the double bottom with full force, until a layer of scum of the thickness of a finger has formed on the surface of the juice, when the valve must be closed little by little, but in such a gradual manner that just as ebullition declares itself in the liquid the steam must have been cut off to one-quarter of its original quantity. This last portion of steam is itself to be suddenly suppressed, as soon as ebullition and consequent termination of defecation indicated by a sudden irruption of clear juice on the upper surface of the scums, have manifested themselves. The defecating operator must always be a man of experience, as much is left to his empirical judgment.

The signs by which a favorably-progressing defecation are known, are as follows:

1. The scums must gradually form at the surface of the juice, in large flakes of a greenish-brown color.

2. These flakes must unite into a thick layer in which large crevices form, through which the limpid juice below is discernible.

If the scums are of a yellow color and look thin, or if ebullition takes place at too early a period, some unnatural alteration in the juice must have taken place, either through heating or putrefaction consequent on the thawing of the beet root, or through the action of fermentation brought on by impure water left in the reservoir or in the *monte-jus*, or lastly, by the use of imperfectly worked sacks.

In our next article, we shall give an account of the mode of preparing the milk of lime used in defecation, and the manner of "dosing" it to the juice. We shall also attempt to give a general idea of the *rationale* of defecation, and proceed to explain the necessity for carbonatation and the mode of effecting it.

The estimate and valuation in gold for the defecating department of a factory for working 150,000 lbs. of beet root every twenty-four hours, is as follows:

Three copper defecating pans, with cast-iron false bottoms, with all their special fixtures, cocks, valves, etc., same capacity as *monte-jus*. Cost, $1,320.

Copper feed pipe, with three cocks for juice, and iron pipe with three cocks for water for washing out pans. Cost, $100.

Total, for a defecating department of a 500-acre factory, $1,420.

Correspondence.

The Editors are not responsible for the Opinions expressed by their Correspondents.

The Singing Mouse.

MESSRS. EDITORS:—It was in the summer of 1867, when I was seated near where the casing of the water pipes passed up through a closet, that I heard what I supposed to be the twittering of a brood of chimney birds within the casing. Some days afterward the cook reported that there was a large nest of mice in a box of fuel near the range in the kitchen. We were at dinner, and I passed out to capture and kill the pests Listening to the sounds, I again pronounced it a brood of birds that must have fallen down with their nest from an adjoining chimney, as the sounds were not those of mice. Removing everything, I found that the sounds did not proceed from the box, but were behind the woodwork of the wall near the floor. Nor did the music, as I may call it, cease when I made several hard raps upon the woodwork. This convinced me that the sounds had their origin at a distance, and were conveyed to that point as through a tube. That evening, when I passed round to see if all the house had been safely closed, the music appeared to be in a different locality, and as all was still, I studied attentively the character of the sounds, and became convinced they were not produced by birds.

On my making a disturbance it ceased. Thus the music continued for two or three days, when one evening I heard it in the china closet of the dining-room, apparently behind a tray on the shelf. But in removing some plates to investigate the matter, the shuffling frightened a mouse, which made good its escape away from the tray and ran into a hole at the corner of one of the shelves. The music then ceased. This was not positive proof that the mouse was the performer in the singing. On the next night I heard the music again in the same place, and having previously adjusted the dishes to suit me, I supposed I would easily capture the musician; but the cook had re-adjusted the dishes, and in shifting them a mouse had again run away, and the music ceased as before; fortunately, however, this time the music was resumed in the place into which it had retreated, affording ample evidence that that the mouse was the author of the music.

The mice being annoying, the cook, next day, introduced a cat into the cellar, and, on the following night, the mouse had retreated up the chimney flues to our bed-room, on the second floor above the dining-room.

About two o'clock A. M., on awaking, I heard the music distinctly proceeding from the hearth beneath the grate. It was loud enough to be heard throughrout our large bed-room. My wife, who had been ill and unable to go down to the dining-room, had doubted our reports; but when I awakened her, she sat up for more than an hour, completely fascinated by the little songster.

On the next night a suitable trap was set and the mouse was captured without injury, but unfortunately, it escaped while we attempted to remove it to better lodging. One very peculiar trait in its character was, that it continued to sing during the whole time it was a prisoner.

On the next night it was again captured and safely disposed of in a secure cage with a wheel.

The cook reported another singing mouse in the kitchen, and a new and elegant cage was procured for our little captive. Its musical notes were identical, as near as we could judge, with the warbling notes of the canary bird. At times, only a single note would be sounded, and after a pause the performer would dash off its warbling notes for hours—even for nearly half a day. Then it would cease and rest, sleeping, perhaps, as it retired to its bed.

This cessation of singing for hours, proved that its performances were not *involuntary*, from a diseased condition of the throat, as has been conjectured in other similar cases, because it could sing and cease from its music at will.

