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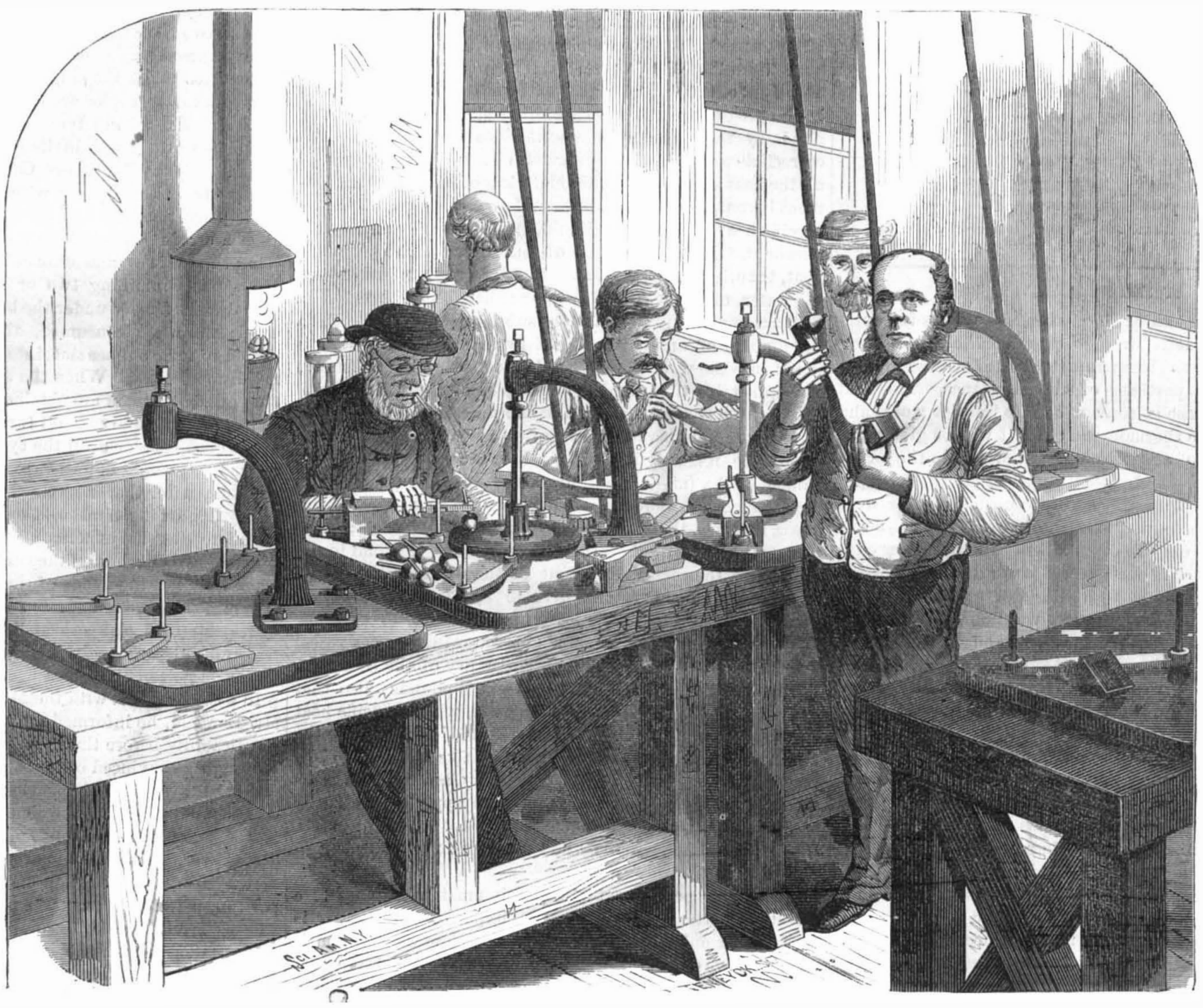
DIAMOND CUTTING--A NEW INDUSTRY IN NEW YORK.

Diamond cutting is an art, not merely an industry, requiring that certain degree of deftness of manipulation which, after a few years of apprenticeship, is readily attained in nearly every mechanical operation, but a fine art in the full sense of the term. It is labor which calls not only for an exquisite refinement of manual dexterity, but an unerring judgment, to be gained only by hard study and constant practice, extending perhaps over a lifetime.

HOW DIAMOND CUTTING WAS INTRODUCED IN THE UNITED STATES.

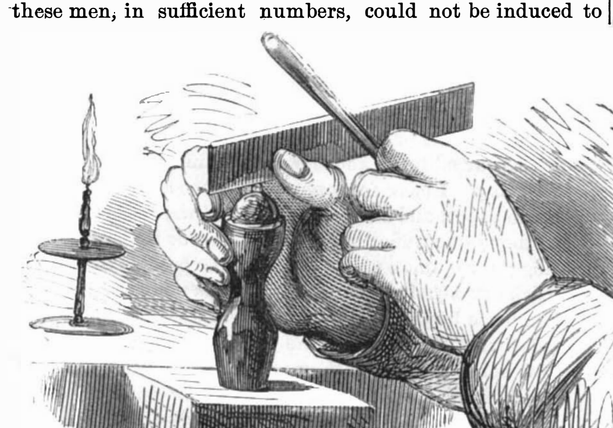
We purpose, in the following paper, to tell the reader how this pursuit, now for the first time in the world's history followed in the western hemisphere, came to be established in the the United States, and then to trace the various processes of diamond cutting as practiced in the city of New York. It is a matter of general information that the art, from time almost immemorial, has been confined to the celebrated lapidaries of Amsterdam, Holland, whither the rough gems were forwarded from all parts of the globe. At the time of the extensive discoveries in the diamond fields of South Africa, however, Mr. I. Hermann, a well known jeweler of this city and an expert in the art, became convinced that diamond cutting could be introduced in this country, both as a valuable accession to the national industries and as a means of attracting large amounts of foreign capital within our borders. To this end he undertook its establishment in the face of many serious obstacles. There was an import duty of ten per cent on the rough stones, the repeal of which had to be secured (a matter of no small difficulty, for the Government seemed unable to perceive the advantage of thus increasing the wealth within the country), large capital had to be obtained to start the enterprise, and, finally, workmen had to be persuaded to leave Holland and try their skill in a foreign land. When these men, in sufficient numbers, could not be induced to migrate, Mr. Hermann sought for other artists among the Dutch already in the United States; and he tells us that he found them pursuing all kinds of callings, in order to gain the support which the art they had studied all their lives was here unable to afford them. Then machinery was imported, only to be abandoned for entirely new inventions, also the work of the projector of the scheme; and thus at last staid old Amsterdam, to the dismay of her artisans, discovered that her long kept secrets were known across the ocean, and her hitherto undisputed supremacy rivaled in the metropolis of the West.



DIAMOND POLISHERS OR SLYPERS.

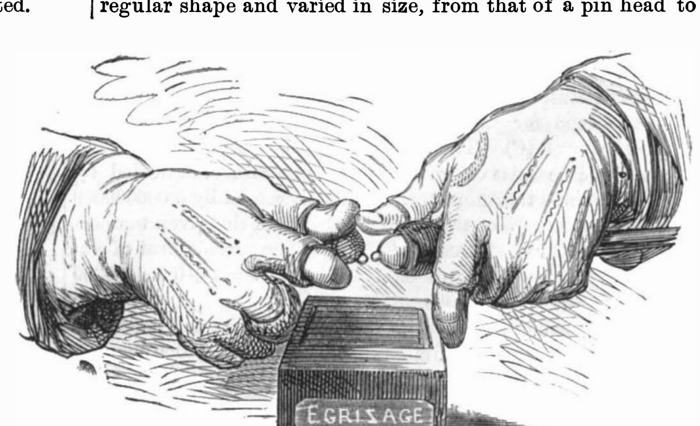
THE MANUFACTORY.

We have thus briefly touched upon the organization of the New York Diamond Company, as a part of the history of the art in the United States, from which others in future will trace its growth. Success, we are told, has been encountered, as jewelers and owners of gems necessarily prefer sending their diamonds to a locality where they may be repaired or re-cut without undergoing the perils of an ocean voyage. Twenty thousand dollars worth of the stones, we learn, are received regularly each fortnight, while millions of dollars worth are yearly handled. The largest diamonds ever brought within the country, one of which weighed 80 carats, have, through the same agency, been imported.



SPLITTING THE DIAMOND.

We recently were enabled to visit this establishment, situated in a small building in Fifteenth street, a few steps from Union Square, in this city, and there to follow the interesting operations which we are about to describe. As, in all descriptions, general explanations are first in order, we were at the outset informed that the business is divided into three entirely distinct branches—cleaving, cutting, and polishing. Also, that each class is a separate art, and that the workman finds the attainment of any one sufficient labor for the balance of his existence without troubling himself about the others. Hence, no one man can carry a stone through all the manipulations. A cutter cannot cleave, nor does a polisher know aught about cutting; and even further, a polisher or cutter of a brilliant cannot produce a rose diamond, and *vice versâ*; so that, in fact, each individual has his specialty, and there stops his knowledge.



CUTTING THE DIAMOND.

NATURE OF THE DIAMOND.

The diamond itself, as all are aware, is nothing but carbon, a combustible body. It is crystalized mostly in the shape of an octohedron (two four-sided pyramids united at their bases) or rhombic dodecahedron, the latter being the commonest. In its black form—as used for stone drilling or sawing—it is the hardest known substance, and in this state differs from the jewel, which has foliated passages parallel to the faces of figure, in which directions it may be split. In the accompanying engraving (Fig. 4) is represented an enlarged section of the rough gem, showing the grain, along which it may be as cleanly cleft as a piece of wood. The resemblance to the latter substance is increased by the fact that there are so called knots, which cause a conchoidal instead of a straight clean fracture.

THE CLEAVER.

This much imparted by way of preface, we were conducted to the apartment occupied by the cleaver, or *klover*, as he is called in Holland. This artist, we were informed, must possess a greater degree of skill than any other workman. So difficult is his labor that probably there do not exist twenty-five cleavers to every five hundred polishers and cutters in the world. The *klover* in Holland is taught from boyhood, and is usually the son of the owner of the establishment, outside parties being rarely instructed. On a small table in front of the workman was a little box divided into two compartments, the furthest containing a covered tray for the reception of stones. The other division was made deeper and had a false bottom, being finely perforated. Also on the table were a number of sticks like spindles, which, with a couple of knives (to which we shall presently allude), a metal rod for a hammer, a pair of scales, and a spirit lamp, constituted the entire kit.

Opening a number of little envelopes, each marked with a full description of its contents, the cleaver first put into our hands a quantity of rough stones. They seemed of irregular shape and varied in size, from that of a pin head to a large pea. Some pieces were quite flat and closely resembled mica. Selecting a diamond from the heap, the artist glanced at it a moment and then secured it in a knob of cement (brick dust and rosin) on the end of one of his spin-

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Contents :

(Illustrated articles are marked with an asterisk.)

SPECIFIC HEAT.

When a substance is heated, it expands, and its temperature is increased. It is evident, therefore, that heat is required both to raise the temperature and to increase the distance between the particles of the substance. The heat used in the latter case is converted into interior work, and is not sensible to the thermometer; but it will be given out, if the temperature of the substance is reduced to the original point. Thus, while heat is apparently lost, it is only stored up, ready to do work, and the substance possesses a certain amount of potential energy, or possibility of doing work. It would be easy to convert this potential energy into dynamic energy, or in other words make it do the work of which it is capable; and if we could measure all the actual and possible energy in the universe, we should find that the sum of the two was always constant, although each might vary in amount at different times. We may say, in passing, that ignorance of or unbelief in this principle has caused many to waste their lives in vain endeavors to construct perpetual motions, or to create force.

Now as different substances vary greatly in their molecular constitution, expanding and contracting the same amount with widely differing degrees of force, it is to be expected that the quantity of heat that will raise one substance to a given temperature may produce a less or greater degree of sensible heat to another; and we find in practice that such is the case. On the material theory of heat, this was explained by saying that one substance could contain more of something called caloric than another, and hence the term "capacity for heat" is still occasionally employed. But, adopting the mechanical theory of heat, we say that different substances require different amounts of heat to raise them to the same temperature, because the amount of interior work differs in each case, and because one body has more particles to be heated, for the same volume, than another. On this theory, we use the term "specific heat" instead of "capacity for heat," and define specific heat to be the number of units of heat required to raise the temperature of a unit of weight (say one pound or one ounce) of a body one degree. By a unit of heat, we mean the amount of heat required to raise a unit of weight of water, at its maximum density (about 39·1 Fahrenheit), one degree in temperature. The unit of weight is ordinarily taken as one pound. Very careful experiments have been made by Régnault on the specific heat of water at different temperatures, and a law has been determined for its variation: Specific heat at temperature 39·1° (T) = 1 (C). Then $C = 1 + 0{\cdot}000000309 \times (T - 39{\cdot}1)^2$, or the specific heat of water at any temperature, indicated by Fahrenheit's thermometer, is unity increased by 0·000000309 times the square of the difference between the given temperature and 39·1°. EXAMPLE: What is the specific heat of water at a temperature of 80°? Answer: $C = 1 + 0{\cdot}000000309 \times (80° - 39{\cdot}1°)^2 = 1{\cdot}00052$.

The specific heat of many solids, liquids, and gases has been determined experimentally, by methods which we propose to explain. The values obtained in this way are average approximations, since the specific heat of a substance varies with the temperature. If a pound of water and a pound of mercury be heated to the same temperature, and allowed to cool, it will be found that the mercury cools about 30 times as fast as the water; hence we say that the specific heat of mercury is about one thirtieth (more accurately, 0·03332). This means of determining specific heat, called the method by cooling, was used by Régnault in many of his investigations on this subject.

Another method of determining the specific heat of a substance is that by fusion of ice, observing the amount of ice that is melted in cooling a given weight of the substance a certain number of degrees.

The method by mixture is readily available, and gives very accurate results if carefully conducted. As some of our readers may like to experiment a little in the subject of specific heat, we will give a few details of this process. It is conducted on the principle that, if definite weights of any substance and water, at given temperatures, are mixed together, the temperature of the mixture will depend upon their respective specific heats. The vessel in which the water is placed should be surrounded with non-conducting materials to prevent the radiation of heat, and should contain a sensitive mercurial thermometer, finely graduated. The substance, if a liquid, can be heated in another vessel; if a solid, in some heated liquid; and if a gas, it can be heated in a closed vessel and plunged into the water, a correction being applied for the heat imparted to the water by the containing vessel.

It is evident that when a heated substance is immersed in the water, all of the heat lost by it is not given up to the water, some being absorbed by the metal of which the vessel containing the water is composed, and some being absorbed by the mercury and glass of the thermometer. The weights of these substances can be reduced to equivalent weights of water, and added as a correction. Thus, let W = weight of water employed, P = corrected weight, A = weight of mercury in thermometer, a = specific heat of mercury, B = weight of glass in thermometer, b = specific heat of glass, C = weight of vessel containing the water, c = its specific heat. Then $P = W + (A \times a) + (B \times b) + (C \times c)$, or the corrected weight of the water is equal to the actual weight increased by the products of the other materials absorbing heat multiplied by their respective specific heats. By using this corrected weight in the calculations, we take account of all the heat absorbed by the materials of which the instrument is composed. We will now show how to calculate the specific heat of a solid or liquid, from data obtained by experiment. Let M = weight of substance, s = its specific heat, t = original temperature of water, m = temperature of the water after the heated substance has been immersed in it, T = temperature to which the substance is heated. Then the number of units of heat lost by the substance, when it is put into the water, must be the weight of the substance multiplied by the number of degrees of heat lost multiplied by the specific heat of the substance, or $M \times (T - m) \times s$, and the number of units of heat gained by the water will be its weight multiplied by the degrees of heat gained, or $P \times (m - t)$; but as what the water gains is just equal to what the substance loses, we must have $M \times (T - m) \times s = P \times (m - t)$, or $s = [P \times (m - t)] \div [M \times (T - m)]$; hence we say that the specific heat of a substance is equal to the product of the corrected weight of the water multiplied by its increase of temperature, divided by the weight of the substance multiplied by its loss of temperature. EXAMPLE: Suppose that we have 2 pounds of water in a copper vessel weighing 0·5 pounds, and that the mercury of the thermometer weighs 0·1 pounds, and the glass, 0·3 pounds; also that a solid or liquid (weighing 0·75 pounds, whose specific heat we wish to determine), when heated to 180° and put into the water, raises the temperature of the latter from 60° to 70°. The specific heats of the copper, mercury, and glass, will be found in any table of specific heats; and applying the rules, we find that $P = (2 + 0{\cdot}1 \times 0{\cdot}03332) + (0{\cdot}3 \times 0{\cdot}19768) + (0{\cdot}5 \times {\cdot}09515) = 2{\cdot}110211$ pounds, and $S = (2{\cdot}110211 \times 10°) \div (0{\cdot}75 \times 110°) = 0{\cdot}25578$.

Te find the specific heat of a gas, it must be enclosed in a vessel and heated, so that the heat imparted to the water is received not only from the gas, but also from the containing vessel. If we call E the weight of the vessel, and e its specific heat, we shall have the equation $M \times (T - m) \times s + E \times (T - m) \times e = P \times (m - t)$, whence $s = [P \times (m - t)] \div [M \times (T - m)] - [(E \times e) \div M]$, or the specific heat of a gas is equal to the quotient of the product of the corrected weight of the water and its gain of temperature divided by the product of the weight of the gas and its loss of temperature, diminished by the quotient of the product of the weight of the vessel containing the gas and its specific heat, divided by the weight of the gas. EXAMPLE: If we have 0·25 pounds of a gas enclosed in a copper vessel weighing 0·5 pounds, which (on being heated to 200° and put into the water, the instrument being the same as in the last example) raises the temperature from 60° to 68°, what is its specific heat? By the rule: $S = [(2{\cdot}110211 \times 8°) \div (0{\cdot}25 \times 132°)] - [(0{\cdot}5 \times 0{\cdot}09515) \div 0{\cdot}25] = 0{\cdot}19968$. There is one other correction, of which we have not spoken. Some of the heat is lost by radiation, though this will be very slight if the apparatus is properly constructed. The amount can be ascertained, however, by experiment: heating the water, and observing how long it takes to lose a given number of degrees of heat. Tables of the specific heat of various elementary and compound substances will be found in most modern text books on physics.

CAMPHOR.

A correspondent, who has suffered from the undue use of camphor, asks for information concerning its usual effects upon the system. It should be known that the physiological action of camphor is not yet understood; but judging by the symptoms that follow the taking of a moderate dose, we are justified in calling it a nervous stimulant. It is somewhat like opium and alcohol, therefore, in its action, when given in small quantities; but when taken in large doses, it causes excessive irritation to the nervous system, producing convulsions and death.

Camphor has another action, more important to be mentioned because many people, depending on this medicine to cure all the trifling pains of life, are constantly taking it; this action is to irritate and congest, and finally to inflame, the mucous lining of the stomach, causing in the milder cases a form of dyspepsia, and in the more aggravated, ulceration of the stomach. From these two actions, namely, that of nervous stimulant and of local irritant, come all the good and evil of its use. As to its constant employment, the same reasoning will apply as to the use of other stimulants. However beneficial opium or alcohol may be in sickness, every one will acknowledge that opium eating or tippling is dangerous to health. Moreover, investigation has established the fact that the constant use of stimulant, of whatever kind it may be, results in degeneration of nervous power. If we remember, also, that camphor produces local injury to the stomach, we readily see how unsuited this drug is to be a household remedy.

Let us add a word for the benefit of those who depend on their "bottles of medicine" for good health. There can be no greater harm done to the constitution than to take medicine unnecessarily. If a person is not sick enough to ask advice of a physician, he is not sick enough to need medicine, and he will recover quite as rapidly by leaving the feeling of *malaise* to the cure of the great physician, the natural renovating power of his system.

CRUDE PETROLEUM FOR FUEL AND FOR ILLUMINATING GAS.

To the Editor of the Scientific American:

I find two recent articles in your paper which I think demand some correction or modification. I refer to the editorial entitled "The Flowing Oil Wells of Pennsylvania," etc., and to an article copied from the *Journal of Gas Lighting* entitled "Mineral Oils for Gas." Through the courtesy of a friend, recently, I was invited to go to the shops of the Philadelphia and Baltimore Central Railroad Company, located at Lamokin, Pa., to witness experiments in burning crude petroleum as a fuel for stationary engines. I found, upon a careful examination into the process, that it was being successfully and economically done. In starting the fire, a pan containing two or three gallons of benzine is placed immediately under the burner and cylinders, and ignited; and when consumed, the cylinders are sufficiently heated to turn on benzine, into the inside cylinder, which rapidly vaporizes. When the cylinders are cherry red, and ten pounds of steam are obtained, the benzine is turned off and the steam and crude oil turned on. It was found necessary to use benzine until the cylinders were properly heated, as crude oil would not all vaporize unless the cylinders were red hot. After that is attained, there appears to be no difficulty in burning crude oil; and on an examination of the cylinders after the experiment was made, there was no evidence of carbon; but on the contrary, they were as clean as when they left the hands of the machinist. [The vaporizing apparatus, we understand, consists of a burner, an iron cylinder in which steam is superheated, and another iron cylinder in which the superheated steam is brought into contact with the crude petroleum.—EDS.]

In a conversation with the Master Mechanic of the road, Mr. Danfield, he informed me that, although he doubted its practicability before the experiment was made, he was now thoroughly convinced of its adaptability for steam purposes; and it being against his previous convictions, he had used all the appliances that the shops afforded to break down its power, but without effect.

However, what I particularly wish to get at is the economic view. You state that, "in markets where coal is worth $6 per tun, petroleum must be supplied at 3½ cents a gallon or $1 per barrel, in order to compete as a fuel with coal." In actual experiments made in the above case, at Lamokin, Pa., seven gallons of crude oil per hour was consumed on an average for four days, at a cost of forty cents per hour. When wood or coal is burned, the cost is from seventy to eighty cents per hour, in the same engine. This would seem to leave a wide margin between your ideas and the actual experiments made.

In the article on "Mineral Oils for Gas," the writer admits that, if the carbon could be got rid of, there would be no doubt that mineral oils would be found a most useful substitute for coal in the production of gas of a high illuminating power. This process to my mind most effectually disposes of the carbon objection. The carbon is not only got rid of, but is actually made fuel to the flame. Mr. Kendrick, the inventor, claims that he can make a pure fixed gas by this process at 60 cents per 1,000 feet, with oil at 8 cents per gallon.

These facts, or rather experiments, seem to be at variance with your editorial and the article in the *Journal of Gas Lighting*. I have for many years been a reader of your valuable paper, and I am constrained to write to you these facts as they came under my observation, for the purpose of getting your opinion upon them. If the process which Mr. Kendrick employs in burning crude oil is not practical, will you oblige me by pointing out its defects?

