially if he is of a nervous temperament. Its tendency is to injure the human system in various ways. The injury is developed differently in different individuals.

(71) L. O. asks: 1. How shall I make nitrate of iron? A. Place in a suitable vessel a large quantity of clean iron in small scraps, and just cover it with dilute nitric acid (one of the acid to two of water). Heat nearly to boiling, and maintain at this temperature until there is no further evolution of gaseous nitric oxide. This gas should be conducted into a large chimney filled with fragments of brick moistened constantly with water. If the gas be kept from contact with the air it remains colorless and insoluble in water. It should therefore be mixed with a sufficient quantity of air before it is permitted to enter the condenser. When the evolution of gas has ceased, add a quantity of pure water equal to the volume of the dilute acid originally introduced, heat nearly to boiling and siphon off into suitable evaporating vessels, and concentrate the solution by slow evaporation. When the nitrate of iron begins to separate it should be removed from the solution as fast as formed, placed upon a suitable drain (a large covered funnel will answer very well)—and the superfluous fluid allowed to run off. The solution in the evaporating dish should have fresh portions of the strong iron solution added to it from time to time; the solution should never be allowed to approach dryness. The nitrate of iron may be purified by recrystallization from an aqueous solution, draining and drying. In order to avoid a loss of materials in the first operation, the iron scrap should be in large excess of the acid, and these conditions should be maintained during the process of solution. 2. How shall I make nitric acid? A. Introduce into a large glass or porcelain retort, the neck (beak) of which should fit snugly into the end of a glass condenser, equal weights of strong oil of vitriol and niter (nitrate of potassa) or nitrate of soda. The retort is seated upon a sand bath beneath which heat is applied gradually when the saltpeter is decomposed by the sulphuric acid, with the formation of nitric acid which distils over and sulphate of potassa or soda as the salt may be, which remains behind in the retort. We would advise you before beginning the manufacture of this acid to consult some good work on technical chemistry.

(72) W. H. H. says: 1. I want to construct a telegraph line, ¼ or ½ mile in length. For insulators, can I use rubber loops to hang the wire in? A. Rubber loops will answer if a return wire is used, but the ordinary insulators are preferable. 2. Which is strongest, 6 half gallon Callaud batteries or 3 one gallon? A. The 6 small jars will answer your purpose best. 3. If I order a sounder to be made for a ¼ mile line, will it work equally well on a 250 feet or a 1 mile line, if number of batteries are changed? A. If changed so as to give the same strength of current, yes. 4. On how long a line can I use a simple sounder without relay? A. That will depend on the resistance of the circuit. An ordinary sounder will not work well with the usual battery power if the circuit exceeds 10 or 15 ohms resistance.

(73) S. A. H. asks: 1. How should I set a two flue boiler so as to make steam as fast as possible? A. You will find good methods explained on p. 339, vol. 33. 2. Should the grates be at the center or end of the boiler? A. Grates at the end will be sufficient.

(74) R. S. F. says: I have a magneto-electric machine, but the current is not strong enough. How can I increase it? A. If increased battery power does no good, the coil may be defective. It is difficult to give definite advice without seeing the coil.

(75) H. C. N. asks: Is there any chemical that may be mixed with plaster of Paris before setting (or any dip in which it may be immersed after setting) to cause it to stand heat almost to redness without cracking, warping, or crumbling? Are there any cements (for stone brick) that will stand this test? A. If the plaster be pure it will stand heating to full redness without cracking, provided this is done slowly and uniformly so as to first expel all the water. After once rendering anhydrous by the above treatment, it will withstand a bright red heat. This precaution must, however, be heeded: don't treat the substance suddenly. It is better to mix the plaster with a little lime (1 to 3) and fine sand before baking.

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

W. L. M.—They are small quartz crystals, the angles of which have been only partially destroyed by corrosion.—C. K.—Your samples are all iron pyrites—sulphide of iron.—O. P. (of Worcester, Mass.) should send us a large piece of his mineral.—T. K. & Co.—It is braunite, or sesquioxide of manganese.—R. W. Co.—It is an argillaceous and calcareous sediment, containing much organic matters.—C. A. McO.—It is galena—sulphide of lead.—J. W. B.—No. 1 is an impure limestone colored by sesquioxide of chromium and iron. No. 2 is a felspattic rock. No. 3 contains amorphous and crystalline carbonate of lime, clay-slate, and iron pyrites.—R. E. M.—It is asphalt (bitumen), of some value if in large quantities. Its solutions in naphtha or turpentine are largely employed as a protecting varnish for exposed metal and woodwork, particularly the hulls of vessels. Large quantities of it are consumed in the preparation of asphaltum pavements and roofs.—T. K. & Co. (H. J. M.)—It is braunite or sesquioxide of manganese.—The specimens numbered 1, 2, and 3 in large tin box (painted blue) are sulphide of nickel and iron. Valuable if in large quantities. There was no name or address on the package, and the postage stamps were 24 cents short.—H. H.—It is what is known as "spongio-piline," a kind of felting made from sponge. It is used to some extent by medical men.—J. A. S.—It is arsenical iron pyrites. If in large quantity, it may be worked as a source of arsenic.