In the wheel of its cage the singing was somewhat interrupted by its efforts, and was not so perfect as when the mouse was in the cage itself. When it appeared to become fatigued with the effort of turning the wheel, sympathy was enlisted in its behalf and the wheel was tied so as not to revolve. This was a fatal mistake, as the mouse then began to nibble at the wires of the wheel in trying to escape. The wires had been painted with white lead, and the mouse was poisoned, and died, to the great grief of the family. It now stands in the parlor, under a glass globe, being neatly set up by a taxidermist. DAVID CHRISTY.

New York city.

Testing Boilers.

MESSRS. EDITORS:—Justice to a class of men known as inspectors of boilers, selected for their acknowledged skill and experience in practical engineering, imperatively demands an answer to your correspondent "J. H. L.," with a view to refuting his arguments on page 182, current volume. As he does not hurl his thunder against any particular division of boilers, I take it for granted that steamboat boilers are meant also.

First, his statement that boilers are subjected to a hydraulic (hydrostatic) test of two hundred pounds, and allowed a steam pressure of eighty pounds, is incorrect, as a simple reference to the steamboat law will show; for the proportion there established is as 165 is to 110; or plainer, the hydrostatic exceeds the steam pressure by one-half; whereas two hundred pounds exceeds eighty pounds two and a half times. I fully concur with him in that this excessive pressure would greatly weaken the boiler, if it were applied, but happily such is not the case. Second, the temporizing, of which he so loudly complains, may be a distinguishing feature of his locality, but in most, if not all, of the ports of inspection it has no being. Lastly, the condemnation that he pronounces upon the test, serves but to show his unacquaintance with its history; for the large reduction in disasters from this cause amply proves the correctness of the theory. And the method of examining the boilers internally and externally is not original with him, and is practiced by inspectors after the test. I can assure the gentleman that nothing can make up the deficiency or carelessness of the engineer, whether it is attempted in the shape of laws or safety appliances to the boilers. Let an employer secure the services of an attentive, skillful engineer, and, my word for it, all will be well, and nothing will be heard of incompetent inspectors and excessive tests.

JAMES BUTLER.

New Orleans, La.

[We do not see how the temperate communication of J. H. L. should arouse so harsh a spirit in Mr. Butler. J. H. L.'s article appears to be merely suggestive and advisory, and in no sense arbitrary or combative. The facts he stated are too well established by experience and observation to be overthrown by the style of attack chosen by Mr. Butler.—EDS.

The Law of Steam.

MESSRS. EDITORS:—The formulæ for determining the latent heat of steam from the temperature indicated by the thermometer, given incidentally by me in my article on the "Law of Steam," published in the last issue of the SCIENTIFIC AMERICAN, and which I took from John Sewell's well-known treatise on "Steam and Locomotion," are incorrect, and as such, liable to lead persons who are not familiar with the theory of latent heat into error.

I take this first opportunity of putting the matter right by furnishing the true formulæ as they should have been stated.

To find the units of latent heat in steam when the thermometric indications are known, use the following:

For the Centigrade scale, $T \cdot 305 + 606 \cdot 5 - T = L$.

" Fahrenheit " $(T-32) \cdot 305 + 1123 \cdot 7 - (T-32) = L$.

In both of which T is the observed temperature of the steam, and L the latent heat.

The number of 17 Centigrade units, which I have given as the *approximate* difference between two terms of the arithmetical progression of my law of steam, being supposed correct, the corresponding figure for the Fahrenheit scale ought to be $17 \times 1 \cdot 8$ or $30 \cdot 6$ Fahrenheit units.

I find, after a careful comparison of the mean pressures and corresponding temperatures *observed* by the Franklin Institute Committee, that the result of their numerous experiments indicates a general average of 30·7 Fah. units, showing as highly satisfactory accordance between the deductions of my theory and their practical results, as I had previously found to exist in regard to the experiments of the French Academy and of Regnault.

J. M. DEBY.

A Challenge to Watchmakers.

MESSRS. EDITORS:—My second challenge to watchmakers is founded on simple, well-known facts, clearly explained in the following:

First, correct poise requires the balance to be poised in its place in the escapement. Second, vibrations of variable extent, in equal motive force, cannot keep their rate unless they are isochronal. Third, equal extent in the vibrations is impracticable in contrary positions of the watch. Fourth, opposite positions must be used in the process of poising balances.

This challenge is intended for all pocket chronometer makers, to the effect that they cannot poise their balances properly, unless they have friction isochronism in the escapement ("isochronal hairsprings" or not), for two reasons: one is the variable resistance to the motion of the balance, in the opposite positions of the movements while testing its equilibrium; the other reason is the variable impulse in equal motive force, such as results more or less from imperfect unlocking in a different position, striking the pallet upward, etc.

As a general thing, all causes (variable and capricious frictions, and variable impulse to the balance) of change in motion, in which the mainspring has no part, have the same effect as altered friction, and like the latter, come under the control of friction-isochronism.