Locomotive No. 4 on the Baltimore Central Railroad is now being fitted up with one of Mr. Kendrick's oil vaporizers and burners for the purpose of running with oil as a fuel. It will be complete in about ten days from this writing, when further developments will, no doubt, be made. I understand that it is the opinion of the officers of that road that it will prove a success, not only in point of economy but in getting rid of the handling of coal, smoke, sparks, etc., that are so annoying to passengers.

Norristown, Pa. HENRY L. ACKER.

REMARKS BY THE EDITOR.—Our correspondent has omitted to give the exact quantity and cost of coal and wood, as delivered at the place of trial. He has also failed to say whether the fuel used in converting the water into steam, before the latter is superheated in the apparatus, is included in his statements of cost. It is very evident to us, from the alleged difference in the resulting costs per hour, that our correspondent has been misinformed on that head, and we need the full data in order to point out the error.

Making the ordinary allowance of 4 pounds of coal per horse power per hour, the amount consumed by the 40 horse power engine would be 160 pounds per hour. The expense, according to our correspondent, was 80 cents, which is half a cent a pound, or $11.20 per tun. This appears to us to be a high price for coal in Lamokin, Pa., which we believe is on the railway and only fourteen miles from Philadelphia, where coal is selling for less than $5 per tun. It appears to us that coal ought to be obtainable in Lamokin at a price not exceeding $5 per tun, at which rate the cost of running the engine in question would be 36 cents an hour. The comparative calorific values of crude petroleum and coal are as 2 to 3. That is to say, 2 pounds of petroleum are equal to 3 pounds of coal. Hence, if it requires 160 pounds of coal per hour to run the aforesaid engine, it ought to require 106⅔ pounds of crude petroleum to do the same duty, or a little more than 15¼ gallons of petroleum, allowing 7 pounds to the gallon. Our correspondent, however, states that the cost of running the engine, when petroleum was used, was 49 pounds or seven gallons of oil, costing 40 cents per hour; which would make the cost of the crude oil, delivered at the establishment he refers to, $2.40 per barrel. It may be that, in the present depressed state of the crude oil market, the article can be delivered in Lamokin at $2.40; but if so the price is exceptional.

We have stated the relative calorific values of the oil and coal at 2 to 3, which gives the oil 50 per cent greater heating power, weight for weight, than coal. This is a result deduced from the chemistry of combustion and from the records of careful engineers, after many trials, allowing every possible point in favor of the oil. But if the information furnished by our correspondent is correct, then they get, at Lamokin, more than one hundred per cent more of heat from petroleum than from coal, a statement which we can hardly credit. We hope that our correspondent will give us the exact data as to the respective costs of oil and coal, at Lamokin, and such other information as may assist the elucidation of the real economics of the subject.

In respect to the manufacture of illuminating gas from crude oil, our correspondent gives us no information further than the statement of the inventor, which, we understand, is not based upon actual experience in the manufacture of permanent illuminating gas, but is an opinion he has formed, judging from the ease with which he produces combustible gases by his apparatus. We think it probable that he will find it more difficult to make permanent illuminating gas than to run a steam boiler with crude petroleum. We shall be happy to receive and chronicle any new facts concerning either of the foregoing subjects.

RESCUE OF THE REMAINING SURVIVORS OF THE POLARIS.

The good news comes to us from Dundee, Scotland, of the safe arrival there in good health of all the remaining survivors of the Hall arctic expedition; consisting of Captain Sidney O. Buddington and twelve others. After leaving their encampment on the Greenland coast, which they did in the latter part of June, 1873, in open boats, they sailed southward, encountering many dangers and exposed to the severest hardships. They landed at various points and searched everywhere for cruising whalers. On the 20th of July, 1873, they had the good fortune to fall in with the Ravenscraig, a Scotch whaler, on board of which they were hospitably received, and subsequently conveyed to Dundee. They return to the United States at once.

Captain Buddington reports that, after that fearful night which separated him and his vessel from his comrades upon the ice, he never saw them again. It was with difficulty that the Polaris was kept afloat that night, and they momentarily expected she would go down. But they finally reached the shore, where the vessel was beached, and the party wintered in a hut on the land, being supplied with skins and walrus meat by the natives.

The incidents and results of this latest and most eventful polar expedition may be briefly summed up as follows:

On the 29th of June, 1871, the steamer Polaris, Captain Charles F. Hall, sailed from New York on a voyage of arctic exploration. In August, 1871, she had reached latitude 82° 16′, the highest point ever attained by any vessel. Soon after this the ship went into winter quarters at Polaris Bay, latitude 81°38′, and Captain Hall organized sledge and boat expeditions with a view to further northerly explorations. Soon after his return from one of these expeditions, he was taken ill and died, on November 8, 1871. He was buried on shore, and there his remains rest, near the north pole which he so ardently endeavored to reach.

On the death of Captain Hall, Captain Buddington, previously second in command, became master. On the opening of the ice in August, 1872, Captain Buddington, finding further progress northward impossible, determined to return home, and the ship started for the south. She was now unfortunately caught in the ice, and drifted down helplessly for two months, receiving injuries which caused her to leak badly. Such was the continual crushing of the ice against the vessel that Captain Buddington caused a portion of the provisions and a part of the ship's company to be landed on the ice, expecting that all the others might at any moment be obliged to follow. On the night of October 15, 1872, a terrible storm and utter darkness set in, during which the Polaris broke away from her icy moorings, leaving the hapless party of nineteen persons on the ice. They had provisions, boats, and clothing. Next day they saw the steamer, but were themselves unseen by those on board. Days and weeks passed, and still the little party waited for relief, clinging to the ice cakes, exposed to the most extraordinary perils, washed by the seas, drenched by the rains. Their supplies of food were swept away, but one or two guns were still retained, with which they occasionally succeeded in killing seals and bears, and this preserved their lives. On the 30th of April, 1873, after 6½ months dreary drifting, they were descried upon the ice by the British sealing steamer Tigress, rescued, and safely landed at St. John's, Newfoundland.

The recent rescue and landing of their former companions at Dundee completes this remarkable arctic narrative, which for thrilling adventure and extraordinary incident has no parallel in the previous records of fiction or fact.

THE FAIR OF THE AMERICAN INSTITUTE.

Judging from the number of articles already in position in the Hall of the American Institute, and from the fact that, as we are informed, the applications for space are in excess of the accommodations provided in the large area, the forty-second Fair has every prospect of surpassing in no small degree its predecessors of last year. The exhibition of 1872, though in many respects a decided improvement (especially in mode of management) on previous displays, was deficient in number and variety of new devices entered, a fact probably due to the attention of the people being diverted by the excitement of the political campaign; while such defects as existed in the conduct of its affairs may with fairness be ascribed to official experience in endeavoring, for the first time, to put in operation many radical and much needed reforms.

We have already noted several changes in the organization of the management. So far as we understand the latter, the occupation of the managers, save as a body, seems gone, and the personal control with which departmental committees have heretofore been invested, regarding the articles in their respective sections, is given to one general superintendent, Mr. Charles W. Hull. A board of directors, regarding whose duties no official whom we have yet met seems to have any very clear idea, has been organized: while the subordinate officers, clerks, etc., remain as before. The post of superintendent of machinery, a position invented last year and ably filled by Mr. R. H. Buel, has been rechristened as chief engineer, and is in the hands of Mr. John T. Hawkins, an engineer and inventor quite generally known.

Several alterations for the better have been made in the interior of the building. A large amount of space in the passage from the main hall to Third avenue has been converted into rooms for exhibitors, judges, and the press, affording accommodations both necessary and ample. The silvered monstrosity, supposed to be a statue, which surmounted the soda water fountain is conspicuous by its absence, and we are also pleased to note that the badly distorted and much confused Goddess of Liberty, which, accompanied by an impossible category of implements, formed a scenic decoration on the main arch facing the entrance, has been removed to a less conspicuous position. The work of art substituted is a shade better, representing a more appropriate subject; but as a production, it would be difficult to discover one in which every law of perspective or drawing is more systematically set at naught. We can only repeat, in this connection, remarks already made to the effect that, while such admirable decorative artists as Gariboldi and others who might easily be named are within access, it is hardly creditable to the Institute to exhibit second rate efforts ostensibly as the best representatives of the progress of this branch of art.

It is hardly possible to forecast with much accuracy the nature of the coming display as regards numbers of especial articles. There appear to be fewer sewing machines than ordinary, and more heavy articles in the machinery department; but, as yet, arrays of empty cases are more prominent than complete exhibits. Space, we understand, will not be reserved, no matter how long ago bespoken. It is the intention to fill up the building as quickly as possible, and exhibitors who imagine that they can come long after the Fair is in progress, and thus avoid waiting through the first few weeks and slim attendance incident to that period, will, we fear, find themselves debarred altogether.

In noticing the various entries, our custom of occasionally strolling through the building and commenting briefly on such as strike us as novel, ingenious, and interesting, will be as heretofore followed. Mere lists of exhibits are doubtless very entertaining to the proprietors as gratis advertisements, but, to the general reader for information, they are excessively dull.

KNITTING AND WEAVING MACHINERY

is represented in quite full force. At present Lyall's positive motion loom and corset weaving apparatus are in operation. The last mentioned device is one of the most important and interesting in the Fair; but as we desire to obtain some further particulars regarding it, the detailed explanation which it deserves is deferred to next week's notes. Messrs. Tiffany and Cooper, of Bennington, Vt., exhibit two knitting machines, one of which is in operation. The invention is designed to manufacture ribbed tops for stockings or cuffs. Briefly, there are two sets of needles, upon one of which, standing vertically, the thread is placed. The second set are barbs, and come down from above, catching the stitch. Then a presser, acting against the point of the barb, presses it in, making an eye, over which and the old loop it drives the stitch. The thread leads from bobbins above to horizontally moving guides. One set of the latter operate until a sufficient length of material is knitted; a bell then rings, and a second series of guides, carrying a lighter thread, come in play, thus marking a space for the division of the fabric. The cuffs or bottoms are turned out with perfect welts, slack courses, and splicing threads, all put in without stopping the machine. By using different colored yarns on the two sets of guides, fancy articles may be produced. From three to ten rolls of fabric are knitted at a time. The mechanism is remarkably well contrived; and, as exhibited, works to a charm. From twenty-five to thirty-five dozen ribbed tops, we learn, can thus be made in a day.

THE MAIN ENGINES

this year are one of 125 horse power, built by Jerome Wheelock, of Worcester, Mass., and driving a 22 inch belt; and, on the other side of the passage, a Hampson & Wheelock machine, of 20 horse power. The large engine is somewhat on the Corliss plan and is a fine piece of workmanship. The valves are nearly underneath the cylinder, and are of the ordinary slide description, but are made to taper outwards in their box, so that the pressure from inside keeps them tight, thus obviating the necessity of stuffing boxes. There is a variable cut-off, arranged in the chest just between the valves, which communicate with the governor.

THE DELAMATER HOISTING MACHINE

is a gigantic affair, capable, we are told, of lifting 15,000 pounds two hundred feet per minute. The engine is a 40 horse power Rider horizontal, which connects with a main fly wheel, 8 feet in diameter and 14 inches in face. The mechanism, though large, is quite simple. The drum, which is five feet in diameter, is loose on the main shaft, and is operated by gearing on a smaller shaft which communicates with the main shaft by friction pulleys. The latter are thrown into or out of gear by moving the small shaft by a toggle joint and lever; so that the drum is either rotated by the cog gearing or left to revolve loosely in the contrary direction for lowering, its motion being then controlled by a suitable brake.

A SILK-MEASURING APPARATUS,

known as Dunn's patent, is an ingenious little arrangement for determining the length of thread or silk, and thus detecting any fraud in case the same is purchased by the pound. It consists of a light wheel, fitted on a sliding pinion, traversing the surface of the spooled thread, and is connected with clock work moving two registering dials. The thread is thus measured after it is spooled, while the operation of spooling is not interfered with. Another form of the same device is exhibited for the use of consumers who desire to test the length of thread already spooled. A crank and spindle wind the thread on a new spool, and dials indicate the amount reeled off. This operation is usually so tedious that a small machine, which seems to perform its work very quickly and accurately and which can be readily attached to the corner of a counter or table, will doubtless prove acceptable to both dealers in and consumers of thread. While this device winds the material, another machine is exhibited for roughing out the spools. In fact, the invention makes almost any small wooden article, in the way of bungs, spool blanks, pill boxes, etc. Mr. J. T. Hawkins is the inventor, and the apparatus was described about a year ago in our columns.

MAKING BUTTON MOLDS.

At present, however, a novel attachment has been combined with it, in order to make button molds of the large size usually worn by ladies on redingotes. The improvement is a revolving steel head, in a cavity in which are arranged cutters and a small drill. The stick of wood, squared to suitable size, is fed by an ingenious appliance into this opening. There it encounters, first, a pair of cutters which turn off the edges, and then another set which give its end a convex form. Meanwhile the drill pierces a small hole in the center. A cam arrangement then comes in play, and carries the wood over against a circular saw which cuts off the mold. The stick then returns, and the same operation is repeated. The speed of the machine is at the rate of 5,000 revolutions per minute, and a mold is finished every second. Three hundred gross, we were told, can be turned out in a day.

Among the small inventions, so far exhibited, is a

SEWING MACHINE ENGINE,

which consists of a little oscillating cylinder attached to the table, having a driving pulley in line with the small wheel of the machine. A boiler holding enough water for a day's work supplies steam, and occupies a small space on the floor in rear of the apparatus. The throttle valve regulates the supply of steam and is connected with the treadle of the sewing machine, so as to be governed with the foot.

New Exploration of the Amazon River.

Among the most recent exploring expeditions is that undertaken during the present year for the exploration of the Amazon river, by Professor James Orton, the well known naturalist, of Vassar College. We have just received our first instalment of correspondence from him, the publication of which we shall begin in our next issue. Our latest advices from this enterprising traveler are dated August 19, 1873, at which time he had paddled one thousand miles up the Great River, taking notes and making surveys and observations *en route*. He had an immense distance yet to go before reaching the Cordilleras, which he expected to cross, and to reach home *viâ* Panama.

The letters of our correspondent are full of interest concerning the marvelous region which he is exploring. He speaks of unbroken forests covering a space eleven hundred miles in diameter, and other equally astonishing revelations of Nature.

THE Neapolitan papers state that, from observations taken on Mount Vesuvius, new earthquakes are expected.

THE PLANET MARS—IS IT INHABITED?

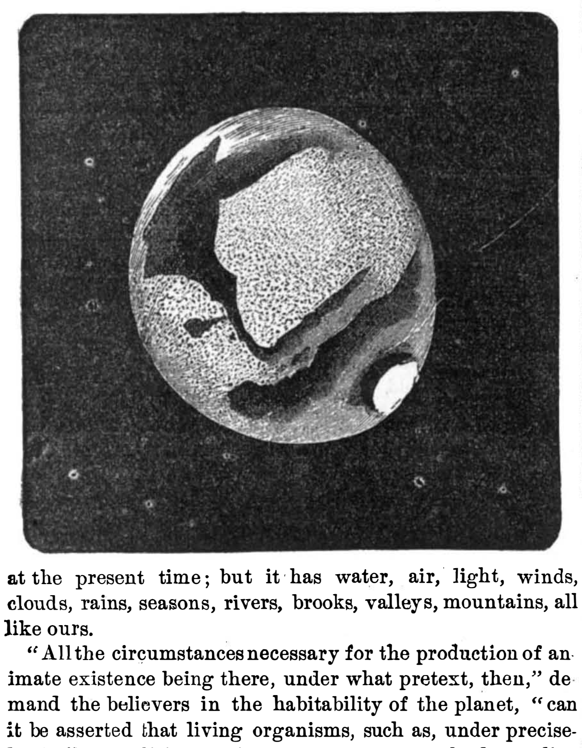
PART 2.

Having determined the existence of a vaporous envelope around Mars, similar to the clouds which float in our terrestrial atmosphere, if we assume the same to be aqueous, we must believe in large bodies of water from which it originates. But other fluids besides water generate vapor; hence, unless direct proof be adduced to the above effect, the hypothesis, that the vail observed is a cloud screen existing in an atmosphere like our own, is without substantial foundation.

The telescope has told its story, and a more wonderful instrument must add the sequel. The spectroscope, in the hands of the eminent English physicist Huggins, solves the problem. The planets reflect the light which they receive from the sun; and if their rays be passed through the prisms, we find in their spectra the solar spectrum, just as if it had been reflected by a mirror. Dr. Huggins on his first observation of the planet was unsuccessful, but at the opposition of Mars in 1867, he attained important results. On directing his spectroscope, attached to a powerful eight inch refractor, toward the star, he noticed that the spectrum obtained was crossed near the orange portion by black lines similar in position "to lines which make their appearance in the solar spectrum when the sun is low down, so that its light has to traverse the denser strata of our atmosphere." The question to determine, then, was: Were the lines due to the passage of the light through the atmosphere of the earth or through that of Mars? Turning his instrument toward the moon, then nearer the horizon than the planet, so that the atmospheric lines, if they appeared at all, would be much clearer in the moon's spectrum than in that of the object of his observation, Dr. Huggins found that they were totally absent. It was thus demonstrated beyond peradventure that the bands belonged to the Martial atmosphere, and not to that of the earth; and hence two aerial oceans, analogous to each other, encompass both planets.

But, it may be asked, what produced these lines? Carefully noting their position, the observer found them to be the signatures, not of oxygen or nitrogen, but simply of the vapor of water, of the same chemical composition as our own, oxygen and hydrogen. This proved, in this direction we need go no further; the existence of sea, of cloud, snow, ice, fog, and rain is demonstrated. Reasoning from this basis, we can trace the presence of winds which shift the masses of vapor from place to place, of aerial and ocean currents, of rivers flowing to the seas, of a climate tempered in the same manner as our own, and of copious rain fall which must nourish the land and cause the production of vegetation. If, further, there be continents and oceans, similar geological forces to those of the earth must be at work; there must be upheavals and depressions, mountains, valleys, and water sheds, in fact a miniature of our earth.

Here, then, millions of miles away in space, is another world, a small one, it is true, and seeming to the eye no larger than our engraving, which represents its appearance



at the present time; but it has water, air, light, winds, clouds, rains, seasons, rivers, brooks, valleys, mountains, all like ours.

"All the circumstances necessary for the production of animate existence being there, under what pretext, then," demand the believers in the habitability of the planet, "can it be asserted that living organisms, such as, under precisely similar conditions, exist upon our own earth, do not live and flourish there? Can it be that the sun, air, water, and earth are held in bonds and prevented from combining in organic evolution? Or can it be credible that, while every drop of water on our earth is peopled with millions, another world is a desert?" In our previous paper we observed that, owing to the eccentricity of its orbit, the amount of light and heat received by Mars from the sun must vary considerably. Further, we may add that, while the earth is 92,000,000 of miles from our source of light, the distance between that luminary and Mars is fully 141,000,000 miles. From this difference, and the relative sizes of the two planets, we can determine the amount of heat transmitted to Mars as compared with the quantity reaching the earth; and the average daily supply is found to be as two to five. More nearly, when Mars is closest to the sun, he receives somewhat more than half as much heat as the earth; when furthest, his supply falls to a little over one third that of our sphere. The sun would appear, to a person on his surface, to be about one third the size that it does to us.

Considering, now, the question of the Martial heat, it seems to be of much smaller importance than it really is. The sun is the great storehouse of power, and the heat we obtain from him underlies all motion and life. If the supply from this source were diminished, manifestly life, as it now is upon the earth, could not be maintained. If we take away half the fuel from under a boiler, the engine, although it may work, will no longer be of the same efficiency. Imagine this reduction to have taken place ages ago, "before the sun's rays in a potential form," as Tyndall expresses it, were buried in the deposits of the carboniferous epoch, and consider that it would require 108,000,000 of horses, working night and day for a year, to develope the work equivalent to the energy in a hundred million tuns of coal—one year's produce of our mines. If, then, Mars, which we have proved to receive a far less quantity of heat than the earth, has been thus deprived during countless ages, it must be apparent that, if it require existing circumstances upon the earth to maintain the creatures thereon, the absence of such circumstances on Mars clearly shows the unfitness of that planet as a habitation for beings.

The point next arising is: Whether Mars be possessed of an inherent heat sufficient to compensate for this deficiency of solar heat, or has the planet enough heat stored up to render it an abode for living creatures? It is very probable that Mars has parted with much more of its inherent heat than the earth, for it is known that, of two bodies equally warmed, the smaller cools the more rapidly. We have no reason to believe that Mars has been hotter than our globe, and hence, as its sphere is smaller, it must now be a much colder body. If, then, we are to adopt the theory that the climate of the planet resembles our own, we must assume that there is a peculiarity about its atmosphere which enables it to retain a larger proportion of the sun's heat than can our aerial envelope. In such case, considering the constitution of such an atmosphere to resemble our air—a necessary hypothesis, if we are to believe in the existence of the beings with which we are familiar,—it must be much more dense, reasoning from the fact that there is a steady decrease in warmth as we ascend to the upper regions of our own atmosphere, due to the increased tenuity of the air.

We may presume that every planet has an atmosphere proportioned to the matter contained in it. Hence, the mass of Mars being about one fifth that of the earth, we must infer that its atmosphere is equal to one fifth part of the earth's. But the surface of the planet is fully two fifths that of our globe; hence, over each square mile, there would be a much less corresponding amount of air. In addition to this, we have already noted that in Mars exists less than two fifths the attractive force of the earth, the proportions being about as 38 to 100. The atmospheric pressure would therefore be reduced in proportion, even if the planet had as much air above each square mile of surface as there is above each square mile of the earth. This quantity of air would be twice as much as we should infer from the mass of Mars, and we should require five times as much air to have an atmosphere only as dense as our own at the sea level. An atmosphere about twice as dense as this would perhaps give a climate as mild, on the average, as that of our earth; but we can hardly assume that Mars has an atmosphere exceeding ten times in quantity what we should infer from the planet's mass.

If, now, we suppose that the Martial air is moderately dense, comparable, in fact, to our own air, then, since we know that considerable quantities of aqueous vapor are raised into that air, we must, from the circumstances already considered, conclude that there would be a precipitation of snow which would keep the surface of Mars permanently covered. But this is not the case, as Mars is not a white planet; and so we must assume so great a rarity of its atmosphere that sufficient water vapor can never be raised to produce a permanent snow envelope by precipitation. Consequently it is probably the most satisfactory course to return to our first assumption, namely, that the Martial atmosphere bears the same relation to the mass of Mars as the terrestrial atmosphere to that of the earth. Under this hypothesis it can be shown that the atmospheric pressure on Mars corresponds to about 4½ inches of the mercurial barometer. Can man exist for any length of time in such an atmosphere?