COMMUNICATIONS RECEIVED.

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

On Emigration to New South Wales. By A. E. B.
On the Lumber Trade of Pennsylvania. By W. T. L.
On Subjects for Discussion. By J. H. A.

Also inquiries and answers from the following:
R. R.—C. W. T.—J. S. A.—W. G.—J. H. R.—W. H. N.—J. R. Q.—W. T. H.—E. P.—J. K.

HINTS TO CORRESPONDENTS.

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

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

Hundreds of inquiries analogous to the following are sent: "Who sells prisms, fit for use in a *camera lucida*? Who sells a small steam engine, suitable for driving one sewing machine? Who sells parts for working models of locomotive engines? Whose is the best surveyor's levelling instrument? Where can phosphor bronze be bought? Who sells mineral specimens for the cabinets of collectors? Whose is the best microscope for scientific investigation? All such personal inquiries are printed, as will be observed, in the column of "Business and Personal," which is specially set apart for that purpose, subject to the charge mentioned at the head of that column. Almost any desired information can in this way be expeditiously obtained.

[OFFICIAL.]

INDEX OF INVENTIONS

FOR WHICH

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

November 28, 1876.

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

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

Acetic acid, making, E. R. Squibb	185,141
Animal trap, C. Koons	185,110
Baling manure, P. C. Ingersoll	185,106
Bandsawing machine, G. B. Phillips	185,045
Barrel cover, McClellan & McBride	184,976
Beer, utilizing waste of, J. J. Suckert	184,994
Belt shifter, F. B. Miles	185,120
Belt-shipping mechanism, G. E. Taft	184,999
Bilge water ejector, R. S. Little	185,115
Bill file, B. J. Beck	185,066
Blowing toy, H. J. Green	185,025
Book sewing machine, G. W. Glazier	184,961
Book sewing machine, J. C. Smyth	184,989
Brick and peat machine, D. Woodbury	185,057
Brick kiln, E. W. Bingham	185,068
Burglar alarm, J. B. Underwood	185,148
Calendar clock, A. Phelps	185,128
Car berth supporter, T. Grant	185,098
Car coupling, E. M. Parrott	185,126
Car coupling wedge, W. B. Dunning	185,087
Car door, G. B. Kiteley	184,971
Car door hanging device, E. E. Pratt	184,983
Car spring, J. S. Lash	184,973
Car starter, A. Whittemore	185,006
Car truck, prismoidal, E. B. Dorsey	185,019
Carving fork, E. Cady	185,074
Case for toilet papers, E. W. Dennison	185,082
Caster bottle, Weber & Wilhelm	185,002
Charbon roux, making, G. L. Harrison, Jr	184,963
Check rower, J. W. Fawkes	185,092
Cheese press, T. A. Murphy	185,124
Churn dasher Duval & Morton	185,088
Clamp for holding rail pieces, C. Lamb	185,111
Clamp for quilting frames, I. W. Doeg	184,957
Clamp for wire rope, H. R. Taylor	184,995
Clock movement, F. Kroeber	184,972
Clothes drier, J. R. Rusby	184,985
Compensating pendulum, E. M. Gorwin	185,016
Compound engine, R. Bogardus	184,951
Compound tool, S. B. Mayfield	185,038
Corn husking machine, J. Lund	185,036
Corn planter, A. M. Southard	185,140
Corset, M. P. Bray	185,071
Cotton bale tightener, C. E. Boardman	185,070
Cotton sweep, H. C. Buhoup	185,073
Counting alarmapparatus, F. L. Burns	184,954
Culinary utensil, Kellogg & Lintner	185,109
Cultivating plow, McAllister & McDonald	185,039
Cultivator coupling, H. Feltman	184,960
Cup and ball toy, G. Schoen	185,049
Curd mill, J. P. Bellinger	185,012
Curtain fixture, R. J. Pospisil	184,982
Cutting stone, I. W. Bradbury	185,072
Dental plugger, R. B. Donaldson	185,085

DESIGNS PATENTED.

9,661.—GLASS, ETC.—J. E. Heuacker, Newark, N. J.
9,662.—RUBBER SHOES.—C. Meyer, New Brunswick, N. J.
9,663, 9,664.—DRAWER-PULLS.—W. N. Weeden, Waterbury, Conn.
9,665.—TYPES.—R. Smith, Philadelphia, Pa.

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