The balance may be exactly poised to suit the circumstances of a case, but as soon as these foreign influences change (neutralize each other, or act in concert), the balance will show defective poise. It is therefore explained that the resistance and impulse effects must be isochronalized before the poise process can be begun. J. MUMA.

Hanover, Pa.

Finish of Paper Collars.

MESSRS. EDITORS:—Some time since you noticed the receipt of a linen-finish paper collar that had been blackened by sulphureted hydrogen. You said that should not be taken as a conclusive test of the presence of lead, but other tests should be applied. I inclose a cuff on which I placed a drop of solution of bichromate of potassa, which appears to indicate the presence of lead by the formation of chrome yellow, as is shown by the contrast between that and the pale yellow spot caused by the bichromate on the "unfinished" side. A piece of the "finished" surface also gave a yellow incrustation when heated on charcoal before the blow pipe, but failed to do so when heated in the same manner with carbonate of soda.

Charlotte, Maine. H. A. SPRAGUE.

[There is no doubt that the specimen inclosed by our correspondent contains lead.—EDS.

A Valued Testimonial.

MESSRS. MUNN & CO.:—In token of my appreciation of your valuable services to my house, as a reliable medium to procure patents, I feel it not only a pleasure, but a duty due to you, to say that within the past four months I have made application for nine patents through your office, and in every case you have been successful. The fidelity and honesty with which you have treated my business, together with the gentlemanly courtesy which I have received, not only from the heads of your house but from all your large staff of employés, in your New York as well in your branch office in Washington, constrain me to send you this. The character of your business is too well established to require any further testimony, but if this can be of any use, I shall be pleased. With my best wishes, Yours respectfully,

CHARLES PRATT.

108 Fulton street, New York, March 26, 1869.

[The above is from of one of the largest dealers in, and canners of oil in the country, and the patents referred to pertain solely to his business. Mr. Pratt's facilities for transacting business are such that he can make 10,000 cans, and fill, seal, and ship 50,000 gallons of oil per day. The value of the solder consumed in this concern amounts to $20,000 annually. Every kind of oil is dealt in by Mr. Pratt, and any package, whether illuminating or lubricating oil, bearing his trademark, can be relied upon as being all it is represented to be. His advertisement may always be seen in our columns, to which the reader is referred for further information.—EDS.

For the Scientific American.

GRAVITATION THE ORIGIN OF THE HEAT OF THE SUN

Having traced back in a former article (page 198) the source of all motion and of all life on our planet to be the heat of the sun, the answer to the question as to the source of this heat, becomes of still greater importance than it has ever been. Considered from this point of view the solar heat is an enormous motive power, stored up when the solar orb was formed, by the very act of its formation, and now this power is gradually returning into space, carried forward by the radiation of the sun's rays; here and there this power reappears in the form of motion, on the surface of some planet where the conditions to this transformation are favorable.

I attempted in the former article to point out that, as chemistry has taught how matter shows itself to us under the most varied forms, and undergoes the most surprising transformations in its properties, even so the modern investigations in regard to force have proved that, being nothing but matter in motion, force will show itself also under different forms, and also undergo astonishing transformations, from motion of masses to molecular motion, the last of which may be vibratory, rotatory, etc., and produce the phenomena of heat, elasticity, etc.

It has also been proved that just as matter is indestructible, so that not an atom can be created or destroyed by man, even so force (matter in motion) is indestructible, and that not the least trace of force can be created or destroyed by man; and like as the universe contains a certain measured amount of matter, so also it contains a certain measured amount of force, which means that even as the sum total of all matter is a constant quantity, so also the sum total of all force or motion is a constant quantity.

I wish now to point out how a modification of the nebular hypothesis of Laplace will explain consistently the origin of the sun's heat, in accordance to the present state of our knowledge in regard to the relation between heat and force, and the convertibility of one into the other.

Laplace supposed that all matter in the universe was once in a state of vapor, or was a nebula, and that by cooling it had contracted, and thus by further contraction formed the sun, stars, planetary systems, etc. This hypothesis presupposes the previous existence of an enormous high temperature, as well as the existence of the matter, the loss of the heat by radiation, the contraction subsequent on cooling, etc. When we, however, accept nothing but the existence of matter and of gravitation urging this matter to coalesce in diverse common centers of attraction, and apply to this supposition our present knowledge of the change of apparently destroyed motion into caloric, Laplace's hypothesis is at once elevated into a theory, and we may accept that when matter, at first diffused in the universe, and, urged by gravitation, commenced to coalesce in different centers of attraction, and had there this motion destroyed by opposing forces (viz., matter falling in opposite directions), the visible motion of the masses had necessarily to be changed into molecular motion, viz., heat.