In the great balloon ascent of Coxwell and Glaisher, in 1862, the enormous hight of 37,000 feet above the sea level was attained. At 29,000 feet Mr. Glaisher fainted and did not revive until the balloon had descended and returned to the same point. At 37,000 feet the barometer stood at 7 inches, and the thermometer at 12° below zero. Coxwell became almost paralyzed, and only saved the life of himself and his fellow aeronaut by seizing the valve rope with his teeth, and thus allowing the gas to escape. If, by extreme fortitude, one man has managed to live at two miles above the fainting level of another, could human beings generally exist in an atmosphere reduced to five sevenths the density?

We have shown that Mars has, therefore, not only a far greater degree of cold, but an atmosphere of much greater tenuity than that of the earth, conditions manifestly incompatible with the existence of terrestrial creatures: a conclusion easily attained by considering the life (mere microscopic animalculæ) found on the mountain peaks of our earth, beyond the last stages of vegetation, where the air is rare and extreme cold prevails.

We have now presented sufficient data to form a clear idea of the arguments which go to prove the unsuitability of Mars as a habitation for the higher orders of beings. Did space permit, we might continue and refer to the atmosphere, which must be at least 100 miles high, and the winds which must prevail, which carry aqueous vapor, in the form of snow, to the poles. Here great masses of glaciers are heaped, which sometimes disappear, leaving vast gaps discernible even at forty millions of miles away, producing convulsions which must affect the entire planet.

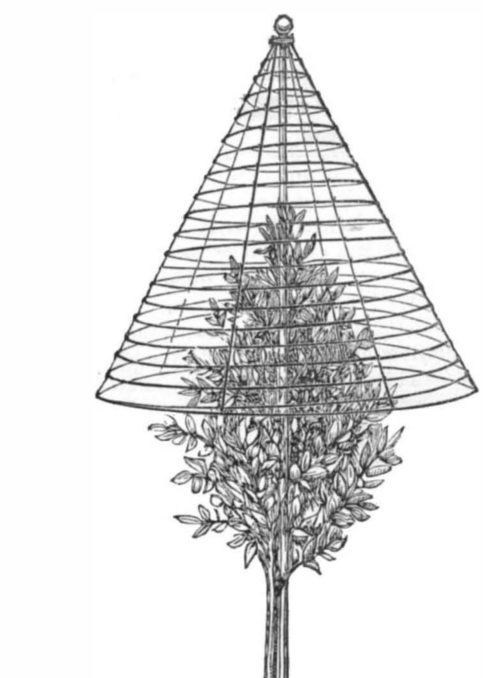
The weight of evidence, it seems to us, is against the existence of beings of a nature with which we are familiar. No terrestrial creature could live even in the torrid zone, so cold and dismal must it be. Even vegetable life, however hardy, would not survive a single hour. If inhabitants there be, they must be of different form from us, to correspond to the decreased attraction of gravity; if red vegetation exist, their eyes must be different from ours; to live in such an atmosphere their respiratory organs must be totally unlike our own; and thus we might go on specifying points of variance until we find that, in the end, there is no more possibility of Mars being inhabited by beings like ourselves than there is of the sun or Jupiter being similarly peopled. In fine, we cannot say whether other worlds are or are not abodes of life. We can assert with reasonable probability that on no other planet are there conditions suitable for the existence known in our globe. Whether there be beings in the fiery vapors of the sun, on the molten mass of Jupiter, in the bleak deserts of the moon, or in those remote parts of the universe, from which our entire solar system seems but as a single bright star, is a problem within the knowledge of only Him "to whom all things are possible."

Exposition Awards.

The *Commercial Bulletin* thinks that it is time that the practice of exhibition rewards should be abandoned. Any one who has seen the inside and secret workings of exhibitors, to obtain the coveted prizes, knows that lobbying and friendship have much to do in determining awards, and that they who have friends at court are seldom found empty handed when the day for awarding prizes arrives. And even those who, in all honesty and from the merit of the articles which they exhibit, are rewarded are, by their brother exhibitors and especially less successful rivals, accused of lobbying in some form or other. If exhibitors did but know it, the benefit which they derive from industrial expositions comes not from diplomas and medals, but from the fact that vast numbers are brought to see and inspect the machines and products exhibited.

A SIMPLE TREE PROTECTOR.

The first frost—and it has already made its appearance in the northern part of New York and the New England States —is apt to cause sad havoc among our young fruit trees,



tropical plants, and ornamental trees, before the gardener is prepared for it. The device represented in our engraving is therefore of timely importance and will prove of value to nurserymen and agriculturists generally. The *Ironmonger*, from whose columns we extract the illustration, states that it has recently been introduced in England, and that in construction it is simply a conical frame of galvanized iron wire, supported at its apex by a wooden post driven in the ground beside the tree. It is only needed to cover the wire with cloth, or even newspaper, to render the tree safe from the frost.

The *Utah Mining Gazette*, published at Salt Lake city, adds to a paragraph from the *Mining and Scientific Press* (in which the editor states that Arizona wants more practical miners and fewer speculators without means, more men of capital, and no mining experts or wiseacres) that Utah, also, would be far better off if she had fewer "experts and more men with plethoric bank accounts. It is these experts —at swindling—that have already done us so much damage. Like Arizona, we want a new class of speculators."

SUCH is the marvelous ductility of gold that a single ounce of the pure metal may be drawn out into a wire thirty three miles in length.

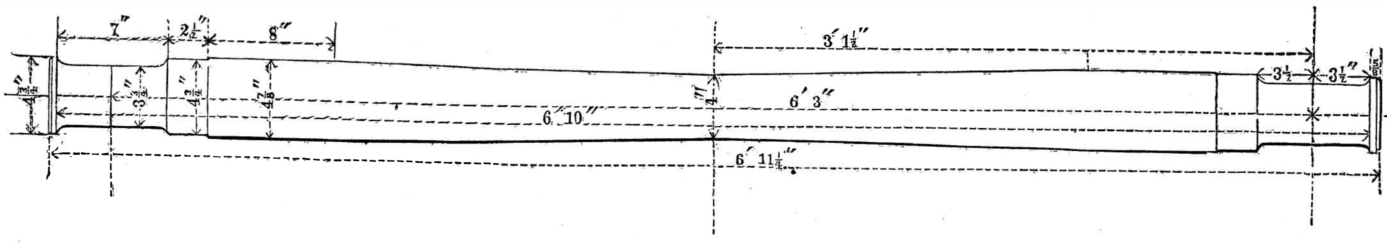


DIAGRAM SHOWING FINISHED DIMENSIONS OF STANDARD AXLE ADOPTED BY THE MASTER CAR BUILDERS' ASSOCIATION, JUNE 13, 1873.

DRAW HEADS.—The standard hight of drawheads, adopted by the Association, is 2 feet 9 inches from top of rail to center of drawbar.

Condoling by Electricity.

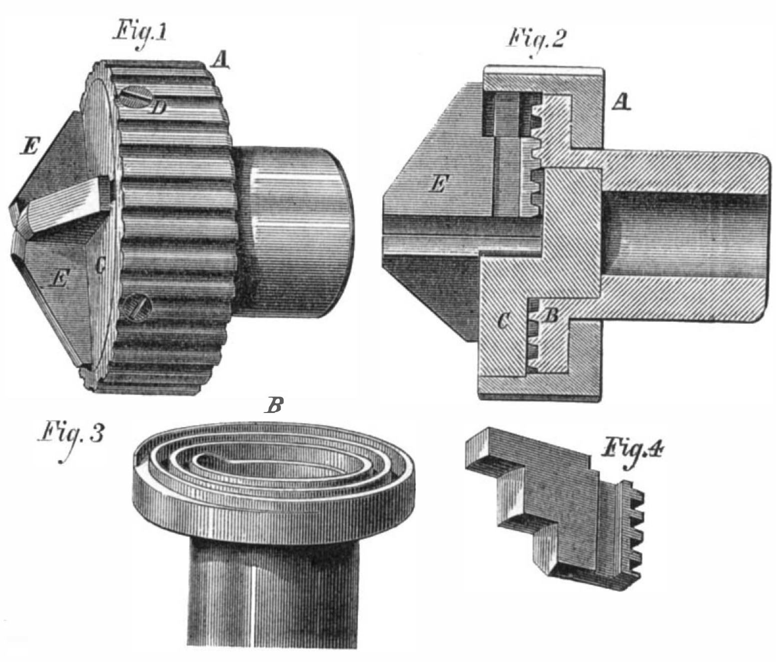
On the recent occasion of the death of Mr. C. L. Goodwin, superintendent of the Northern New York division of the Atlantic and Pacific Telegraph Company, the various operators of the division united in a meeting of condolence in the following remarkable manner: All the stations included in that division were connected into one circuit, extending from New York to Albany, thence *via*] Troy to Saratoga and return to Albany, westward to Syracuse, and *via* Oswego, Clyde, and Rochester to Buffalo and Niagara Falls, back from Buffalo *via* Auburn, Seneca Falls, etc., to Auburn again, being over twelve hundred miles of wire. Each person remained in his own office and all the instruments were so connected that the remarks made by one operator upon his instrument were sent through all the other instruments. Promptly at 2 P. M. (Buffalo time) New York called the meeting to order. Buffalo moved that Mr. Hauff, chief operator at New York, be made permanent chairman. The motion was seconded by Troy, and carried. The chairman then suggested that Mr. McCoy, manager of the Buffalo office, be nominated as secretary, which the meeting unanimously resolved in the affirmative. Various speeches were made and the resolutions were then read and adopted, and an adjournment then followed. The meeting was entirely harmonious throughout, and the state of the weather and condition of the wires peculiarly favorable to its success.

SELF-TIGHTENING DRILL CHUCK.

Our illustration represents an ingenious appliance which, it is claimed, is self tightening, and may be caused to hold any drill of a size within the compass of its jaws with complete firmness, and this with no further trouble to the operator than a clasp of the hand. That such an improvement is of value, both as applied to the drill as well as to the lathe chuck, will be evident to every mechanic even without the further corroboration of its merits found in the substantial victory which the manufacturers assure us was won by the device at the Vienna Exposition.

The material used in the construction is forged steel in every part, except the jaws, for which the best and most carefully tempered cast steel is substituted. The shell or case, A, Figs. 1 and 2, contains the working portions and, as will be noted from the sectional view, is provided with a shoulder within, flush with the face of the scroll, B. On this shoulder, and at a slight taper, is driven the plate, C. The latter is thus made to form a close joint and still may be easily removed, while it is afforded a support calculated to bear the strain (often caused by inexperienced persons driving it upon the arbor) from the screws, D, by which it is held in position. The plate is fitted in the usual manner with tongue and grooves, and is also provided with a center which serves to center and steady the back end of the drill, and thus insure the proper holding of the tool in its place.

In order to give greater strength, and also to guard against the entrance of any dirt through the slots into the working parts, the jaws, E, are made with projections, the upper parts of which, when the chuck is open, are flush with the outside of the shell. The inner sides of the jaws, as shown in Fig. 2, are provided with segments of screw threads which engage with the face of the scroll, B, Fig. 3. The latter is provided with a tapering hole which is held on the center of the lathe in the usual way, the shell plate and jaws revolving around it. Outside the shells grooves are placed to favor a firm grasp of the hand around the chuck, so that the device, when in use, is thus self-tightening, the strain of the tool while cutting serving to make it hold more securely.



THE VICTOR SELF-TIGHTENING DRILL CHUCK.

The size represented in our engravings, No. 3, retains drills from ⅝ down to 0; while the next form, No. 4, holds from ⅝ down to ⅛ inch. The jaws are made rounded at their outer ends so as not readily to catch hands or tools near them. An extra set of these appliances, of the form shown in Fig. 4—which make a lathe chuck of the apparatus,—are furnished when desired, and, as we are informed, may be substituted for those in use in the space of three minutes.

For further particulars address the manufacturers, the Hubbard and Curtiss Manufacturing Company, Middletown, Conn. The article itself may be found at the factory, at the above address, or at the warehouse, No. 82 Chambers street, New York city.

CALFSKIN TANNING IN EUROPE.

Mr. Jackson S. Schultz of this city, now in Europe, in a letter to the *Shoe and Leather Chronicle* gives the following interesting particulars of his visit to Mercier's great tannery:

The calfskin tanneries of Mr. Raichlen, at Geneva, and Mr. Mercier, of Lausanne, both situated on the Lake of Geneva, are among the largest, if not the very largest, in all of Switzerland; and with the exception of one, Mr. Mercier's tannery is the largest calfskin tannery in Europe, or perhaps the world.

Mr. Mercier many years since found out—what has been the experience of all other tanners—that to excel in the trade, attention must be given to one single department, and for these years of his triumph and success he has devoted himself to the wax calfskin trade exclusively.

He does not depend at all upon his home market for a supply of skins, but lays all Southern and Eastern Europe under contribution.

These skins are brought to him invariably "flint dry," not even drysalted. They come in compressed bales, and these are opened, assorted and piled away in a cool, dark loft or storehouse in large compact piles, to be withdrawn at the rate of about 500 per day, for his daily use.

These skins are so perfectly cured and so uniform in condition that it is seldom that one skin in a hundred breaks or indicates the fact that it has been dried. Even the grain does not show a crack, as is too apt to be the case with us, where skins are dried in the sun or otherwise exposed.

These skins are soaked in the usual manner and are softened in wheels precisely as our best tanners are now softening their light stock, with this difference: In the construction of the wheel, there are four compartments, instead of being, as with us, one open space. These compartments turn the skins more actively, and Mr. Mercier says the force is sufficient to do the work of either "softening" (breaking) or rinsing and otherwise cleansing the skins. It will be seen after a moment's reflection that a wheel divided into four compartments or segments must turn the contents four times as frequently as if left in the whole wheel.

The liming of the calf at this tannery presented no new features. They are fully limed, so that the hair comes freely. The skins are washed in the wheel after being unhaired, and worked with a stone worker to remove the remaining short hair. Great care is manifested throughout to keep the grain sound, and to work every part of the skin uniformly, so that no more lime will be left in one part of the surface than another; the tendency of an omission in this respect is to cause the grain to color unevenly and appear clouded when tanned.

The most remarkable fact to which I wish to call attention is this: Mr. Mercier declares it unnecessary to break the nerve—and he certainly devotes less labor to this end than any other manufacturer I have met. He does work all the flesh off with a worker, but when this is accomplished I did not see that an additional stroke of the knife was given to soften the pelt or break the nerve. Each man thus worked off the flesh from about one hundred and twenty skins per day; from the amount of work thus performed it can be estimated about how much labor was bestowed.

The next remarkable fact I wish to mention is that Mr. Mercier, in common with all other calfskin tanners in this section, entirely omits bating, as we practice it. They use no other bate than some liquor.

The acid which forms, known as "gallic acid," and which is abundantly found in all oak yards, is the only bate here employed. This acid liquor, it is well known, will kill the lime (neutralize it), and will, with a few days' handling, remove all appearance of lime from the pelt. When thus reduced and brought back to its normal condition, then Mr. Mercier treats his stock to the usual nourishing process. He begins this process by a solution of liquor made from spruce bark, which, as I had occasion to say before, is very abundant and comparatively cheap all through this country. The strong acid from this bark has a wonderful tendency to plump. Mr. Mercier is disposed to attribute these remarkable plumping powers to the resin or sap in this bark. But it is proper to say that this practice is a specialty in this tannery, and is seen nowhere else.

When the skin is slightly raised and fairly colored, it is laid away in oak bark. This process of laying away is universal in this country. The skin is folded so that the grain of the neck and shoulders is folded on the grain of the butt, that is, doubled over. The bark only comes in contact with the flesh. In some tanneries, I notice, they vary this practice by putting two skins of about the same size together, grain to grain. This, I judge, with all respect for the experience and practice of Mr. Mercier, is an improvement upon his method.

The object of this practice is variously considered; some say it is to prevent the over tanning of the grain and to induce, as far as possible, the tanning from the flesh side. This object is desired to make the grain tough, so that it will hold the stitch when sewing the side linings. Others say it is to aid the color of the skin. My own judgment is that it may aid and help to produce both of these results, and therefore the practice is justified.

The bark is laid on the skins fully one to two inches thick, and all the interstices are filled with bark and stamped down solid. I should judge that not more than half the number of skins are laid in the vat that our practice would call for.

When the vat is filled with skins and bark thus put away, the vat is run up with water or weak sweet liquor, most frequently with water, although Mr. Mercier's practice is to run liquor from his leaches; but I judge that only spent bark was placed in these leaches, and consequently the liquor was little more than the washings of the bark.

These skins are allowed to remain for three months, and in Mr. Mercier's case two such layers, and in most other cases three such layers, occupying nine months, completes the tannage of the skins.

I need not say to any intelligent tanner that skins prepared in this careful way and tanned by this slow process must yield a very tough skin. The grain must be soft and yielding, requiring but little scouring, and I think beyond the working of these skins on the flesh over a beam and the softening in the wheel before scouring, the skin gets but little labor—hardly so much as is bestowed by our practice. The stretch is left in the skin and not taken out in the effort to get out the old grain, as our system of strong liquors compels us to do.

The shaving, whitening, blacking, etc., is after our method and is in no sense an improvement. Of course where so many skins are tanned, and the selections and classifications begin with the raw material, there can be no difficulty in rendering the most severe classifications possible in putting up the skins for sale.

All that it is further necessary to say, in regard to the manufacture of Mr. Mercier, is that he devotes himself to the work of making as good leather as can be made, and he has succeeded. Whether he makes more or less profit, whether he makes as many pounds of leather from the skins taken in hand by him as an English tanner would, is quite another question, and one I fancy he does not care to consider. He sacrifices everything to toughness—to wearing qualities.

Mr. Mercier showed me some French coppice bark which cost him five cents per pound, or $100 per tun, although his usual coppice bark cost him but $40 per cord, or two cents per pound, and he considered the former profitable even at this high price.

He confirmed my opinion that the spruce bark contained little or no tannin, and although for the purposes indicated he did use a small quantity, at about the price of one cent per pound, he did not look upon it with much favor.

If this view is true, what kind of leather must that be which is made out of spruce bark exclusively? More than half of the bark used in sole leather tanning throughout Germany and Austria is this spruce.

M. B. writes to suggest the construction of a spherical metallic balloon, 70 feet in diameter. Such a sphere would lift 11,225 lbs.; and if made of metal weighing ½ a lb. to the square foot, it would weigh 7,647 lbs., leaving 3,578 lbs. of lifting force available. The balloon could be raised and lowered in the air by an engine of half a horse power, and no gas need be lost or ballast thrown out.

ERRATUM.—In Professor Morton's article on "The Magic Lantern as a Means of Demonstration," on page 163, in place of 18, 14 and 16 inches as the radii, read 4½, 3½, and 4 inches. The Professor's attention was called to this oversight by the kindness of Mr. R. S. Bosworth, of Adams, N. Y.

Correspondence.

Combined Steam and Bisulphide Engines.

To the Editor of the Scientific American:

Your correspondent Mr. C. H. Aaron suggests that it would be better to apply heat directly to bisulphide of carbon, by putting it in the boiler instead of water,and dispensing with the steam engine altogether. Many men have made the same suggestion since I began to experiment in utilizing the latent heat in exhaust steam, and have fallen into the error of supposing that power could be produced with much less heat when it is applied to the bisulphide of carbon than when applied to water.

The difference in the amount of fuel that would be required to produce a horse power an hour with the two fluids is by no means as great as most persons imagine. To illustrate: 4 lbs. of coal will run an engine of 1 horse power an hour, if the boiler and engine are well constructed. If the boiler is filled with the bisulphide of carbon instead of water, 4 lbs. of coal will run an engine of 1½ horse power an hour. If a combined steam and bisulphide engine is used, the 4 lbs. of coal will work the steam cylinder 1 horse power an hour, and the exhaust steam from this cylinder will work the vapor cylinder nearly 1½ horse power during the same time; and we get about 2½ horse power from the same fuel that would be required to produce 1 horse power with steam alone or 1½ horse power with bisulphide of carbon alone. This I have proved by trial many times.

In other words, with the combined engines, the same heat is used twice and produces two results; and I know by actual tests that the latent heat in the exhaust steam from an engine will do nearly as much work when used to heat a bisulphide boiler as the coal, burned to make that steam, originally would have done if it been burned under the bisulphide boiler in the outset. The loss of heat by using the steam in an engine does not exceed 95 per cent; and the exhaust will heat, to 200°, 95 per cent of the water that the coal used to make that steam would have done. The loss of heat is entirely due to the radiation from the pipes and cylinder; it does not make the slightest difference in the amount of heat it contains, whether the high pressure steam is used to produce a large amount of power in an economical engine or whether it escapes direct from the boiler. The theory that the heat extracted is in exact proportion to the power produced is theory only, and cannot be sustained by any practical tests; but on the contrary, heat is no more destroyed or used up in producing power than water is by flowing through one wheel to another at a fall below.

Another popular error is that a large amount of the heat produced by combustion goes up the chimney flue, in a well set boiler. I have put a bisulphide boiler into the smoke stack of a steam boiler and found that more work could be done with the exhaust steam from one engine, when applied to a bisulphide boiler, than with the heat escaping from the smoke stacks of twenty-five engines of the same size.

I hope that these facts will convince your correspondent and others that more work can be done with a combined engine where the heat is used twice than with a single engine where it is used but once.

Springfield, Vt. JOEL A. H. ELLIS.

To the Editor of the Scientific American:

I have read C. H. Aaron's remarks on the steam engine; and I wish to say that a pound of steam at any temperature contains about 1,150 units of heat; of these not more than 250 go to working the engines, even when the feed water is heated to 180°; the rest is blown off through the exhaust pipe or enters the water of condensation. Fifty years ago, the Cornish steam engine made one horse power per hour out of 2½ lbs. of coal; to-day the average of all engines running will not be less than 4 lbs. of coal per horse power per hour, the very best compound condensing marine engines requiring 2 pounds of coal per horse power per hour.

The units of heat in a pound of coal, when tried with the mechanical equivalent (772), ought to produce 2 horse power for 1 hour.

We have been exercising our ingenuity in making every imaginable style and shape of engine, cut, off, catching the gases going up the chimney,etc. So far as they go,these are good; but they do not go to the root of the evil,which is,pre-eminently, the 966·6 units of latent heat which pass out with the exhaust steam. The half of this may perhaps be utilized by making it heat a second boiler containing a substance with a low boiling point, which substances render latent a small quantity of heat. Such are ether, gasoline, bisulphide of carbon,etc.; all these boil at about 100°. Ether in passing into steam renders latent only 163° of heat.

With regard to putting the fire directly to the boiler containing these substances, it would be very dangerous; and I doubt not, if Mr. C. H. Aaron were to try it, the chances are that he would not long be able to eat apple pie even though it be seasoned with quince. And it would be of little practical utility; because, when the specific heat of a substance is low, the steam is proportionally weak, that is, although 1 unit of heat will raise 1 pound of water 1° and 1 pound of ether 2°, but the steam of the ether will only have half the power of the steam of the water.

Wilmington, Del. J. W. H.

The Patent Right Question.

To the Editor of the Scientific American:

Several of your correspondents have given opinions on this question, arguing in favor of certain general principles which seem to me to be essentially wrong. Permit me to say a few words on the other side, though we all come to the same conclusion, but for different reasons. Mr. H. A. Walker says: "A citizen has a right to claim from the State only such protection in the use and ownership of property as shall redound to the general good." J. E. E. says: "I cannot see that an inventor has any inherent right in his own discovery." Both of these propositions, I call fundamentally wrong. The citizen claims protection from the State for his property because it is his, independently of the State, and the State itself exists, simply by the universal consent of the individual members, because it is only by union that each can be protected; and without that union there would be and could be no such thing as public good. If this principle be correct, all Mr. Walker's reasoning fails.

As to the other *dicta* of J. E. E., I must say that, in my opinion, the inventor has as much inherent right to his own discovery (exclusive right, I mean) as he has to the use of his hands or his teeth. But he is powerless to enforce that right; to do so, he becomes a member of a community or State, each member of which, by mutual agreement, binds himself to all others; so that, if any one will invent a new thing that is useful, they will all protect him in the exclusive use and profit of that thing. But only for a limited time, for the cost of a perpetual monopoly would be too much. Under this condition, the inventor has an inducement to invent, and the State the benefit of the free use of the invention finally. CHARLES STODDER.

Boston, Mass.

To the Editor of the Scientific American:

On reading H. A. Walker's letter on page 132 of your current volume, I can see very plainly that a citizen has the exclusive right to whatever he produces with his head or hand, and none but a thief or robber can take it from him without obtaining his consent, and remunerating him for it. The best protection to the individual is for the best interest of the State. The State has no right to my service, in any capacity, only as I sell it, and the idea that it has is only one of those barbarisms which advancing civilization has failed to eradicate. The above will do also for J. E. E., and I will add that the idea of reward for doing good and punishment for doing the opposite is as old as man; and if the inventor benefits the public, he is entitled to a reward, simply because he does so. J. E. S.

Portland, Me.

Water as Fuel.

To the Editor of the Scientific American:

I observe in your issues of April 5 and July 19, under the head of "Water as Fuel," some observations on the newly invented Stevens steam furnace exhibited in San Francisco. Will you allow one who has seen its workings, and had its objects stated to him by the inventor, to correct a few errors in those communications?

First, I will mention to the *Alta* reporter that the "tremendous roaring" is caused simply by the escape of steam from the pipe, as would be the case if there were no combustion at all, and not, as he seems to think, by the chemical action. Next, the inventor is not so unscientific as to think that steam can be decomposed simply by striking disks of iron, or by any other mechanical means. It is true that it is practicable to decompose water by contact with red hot iron, but only at the expense of the metal, which is oxidized, hydrogen being set free; but this is far from being the design of the inventor, he using the disks of iron only to deflect the current of steam on to the jet of oil. As stated by him to me, the objects of the inventor are: To decompose superheated vapor of water in presence of red hot carbon, thereby getting abundant oxygen in a very small space, and then to burn the carbonaceous matter to carbonic oxide. The merit of the invention consisting in having at command a limited space where the temperature is very high. This would make the furnace specially valuable for reducing very valuable ores, and for other metallurgical operations. He did not pretend to economy of fuel, and such a device could not possibly be economical when no arrangements are made to introduce air to consume the hydrogen set free from both oil and water. Oil is used, being the only fuel that could be fed constantly into the right spot.

The inventor knows that as much heat is necessary to decompose water as will be produced by combining the oxygen set free with the carbon of the oil. But if his ideas are correct, he gets, as I said, an abundant source of oxygen. I make these corrections for the benefit of those of your readers who might be misled. H. O. L.

Stockton, Cal.

The Thermal Expansion of Mercury.

To the Editor of the Scientific American:

In your clear and useful article on the "Properties of Saturated Steam," in your issue of August 9, current volume, there is an error, derived probably from a similar error on page 61, of Charles T. Porter's useful "Manual on the Steam Engine Indicator," to which work you refer in terms of just commendation

The coefficient for the expansion of mercury for each degree of Fahrenheit's scale, as there given, is 0·0010085, and you reproduce it exactly. As given by Rankine ("Steam Engine," art. 107, I, p. 111), it is 0·00010085, and it is so given in Rankine's "Civil Engineering" and Young's "Physics." Your coefficient is therefore ten times too large, and may mislead the inexperienced. I have called Mr. Porter's attention to the error. J. C. HOADLEY.

Lawrence, Mass.

REMARKS BY THE EDITOR:—We are much obliged to our correspondent for calling attention to this error, which was reproduced, as he supposes, from Mr. Porter's valuable and, in general, very accurate work. Applying the correction to the problem given in our article on the properties of steam (page 81, current volume of the SCIENTIFIC AMERICAN), we find that the expansion of mercury is $61{\cdot}11 \times 0{\cdot}00010085 \times (80-32) = 0{\cdot}3$ inches, and the corrected hight of the column $= 61{\cdot}11 + 0{\cdot}3 = 61{\cdot}41$ inches. We advise our readers to make a note of this correction, and affix it to the article.

A Toad in the Solid Rock.

To the Editor of the Scientific American:

The other day Mr. Moses Gains of this place, while digging into a bank, found a toad embedded in the hard pan. He came to a stone some 2 feet square; and after digging this out, a man who was with him observed something black: taking his pickaxe, he carefully dug it out, and it proved to be a toad. It was some six inches below the surface of the stone, and its place of concealment was as smooth as if it had been made of putty. The toad was about 3 inches long and very plump and fat. Its eyes were about the size of a 3 cent silver piece, being much larger than those of toads of the same size such as we see every day. They tried to make him hop or jump by touching with a stick, but he paid no attention to them.

How came this toad embedded, 5 feet below the surface under a stone, in that hard pan? What did he subsist on? Will such toads live on being brought to the light? Is there any air in the ground, on which a toad could live, and how long must we suppose that he had been there?

New Hartford, Conn. A. W. ARNOLD.

The Hartford Steam Boiler Inspection and Insurance Company.

The Hartford Steam Boiler Inspection and Insurance Company makes the following report of its inspections in the month of July, 1873:

The number of visits made during the month were 1,108; boilers examined, 2,300; internal examination, 1,112—these were very thoroughly done, including examination of bottoms and all fire sheets, as well as flues and tubes and boiler attachments; external examinations, 2,029. The hydraulic pressure was applied in 180 cases. These were, in most instances, boilers so small, or of such construction, that an inspector could not get into them; but, in addition, the hammer test was applied externally while the boilers were under cold water pressure. Number of defects in all discovered, 1,123; dangerous defects, 275. The dangerous defects were in most cases such as were liable to result in accident at any moment, and they were in many instances caused by bad management. The defects in detail were as follows:

Furnaces out of shape, 49—9 dangerous; fractures of plates, 56—20 dangerous; burned plates, 53—34 dangerous. These defects were from various causes. In some cases, the fires were too fiercely urged from insufficient boiler capacity. In other cases, the boilers were not properly constructed. The builder, anxious to provide the greatest area possible of fire surface (very likely to outbid his rival), had placed his tubes so near together that, when the fires were driven, the heat was so great that the water was nearly or quite all forced away from the iron, and, having no protection, it could not be otherwise than burned. Another difficulty: tubes and flues are often placed too near the shell of the boiler. The space is sometimes not more than one inch, when it should be not less than three inches. Even four inches would be better. There should be abundance of room for good circulation of water. We have found fire sheets, tubes, and flues badly burned from want of sufficient water space between them. Another difficulty. and one which causes many boilers to be burned, is that they are not opened frequently enough. Cleaning is neglected. Potatoes, or some solvents of scale are used in the boiler, the scales are thrown off and down into the bottom of the boiler, and, instead of having it removed through the hand-holes or man-hole, it is allowed to remain, and, becoming conglomerated, prevents the water from protecting the fire sheets, and they become burned and contorted, or, as it is generally called, "bagged" and buckled. Hundreds of boilers are injured or ruined in this way every year. Have your boilers constructed so that no tube or flue shall be nearer than three inches to the shell. If tubular, have the tubes placed in vertical rows, and not staggered—the water will circulate much more freely and the tubes can be much more easily cleaned, and scales will not be as likely to fill up the space between them. We have had some bad cases of late, where the spaces around staggered tubes were filled with scale. Cases of blistered plates, 182—31 dangerous; deposit of sediment, 261—36 dangerous; incrustation and scales, 223—15 dangerous. The danger of these defects is sufficiently explained above. External corrosion, 88—18 dangerous; internal corrosion, 52—12 dangerous; internal grooving, 28—3 dangerous; water gages defective, 72—5 dangerous; blow-out defective, 23—10 dangerous; safety valves overloaded, 29—7 dangerous; steam gages defective, 149—16 dangerous—dangerous varying from —17 to + 50. Where there space, we should say something on this defect. We have often enlarged upon it, but will leave it for a future report. Boilers without gages, 83; cases of broken and dangerously loose braces and stays, 50—21 dangerous; boilers condemned as unsafe and unfit for future use, 18.

THE railway link, of about eighty-five miles, between Cairo, Ill., and Jackson, Tenn., is progressing rapidly, and is expected to be finished about next October. On the completion of this road, Chicago will have an uninterrupted railway line to Mobile and New Orleans by the Illinois Central Railroad, over which passenger trains will run the entire distance without change of cars.

THE GREAT EXPOSITION—LETTER FROM UNITED STATES COMMISSIONER PROFESSOR R. H. THURSTON.

NUMBER 12.

VIENNA, September, 1873.

It is with mingled pleasure and regret that we take leave of Vienna and of this vast exhibition.

Several weeks of unremitted toil—of the most fatiguing kind of toil, in which body and mind have both been severely taxed from early morning until late in the afternoon, day after day, without relaxation,—have prepared us to look with pleasure to an early departure. There is probably no severer labor imaginable than that of examining critically the exhibits here grouped in the Machinery Hall. And when the visitor has kept at his work all day, the physical exertion of walking or standing so many hours, together with the mental strain which is occasioned by the uninterrupted work of examining and comparing competing machinery and novel methods, are found to be singularly exhausting. The excessive heat of the summer has also been seriously enervating. Yet probably no one can finally determine to take leave of this splendid collection of

THE WONDERS OF MODERN ART AND INDUSTRY

without some reluctance. If he is a lover of the beautiful, the great picture gallery, containing contributions from the finest collections of Europe, the statuary, and the thousands of magnificent creations scattered in every direction throughout the vast enclosure, must still attract him. Hundreds of these beautiful objects would well repay him for the time which might be required to revisit them, and scores, equally beautiful, remain yet undiscovered. If he is essentially utilitarian, he desires to investigate more thoroughly some new and interesting process, or to trace the growth of some established department of industry, to learn more of some recent invention, or to examine yet a little more fully the construction of some novel machine. Here no one is ever satisfied. The longer the exhibition is studied, the more does the student find to occupy his attention. The task, once entered upon, becomes almost as endless as the study of Nature itself, and hardly less remunerative.

The engineer, however, who attends the *Welt-Austellung* soon finds that, to learn thoroughly the lesson which he has come here to study, he must pursue his investigations at a distance from, as well as within, the exhibition limits. He finds here a splendid exhibit of machinery and of manufactured products, but, to see the processes and the methods by which these products are created, he must visit the establishments which have contributed them. We therefore propose to leave at the earliest possible moment, after the most important work is done here, and to spend the remaining portion of available time in visiting some of the most successful or most interesting of those establishments in various parts of Europe, and also, where possible, to see something of that system of technical schools which has done so much for Germany.

Taking a farewell stroll about the grounds and buildings, we have found almost as much to interest us as on the first day of our visit. Even the Machinery Hall, where these several weeks have been almost exclusively spent, seems to be still rich in novelties, and we have not yet lost interest in many objects which are now quite familiar to us. At one side, and almost unnoticed before, we find one of the most singularly interesting exhibits to be seen in the building. An old glassblower's lamp and a roughly made reel, standing before a case containing a few new but not, apparently, remarkable specimens of woven goods, form a group which does not appear at all attractive. But when the exhibitor makes his appearance and, sitting before his lamp, begins to heat and to draw out a little rod of glass and to wind off, from its red hot semi-fluid point, a thread finer than that of the silk cocoon, and when it is found that this glass thread is spun and woven like silk, and that the cloths and made up garments, and the hats and feathers, and strong flexible cords exhibited, are all made of a material which we are accustomed to regard as the best illustration of combined inflexibility, brittleness and hardness, the collection awakens extraordinary interest. Cloaks, capes, ladies' and children's hats with their elaborate trimming of ribbons and feathers, muffs of apparently a curly fur or fleece, and dozens of other articles, are shown, having all the suppleness and softness of silk, with a remarkable variety of coloring. These

GLASS TEXTILE GOODS,

the exhibitor claims, wear well; and, if soiled, are readily cleansed by washing in strong lye or dilute acid. The visitor, after examining this extraordinary collection, finds himself prepared to believe that the story told by a classic author of the discovery, by the ancients, of flexible glass has at least some foundation in fact.

In another part of the hall we meet with a train of "three high rolls," such as have now been long used by our own ingenious engineer, Holley, here exhibited as a new invention by a gentleman well known on this side of the water. In still another place, we discover the peculiar and very excellent form of bridge column, constructed of four rolled iron beams, having a section formed of the quadrant of a circle with each extremity turned outward to form a flange, which has so long been used by some of our best builders of iron bridges; this is also now claimed as a new invention here.

In some of the many cases in which well known American inventions are brought here by foreign exhibitors, they have been undoubtedly either "pirated" and adopted precisely as they have been brought out in the United States, or with slight modifications, which are usually claimed to be improvements. In other instances, the European inventor has actually produced the device contemporaneously with and independently of the American. Piracy is probably not unusual in those countries where the patent code is so incomplete and so unjust to foreign inventors, and instances of it occur quite frequently here, probably, although it is often difficult to distinguish the pirate from the contemporaneous inventor. The latter deserves as much of credit as the former does of reprobation. It is particularly creditable to produce an invention in a country where the talent for invention is so rare, and where it finds discouragement rather than assistance by existing legislation. In the majority of observed cases, however, the foreign exhibitor pays a royalty to an American patentee.

The aid which American inventors have extended to Europe is well illustrated in the agricultural halls, where

AGRICULTURAL MACHINERY,

and particularly mowing and reaping machines, are found in large numbers, all embodying the inventions of American mechanics. The English are now building some fine machinery of this class, and particularly excel in threshing machinery and steam engines for agricultural purposes, a direction in which our own people are doing too little. The German builders are also just entering upon this field. The English machinery is well built, substantial and finely finished, but American farmers would probably hesitate about adopting it on account of its weight, and would prefer our own styles which, while equally well made and quite as well finished, are much lighter and yet are exceedingly strong; and which, if rather less substantial and durable than the English machines, cost less and may be expected to last until later improvements shall have caused other styles to supersede them; that is to say, quite as long as is necessary or expedient.

Hofherr, of Vienna, is the only continental builder who has attempted to compete with American exhibitors of mowing and reaping machines. His machine, though creditable and doing good work, is far too heavy for our market and in several respects inferior to the best American machines The English builders have all declined to compete at the field trials. The official trial was therefore a contest between American machines.

The American styles of

STEAM PUMPS

are finding an extensive sale in Europe, apparently, and some firms are building under royalties to American patentees. The Earle pump is exhibited both in the United States section and by their European builders, Decker Brothers, of Canstatt. The Cameron Special pump appears to good advantage in the exhibit of the great English manufacturers, Tangye Brothers. The Selden pumps, exhibited in the United States section, seem to attract attention and to receive much commendation.

The European exhibits would not attract very much attention in the United States. The exhibition of centrifugal pumps, by the two firms of Gwynne & Co. and J. & H. Gwynne, of London, are more interesting; not so much, however, on account of the novelties to be observed there, as because of the fact that the wonderful adaptation of the centrifugal pump to raising large quantities of water, where the lift is comparatively low, has been most convincingly illustrated by these pumps.

One of these firms is now building eight pairs of pumps to be used in draining the extensive Ferrara marshes in Northern Italy, where the quantity of water to be raised is stated to be 2,000 tuns per minute—enough each minute to float a large ship—and the highest lift is 12 feet. This quantity amounts to 650,000,000 gallons per day. The pumps are stated by the agent to have disks of five feet, and nozzles of fifty-four inches, diameter. Each pair is driven by compound engines, of 27¾ and 46¾ inches diameter of cylinder and 2¼ feet stroke of piston, furnished with steam by a boiler having more than 700 square feet of heating surface.

The proper construction of the centrifugal pump is not usually well understood by builders, either at home or abroad, and both theoretical investigations and careful experiment are probably required to assist in perfecting existing designs; but it is well known that the centrifugal pump affords the best known means of raising very large volumes of water to moderate hights, where the first cost of apparatus is a matter of consequence; and in extreme cases, as the one above given, it is the only form of pump which can well be used. The sale of centrifugal pumps in the United States, as well as abroad, is becoming an important branch of business, and when builders shall succeed in fulfilling guarantees of an efficiency, under moderate lifts, in ordinary work, of seventy per cent. they will confer a great benefit upon the world and secure corresponding rewards for themselves. Experiment and competition are gradually producing a much desired and greatly needed improvement.

As we take a last glance at the long Machinery Hall and its crowded exhibits, the embodied inventive genius and constructive talent of the world, past as well as present, we feel that we are leaving it with our task hardly commenced and with an oppressing sense of the hopelessness of any attempt to accomplish it fully, were the whole period of the exhibition available. Indeed a lifetime would hardly suffice to make the best mechanic, of the thousands who visit it, familiar with all that he probably would desire to learn.

As the Machinery Hall may be considered to contain the apparatus with which the material civilization of the world has been produced, the

EDUCATIONAL DEPARTMENT

of the *Austellung* may be looked upon as the illustration of the system of machinery by which we are to-day endeavoring to aid the advance of the more purely intellectual part of the work of civilization. The collections in this department are not as extensive as they might be, or as they were expected to be. The ordinary and standard apparatus which are everywhere used in higher schools and colleges, text books in every branch of study for all grades and in every language, maps and charts, the familiar forms of physical and chemical apparatus, are all illustrated, with some few novelties, but with rare examples of strikingly interesting innovations or improvements. The school apparatus and furniture from the United States, our American text books, the French illustrative apparatus for very young pupils, the apparatus exhibited by London and Paris makers of philosophical instruments, are all attractive and exceedingly interesting to all who appreciate the public as well as private benefits which follow the adoption of effective and truly practical methods of education. The German exhibits of apparatus for technical instruction, we have found exceptionally interesting, both as constructions and as illustrations of German methods. Models exhibiting kinematic combinations, the various kinds of gearing, elements of machines, modes of transmission of power, models of typical forms of important machines, and other models illustrating processes of metallurgy and engineering, are here in great variety. Supplied with such apparatus, our American technical schools would, with their advantages of excellence of material in their classes, probably excel any schools even of Germany, in the efficiency of the education which they would confer upon their students. A few of our professedly technical schools are already nearly as well provided with this kind of *matériel* as are the German, and one or two of our schools are even superior to the continental schools in this particular, with perhaps one or two exceptions. It will probably not be long before we may expect to find ourselves in a position to offer to our young men all the advantages at home which they now seek abroad, and, in addition, some which can only be had in a country like our own, and among a people like ours.

Here we are compelled to take leave of the great *Welt-Ausstellung*, a gigantic failure financially, but yet a stupendous creation, which entitles those who have inaugurated the scheme and who have, with even moderate success, conducted its administration to far greater credit than the world generally will be inclined to accord them.

The result of her venture may be the temporary financial prostration of her government, but it can hardly be doubted, by those who have had the privilege of visiting the exhibition and of studying its political as well as its economical relations, that Austria will eventually derive from it, directly and indirectly, benefits which will far more than compensate her for all her pecuniary losses.

There are whole groups of exhibits, and numberless articles of specially interesting character, which well deserve notice, which we have had neither time nor space to give them in this short, hastily written and ill digested series of letters.

To the *Art Journal*, the London *Engineering*, and other periodicals devoted to special branches, we must leave the task of going more fully into detail and of giving more extended descriptions than would suit the pages of the SCIENTIFIC AMERICAN. One or the other of the editors of the second paper mentioned is always on the ground, and it is a gratification to learn that the vast amount of valuable engineering information collected by them will be published, at the close of the exhibition, in book form.

In the course of our journeyings among the manufacturing districts, and when visiting the great establishments of Europe, we may have occasion to refer again to a few important exhibits, while considering the methods adopted in their production. R. H. T.

Cement for Making Concrete.

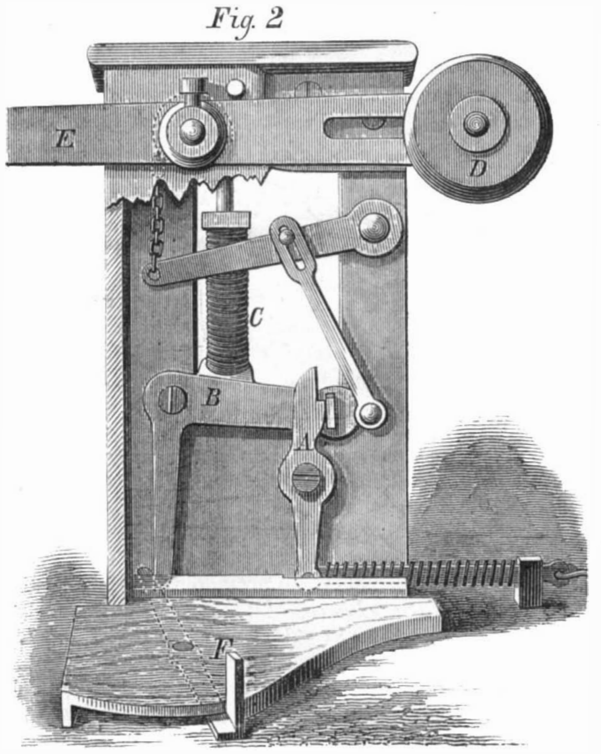
J. S. R., of Germanton, N. C., has read our article in our issue of August 9 on "Concrete for Building Purposes," and asks what the cement is made of, etc. In reply, we have to say that the cement is made from what is called cement stone. The stone is quarried from the mountain and burned in a kiln, similarly to the process for making lime. Cement is similar to lime, and is used with the sand instead of lime, in making mortar. It is termed "water lime" in some parts of the country, from the quality it possesses of setting or becoming hard under water. It may be procured in any of our principal cities. There are various qualities of it. It should be used with as little delay as possible after burning. To make garden steps or other pieces of artificial cut stone, it is safer to employ Portland cement. This is made in England, but is imported and for sale in New York city.

AUTOMATIC RAILROAD GATE AND SIGNAL.