When now we take in consideration the enormous amount of matter falling together, and the almost immeasurable distances through which it fell, and apply to it the rule proved by modern mechanics, that the falling of 760 pounds 1 foot, or 1 pound 760 feet, will produce one unit of heat, the number of units of heat produced at the formation of sun and planets must have been so immense that it takes thousands of millions of years to cool such large masses, raised to so high temperatures, by radiation, a process which has been going on in the planets, as is proved in regard to our earth by geology, and as also is going on at present, as we know in regard to our sun by daily experience.

The old hypothesis of Herschel, still also copied in some of our school books, that the sun is a dark, cold, solid body, surrounded by a luminous atmosphere, is utterly disproved by the investigations by means of the most valuable inventions of our decade—the spectroscope. Indeed, this instrument has not only proved that the sun possesses a high temperature, but also that this high temperature is not the result of a permanent combustion, like the high temperature on our earth (excepting volcanic fires), and also that this temperature is so high that most substances solid on our earth are surrounding the globe of the sun as an atmosphere in the state of vapor, as some of our metals, iron, nickel, sodium, etc.

The ideas here presented were fully developed by the writer three years ago, before the American Institute, New York City, in a series of three lectures on the universe, its past history, present condition, and its probable final fate, which lectures are found in the Transactions of the Institute for 1866.

If, then, the law of gravitation is the sole source of the sun's heat, and also of our ocean tides, and the sun's heat the cause of all motion on our planet, we must come to the conclusion that the simple and single law of gravitation once acting mutually between particles of matter dispersed in space, is the primary cause of all other forces, and that all the complex actions of life and other motions on the surface of our earth, being traceable back to the simple law, are only gravitation in disguise. P. H. VANDER WEYDE, M. D.

Causes of Steam Boiler Explosions.

It is certain that any information as to the circumstances of steam boiler explosions, even if it does not give the causes, is valuable. We copy a few remarks from the fourteenth half-yearly report of the Chief Engineer of the Midland (Eng.) Steam Boiler Inspection and Assurance Company, which may be of real use.

"At the end of the year 1868, 1,103 boilers were under inspection, and 1,530 under assurance, making a total of 2,633. These boilers were used for the following purposes: 1,238 in collieries, 1,156 in ironworks, and 239 in mills of various kinds. The boilers were of the following general description: 2,205 fired externally, and 428 fired internally.

"During the year, there have been made 11,900 inspections of boilers, 1,483 of which have been internal, and 1,361 in the flues, and 1,656 reports have been sent to the owners. The following brief epitome of the chief points referred to in these reports may be of general interest:

"The point of first consideration is the general construction or repair of the boilers, and the arrangement of the flues. Many boilers have been taken out as not being fit for the required pressure. Some or these have been discarded because the plates were arranged lengthways in the boilers, producing in the weakest position, long, straight seams without any crossing of joints. In some cases this weakness has been increased, by the inside lap of each plate being so small, that the rivet holes were almost at the edge of the plates. The flat ends of boilers have been frequently found insufficiently stayed, especially were tubes have been removed, and it has been at times difficult to convince owners of the danger of this, although the ends have been shown to be bulged from weakness. Some few machine-made boilers have been found quite unfit for use, simply because the work was inaccurately done. There is no question, boilers can be well made by machinery, but if the work is placed carelessly, so that the plates do not meet, or the rivets are not struck fairly, the boiler cannot be made sound. Boilers are constantly noticed needlessly weakened in order to obtain the doubtful benefit of a dome, especially where the hole in the shell is its full diameter. One small boiler (9 ft. 6 in. by 3 ft. 6 in.—30 lbs.) was pierced with so many holes for fittings in one line on the top, that more than one-half the strength of the shell was lost.

"Boilers of good design and safe proportions are frequently made insecure by injudicious alterations. Tubes are taken out without any compensation for the loss of strength, and stays or tie-bolts are allowed to get slack. This has been more particularly noticed in upright furnace boilers, where new bottoms have been made nearly flat instead of hemispherical, causing a new strain on the angle iron and on the old work. In a somewhat similar way, mischief is often done by altering the arrangements of the puddling furnaces, or by substituting large mill furnaces, so that the boiler is exposed to more heat than the metal can transmit, or the water convey away in the shape of steam, and the plates become injured. Sometimes the exact contrary is done, and a furnace is discontinued, and half a boiler is exposed to cold air, while the other is furiously heated, causing a new and unequal strain.

"Sometimes internal tubes have been found forced out of the circular shape, for want of strengthening rings or other means of security. Manholes have been found in a dangerous state from want of guard rings, the edges of the plates having perished or cracked, rendering it impossible to make a good joint, and the continual leaking has made the matter worse. Serious complaint has had to be made of some of the workmanship in repairs, by which boilers have been nearly ruined.

"Corrosion has as usual proved a serious evil. Suspicion was entertained that corrosion existed on the side of a plain cylinder boiler (22 by 5—16 lbs.), from its peculiar position below the surface of the ground, and on the brickwork being removed, the plates were found so dangerously thin all along the side, that holes were knocked through them with a light hammer. Some boilers have worked a long time with a brick covering to prevent radiation, corrosion was suspected beneath, and on removing the covering, every plate was found so thin as to make them quite unsafe. The tops of some plain cylinder boilers were frequently found wet from the leaking of the fittings and feed pipes, and as it was known that this could not continue without causing mischief, examination was urged, and the most dangerous corrosion was found, in boilers which ought to have worked many years longer without repair.

"A vast number of safety valves are found needlessly overloaded, while the steam gages are often out of order and inaccurate. As the gages become only gradually defective, the evil is not seen unless they are trusted long after they are incorrect. The habit of putting them on the steam pipes, where the pressure is always varying, causes them unnecessary wear. It is always best to have one attached close to each boiler, but where they must be in the engine house, or one has to serve for several boilers, they should be attached by separate pipes. It would often lead to great improvement, in the duty of engines working night and day, if the steam and vacuum gages were self-registering."

Poisonous Dyes.

At a recent meeting of the Académie Impériale de Médecine, M. Tardieu made a communication touching the poisonous action of some modern dyes. He reminded his hearers that M. Cerise had confirmed his former statements respecting the poisonous nature of coralline, by calling the attention of the Académie to a case of such poisoning produced by wearing socks dyed with this substance; and said further, that Dr. Despaull Ader had a marked case of the same kind, which, however, had not been published. Another case of a little girl who had suffered from the characteristic cutaneous eruption, brought on by wearing some garments dyed with coralline, of English manufacture, had been brought under his notice by Dr. Michalski, of Vierzon. These cases are examples of a special kind of poisoning, by means of a special poison—coralline—and are to be carefully kept distinct from other cases of a different kind, which M. Tardieu referred to. He mentioned that Dr. Viaud Grand-Marais, Professor in the Medical School of Nantes, had met with a case in which the poison contained in a dyed shirt was not coralline, but magenta, the well-known aniline-red. The poison in this case was the arsenic contained in the magenta, so that, strictly speaking, it was an example of arsenical poisoning. M. Tardieu called attention to the well-known fact of the employment of arsenic in the manufacture of magenta, and remarked that, despite all processes of purification, this dye almost invarably contains arsenic. In order to facilitate the collection of information relative to poisoning by means of dyes, and to avoid confusion, M. Tardieu gave a brief *resumé* of the distinctive chemical characters of the different organic red dyes to be met with in commerce. These dyes are six in number—garancine (madder), cochineal, murexide, carthamine, magenta, and coralline. The first three cannot be used in dyeing without a mordant; the last three are taken up by woolen or silk fabrics without it being necessary to employ a mordant. 1. Garancine (madder) is the most fixed of all the organic red dyes; it is not altered by a solution containing three or four per cent of hydrochloric acid or of ammonia. 2. Cochineal is turned violet by ammonia, and, at the same time, communicates a bright violet color to the ammoniacal liquid. 3. Murexide is bleached by citric acid. 4. Carthamine is decolorized by a short boiling with a weak solution of soap (about one part of soap in two hundred of water is enough). 5. Magenta is decolorized by ammonia. 6. Coralline is not diminished in intensity by contact with alkaline fluids. It is dissolved off the fabric by means of boiling alcohol, giving a red liquid, which is *intensified* by ammonia or potash, a character which at once distinguishes it from magenta. At the same meeting of the Académie, M. Chevallier observed that the confectioners who had been in the habit of coloring bon-bons with magenta, had received orders to substitute some other dye for that purpose.

Mr. Wanklyn, whose communications respecting the dangers of the modern dyes will be remembered, and who was, we believe, the first to point out the danger of arsenical poisoning, by means of magenta-dyed underclothing, writes to us to say that a composite dye is now very much in vogue, consisting of magenta, tinted with some orange-coloring matter. This dye, a splendid scarlet, very much used for underclothing, is doubly poisonous, and exposes the unfortunate wearer to the risk of being poisoned by arsenic, and the risk of being poisoned by an irritant orange dye.

The Great Pyramid.

The accurate measurement of the sides of the Great Pyramid, says the *Public Ledger*, is still attracting attention, and the result of the labors of the party of Royal Engineers of Great Britain, now engaged in this work, is waited for with much interest. The surveys, if correctly made, will settle many interesting points in reference to the units of lengths used among the ancients. Thus Herodotus states that the Egyptian cubit is equal to the Grecian cubit, and that the Great Pyramid has sides exactly five hundred Egyptian or Greek cubits in length, and covers exactly twenty-five aruræ or Egyptian acres, the arura containing one thousand square cubits. Again, the Parthenon at Athens, according to other historians, gives the Greek units of length, and by modern measurements of this ancient building, the mean length of the Greek foot is 12.149 inches, and of the Greek cubit 18·224 inches. Multiplying the cubit thus ascertained by 500, the length of the side of of the Great Pyramid should be 9,112 inches. The mean length of the side of the Pyramid as obtained by examining the structure itself, is calculated to be 9,110 inches, and thus a reasonably accurate standard of ancient measures has been fixed. The difficulty in the way of arriving at the true results is greatly enhanced by the fact that the casing stones of the Pyramid have been removed. The sockets cut in the rock to receive the corner blocks still remain, and the calculations as to the actual width of the casing stones are affected by errors arising from this source.