The frequent disasters at level crossings on railroads have called forth many inventions for the purpose of at once closing the roadway to vehicles and warning drivers of their impending danger; and we herewith illustrate a device, simple and apparently universally applicable, which is intended to automatically close the gates at cross roads, and to exhibit, to travelers going in either direction, an indication of the coming train.

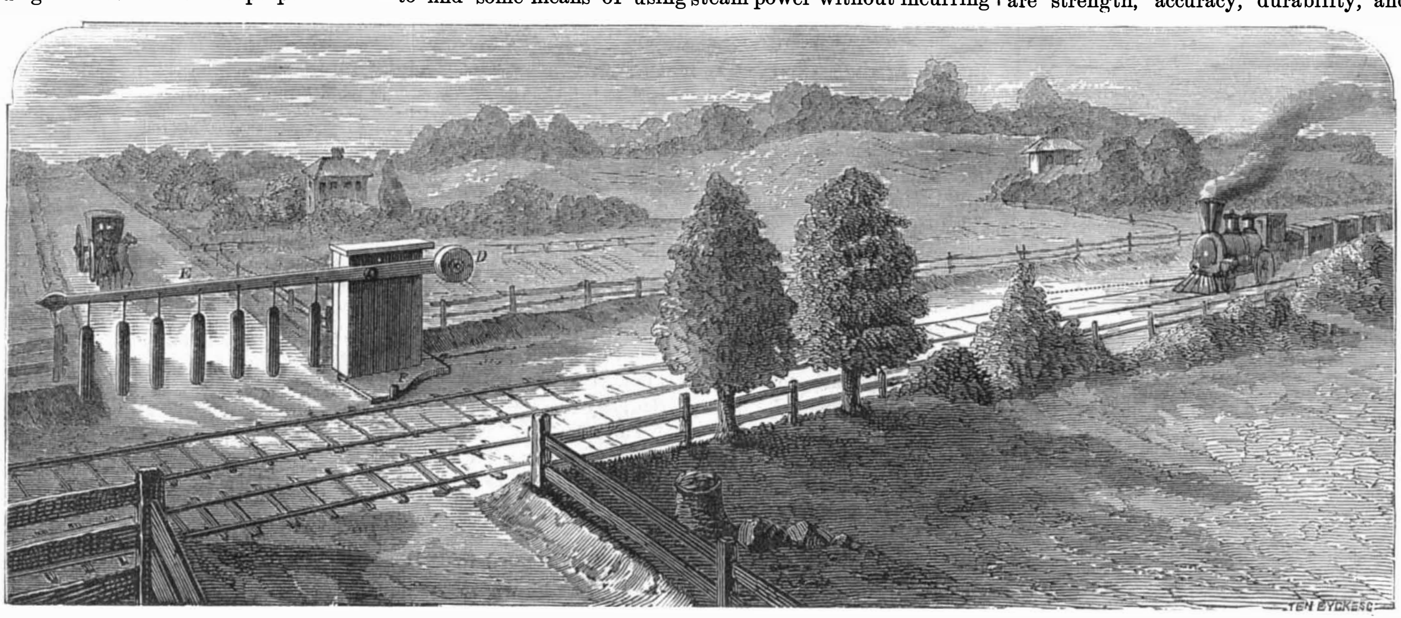
In Fig. 1 is seen a perspective view of the apparatus, which consists of a gate, let down to the horizontal position by a coming train, and again elevated to the perpendicular by the same train when it has passed the point of danger. In the latter position, a signal, attached to the top of the bar, is clearly visible from a considerable distance. Fig. 2 shows the working of the device. As the locomotive approaches the crossing, a projection (seen in Fig. 1 close to the engine near the rails is struck by a clutch on the post of the cowcatcher; this pulls a wire or rod (laid parallel to the track and partly underground if preferred) which draws the catch, A, away from the projection on the bell crank, B, as represented in Fig. 2. The horizontal arm of bell crank, B, is thus pushed down by spring, C, and, pulling on the connecting rod and pivoted horizontal lever, shown above, turns, by the chain on the end of the latter, the pulley or signal bar, E (dotted lines), thus overcoming the weight, D, and throwing the bar down across the road. As the train comes immediately op-

Fig. 2



posite the gate, the clutch on the cowcatcher strikes another projection, F, moving the lever (shown in dotted lines, Fig 2), which pushes in the vertical arm of bell crank, B. The projection on the horizontal arm of the latter is thus raised, so that, by the action of its spiral spring, the catch is drawn under and in connection once more with the lug. The pressure of the end of the catch on the latter raises the connecting levers, compressing spring, C, and allows the weight, D, to lift the bar to a vertical position, leaving the apparatus ready for the approach of the next train. The form of gate and of signal can, of course, be adapted to suit varying circumstances.

This device was patented on April 15, 1873, to Mr. Richard Walker, of Hopedale, Mass., who may be addressed for further information.



WALKER'S AUTOMATIC RAILROAD GATE AND SIGNAL.

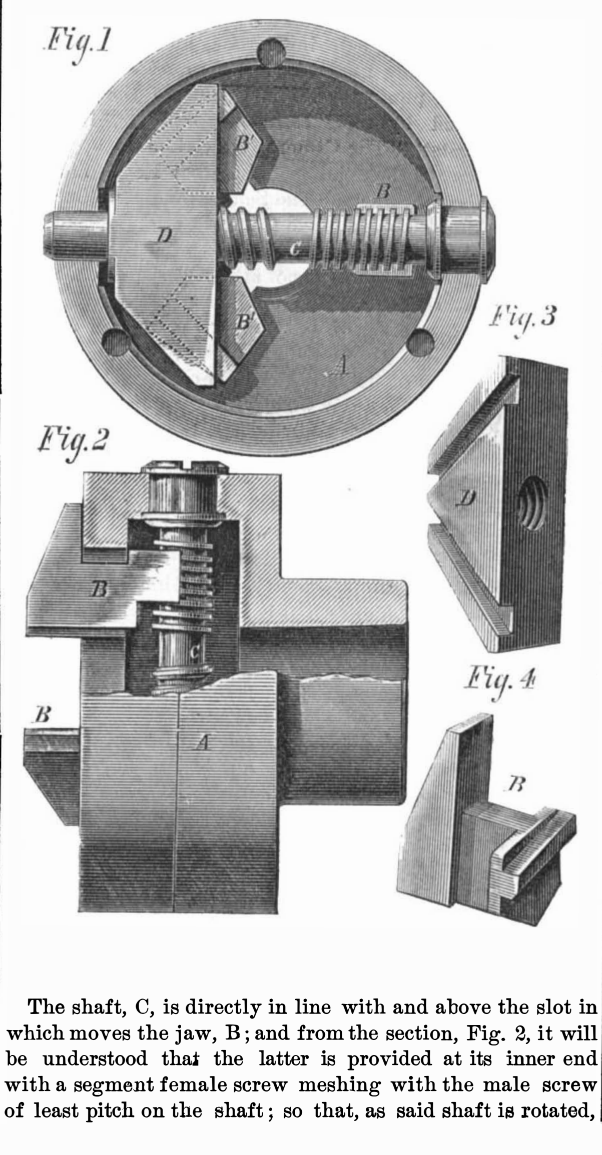
The New Straw Burning Steam Engine.

An interesting trial has been made at Vienna, before several German professors and landed proprietors, of the patent steam engine (illustrated and described on page 403 of our volume XXVIII) which utilizes as fuel straw and other vegetable products. This engine is one of the novelties of the exhibition. A 10 horse power engine was used for the experiment, making 140 revolutions per minute, and the brake was loaded for a duty of 19 horse power. 355 lbs. of straw was carefully weighed, consisting partly of straight rye and partly of loose broken wheat straw, purposely mixed in order to test the capabilities of the engine for burning all kinds of fuel of this description. It required 46 minutes to consume the straw, steam being kept up during the whole time at a pressure of 70 lbs. per square inch with the greatest regularity. This result gives a consumption of about 24·5 lbs. of straw per horse power per hour, and as an engine burning average coal under similar circucumstances would have required about 6·4 lbs. per horse power per hour, it appears that rather less than 4 lbs. of straw are equal to 1 lb of coal. In thrashing, about nine sheaves of straw are required to thrash 100 sheaves of wheat or barley. Everybody present was highly satisfied with the results of the experiment, as it has long been the desire of the eastern farmer to find some means of using steam power without incurring the enormous expense of bringing coal and wood from a long distance. This invention completes another link in the history of the steam engine, and will enable every farmer who grows more straw than he requires for the use of his estate, and who is miles from a coal mine or forest, to use steam instead of animal power, and at far less cost than hitherto.

THE DANBURY DRILL CHUCK.

This invention, of which illustrations in detail are herewith presented, is a three jawed lathe chuck, so constructed that the three jaws are simultaneously moved in radial directions by the revolution of a single right and left hand screw. The action is direct and positive, and, it is claimed, cannot clog, set, or in any way get out of order.

In the sectional views, Figs. 1 and 2, A represents the case, which is made in two parts, suitably secured together, and in the face of which are three slots for the sliding jaws, B B′ B′. Resting in bearings in the case is the shaft, C, upon and near the ends of which are formed screw threads, cut in opposite directions and extending nearly to the linear center of the shaft. It will be observed that these screws are of different pitch.



The shaft, C, is directly in line with and above the slot in which moves the jaw, B; and from the section, Fig. 2, it will be understood that the latter is provided at its inner end with a segment female screw meshing with the male screw of least pitch on the shaft; so that, as said shaft is rotated, the jaw, B, is caused to approach or recede from the cente of the chuck.

D, Fig. 3, is a yoke piece, through which the screw of greatest pitch passes, and thus actuates it in a direction opposite to the motion of the jaw, B. Upon its under surface are two diagonal grooves into which enter corresponding ribs on the jaws, C′, Fig. 4. As the yoke piece, D, is moved, the jaws, C′, are thereby caused to slide in their radial slots. The motion of the three jaws is made isochronous by a proper ratio of pitch between the screws on the shaft.

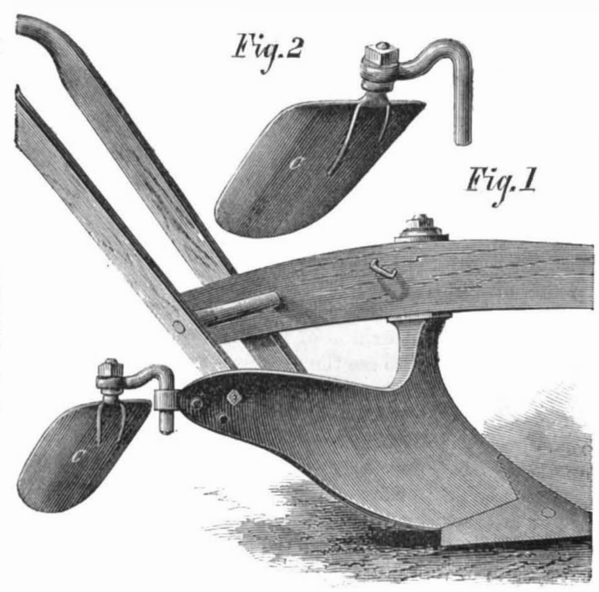
The main points of advantage claimed for this invention are strength, accuracy, durability, and cheapness. It is stated to be the most powerful chuck made, and to hold drills from 0 to $\frac{5}{8}$ (full size of drill). By turning down shanks to $\frac{5}{8}$, t will retain drills up to one inch inclusive, and this, it is said, without slipping even in the most difficult work.

The chuck has now been in use for six months, giving good and satisfactory results, and is sold with a full warrant as to efficiency, etc.

Patented by Mr. C. H. Reid, August 12, 1873. For further particulars address the manufacturers, F. A. Hull & Co., Danbury, Conn.

IMPROVED PLOW ATTACHMENT.

The invention herewith illustrated is an attachment to the ordinary plow, and is designed to open furrows or channels in the soil of suitable depth to receive potatoes, and afterwards to cover the latter with earth. The device consists simply in a plate, C, pivoted and secured by a screw and nut to an elbowed arm. The vertical position of the support drops into a socket, as shown on the rear of the mold board when in use, or, when not employed, is carried by the staple represented on the plow beam. It will be understood that the furrow left by the plow is too deep for potato planting, and hence the primary object of the attachment is to partially fill the channel with the loose earth thrown up by the



share. A bed of friable soil is thus prepared, excellently suitable for the germination of the seed. To cover the latter. it is simply necessary to use the plow without the attachment, the ground being thrown up and over the potatoes by the moldboard in the ordinary way.

The device can be placed in the socket with the end of the vertical part of the arm either up or down, it being suitably secured while in the latter position, so that the downward reach of the plate can be adjusted to plow in grain, etc., to any desired depth. Properly arranged, it is stated, the implement is well adapted for putting in manure or plowing grass ground.

The seed potatoes are of course deposited by a suitable dropper or other convenient means. It is also claimed that a result of using the invention is that the digging of the hills, when the vegetables are ripe, is attended with much less labor than ordinarily. The apparatus is simple, very quickly attached or removed, and readily adapted to the plow. The patentee is a practical farmer, and informs us that he has found it in operation a useful and valuable tool.

Patented through the Scientific American Patent Agency, Aug. 12, 1873, by Mr. William Donnelly, of Calverton, N.Y

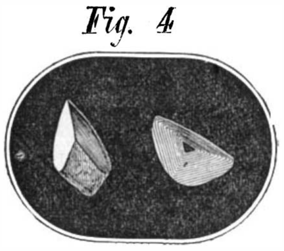
NEW YORK AND LONG BRANCH RAILWAY.—The northern section of this road, the New Jersey Central's Long Branch line, is rapidly approaching completion, and, it is expected, will be open to Perth Amboy about October 1. The bridge over the Raritan between Perth Amboy and South Amboy is nearly finished. It is about 3,000 feet long.

[*Continued from page* 207.]

dles. Taking a fragment of a stone that had already been operated upon, he fastened it in a second spindle in similar manner. Next, with an implement in each hand, he brought the diamonds together, steadying the shanks of his tools against two metal projections on the edge of the box before him. Applying the second diamond to the rough gem, with a quick grinding motion he rapidly cut a notch in the latter; it was hardly the work of an instant, but the line was perceptible.

At this point our curiosity prompted us to ask explanation, and suspending his labor, the cleaver showed us that there were flaws in the stone which had to be cut off and, besides, other pieces to be removed to give the gem its proper shape; so that probably, of the whole rough jewel, hardly one half would be available. We looked wisely for the flaws but utterly failed to detect them, a fact not be wondered at when we were informed by the artist that this ability constituted an important part of his art. "Indeed," he observed, "I have to know the structure of a diamond far more intimately than a physician that of the human body." As hardly any two stones are alike, and no rule can be laid down for the work, some idea may be gained of the consummate skill which enables a man to pick up a tiny fragment, glance at it once, and instantly detect not only flaws or streaks but where they are located, in the heart or on the surface, to make up his mind exactly what microscopic pieces must be removed, their size, and how they may be cut to turn them to best account, and, finally, how to so divide the stone as to produce the best color. And all this so quickly that, although we saw half a dozen stones operated upon, we asked afterwards: When the workman had examined them? We had not noticed the single swift look given at each, as one after another was split by the artist as he continued his explanations.

Fig. 4



SPLITTING THE DIAMOND.

We left the diamond, to indulge in the above digression, with a streak cut across it at the point at which it was to be divided. Placing the spindle containing the gem upright before him, the operator placed one of his knives directly over the cleft. The knife used was nothing more than a piece of steel, perfectly flat, with a square edge, and about six inches long. It is ground blunt purposely, for if it were keen, the hard stone would quickly turn the edge. Tapping the back of the blade lightly with his iron rod, the artist split off a fragment and then, melting his cement and removing the parts, showed us a clean smooth cut (see Fig. 4).

"But is not this a very risky performance?" we almost involuntarily exclaimed. "Suppose that you make a mistake?" The workman smiled superior, and explained that such is hardly possible, though he admitted that it would be a very easy matter to halve the value of a gem by a single false stroke. Imagine a $5,000 diamond—and that is not a large one—thus treated; $2,500 irretrievably lost by a single tap

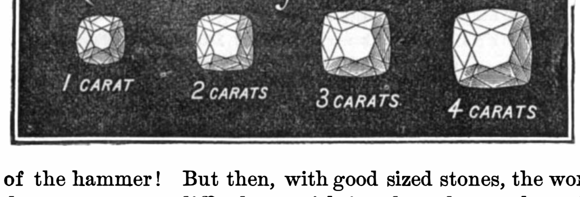
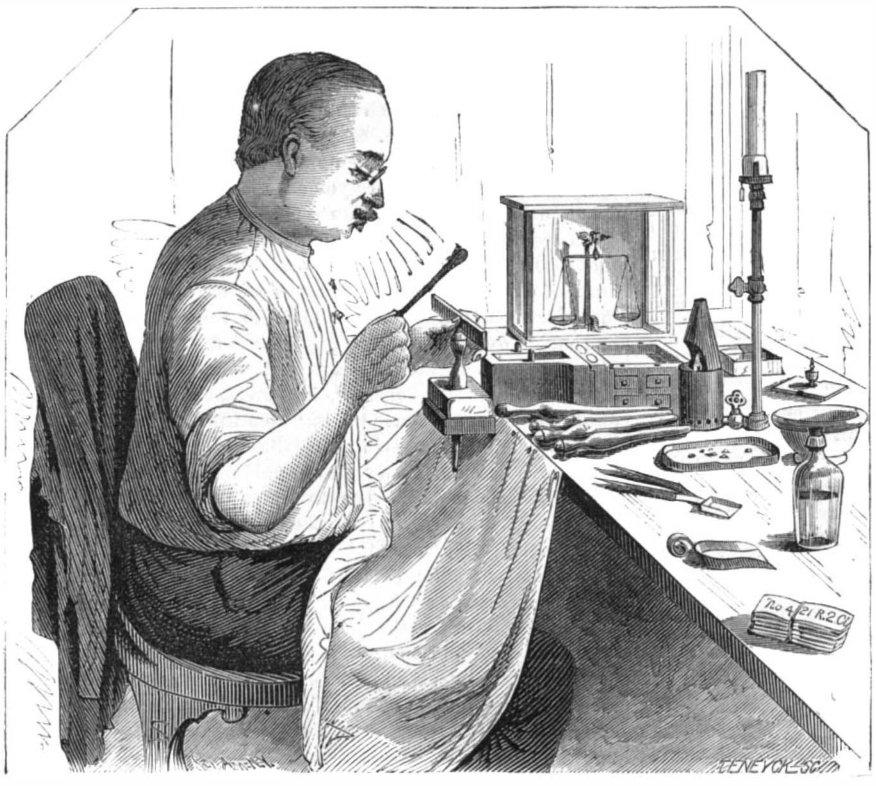


Fig. 1

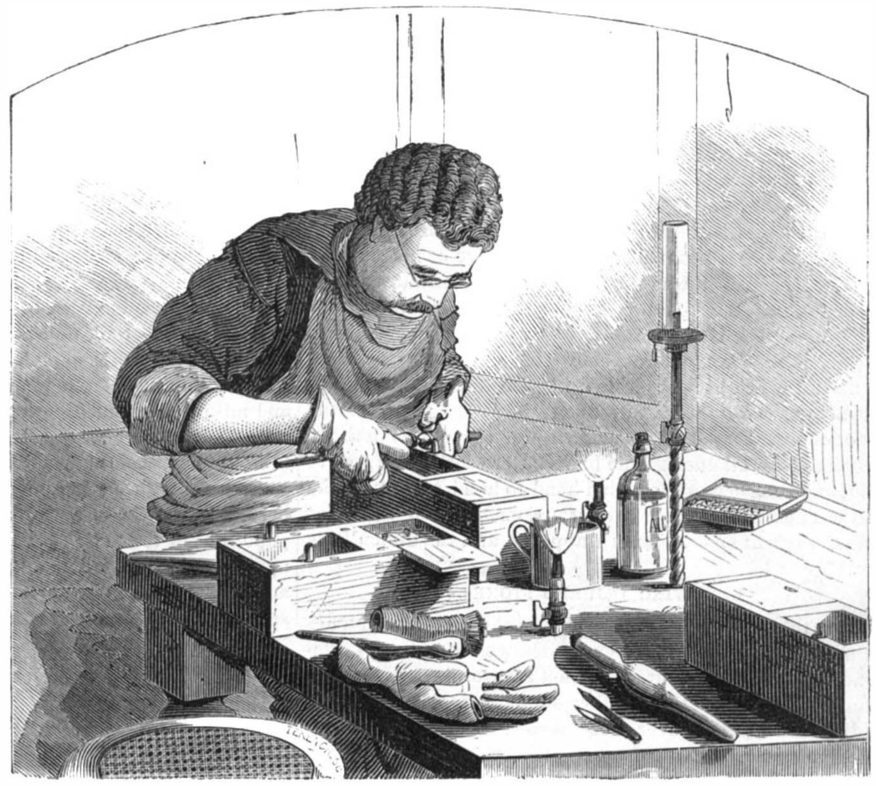
of the hammer! But then, with good sized stones, the work does not seem so difficult as with jewels no larger than pin heads, so small indeed that, in some cases, they number as many as 300 to the carat in the rough, or 400 finished. An idea of the relative sizes, proportionate to the weight of the stones, may be gained from Fig. 1, representing diamonds of 1, 2, 3, and 4 carats. Of course nothing is wasted; the dust that falls through the false bottom of the box, we shall find again in the hands of the polishers, while the odd scraps are cut into rose diamonds, or the little sparkling grains used for inlaying initials and similar fine work in gold jewelry.

THE SHAPES IN WHICH DIAMONDS ARE CUT.

Leaving the *klover* at his delicate labor, we were afterwards conducted to the cutter or *snyder*. Three workmen were engaged in shaping the diamonds after the rough forms indicated by the work of the cleaver. Regarding these shapes, a word is here necessary. The brilliant (Fig. 2) displays the luster of the stone to the greatest advantage, and is described as obtained by two truncated pyramids united together by one common base, the upper pyramid being much more truncated than the lower. *a* is the crown and *e* the collet, the two principal divisions formed by the girdle, *c*. *d* is the table, and the opposite side below, the culasse. The faces are called facets, and, including table and culasse, may number sixty-four. The rose diamond (Fig. 3) has a crown but no collet, that is, one side is flat; and it is usually made from stones and fragments which would not, without loss, form good brilliants. Then there are table diamonds, which are flat and have little luster, and bastard diamonds or those of mixed shape. The brilliant and the rose are the general types, and those with which we have in the following description to deal.



THE CLEAVER OR *KLOVER*



THE CUTTER OR *SNYDER*.

THE SETTER.

THE CUTTERS.