Fiber of Cocoanut Husks.

The method of converting cocoanut husks into useful fiber, is thus described in the *Mechanics' Magazine*:

The shell, or outer covering of the nut, is first soaked in a tank of water kept warm by steam. When sufficiently soaked, the shells are conveyed to a hopper, through which they are fed to a crushing mill, which consists of two coarsely-fluted rollers, between which the shells pass and are crushed. They are removed thence to the fiber mills. Here the shells are drawn in between two rollers, behind which are arrangements for tearing away the finer fiber and leaving the coarser in the hands of the operator, who presents first one and then the other half of the shell to the action of the mill. The coarse fiber is then carried away and prepared for conversion into brushes and brooms. The finer portions of the fiber are removed from the mill, and undergo a process of final dressing. This is effected by feeding them through a hopper into a circular screen, in which an Archimedean screw rapidly revolves. The fine fiber is delivered at the mouth of the screen, while the dust and smaller particles of fiber are carried through the sieve. The fiber thus produced is used for making mats and matting; the siftings find a ready sale with florists and market gardeners, for manure. The sweepings and refuse are collected and burned under the boilers.

Welding Powder.

A powder of the following composition, recently patented in Belgium, is said to be very useful for welding iron and steel together. It consists of one thousand parts of iron filings, five hundred parts of borax; fifty parts of balsam of copaiva or other resinous oils, with seventy-five parts of sal-ammoniac. These ingredients are well mixed together, heated, and pulverized. The process of welding is much the same as usual. The surfaces to be welded are powdered with the composition, and then brought to a cherry-red heat, at which the powder melts, when the portions to be united are taken from the fire and joined. If the pieces to be welded are too large to be both introduced at the same time into the forge, one can be first heated with the welding powder to a cherry-red heat, and the others afterward to a white heat, after which the welding may be effected. Another composition for the same object, consists of fifteen parts of borax, two parts of sal-ammoniac, and two parts of cyanide of potassium. These constituents are dissolved in water, and the water itself afterward evaporated at a low temperature.

LIQUEFACTION OF GASES.—Mr. Ladd has lately exhibited at the Royal Institution, London, a very elegant experiment, showing the liquefaction of gases by pressure. Three glass tubes, open at the bottom, containing cyanogen, sulphurous acid, and ammonia in their upper parts, and filled with mercury below, are inclosed in a strong glass cylinder filled with water. At the top of the cylinder is a small force-pump, which, when worked, drives more water into the cylinder, and forces the mercury, which acts as a piston up the tubes. As the mercury rises the gases are condensed, and now appear as liquids at the top. When the pressure is reduced by opening a stop-cock the liquids boil, and the gases speedily resume their normal dimensions.

A MONSTER BLAST.—A blast of unprecedented magnitude was recently set off at Smartville, California. The tunnel in which the enormous charge of powder, no less than 1,200 kegs—was placed, has been some time in progress. It was 570 feet in length, and undermined a mountain which it was desired to shatter for purposes of hydraulic mining. The charge was ignited by an electic wire, a romantic young lady being the one chosen to perform the task. The mountain was thoroughly shattered in the presence of thousands of people collected to see the novel sight.

Improved Style of Two-Wheeled Velocipedes.

Some time ago we intimated that the perfect velocipede was yet to be built; since then we have secured patents on a number of improvements, not possessed by any of their predecessors, and thus the point of perfection is being attained. The one represented in the accompanying engraving is well worthy the attention of velocipede riders and builders, for its simplicity of construction, cheapness of cost, ease of management, and adjustability for suiting the size and strength of the rider.

The frame is of hollow pipe, the rear being a complete circle in which the steering wheel rotates on its axis, the driving wheel running between the parallel bars of the front portion. The axle of this wheel passes through boxes secured to the parallel bars by set screws, so it may be adjusted forward or back to suit the *physique* of the rider. The axle of the steering wheel runs in boxes secured to sliding bars curved to fit the inner diameter of the circular portion of the frame, thus allowing this wheel with its axle to perform an entire revolution within the frame on a horizontal plane. Its movements are controlled by means of rods attached at one end to the ends of the axle, and at the other brought together to the lower end of a lever directly under the rider's seat, the handle of which comes up in front of the rider, the fulcrum being on a cross piece between the rear portion of the parallel bars, serving not only that purpose but that of a brace. It will be seen from the figure that the guiding of the vehicle may be effected by one hand. The seat need not be so high as represented in the engraving; it may be lowered until nearly to the level of the reach, which is the horizontal line of the axles.

MCDONALD'S ADJUSTABLE BICYCLE.

Such a vehicle is easily and cheaply constructed, and will operate with ease. The reach, which in the ordinary bicycle extends in an upward curve from the level of the rear axle to the top of the driving wheel, is easily made, while in others its forging adds greatly to the cost of the vehicle. In mounting the ordinary two-wheeled velocipede the rider must spring from the ground to a hight not easily reached by persons of obesity or of sluggish habits, and the danger of damage to both rider and vehicle is greatly enhanced by hight from the ground. If overturned, this machine cannot fall upon the rider, as the circular formation of the rear portion forbids a complete inversion. The danger of overturning this machine is still further diminished by the weight of the rider being brought nearer the center of suspension, as his seat may be brought very near the horizontal line of the axles without preventing or interfering with the action of his legs. The ease of guiding is sufficiently clear by an examination of the engraving, where the rider is shown as using only one hand for this purpose.

Patent pending through the Scientific American Patent Agency by C. E. McDonald, who may be addressed at Amsterdam, N. Y.

CULTIVATION OF THE POPPY AND MANUFACTURE OF OPIUM.

We are in receipt of inquiries in regard to the cultivation of poppies, and the manufacture of opium; it having been suggested by certain agricultural journals that there are various parts of the United States where this industry might be profitably introduced. The failure of several attempts which have hitherto been made to produce this costly drug in America, is justly considered as an insufficient reason for supposing it impossible to succeed in other parts of the country possessing more favorable circumstances of soil and climate.

The opium, which finds its way to European and American markets, is raised principally in India, China, and Persia. The climate of these parts of Asia seems peculiarly adapted to the growth of the species of poppy (*papaver somniferum*), from which opium is obtained; accumulating in the juice of the plant the peculiar substances which form the complex compound called opium. The latter is the dried juice of the plant obtained by tapping the capsules, which allows the juice to flow out and stand in drops upon the surface from which it is scraped with knives when it is dried sufficiently. Another method, that of dissolving out the remainder of the juice after tapping, with water, and evaporating the solution has been also practiced to supplement the former.

Each capsule will yield opium only once by tapping. The tapping should be performed a few days after the flower has fallen, and the incisions should be made horizontally, and not so deep as to cut into the inner portion of the capsule, as should this happen, the juice would flow into the cavity and be lost.

Various experiments have been made in England, France, and Scotland, to produce opium, with encouraging results. So far as our knowledge extends the attempts made here have not given much encouragement of final success.

The poppy will grow luxuriantly in almost any fine rich soil. It may be sown in hills sufficiently wide apart to admit of cultivation, and harvesting the opium as the capsules mature. Experiment alone will suffice to determine what soils and what section if any in this country will answer well for its cultivation, and what quantity of seed will do for a given quantity of land.

We see no reason to doubt, that in the very diversified conditions of climate and soil to be found in the United States, there may be some sections well adapted to the culture of opium, and thus another drain upon the resources of the country be cut off by home production.

SHAFTING, PULLEYS, AND BELTS.

No. II.

In our former article directions were given in regard to the preparation of the shaft sections for turning. The shaft having been centered and straightened is now ready for turning. Whatever may be the diameter of the shaft proportioned to its length, it should be supported about midway of its length by a rest secured to the ways of the lathe. Before adjusting this rest, however, the ends of the shaft should be squared up to the center hole with a side tool. If the vise centering was properly done, there is little danger of throwing the center out of true by this process. If so, a hand, half-round, conical-pointed reamer may be used to scrape the edge of the center hole until the shaft turns true. A good form of center rest is shown at Fig. 1, a front view. It is a casting in a circular form, with three equidistant projections for the reception of the bearing slides, shown in dotted lines in Fig. 1, and better in view, Fig. 2. These slides are simply plain castings with a slotted hole through their centers calculated, or filed to fit the recesses in the radial channels.

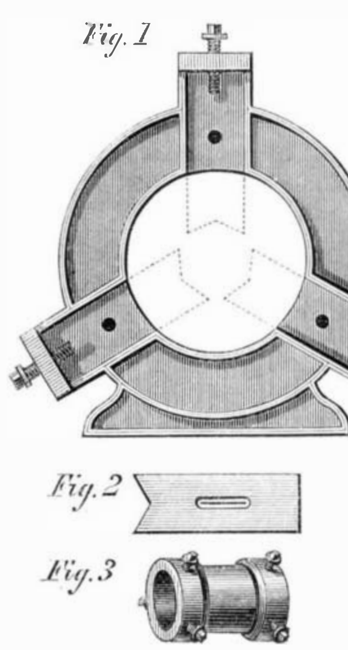

Fig. 1

Fig. 2

Fig. 3

Fig. 3 is a thimble fitted with three set screws at each end, placed equidistant, and set up when the thimble is on the shaft until its turned surface between the collars at either end runs perfectly true. The use of this thimble is much better than hand-tooling or filing a place on the shaft at the middle to receive the bearing slides directly upon the shaft, as it is impossible to get the shaft perfectly round, owing to its springing. In lengths of shafts of small diameter, as one-and-an-eighth, or perhaps even one-and-a-half inches two of these rests may be advantageously employed. Sometimes, also, a follow rest attached to the carriage is used, but in practice we have not found this plan desirable; the friction is very great and the care of the tools, even in the first cut, is considerably enhanced.