Our artist has graphically depicted the cutter at his work in the engraving. The same form of box used by the cleaver is before him, and the diamonds are fastened by cement, as before, in the ends of spindles. The cutter's labor is purely "diamond cut diamond." The stone to be cut is held in its setting firmly in the left hand, while the cutting piece is moved by the right. Both gems are of course affected by the mutual abrasion, but the attention of the workman is directed to but one. Very slowly the faces are ground away; no measurements are taken or angles calculated. The eye is the only guide, and it seems to be a faultless one. As soon as the first stone was finished, the diamond used for cutting it is operated upon, so that diamond No. 2 is, in turn, cut by No. 3, this by No. 4, and so on. Again the gems were handed to us for examination; all their mica-like sheen was gone; and, were it not for their form, they presented no different appearance from rough quartz pebbles. The friction dulls them, for they are ground together with considerable force, the workman being obliged to protect his hands by thick coatings against the rubbing action of the tool.

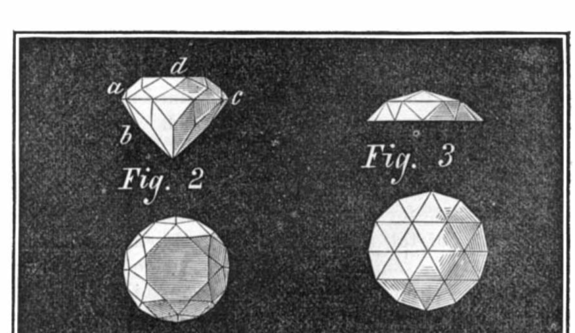
POLISHING THE DIAMOND—THE SETTER.

The polishing operation next claimed our attention; and ascending to an upper story, we found the polishers or *slypers* at their work, each man with a machine before him, as represented in the large engraving on our front page. In addition to these workmen is the setter, and with him we have first to deal. At one side of the room was a small charcoal furnace in which a number of metal acorns seemed to be roasting. Each of the latter consisted of a copper cup about an inch and a half in diameter, provided with a stem of stout wire of the same metal and filled with plumber's solder. As these rested on the glowing coals, the setter occasionally tried the hardness of the solder with his forceps until the metal became of about the consistency of putty. Quickly removing an acorn, or, to use the technical name, a "dopp," from the fire, he placed it upright in a small stand. Then he fixed a diamond exactly in the center of the plastic metal, and, with his fingers, coolly molded the latter in conical shape around it. Burning seemed to have no terrors for him, and although when the dopp was plunged in water it hissed at a great rate, the hand of the workman showed no effect of the heat. Each brilliant, large or small, has to undergo this operation once for each facet; that is, the setter must reset it so that every one of its facets in succession may be exactly horizontal and outside the holding metal, in order that each face may receive its proper polish—an operation requiring no small amount of delicacy and skill.

THE DOPP.

THE POLISHERS.

Again referring to the large engraving on our front page, the polishers were seated before long tables, on which were swiftly rotating horizontal disks fastened on vertical spindles, the lower ends of which revolved in antifriction steps. The disks, we were told, revolved at the rate of 2,000 turns a minute, and yet the bearings kept perfectly cool. The machine is an invention of Mr. Hermann's and an improvement upon the old apparatus used in Amsterdam, a specimen of which he exhibited to us. The construction of the latter



seemed very rude and primitive, being formed almost entirely of wood; the bearings, it is stated, were continually beating and wearing out.

The disks or *shives* are circular plates of a composition containing both iron and steel, and are made and turned in the establishment. They are ground in lines, at an angle from center to circumference, so as to hold the oil and diamond dust used in the polishing operation.

Three diamonds, set as above described, are ground at once, by each polisher. The stem of the dopp is fastened in tongs or clamps, the extremity of the latter being supported by legs an inch or so high. Two thirds of the dust ground off in the cutting is allowed to polish each diamond, and this, mixed with oil, is applied to the stone by the quills which the men seemed to be phlegmatically chewing. The adjusting of the gem on the disk requires wonderful accuracy in order that exactly the proper facet be ground and no more; for the slightest mistake might cutaway an angle and produce serious damage to the stone. The reader will share in the astonishment we felt on learning that this extremely delicate work was done by feeling. So sensitive is the touch of the artist that he tells by pressing on the stem of the dopp exactly whether it lies true against the shive or not, and by his fingers adjusts the stone over incredibly minute angles and distances. This goes on until each facet is brought to the requisite brilliancy. Standing by one of the machines, we saw, as the diamond was removed from time to time from the disk, the bright spot on its dull face gradually enlarge, as heavier weights were put upon the tongs to press the stone with increased force against the shive. Sometimes the gem defies all efforts, the hard outer coating refuses to yield, and then it is passed from hand to hand, and for weeks each workman tries to conquer it. Sometimes they fail; at others, a bright spot at length appears, and the difficulty is over.

RENEWING INJURED STONES.

It is to this portion of the establishment that injured stones are sent for repairing. We were shown a number of diamonds that had been through the Chicago fire. They had become intensely heated and then suddenly cooled. A white hard film had formed over them, necessitating as careful repolishing as the unfinished gem. We were told that it is a common fault among jewelers to thus hurt the stones during the process of setting them. The difficulty can be easily avoided by allowing the diamonds to cool gradually instead of plunging them at once into cold water. It is the sudden transition and not the heat that does the injury.

ABOUT THE WORKMEN AND THEIR PAY.

Our examination here concluded, for polishing is the last process. The workmen, numbering thirty-five in all, we learned, were all Israelites, and, with the exception of the cleaver, were paid by piece work. Their wages reach from 60 to 200 dollars a week, depending on the skill and experience of the artist. The greater number of carats manipulated and the more diamonds there are to the carat, the higher the price paid for the work. The establishment is necessarily organized with great strictness, and every diamond is weighed, registered and fully traced throughout its entire course. Large and valuable stones, before being operated upon, are made the subject of a consultation between the head of the company, the cleaver, chief cutter and chief polisher. Each gives his view, and thus the question of shape, color, etc., is carefully determined.

WHERE THE DIAMONDS COME FROM.

The diamonds are principally imported hither from Brazil. South African gems have caused no very marked effect in the market. They are fine, but, it is stated, more difficult to cut than those from South America. The Arizona swindle created considerable excitement when the first "salted" stones reached the trade, but of course the dismay of the diamond merchants was allayed when the fraud was exposed.

DIAMOND CUTTING IN ENGLAND.

We notice that diamond cutting has recently been introduced in Birmingham, England, where there is every prospect of the art reaching a flourishing state. Recent advices also inform us that a huge diamond has been discovered and brought from the Cape. It weighs 288$\frac{3}{8}$ carats in the rough, and when cut will be half as large again as the world renowned Koh-I-Noor.

PROSPECTS OF THE ART.

We see no reason why the art which we have described should not grow in this country to be an important branch of national industry. To Mr. Hermann, now the President of the New York Diamond Company, a corporation of wealthy gentlemen, founded by himself, belongs the credit of its establishment among us, and the consequent enabling of the artisans of the United States, who may be instructed in his *atéliers*, to compete with and successfully rival the monopoly which, for centuries, has maintained an exclusive and undisputed supremacy in the old world.

The Smokometer.

We have heard of the idea of laying oxygen in pipes through dwellings for purposes of ventilation and purification of the air, of the scheme for similarly supplying carbonic acid for the extinguishment of fire, and of the ingenious proposal to supply milk to our dwellings through conduits leading from suitable reservoirs. Further still, we have perused the glowing prospectus of the electric piano inventor, who proposes to give us the means of turning off or on a flow of music as easily as a stream from a water faucet, and we remember having read of the telephone by which the choicest vocal efforts of celebrated singers might be brought into our parlors as easily as the voice of the Bridget hailing us from the nether world through the speaking trumpet. But now we have found an idea which surpasses all. According to the *Virginia City Territorial Enterprise*, a Professor Maulesel is going to erect extensive works similar to those of a gas company. In these, there will be large retorts in which tobacco will be burned, and the smoke thus produced will pass through proper pipes to a large bell shaped receptacle, similar to a gasometer, where it will be cooled and purified and so scented as to have the flavor of the finest Havana cigar. From the smokometer a main pipe will lead up into the city, and from this will be small branch pipes leading to all the principal houses and saloons in the town. In every house where the smoke is taken, there will be placed a meter, similar to a gas meter but much more delicately constructed. Running from these meters will be pipes leading to all the rooms in the house, and connected with these pipes, at convenient points, will be long flexible tubes, each tipped with a handsome amber mouth piece for the comfort and convenience of smokers.

When a man desires to take a smoke, he has not to go to the trouble of hunting up tobacco and filling his pipe, then of finding and lighting a match, and perhaps burning his fingers, and afterward getting fire and ashes upon his clothes half a dozen times before his smoke is ended. There is none of this trouble and vexation. He has only to place the amber mouth piece between his lips, turn a small silver thumbscrew, and the cool, delicious, perfumed smoke glides into his mouth. By this ingenious and delightful arrangement, all danger of fires from pipes and cigars will be obviated, and millions in valuable property annually saved.

An india rubber receptacle filled with smoke is arranged in the breast, inside the shirt bosom, for smokers to draw from while walking in the street; and ladies, with whom it is conjectured the delicately flavored fumes will become very popular, are to have for their use elegantly carved amber mouth pieces, hooped about with gold and set with diamonds and other gems. When out walking their reservoir of smoke will be contained in the pannier, to which it will impart a much more symmetrical shape than can be attained by the use of newspapers; besides, by giving the rubber of the smoke tank a suitable thickness and strength, it will be found to be very convenient when the wearer desires to sit, as it will serve as a cushion, a something which is often a great convenience and comfort.

Maulesel is a name as yet unknown to fame; and it may be noticed, as a coincidence quite remarkable, that the generic name of the ingenious idea is contained in its last syllable. The Professor, we presume, is somewise connected with Professor Cantell A. Biglie, who recently aroused popular curiosity in this city by announcing, in widely distributed handbills, an aerial flight from the steeple of Trinity Church.

Three Hundred Miles of Oil Pipes.

The system of transporting oil, by means of pipes laid over moderate distances, has been in practice in the oil districts of Pennsylvania for several years, proving a convenient means for carriage and a profitable investment for large amounts of capital. While the success of the scheme has thus been demonstrated as applied to comparatively small sections of country, it remains yet to be determined whether the project can be carried out on a gigantic scale over more extended space. With the late discoveries in Butler county, Pa., it appears that interest in the plan, suggested we believe some years ago, has revived, and the idea of transporting oil through iron pipes, from Titusville over the Alleghanies to Philadelphia on the sea board, a distance of 260 miles, is now exciting considerable attention.

Mr. G. W. Platt, an engineer quite well known throughout the country from the fact of having superintended the construction of the Holley waterworks system in various cities, gives, in a letter to the *Titusville Herald*, detailed specifications for the construction of a huge conduit of this description. He considers the scheme entirely practicable, and estimates its cost at $4,406,150. It is proposed to lay a cast iron six inch pipe, in a bee line between the points above named, which at one locality of its route will be 3,000 feet above the sea level; 40 miles of pipe will be allowed for undulations, so that the tube will, from end to end, measure fully 300 miles. Its contents will be 37,000 barrels of oil, and it is asserted that there will be no more difficulty in ensuring a flow through the bore than there now is in the water mains of London or Chicago, both of which systems each aggregate 300 miles in length. Between Titusville and the summit, a distance of 40 miles, eight pumping stations will be established, so as to relieve undue strain on the pipe. Each pump will have to raise the oil 300 feet. Water by the Holley plan of piston pumps is elevated to this hight, and the friction of eight miles (the space between stations) is overcome at the rate of a million gallons per twenty-four hours, which is equivalent to 23,000 barrels of oil, fluid measure. The cost of the five pumps, machinery, etc., is estimated at $50,000; in addition to which, there must be as many tanks of 25,000 gallons capacity, each costing $72,500, and finally a huge 100,000 gallon reservoir, worth $50,000 more at the summit.

Mr. Platt enters into detail regarding friction with the tube and other drawbacks, which, however, he proposes to obviate at once by establishing, if necessary, more pumping stations: and he finally concludes that 23,000 barrels may be delivered every twenty-four hours, at ten cents per barrel. He figures up the profits as follows: The pipe would deliver 7,300,000 barrels of oil per anuum, which, at a transportation rate of 50 cents per barrel, would yield $3,650,000. The cost of running, together with interest on capital, amounts to $412,717, giving, therefore, a profit per annum of $3,237,738, supposing the line to be run at its full capacity. The pipe could be thoroughly tested with water and thus leakage obviated, while, it is believed that, it would be as indestructible as an ordinary water main. The loss from other sources of waste during transport, it is further considered, would not be so great as is now the case in the regular tank cars.

A Word to Apprentices.

"Forfex" gives our youths the following advice: "Education is the basis of all success in life. It is much to your interest to recognize this fact as early as possible. Your shiftless, elder companions in the shop will tell you that affluence and ease result from mere luck. With display of dignified independence, they challenge your admiration for their manliness by proclaiming themselves as good as those persons whose apparent leisure, luxury and dress awaken a feeling of hostility, which they endeavor to intensify by the bitterness of comparison. As you have little intercourse with the world during the active hours of the day, unless warned by the voice of experience you are apt to imbibe these hurtful impressions, which indicate vindictive jealousy, the consequence of dense, wilful ignorance. The senseless discord that destroys the identity of interest of capital and labor is born of such parentage. Persons advocating these sentiments are generally men who ridicule the efforts of young mechanics desirous of self improvement. They harangue idle crowds at strike meetings and demonstrations, which they are pleased to consider, in spread-eagle phrase, 'the efforts of downtrodden working men to achieve their independence.' Drinking saloons are the chosen theaters of their wordy disaffection. They crave applause, and endeavor, by mock heroism, to entice you to places where lost time and squandered earnings are not the only expenses; for, under their tuition, the root of false principles is made to flourish in the soil of intemperance. Such influences should be shunned as carefully as we avoid a loathsome disease. Every man will gravitate to the sphere of life for which his acquirements fit him, and neither higher nor lower. Those sterling men round us, who represent the wealth and weight of a great people, are but reaping the reward of time well spent; and could we retrace the course they have pursued, we would find the student's lamp illuminating the hours that end days spent in exhausting toil. You may be told that many educated men achieve but little in the great struggle of life; yet would they not have done much less if they had been aided by the brute force of ignorance alone? We know of a man, now occupying a position of responsibility under the government, who, some years since, broke scrap iron with a sledge for a foundery and axle forge, day after day, unsheltered from the weather; yet he found time to read at least one hour per day, as well as to educate himself in useful branches of learning. His first expenditure for mental improvement purchased a Webster's Dictionary, a year's subscription to a leading scientific journal, and a daily newspaper. He now owns a library which would do credit to a university, and he is known to and esteemed by our most prominent citizens. A different course when a young man would have enrolled him in that army which stupidly drudges out a mere existence.

As you value your future happiness, dèvote as much time as you reasonably can to education. Throw away your boxing gloves, for the exercise which they afford can be had from other sources, without pernicious associations. Let your shop mates dub you 'a flat,' if they choose, because you resign billiards, and know nothing of the mysteries of keno; and spend your evenings in the peaceful acquirement of knowledge, which brings length of days, and tranquillity unembittered by the experiences of the mere sensualist."

New and Remarkable Cannon.

The German journals announce that the recent trials of new guns on iron plated targets, which took place at Tegel, near Berlin, fully satisfied all expectations. The shot from the 11 inch ring cast steel gun penetrated an iron plate 12 inches thick, that from the 10 inch gun of the same pattern an iron plate of 11 inches, and there was force to spare in both cases. At Krupp's works, at Essen, trials have been made with the newly constructed 30½ centimeters (12 inch) ring cast steel gun, and the result justifies the belief that this gun will pierce 14 and perhaps 15 inches of armor. Thus, the strongest ironclad now existing, her British Majesty's ship Devastation, which is provided with an armor of 14 inches, will no longer be invulnerable if opposed to such guns.

Church Clocks and Chimes.

W. M. says that the Church of the Holy Redeemer, on 3rd street, between avenues A and B, New York city, has a very interesting clock. This specimen of workmanship was made in 1869, by Edward Emrich, of Rochester, N. Y. The movement is guided by an anchor escapement with solid jeweled pallets; the wooden pendulum is a 2 second one, its length being 14 feet; the weight of the movement is 100 lbs.; the hour-striking part has a weight of 600 lbs. and the hammer striking the bell weighs 32 lbs. The quarter striking part has 500 lbs. weight, bearing three levers for the three hammers striking the four quarters. The wheels of the clock are made of fine bronze and are as well finished as a watch. The dials are 8 feet in diameter and the figures are cast in composition. The same maker also finished in 1869 the clock and attachments to the great chimes of St. Joseph's Cathedral in Buffalo, N. Y. The chime numbers 43 bells, which were cast at Le Mans, France, and were ordered and imported by the late Rt. Rev. Bishop Timon, of Buffalo, after being exhibited in the World's Fair in Paris, 1867.

Secondary Spectra.

Professor O. N. Rood, of Columbia College, New York city, communicates a paper to the *American Journal of Science and Arts*, on the secondary or residual spectrum found on passing a ray of white light through two prisms of different substances arranged to compensate each other for color. This secondary spectrum is generally of small dimensions and peculiar appearance, and is due to the circumstance that the spacing of the colors in the two original spectra is not accurately correspondent. In dimensions, it varies with the amount of the disproportion of the original constituents.

The writer, after alluding to Sir David Brewster's investigations in the same direction, observes that, by proceedings of a different kind, he has succeeded in producing secondary spectra, comparatively gigantic in size, which display the fixed lines with a distinctness which allows the study of their peculiar construction by an ordinary spectroscopic mirror. The constituents used are one spectrum furnished by oil of cassia, bisulphide of carbon, or even flint glass, and the other a normal spectrum obtained by the diffraction grating. Thus it is considered that a very near approach is made to the maximum difference of spacing attainable in the present state of optical science; and hence to the secondary spectrum is given its maximum dimensions.

The lines of the solar spectrum not being adapted for the study of the arrangement of the secondary spectrum, a number of chemical lines of easy identification were selected. The cases considered in experimenting were three. 1. Where the opposing spectra are of equal or nearly equal lengths. 2. Where the spectrum from the grating predominates. 3. Where the prismatic spectrum is the longer of the two. Measurements are given, in each instance, of both primary spectra, also of the actual secondary spectrum due to the same in combination, and of the secondary spectrum obtained by construction. In the last case, Professor Rood finds that the distance of any two lines apart in the secondary spectrum will be equal to one half the corresponding distances in the primary constituents; and that the secondary spectrum, thus constructed, will always be half the size of the actual physical spectrum which it represents. From this, he deduces a formula by which, taken in connection with maps of the primary spectra, he is enabled to construct a correct map of the secondary spectrum in any case.

This construction furnishes a simple means of determining the size and arrangement of the secondary spectrum furnished by two prisms of selected angles, placed in any desired positions relative to the incident ray and to each other. The accuracy of the result depends on the exactness with which the measurements on the primary constituents are effected, and, it is considered, may practically prove useful in dealing with the secondary spectra in optical instruments.

In order to reveal the nature of the secondary spectrum at a glance and permit of its study in a qualitative way, instead of using the slit as a source of light, a pin hole is employed; and the refraction edge of the prism being vertical, the diffraction grating is revolved in its own plane, somewhat so that its lines shall be no longer vertical. This process reduces the secondary spectrum to a line which, on rotating the grating or prism, assumes various curves. It is considered, therefore, that a true secondary spectrum must be regarded as a resultant spectrum in which any two, even closely adjacent, lines are united; even although the actual union of different tints has not been effected and the general appearance still resembles that of one of the primary constituents.

A Trap to Catch Lions.

In Algeria, there is annually a great loss of life and property, by the depredations of lions. The loss of property is estimated at $50,000 a year. The inhabitants cut away the forests as a means of protection against the wild beasts. M. Cheret devotes himself wholly to their extermination. As an assisting means in this, his life work, he has invented a lion trap, made as follows:

The frame and bars are of iron. It is 10 feet long, 6 feet 6 inches wide, and the same in hight. Mounted on three cast iron wheels of small diameter, it can be moved on difficult ground. The upper part opens with folding doors, like a wardrobe, which close of themselves at the slightest shock given to springs of steel. Catches retain the lids as they fall, and imprison the animal as soon as he touches the bottom of the trap. The plan is to place this trap, properly baited, on the ground frequented by the wild animals, and then, when the game is caught, to wheel the machine away to some menagerie prepared for the purpose.

Fatalities from Lightning.

The human mortality from lightning is not generally on a large scale, and might be very much reduced by precautions on the part of builders; so thinks the *Building News*. Arago estimated that the number of deaths from this cause amounted in France to about 70 in the year; Bondin calculated that from 1835 to 1852 1,308 so perished; none in November, December, January, and February, but most in June and August. The lowest rate is assigned to Belgium, and the next to Sweden, the United States and England being about on a par. As a rule, however, these fatalities do not occur inside a structure of any kind. The peril, as experience shows, is less in a crowded town than in a village or in the open country, and, naturally, the more elevated structures are the most liable to be struck. Fuller, indeed, in his "Church History," asserts that there scarcely ever existed a great abbey in England which had not been, at one time or another, wholly or partially destroyed by lightning, and his citations, taken in comparison with the records of our own times, are certainly remarkable. In all cases it is the spire, the tower, and the dome which has been mutilated. As to ordinary habitations, all sorts of theories are in vogue on the subject of danger and safety. Some rely on thick glass in the windows, and some on register stoves; others recommend stone roofs instead of slate, and others tell timid people that they should live in a hollow. It is contended on this side that there should be the least possible admixture of metal in the combination of an inhabited structure; and on that, that all the bells beneath the roof should be kept continually ringing, just as, in obedience to an old superstition, cannon are fired at sea. The mass of evidence upon this topic points, however, to the one conclusion already suggested, that a good lightning conductor is the solitary safeguard; but that, unless good, it is worse than none.

Cumberland Gap Cave.

A correspondent, A. L. S., says, in reference to this remarkable formation, described in our issue of September 13, that, after General Morgan's retreat from that spot, the cave was explored for a distance of four miles by Confederate soldiers, and a new opening was discovered, 3 miles from the one mentioned by H. B. N. The place has never been thoroughly investigated, but chambers, far surpassing in grandeur that described by our earlier correspondent, have been found. In penetrating the rock, it is found that the new entrance leads for 6,000 yards through sandstone; and in this section of the cave, vast quantities of human bones of gigantic size were found, some of the skulls being large enough to put on over a man's head. It is intended, during the current month, to thoroughly explore the cave.

NEW BOOKS AND PUBLICATIONS.

PHYSICAL GEOGRAPHY. By Arnold Guyot, Author of "Earth and Man." New York: Scribner, Armstrong, & Co.

This is a very excellent work on a most interesting branch of study, and is a model school book, full of accurate information, placed before the reader in a lucid and concise style. It is well illustrated with maps and wood engravings.

A CATECHISM OF HIGH PRESSURE OR NON-CONDENSING STEAM ENGINES, including the Modeling, Constructing, Running and Management of Steam Engines and Steam Boilers. By Stephen Roper, Engineer. Philadelphia: Claxton, Remsen, & Haffelfinger, 624, 626, and 628 Market Street.