The follow rest is simply a modification of the center rest, its main difference being that it is bolted to the carriage and moves with it. Some use, with the follow rest, a hardened steel thimble, bored to the finish diameter of the shaft, and sliding with the carriage. Its use is to be reprehended for its costliness, wear, close attention required, and other reasons apparent to the thinking workman. We prefer to do without the follow rest in turning shafting; the center rest is sufficient and preferable.

When the shaft is turned to a point as near the fixed center rest as the carriage can run, the lathe is stopped, the rest moved to the other side of the carriage, secured, and adjusted, and if the shaft is decently turned the thimble may be dispensed with, and the bearing slides of the rest brought directly against its surface. Some prefer to turn and finish the shaft at one operation by using two tool posts and a diamond point and a square nosed chisel at the same time. It is doubtful if anything is gained by this combination. All rolled bars—excepting the cold rolled shafting mentioned in the former article, which requires no turning whatever—are more or less out of round, and consequently the first chip is an uneven one; so if the finishing cutter is attached to the same carriage as the roughing tool, it will partake of the carriage's vibration, a vibration, however small, necessitated by the unevenness of the shaft's surface, and certain to leave the shaft out of round

Shafting is turned very rapidly by a method practiced in many shops of having a high auxiliary tool post at the back of the shaft, and a little in advance of the front one on the carriage. In this back post is secured a reversed diamond point that acts as the roughing tool. Other workmen discard entirely the use of the diamond point, and employ instead, a side, or squaring-up tool, setting it at an angle of about 20° to the shaft. Neither of these plans do we admire in practice, although employed by many first-class mechanics. Still, each is free to follow his own whim in this respect.

When couplings are turned on, the shoulder should be as light as possible, in order to retain the strength of the shaft. The key-ways should be milled or planed rather than chipped, as blows may spring the shaft. The couplings, bored, reamed, splined, faced, and turned, should be again faced after being seated and keyed on the shaft.

The pulleys should be chucked and trued by their outside perimeter, without regard to the hub or its cored hole. The old-fashioned way of chucking a pulley on an extemporized chuck of hard wood plank, secured to a face-place, has its advantages. In this case the face of the chuck is turned true, having a hole through the center for the reception of the hub and the passage of the drill and reamer, and a number around the circumference of the pulley for the reception of bolts. These bolts should be made hooked, instead of headed, for the embracing of the rim, and should be screwed up on the back with washers and nuts. We must say that this method of chucking pulleys for drilling seems to us more satisfactory than by the use of the scroll, or a universal chuck. The pulley has a bearing against the wood that appears to be superior to that on an iron chuck, and when once secured in place the pulley cannot be moved out of true.

Pulleys are, of course, turned on an arbor. The edges of the hub and the rim are first trued, the former with a side tool and the latter with a narrow edged cutting-off tool. Then the face of the pulley is turned, usually with a bevel from edge to center, but sometimes perfectly flat, according to its proposed use. If to be used by a shifting belt it should be perfectly flat, or straight. The pulley face may be finished by filing, and if considered necessary, polished with emery and oil; but on no account should the shaft be filed; its finish should be given by the square nosed tool and water, clear or soapy. The speed for turning is from 24 to 30 feet per minute, according to the quality of the iron. This may be readily understood by calculating the circumference of the shaft or pulley and the number of feet per minute. By a rough calculation a shaft of four inches diameter (twelve inches circumference), to run 24 feet per minute should have a velocity of 24 revolutions in the same time; one of two inches a velocity 96 or 100 revolutions per minute, etc. The feed for a shaft, in turning it, should be from 30 to 50 to the inch; that is, the shaft should revolve 30 or 50 times while the carriage and tool runs over one linear inch. These proportions may be varied according to circumstances, but the best work will be obtained between these proportions.

Balancing pulleys, calculations for machinery to be driven, and hanging shafting will be next considered.

Fastening Beams in Walls---Rat-proof Buildings.

A correspondent, G. W. Tinsley, of Minneapolis, Minn., says that the method of fastening beams in the walls of buildings illustrated on page 165, current volume, has been practiced in Louisville, Ky., for many years, and he thinks it is exacted by an ordinance of that city. He sends also a sketch and description of a method of rendering frame buildings rat proof. The plan is simply to nail to the sill strips of board between each flooring joist, on the inside, reaching to the under side of the flooring planks or board, and thereby covering the shelf formed by the sill between the joists. His idea is to allow the rats no place to stand upon while they are cutting through the floor.