This is yet another handy book on the steam engine, and it contains much needed general information, as well as descriptions of many American improvements and specialties.

PRACTICAL DESIGNING OF RETAINING WALLS. By Arthur Jacob, A.B., A. I. C. E., late of H. M. Bombay Service. Price 50 cents. New York: D. Van Nostrand, 23 Murray and 27 Warren Streets.

Inventions Patented in England by Americans.

[Compiled from the Commissioners of Patents' Journal.]
From August 29 to September 4, 1873, inclusive.

BLOWER.—P. S. Justice, Philadelphia, Pa.
BURNISHING PHOTOGRAPHS.—G. P. Critcherson, Worcester, Mass.
ELECTRIC TELEGRAPH.—J. B. Stearns, Boston, Mass.
GAS.—W. Steers, New York city.
PRINTING PRESS.—G. F. Pabst, New York city, *et al.*
RAILWAY CAR SPRING.—H. Gardiner, New York city.
SEPARATING METALS.—S. W. Kirk, Philadelphia, Pa., *et al.*
SEWING MACHINE.—J. Knous, Hartford, Conn.
SURFACE CONDENSERS.—J. P. Bass, Bangor, Me.

Recent American and Foreign Patents.

Improved Hame Fastener.

Thomas L. Booker, Shady Grove, Va., assignor to himself and E. H. Booker, Donaldsonville, S. C.—The object of this invention is to provide ready and convenient means for adjusting and fastening hames on the collars of horses and mules; and it consists in a connecting band, screw bolts, and clips at the ends of the hame. The invention is specially adapted for draft horses, and for plantation use.

Improved Rotary Churn.

William H. Bunch, Windsor, N. C.—The body of the churn is provided with a closely fitting cover, to the lower side of which, upon the opposite sides of its center, are attached wings or stationary dashers. These wings are made curved upon the side against which the milk dashes.

Improved Picture Hangers.

Franklin W. Ely, Duluth, Minn.—The picture frame has a web attached to it at two points, one being below the center of the frame or picture, and the other near the top. The web, similar to suspender webbing, is doubled at one or both points where it is attached to the frame; but to outer portion a ring is attached, with which the suspending cord is connected. The use of the slide is to vary the inclination of the picture or frame. By moving the slide upward, the web is shortened, and the frame is brought nearer to an upright position; and when the slide is moved down the effect is contrary.

Improved Candlestick.

Samuel D. Hill, Downieville, Cal.—This invention consists in arranging the socket of the candlestick for different sizes of candles, by making it in two pieces connected by a slotted band spring.

Improved Metallic Lathing.

Timothy O'Callahan, Boston, Mass.—The object of this invention is to furnish an improved metallic sheathing for the inner walls of buildings. The ceiling and side walls of a building may be covered with sheets of cheap metal, having stamped, cast, or otherwise connected to its face dovetail shaped studs. The studs are in the shape of truncated pyramids, with face recesses for the firm adhesion of the plaster to be placed around and over them. These sheets are to be nailed or otherwise secured to the wall. Much less plaster is required for filling the space between the studs than for covering the ordinary lathed wall, and the work is performed in less time, while the plaster dries quicker, and is not so liable to crack.

Axle Box and Sleeve for Vehicle Wheel.

William H. Cowell, Columbus, O.—In this invention the axle is made of wood and the skein is fitted to the axle in the usual manner. There is a nut on the outer end of the skein and the sleeve is made of sheet metal and fitted on to the axle over the skein. A recess opens in this sleeve for the retention of the lubricating material. The interior of the pipe box is chambered out for containing the lubricating material, and the box is cast on a chill, to render it hard and durable. The sleeve may be made of sheet steel or composition metal, and not being confined except by a lug or other device, to prevent its revolving with the wheel, it may be turned, when worn, upon one side, thus presenting a new surface for the bearing.

Improved Advertising Lamp.

Francisco R. Warner, Paris, France.—This invention consists of a metallic frame of peculiar form, adjustably attached to a lamp post and provided with removable glass plates, upon which the advertisements are displayed.

Improved Portable Steam Engine.

Reinhard Scheidler and John H. McNamar, Newark, Ohio.—This invention consists in the improvement of the heaters of portable engines. The pump is arranged in a vertical position on one side of the boiler near the smoke pipe, attaching it to a vertical supporting plate having a concave side, fitting the boiler and bolted to it; also having a bearing at the upper end for a countershaft for driving the pump, said shaft extending across the top of the boilers, in front of the smoke pipe, to a bearing on the other side, where it carries a pulley for turning it by a belt from the crank shaft at the front end of the boiler. The plate is detachably connected to the boiler, so that it can be taken off readily for shipping. The portion of the shaft having the crank for driving the pump connects with the other portion by a clutch which is shifted by a lever, so that the pump can be worked or not, at will. This arrangement is claimed to afford a simple, compact, and reliable connection of the pump in a portable engine, so that it can be stopped without stopping the engine whenever it may be required to do so, which often happens, and causes considerable unnecessary delay in all portable engines having the pump directly connected to the cross head in the ordinary way. Moreover, it saves the unnecessary loss of power expended in running the pump when it is not required.

Improved Mallet.

Albert Holbrook, Providence, R. I.—The object of this invention is to furnish a durable rawhide mallet for the use of machinists and others in putting together, taking apart, fixing, or adjusting metallic or wooden machinery, and for all similar purposes. It consists in a mallet with one or more rawhide heads secured in a metallic socket, which is made of metal in one solid piece. The handle is secured in the socket in the ordinary manner. The socket or body has a recess at one or both ends which receives the heads. These heads are made of rawhide coiled up and dried, and then turned to the desired size and shape, and secured by means of a screw inside the socket.

Apparatus for Preserving Beer on Draft.

John W. Moore, Bellefonte, Pa., assignor to himself and P. Gray Meek, of same place.—This invention relates to means for introducing air into casks to take the place of the liquid drawn out; and it consists in the combination, with a flexible bag or air holder, of a valve and bellows mechanism of a novel construction. Into the bung hole of a cask containing beer or other liquid that would be injured by contact with air is fitted a hollow bung having a nozzle formed upon its inner end, to which is secured the mouth of the bag, made of rubber or other suitable material, and of sufficient size and elasticity to fill the cask when expanded. By this construction, as the liquid is drawn out of the cask, the air will enter the bag through the hollow bung and expand said bag to take the place of the liquid drawn out.

Improved Extension Table.

Christian Rieger, Morrisania, N. Y.—This invention consists in extension rails, hinged to the rails of the side table, and to extension legs. These extension rails are each made in two pieces, connected together by pivoted strips on the bottom and top of the rails. When the rails are extended, they are held in position by means of knob buttons. These buttons are attached to one part, and turn on a central pivot over on to the other part, thus holding the two pieces parallel with the rails of the side table. The cover of the table is in two parts, hinged together like ordinary card tables. When the extension rail is drawn out, the half of the table top is turned over on to it, thus making a square table. When the extension rails are folded, they are in a position with the half of the top turned back and resting on the other part of the top. There is a spring catch on the bottom of the drawer frame which engages with a lip on the side rail which holds the parts securely together. When the table is extended, the rails of the four sides present a uniform and finished appearance.

Improved Corn Planter.

William Mull, Rantoul, Ill.—In this invention the seed hoppers are attached to the frame of the machine. The ends of the dropping slide enter the lower parts of the hopper through holes in their inner sides. A spring has its upper end attached to a cross bar of the frame, and its lower end enters a hole in the dropping slide, to bring said slide back to its position when released from the device that moves it. To the slide, toward one end, is pivoted the end of a connecting rod, the other end of which is bent at right angles, passing through a short curved slot in a wheel or disk, and is secured in place by a nut or other convenient means. The wheel or disk is attached to the end of a short shaft which revolves in bearings attached to a cross bar of the frame, and to its other end is attached a bevel gear wheel, the teeth of which mesh into the teeth of a similar wheel attached to the axle, which revolves in bearings attached to the frame, and to its ends are rigidly attached wheels, so that the said wheels may carry the said axle with them in their revolution. In each end of the axle, at a little distance from the wheels, is formed a universal joint, so that the said wheels may accommodate themselves to the surface of the ground, however uneven said surface may be. A further use of the joint is to enable the wheels to be lifted by levers and rods when the machine is to be turned about, or the discharge of seed requires to be arrested.

Improved Door Fastener.

Henry Orcutt, Amherst, Wis.—This invention consists in applying a semicircular bar to a door and arranging a weighted lever to engage therewith (the bar being notched or perforated for the purpose), so that the door may be locked in any position, shut, open, or partly open. The contrivance is designed more particularly for stable, carriage house, barn and shop doors but it is alike applicable for doors of dwelling houses.

Improved Steam Generator.

Harry P. Wright, Bonaparte, Iowa.—This invention consists of secondary return flues, arranged in the masonry along the sides of the boiler, above the furnace, into which the heat is turned at the front of the boiler, instead of discharging into the smoke stack, thus economizing the heat by causing it to pass along the boiler once more than in other arrangements.

Improved Fireproof Shutter.

John B. Cornell, New York city.—This invention consists of a door or shutter composed of three plates of metal united together side by side, the two outer sheets being plane, and the middle one being bent in zigzag or other form, so as to form channels or spaces between it and the outer sheets for the circulation of air or water to cool the door or shutter in case it is exposed to fire, and prevent the transmission of heat through the door.

Improved Earth Boring Machine.

Joseph Burns, Anamosa, Iowa.—In this invention the square auger shaft has a screw point fixed in it permanently. The lower part of the screw auger is fitted so as to be adjusted relatively to the point, to use said point with it or not, and will have a set screw to fasten it where it is required to be. The upper part of the screw auger is arranged to slide up and down freely, and rests on the lower part when boring. By the bar or plate, in which it is fitted to turn freely and in which it is confined by the collar this part of the auger is connected to cords, which pass over pulleys under, the platform to a drum, which is fitted loosely on the crank shaft, and clutches with it to be turned by it for elevating the borings when moved to the right by a lever, so that studs will engage, and it disengages them and lets the auger fall again when the lever is moved the other way. This shaft is the same one that is employed to turn the shaft for boring, and is itself turned by a shaft, pinion and wheel. The driving power is applied to the shaft by a belt from a steam engine, horse or other power; or it may be turned by hand.

Improved Mold or Box for Brick Press.

John McKenna, Cambria, Pa.—The press boxes for making fire brick have heretofore been cast solid and lined with steel. The steel facing soon wears away, so that the bricks are too large and untrue. The steel has then to be taken out and replaced with new, which can only be done at considerable expense. The object of this invention is to furnish a mold which shall obviate the difficulties experienced in the use of the usual press box.

Improved Plow Coupling.

Thomas L. Thrasher, Paris, Texas.—The invention has for its object to furnish an improved coupling for connecting two plows, to enable them to be guided and controlled by one man; and it consists in the bent bars strengthened at their bends by extra rods, provided at their lower ends with swiveled clamping plates and set screws, and at their upper ends with eyes, slides, and notches to receive the key.

Improved Flux for Smelting Ore.

Samuel D. Young, Elizabethtown, Ill.—In this invention is produced, by a calcining process, from fluor spar, an improved flux for iron ore; and, by a similar treatment of lead ores, mixed with fluor spar, the rapid separation of the calcined spar from the lead ores. In its natural state fluor spar is detrimental to the hearths of iron furnaces. The fluor spar, however, which is treated by the calcining process described forms a superior flux for iron ore without destroying the brick lining of the furnaces. The calcined spar, when produced from the lead ore with which it is formed, is turned thereby to satisfactory use in the arts, while the calcining process at the same time, by melting the minute particles of lead which are carried off by the old processes, increases the yield of the ore. The ore is also desulphurized, and the carrying off of particles of lead through the chimney prevented for the same reason, so that a greater percentage of lead is produced from the ore.

Improved Chuck.

Eli Horton, Windsor Locks, Conn.—It is a well known experience in case hardening jaws that the relative positions of the metallic particles change more or less, so that it is almost impossible to hold work and get it perfectly true. To overcome this difficulty the inventor has introduced on the face of the jaw a raised seat, together with a groove between the face and bite of the jaw, rounding off thereby the corner, and allowing the use of a Tanite or vitrified emery wheel, by which the raised seat may be ground perfectly true. On the face part of each jaw, on which the work rests for turning, is introduced a raised seat, of suitable size, together with a groove or recess formed in the corner of the bite and face of the jaw, removing and rounding off the same. The groove admits the use of an emery wheel for grinding off the raised part, so that work coming to a sharp corner will rest upon the ground seat and the bite of the jaw only, and assume a perfectly true position thereon, as an equal pressure is exerted on the same. Another advantage of the groove is that a grinding wheel without a perfect corner can do its work accurately, as it projects beyond the raised part into the recess formed by the groove, grinding the seat perfectly without fracture at the edges.

Improved Log Turner.

Esau Tarrant, Muskegon, Mich.—In this invention the forward part of the log deck is made inclined, so that when a log is rolled past its center it may roll directly upon the carriage, where it is stopped in proper position by the standards in the head block. A wheel or segment of a wheel has an axle which works in short guide slots in the middle part of the log deck. The wheel is preferably in the form of a half wheel or semicircle, and an axle is arranged in such a position that the straight side of the said wheel or segment, when turned into the horizontal position, may be a little below the top line of the log deck, so as to be out of the way of the logs when rolled upon said deck.

Improved Steam Engine Governor.

Anders Matson, Quincy, Ill.—In this invention a pipe conducts the steam from the boiler, and is connected with a chamber. The valve and seat are made of metal suitable for the purpose. The cylinder has a flange which fits steam tight into the base flange of the chamber. The cylinder is closed at the top and fits inside the valve. The steam presses equally on each side of the valve, so that it is balanced, and has free motion to regulate the speed of the engine. The top part of the shell of the chamber fits into the upright bow, so that the latter can be turned to give the driving shaft any required direction.

Improved Hydraulic Motor.

William Walter, Arkada, Washington Territory.—This invention consists in the application of the stream or body of water to a vertical cistern and cistern valve, which is balanced by a weighted lever, so that, on floating, the water rushes into a horizontal pipe and trough filled with water. The forward motion of the water, in connection with the closing of the cistern valve, produces a forward motion of a piston valve at closed end of horizontal pipe, which is connected to the machinery to be driven by it. Both the lever power and piston power may be utilized, as desired—the lever power for crushing quartz and stamping bones, the latter, by suitable transmission, for driving different machines.

Improved Spring Bottom.

In this invention, three bottom rails, preferably, are employed in one bed. The top slats are placed transversely upon three rows of springs that stand on the rails. Each slat is mortised, near the end, to receive a loop from each spring beneath, except from the middle springs, which have loops that lap around the slats. Straps are fastened to the head and foot pieces of the bed bottom, and pass through the loops of the side row of springs and over the slats, so that the said straps will serve to prevent the loops from being drawn down through the mortises of the slats. These several clasps form holders by which the springs will be evenly held upon the lower rails, and are a very convenient and practical mode of attachment for the springs, allowing them ready application and removal.

Adjustable Treadle for Sewing Machines.

Joseph McEvoy, Brooklyn, N. Y.—This invention consists of an arrangement of the treadle pivot rod, in curved slots in the end frames or other supports, for adjusting the treadle toward or from the front of the machine to suit the operator; the slots are curved to the axis of the crank shaft, so that the distance between the rod and the center remains the same. It is applicable to the table of a sewing machine, lathe, or any other machine to be worked by foot power.

Improved Drill Rod Coupling.

Robert A. Clark, Petrolia City, Pa.—This invention consists of one section, having a screw threaded portion at the end, of smaller size than the rod screwing into a socket in the end of the other section by a right hand screw, and a sleeve screwing on the two sections by a left hand thread down against a collar on the lower section, by which the joints are locked so that they cannot work loose.

Improved Device for Dressing Saw Teeth.

William Rowe, Westerville, Ohio.—This invention consists in a slotted clamp, provided with recesses to receive the saw, to which it is secured by clamp screws, and an anvil, which is placed under a saw tooth, and clamped in place against the same by a wedge pin. The anvil is placed directly under the inner side of the saw tooth, so that the same rests fully thereon: then the set screws are firmly applied to the saw, so that the tooth can be forged or dressed to the width and thickness required.

Improved Grain Dryer.

Richard J. Williams, Ottumwa, Iowa.—The preparation of grain for grinding by toughening the husk or bran has hitherto been done by moistening the grain and then heating the same, the main object being the dampening of the bran and keeping dry the inside of the grain. The drying the grain after moistening does not only take longer time, but has also a softening influence on the interior, which is to be avoided, while by heating the grain first and dampening it afterward the husk will toughen in less time and the inside part of the grain remain perfectly dry. This apparatus is constructed on this principle; and consists of a series of tubes which pass the grain through the heating chamber into the steam chamber. The ends of the tubes which enter the steam chamber are perforated to facilitate the moistening process. By means of different steam chambers and increased admission of steam, husks of different texture may be prepared and passed through at the same time.

Improved Tree Protector.

George H. Hume, Paola, Kansas, assignor to L. C. Crittenden, Geo. H. Hume, and Chas. W. Carr, of same place.—This invention consists in providing the metal slats composing the protector with sharp downwardly projecting spurs. The protector, placed around the tree, is made of upright sheet metal slats which are connected by wire bands, so as to be held together around the tree. The lower part may be bent outwardly to rest on the ground. The slats may be made of any suitable material, preferably of sheet iron; and are covered with coal tar or other preservative against the influence of the weather. For still further protecting the trees against rabbits and other destructive animals, the slats may be provided with projecting parts or spurs placed at convenient hights.

Improved Fruit Crate.

Daniel Crane, of Saginaw, Mich., assignor to himself and Charles A. Lee, of same place.—In this invention staves or slats are placed a suitable distance from each other, according to the use for which the crate is intended, and in number according to the size or diameter desired. The heads may be two or more in number, according to the size and number of compartments of the crate.

Improved Shingle Machine.

Alanson Anderson, Chadwick Mills, N. Y.—This invention consists of two reciprocating block holding frames, which are alternately moved against a horizontal circular saw by means of the vertical saw shaft in gear connection with slotted lever arms. The blocks are properly set in frames by tilting platforms, as in other machines of this class, the same being operated by a pawl and ratchet mechanism, in connection with a bent lever and spring arrangement for engaging and disengaging the blocks.

Improved Weeding Hoe.

Henry S. Crossland, Dresden, Texas.—This invention consists in a hoe with an inclined cutting edge: the object being to enable it to enter the ground more easily and to prevent dirt adhering to the blade underneath the eye.

Improved Harvester Rake.

Samuel Clevenger, Vibbard, Mo.—This invention consists in a slide, toothed bar, slide rod, guide, rake head, rake bar, trip pin, two shafts, four gear wheels, and two segments of gear wheels, in combination with each other and with the frame, the platform, and the drive wheel of a harvester. By this construction, as the rake head begins to move inward to sweep a gavel from the platform, the guide enters a notch in the under side of the rake head, which allows the rake head to drop, so that its teeth may move along the platform and carry the grain with them. As the rake head begins its outward movement, the pin strikes the inclined inner end of the guide plate and moves its outer end forward, so that the slide attached to the rake head may slide along the said guide which raises the forward part of said rake head, so that it may pass back without its teeth coming in contact with the grain upon the platform.

Improved Micrometer Gage.

Antoine Bonnaz, Paris, France.—This invention is intended for measuring articles in minute fractions, and with unusual accuracy. A frame supports upper and lower screws formed with threads, whose section shows an equilateral triangle, and which are reversed in their direction. A milled head or knob, swiveled on a screw, is fastened in the head of the upper screw. A plain outer socket is rigidly attached to this screw, while the knob has a downward flange extending over the upper part of the socket. Between this part and the knob is a washer having a series of springs which produce within the three parts a frictional connection that will cause them to turn together until a resistance is met with, adequate to overcome this friction. Packing rings are let into annular recesses of sockets to exclude dust. A numerical circular notation is made upon the movable socket and a linear notation on the stationary socket.

Improved Air Gas Machine.

Pelag Werni, Newark, N. J.—This invention has for its object to furnish an improved apparatus for forcing air in uniform quantities into a carbureter. The invention consists in the combination of series of water sealed vessels, toothed uprights, segmental toothed gear wheels, shafts, inlet pipes provided with valves at their inner ends, outlet pipes provided with valves at their outer ends, water sealed vessels, and discharge pipe with each other; and is an improvement on a device patented on July 23, 1872, to the same inventor and Henry Curliss.

Improved Seed Separator.

Frank C. Miller, Blue Earth City, Minn.—In this invention, a hollow sheet metal cylinder has its interior surface studded with numerous small cells, too small for the grain, but large enough to admit the cockle and other small matters, to be retained and carried above the grain, and thus separated from it. A stationary trough or receptacle extends through the cylinder from end to end, and is arranged with one edge close to the surface of the cylinder near about the center vertically on the upwardly moving side, so that the matters contained in the small cells will be carried above it and then fall into it. A small perforated cylinder is arranged in the hollow sheet metal cylinder to receive the grain first, and separate the large coarse matters. The foul matters accumulating may be scraped out at one end from time to time.

Improved Tool Receptacle.

Levi L. Lamb, Chelsea, Mass., assignor to himself and Sewell K. Lovewell, of same place.—The object of this invention is to furnish, for the use of mechanics, artisans, and machinists, an improved die stand, into which the different dies for marking metal work are placed and protected against loss or accidental damage; and the device consists of a case of suitable material, surrounding a block with holes, corresponding to the number of dies, into which they are inserted through a perforated top, and inclosed therein by a revolving cover plate.

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For patent Electric Watch-clocks, address Jerome Redding & Co. 39 Hanover Street, Boston, Mass.

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Dovetailing Machines and Surface Planers, by A. Davis, Lowell, Mass. Send for circular.

Rayner & Bro., Thin Board Manufacturers, 13 Cannon St., N. Y., have 6 of A. Davis' 17 inch Planers.

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Lathes, Planers, Drills, Milling and Index Machines. Geo. S. Lincoln & Co., Hartford, Conn.

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All Fruit-can Tools, Ferracute, Bridgeton, N.J.

For best Presses, Dies and Fruit Can Tools Bliss & Williams, cor. of Plymouth & Jay, Brooklyn, N.Y.

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Bolt Makers, send for descriptive cuts of Abbe's Bolt Machine, to S. C. Forsaith & Co., Manchester, N. H.

2 to 8 H.P. Engines, Twiss Bros. N. Haven, Ct.

Boring Machine for Pulleys—no limit to capacity. T. R. Bailey & Vail, Lockport, N. Y.

Brown's Coalyard Quarry & Contractors' Apparatus for hoisting and conveying material by iron cable W.D. Andrews & Bro. 414 Water st. N. Y.

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Steam Fire Engines, R.J. Gould, Newark, N.J.

Peck's Patent Drop Press. For circulars, address Milo. Peck & Co., New Haven, Conn.

Gauge Lathe for Cabinet and all kinds of handles. Shaping Machine for Woodworking. T. R. Bailey & Vail. Lockport, N. Y

Notes & Queries

P. C. G. asks: How can I take India ink from a linen shirt bosom?

C. H. W. & Co. would like some one to give the process of churning butter from milk on a large scale, as is done in large butter dairies in New York.

G. C. R. asks: How can I make sheet iron soft and malleable? Are there any books on the subject?

A. L. T. asks: Can you give us a recipe for something to mix in with putty, so as to prevent it from falling from the sashes?

D. B. W. asks: How fast ought the reels of a bolt, of the following dimensions, to run? 2 reels of 52 inches diameter, 20 feet long, with 5½ inches fall to each reel. The cloths are as follows: 1st reel, No. 11 Dutch anchor brand. 2d reel, 9 feet No. 8, 6 feet No. 4, and 5 feet No. 0. These reels run at 37 revolutions per minute. We make too much seconds flour, and it is very coarse. The shorts are very bad and very light. 2d. Ought reels to run faster or slower with little fall? I contend that the flatter the reels, the slower they ought to run, as the flour will not travel so fast as it does in reels with more fall, and consequently it will get more knocks on its route through the reels. [There is such difference in the practice of millers that we place your letter before them, in preference to answering it ourselves, as we could only give you general figures. We think, however, that your reels are running rather too fast.—EDS.]

Answers to Correspondents

W. O. C. asks: 1. What is the difference in composition between white corn and yellow corn? 2. The common text books on physics say: A falling body will pass through $16\frac{1}{12}$ feet of space in one second. Is that space to be regarded as a vacuum, or as filled with air? 3. Where can I find a book giving the rate of fall of bodies of different specific gravities through water? 4. Is the upward motion through water of bodies specifically lighter than water a uniform or accelerated motion? If accelerated, what is the law? Answers: 1. There is no essential chemical difference. 2. In a vacuum. 3. There is no general law governing the rate of fall of different bodies through water. The rate will depend not only upon the specific gravity of the body, but upon its shape, whereby its resistance to the water in falling through it will be more or less modified. 4. The force with which a body specifically lighter than water is urged upward is equal to a weight which equals the difference between the weight of the body and the weight of an equal bulk of water. The motion of bodies either falling or rising through water is at first accelerated, but becomes uniform when the resistance of the water equals the accelerating force. Consult Jamieson's "Mechanics of Fluids."

W. B. M. asks: Is there a cheaper, less dangerous to handle, or more practicable, solvent for silicate of soda than nitric acid? Would water dilute this mixture? If not, what will? What I want is a glaze for articles made of hydraulic cement. Answer: The proper solvent for silicate of soda (soluble glass) is boiling water. We do not know how nitric acid could be used without decomposing the silicate.

E. D. S. asks: Can silver be precipitated from the resulting solution of washed photograph paper (chloride of silver) by metallic or sulphate of iron; or must it (the paper proper) be first reduced by sulphuric acid by iron, as we now do? The former, as recommended in your journal of August 23, is much easier, but I thought it an error. The chloride of silver is formed by floating a chloride paper on a nitrate of silver solution. Please give proportions of iron to the ounce of silver. Answer: The method of precipitating metallic silver, given in the answer referred to, is one practiced in Germany on a large scale in treating certain ores of silver. In this process the chloride of silver, which is insoluble in water, is shaken up in contact with metallic iron and water. Water alone will not dissolve the chloride of silver from your photographic paper, but a solution of ammonia will. You can then add twice as much metallic iron or zinc as there is chloride of silver.

A. G. Jr. asks, in reference to the conversion of starch into glucose: Can it be accomplished in open vessels by the use of such a small proportion of acid as one tenth of 1 per cent? If not, what proportion of acid must be used to convert it with 5 or 6 hours boiling. Would the free acid, SO_3, be detrimental to fermentation? Would bringing the rightly acidulated solution to the boiling point and then stirring in the starch diffused in tepid water do, or must the starch be gelatinized first and then boiled? How can I easily determine as to the time when the starch is mainly converted into glucose and not into dextrin? Answer: Glucose is manufactured on the large scale, especially in continental Europe, in the following way: A mixture of starch and water at a temperature of about 130° Fahr. is made to flow gradually into a vat containing water, acidulated with 1 per cent of sulphuric acid, kept at the boiling point. In about half an hour the starch is converted into sugar. The liquid is drawn off, and the sulphuric acid neutralized by the gradual addition of chalk, till there is no longer any effervescence. Sulphate of lime precipitates and the clear solution, after concentration by evaporation, is set aside to crystallize. The molasses is drained off and the sugar dried at a gentle heat in a current of air.

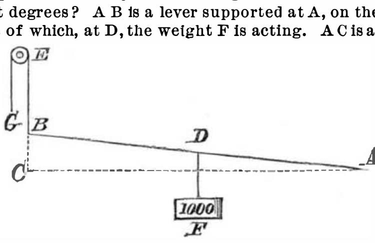
H. M. C. says: I am building a small boat. If I give it a coat of shellac, would the water take it off? Would it be as good as paint? Could you not suggest some way to varnish a boat? Answer: You can make waterproof varnish as follows: Pale shellac 5 ozs., borax 1 oz., water 1 pint; digest at nearly the boiling point until dissolved; then strain. It would perhaps be better to give your boat a good coat of paint before applying the varnish.

P. R. asks: 1. Is slate a mineral or vegetable substance? 2. When was slate introduced into use for roofing purposes? 3. In what country was it first used for that purpose? Answers: 1. Slate is a mineral substance, consisting of silica and alumina, with varying proportions of iron and other metallic oxides. 2 and 3. The history of the use of slates for roofing purposes indicate Europe as the place where they were first used, but at what date is uncertain.

L. T. B. asks: How can I remove the bituminous substance from the Egyptian mummies? It obscures the hieroglyphics underneath. Answer: If the substance you refer to is bitumen, try naphtha as a solvent. Rub with a sponge or cloth soaked in the naphtha.

G. W. S. asks: What is the best way to extract grease from pork cracklings, and what is done with the residuum? I understand that potash is made from it. Answers: Digest the pork cracklings in bisulphuret of carbon, covered closely to prevent evaporation and in the cold, until the fat is dissolved. The fat extracted by the bisulphuret of carbon can be recovered by careful distillation, and the fluid recovered by condensing it in a receiver surrounded by ice, while the fat remains behind. The residuum not dissolved is valuable in the manufacture of prussiate of potash (potassium ferrocyanide), which is largely used in the manufacture of Prussian blue.

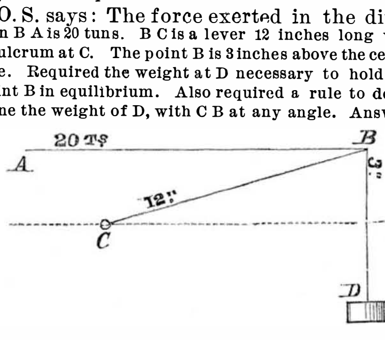
A. K. asks: 1. How can I calculate the loss of power caused by forces acting on levers under different degrees? A B is a lever supported at A, on the middle of which, at D, the weight F is acting. A C is a hori-



zontal line 20 feet long, B C is 6 inches long, D F and E B C are vertical lines. How much power will a weight of 1,000 lbs. at F exert at D, and how much at E or G, not counting friction? 2. What shape must I give the spokes (or their substitutes) of a metal wheel, leaving it perfectly balanced as to center of gravity? I want it to be as strong and light as possible. Answers: 1. The pressure at E or G is equal to the weight multiplied by its distance from A, measured in a horizontal direction, divided by the distance of E from A, measured in a direction perpendicular to the direction of the cord B E. 2. If the wheel is for a carriage, observe the practice of the best builders, who have worked out the matter pretty thoroughly in light trotting wagons.

W. F. McK. asks: 1. Is there any cement or paint for shingle roofs that will stop the leaks? 2. Why is it that, when glycerin is used in the manufacture of printers' inking rollers, less glue should be used? I would naturally suppose that more glue would be required. Answers: We would recommend you to apply Portland cement, mixed with water to the consistence of ordinary mortar, over the coating of ordinary sand and lime. This will set hard in a short time and is a good waterproof cement, as well as a comparatively cheap one. Do not mix more cement than you can conveniently use at once, as it soon sets. 2. The object of using glycerin, which is a non-drying material, is to keep the rollers soft, and the greater the proportion of this, the less, of course, the proportion of glue in a given quantity of the compound.

O. S. says: The force exerted in the direction B A is 20 tuns. B C is a lever 12 inches long with a fulcrum at C. The point B is 3 inches above the center line. Required the weight at D necessary to hold the point B in equilibrium. Also required a rule to determine the weight of D, with C B at any angle. Answer:



Disregarding friction, the weight required at D, in the given case, will be about 5·145 tuns. The weight for any position of the lever may be found by multiplying the 20 tuns by the distance of the point B above the center line, and dividing the product by the square root of the difference of the squares of the length of the lever and the distance of the point B above the center line.

B. C. asks: What cheap substance will prevent lubricating oil from gumming and separating after being manufactured? It is composed of equal parts No. 1 whale oil, No. 1 lard oil, best imported soaps, and exhaust water. Answer: The cause of oil gumming is owing to oxidation, the oxygen being absorbed from the air. You cannot prevent this unless you can use it where it will not come in contact with the air. The uncombined water will always separate from the oil, on account of its greater specific gravity. Thanks for the back numbers.

A. L. asks: Will muriate of tin evaporate or change its quality and lose its strength (so as to be unfit for use in dyeing) if left in a bottle or vessel open to the action of the air and exposed to the heat of the sun? Answer: The compound of tin to which you refer, being a volatile substance, of course is lost, if left open to the air. It should be kept in close vessels.

A. B. asks: 1. Would it not require a current of air blowing at the velocity of a storm to carry the big balloon to Europe in the short space of time that Mr. Wise has calculated on? 2. What is asbestos? 3. What shall I mix with English vermilion or Prussian blue to give them a consistency for marking like pencil leads? 4. How can I make a good permanent marking ink for marking dry goods? Would a solution of vinegar and iron shavings answer, or would it be injurious to the cloth? Answers: 1. No, although to an opposing force the velocity of the current of air which Mr. Wise expected to meet would be decidedly felt. When once the balloon reaches such a current, there is no opposing force, the balloon being carried with the wind. This wind might blow a hurricane, and yet be unfelt by the occupants of the car. For a balloon to reach Europe in 50 hours, a velocity of from 30 to 40 miles would be sufficient. This velocity is not nearly so great as the wind sometimes attains, namely, 100 miles an hour. 2. Asbestos is a silicate of magnesia. From its property of withstanding heat is derived its name, which signifies in Greek "unconsumable." It is found, among numerous other localities, on Staten Island. 3. Use fine clay. 4. A good recipe for an indelible ink, to be used with a stencil plate, is: Dissolve asphaltum in amber varnish, and add oil of turpentine until of proper consistence. Color with lamp black.

W. W. E. asks: Is the following, intended for a fluid gas liquid, a dangerous compound? "To make one gallon: Add to one gallon gasoline, 1 table spoonful of salt, 1 tablespoonful of sal soda, half as much alum, 1 piece of alkanet root 1 inch long." What is gasoline? What is alkanet root? Answers: Gasoline is highly rectified naphtha obtained from petroleum, very volatile and inflammable, explosive when mixed with air, and consequently very dangerous to handle. Alkanet root is the root of a deciduous plant which the botanists term *lithospermum tinctorium*. It contains a fine blood red color, which it freely gives out to oils, fats, wax, spirits, etc., and is used by druggists, perfumers, varnish makers, etc. It grows in Asia Minor, Greece, and Hungary. The additions you propose to make to gasoline would not sufficiently destroy its inflammable properties, so as to render it safe to handle in open vessels.

P. G. G. asks: Is there any cheap preparation with which I can clean paint from the outside of iron gas pipe so that it will leave the pipe in good condition? The paint is thoroughly dry and the pipe is old. Answer: The most effective way, if the paint is hard and dry, is to first scrape as clean as possible, and afterwards remove the adhering particles with spirits of turpentine

A. G. asks: What is the cause of the explosion of fulminates, if effected by a blow? Is it the amount of heat developed, or only the change or disturbance of the particles, independent of any temperature? Answer: Both the causes that you have named may be considered as conjointly effecting the decomposition and explosion of the fulminates. Friction and percussion, however, seem to be the chief causes, as fulminating mercury explodes violently by both friction and percussion, but burns with almost a noiseless flash when kindled in the open air; and fulminate of silver which can hardly be touched with safety, may, when mixed with oxide of copper, be burned in a tube to determine its composition.

C. & Co. ask: What is iron pyrites used for, and where? Answer: Iron pyrites is used very extensively in England, and to some extent in this country, for the manufacture of oil of vitriol or sulphuric acid. To be of value for this purpose, however, it must be found in large quantities, and be easily and cheaply mined, and near means of transportation. Means have been tried, after burning it for the sulphur, to make the residue available as an ore of iron, but so far as known without success. If this should be accomplished, however, iron pyrites would be a much more sought for mineral than it is at present.

B. asks: How can I prepare crude india rubber so as to make a small balloon? Dissolving it and allowing the liquid to evaporate would answer the purpose, as the sheets must be very thin; but by what process can it be dissolved? Answer: The best and cheapest solvent for your use is carbon bisulphide, ordinarily called sulphuret of carbon. After the rubber is dissolved, pour it out thin upon a smooth, slightly greased surface, and leave until dry.

R. W. W. A. asks: How is the silver jewelry, known as oxidized jewelry, made? Answer: There are two distinct shades which can be formed in oxidizing silver. One is produced by chlorine, which has a brownish tint; the other by sulphur, which has a bluish black tint. To produce the brownish shade, wash the article with a solution of sal ammoniac. A more beautiful tint may, however, be obtained by using a solution composed of equal parts of sulphates of copper and sal ammoniac dissolved in vinegar. A fine black tint may be produced by a slightly warm solution of sulphuret of potassium or of sodium.

S. L. C. says: I have a pair of cavalry boots ornamented with considerable stitching around tops and sides of legs. This is all hand work, done with waxed ends. The wax exudes upon the boot, and nothing will apparently stop it. I have scraped it off with a knife and washed with benzine, apparently removing already enough to make a dozen pairs of boots; but they are now worse than ever, after lying unused for several months. Answer: We can only advise you to persevere with scraping and benzine; the wax must come to an end.

J. M. asks if there is anything that will soften buckhorn or bone so that it can be readily cut and carved, becoming solid after it is dried. Answer: Immerse the horn or bone in cool dilute hydrochloric acid, until the earthy matter is dissolved. The bone will thus be rendered transparent, flexible and elastic, and will dry hard.

J. W. B. asks: When is the sun on the meridian? Answer: When shadows are shortest. See Gillespie's "Land Surveying," pp. 190-192.

W. J. asks: In making artificial fibrin, do you separate the white from the yolk of the eggs? Answer: Break the raw eggs, one by one, into a dish containing cold water and let them remain for twelve hours. Then carefully remove them, one by one, and place in boiling water for two or three minutes, or longer, as desired.

E. N. C. says: Suppose you have a small amount of power to drive a saw mill, the majority of the timber being rather small, but occasionally there is a large stick; which would be the best, a 52 inch or a 42 inch saw, with 15 inch top saw? The 15 inch is to run only when the 42 inch is not large enough. Answer: We should prefer the 42 inch saw.

W. L. M.—The pressure of the wind at 15 miles per hour is 1 lb. 2 oz. per square foot. At 20 miles per hour, 2 lbs.

W. S. asks: 1. How do you determine the size of an air chamber, diameter of valves and amount of lift for a force pump? 2. How do you obtain the length of lever and throw of eccentric for a rotary valve? How do you obtain the diameter of a steam chest? Answer: It would require too much space to answer these inquiries in this column. Consult some standard work on the subject.

E. F. R. says: I have made brass lacquers according to various recipes which I have seen in your "Answers to Correspondents," and applied them in the manner described; but the work has a daubed look, and the lacquer will not adhere evenly. I have tried it at all temperatures. Dipping gives no better success. Does it require great practice to do it nicely? Or does it depend on the manner in which the brass is finished? Should it be very smooth or slightly rough? Answer: Polish your brass as smooth and bright as possible, and apply with a fine brush the following lacquer: Seed lac 3 ozs., turmeric 1 oz., dragon's blood ¼ oz., rectified spirit 1 pint; digest for a week, frequently shaking then decant the clear portion.

W. W. P. says: 1. A ball is set in motion, and immediately thereafter everything is annihilated except the ball; will the ball stop or move on forever? 2. What is the best definition of inertia? Answers: 1. In the impossible case mentioned, the ball would continue to move with the velocity and direction (if these can be conceived of, in this connection) that it had at the time of the general annihilation. 2. Inertia is a body's incapacity to change its state of rest or motion without the application of some external force.

E. W. asks: What will take grease out of sheep skins? Answer: Try bisulphide of carbon.

J. W. C. asks: 1. Is a vein or pocket of lignite (brown coal) any indication of coal below or in the coal formation? 2. What book is best for an amateur mineralogist to study? Answers: 1. We should say not. Lignite is usually found in alluvial earths, or connected with rocks of the more recent formations; while coal, strictly so called, appears to be of the same age as the older secondary rocks, or immediately to follow them. Anthracite coal most frequently occurs in primitive or transition rocks. 2. Dana's "Mineralogy" is a standard work.

S. C. C. asks: Is there any chemical solution which will renew the color of the ink in an old and faded manuscript? It should be colorless itself, lest it should stain the paper. Answer: Try the application of a solution of nut galls with a soft sponge or rag to the writing, or damp with a strong solution of yellow prussiate of potash. The latter will turn the ink blue

H. H. J. says: I have been studying upon a harvester to reap and thrash the grain as it runs, leaving the straw on the ground and delivering the grain to a proper receptacle; but I am told that the idea is not new. One man told me that such harvesters are used in California, but it takes 25 horses to run them. What is the reason that such a machine is not in general use? 2. Can a chemist ascertain by a quantity of scum on the water, whether it comes from any mineral or not? 3. Where in the United States is manganese found? Answers: 1. The reason such a machine as you speak of has not come into general use is probably either on account of the expense attending its employment, or its not being adequate to the work required, on account of a want of simplicity or easy derangement of parts. 2. He can. 3. Oxide of manganese is found in the United States in Vermont and Massachusetts.

W. F. S. asks: Will a ball fired from a rifle rise above a horizontal line drawn through the center of the barrel, or will it continue on a direct line? In neither case is the rifle elevated. Answer: The ball will follow neither of the paths mentioned, but will describe a curve, continually falling under the influence of gravity.

D. & W. say: A reservoir at a certain hight has a pipe leading from it, which pipe has a stopcock at its end. Is the pressure on each square inch of the pipe the same, whether the cock be open, allowing the water to flow, or shut, cutting off the water? If not, why not? No account is to be taken of the *coup de marteau* caused by closing the cock. Answer: The pressure will be different in the two cases, for the reason that when the water is in motion some of the pressure is required to overcome friction.

C. E. A. asks for the *modus operandi* of raising a number to a fractional power without the use of logarithms. For example, raise 2 to the power of $3\frac{6}{10}$. Answer: Raise the number to the power indicated by the numerator of the fractional index, and extract the root indicated by the denominator. In the example given, you should take the tenth root of the thirty-sixth power of 2.

J. B. P. asks what is asbestos, and what is its original formation? Answer: Asbestos is a mineral substance. It is a silicate of magnesia. It is composed of the three elementary substances, silicon, magnesium and oxygen.

G. R. B. asks: What should be mixed with ground asbestos to keep it from being blown out of stuffing boxes when used for packing? Will oil or tallow do? Answer: Try plenty of tallow.

W. S. A. asks: Would a balloon filled with smoke rise? Answer: Smoke really consists of fine particles of unconsumed carbon, which are elevated in the atmosphere by the warm current of air or gases from combustion in which they are suspended. These particles of carbon, however, after the air surrounding them has cooled, or after they have drifted into a cooler atmosphere, ultimately fall to the earth. The term smoke, though, as generally understood and as you evidently regard it, embraces both the unconsumed carbon and the surrounding hot air gaseous media. This would raise a balloon a certain hight until the hot air, etc., filling it, fell to the temperature of the surrounding air, when the balloon would fall.

S. asks: From 900 gallons liquor at 15°, how much evaporates at 22·5°, at 30° and at 36°? Answer: The question does not give sufficient data for an explicit answer. What is the alcoholic strength of the liquor, that is, what percentage of alcohol does it contain, and does the writer refer to Fahrenheit's or the centigrade scale?

C. M. asks for a recipe for removing printers' ink from paper. Answer: Printer's ink consists of a mixture of linseed oil and lamp black, a kind of very finely divided carbon. There is no solvent for the carbon, but the dried oxydized oil might be removed to some extent by sulphide of carbon or ether, and with it some carbon might also be washed away. On the large scale, when old paper stock is worked up for the manufacture paper, the ink is removed in the process of bleaching, where the pulp is exposed in a vat to the action of chloride of lime. The removal of the carbon of the ink in this process is due to mechanical not to chemical, action. The carbon is not bleached by the chlorine, but the severe mechanical operations through which the material is passed, as pulping, washing, etc., serve to wash away and obliterate all traces of the carbon of the ink. On the small scale, as removing the ink from a printed page, the only effective way is by scraping with a sharp knife.

W. P. H. says: In coating friction match ignitors with emery, put on with varnish, the latter does not hold the emery on to the tin firmly, and it does not harden. Can I use any other preparation instead of varnish, or can I put something into the varnish that will cause it to dry quickly? Answer: Your varnish probably does not contain a sufficient amount of spirits of turpentine or other dryer, or it is otherwise improperly prepared. Use a spirit varnish, consisting of shellac, broken fine, and yellow resin, each 1½ lbs., rectified spirit 2 gallons; or shellac 8 oz., alcohol 1 quart; digest in close vessel in warm place 3 or 4 days, then decant and strain. You can try a strong solution of glue, applied to the metal with a brush, like a varnish, dusting the emery over the surface of the glue while still hot.

A. says: The following question has arisen: A stood within three feet of a window trying to get the focal length of a watchmaker's eye glass, by forming the image of the window on a piece of paper and measuring the distance from the paper to the glass, assuming that to be the focal length. B, who was standing by, said: "Go farther back from the window; an object so close as the window is no fair test." A insisted that it made no difference; that a four inch lens would show the image at four inches from the lens, no matter how near or remote the object. The following statement was drawn up at the time; "The nearness or distance of an object from the lens does not vary the focus, that is, the image formed by the lens is constantly at the same distance from the lens, no matter what the distance of the object." B contended that the focus receded as the object advanced; or that the focus for near objects would be farther from the lens than for distant ones; and that the test to get at the rated focus of a lens was with parallel rays. Which was right, A or B? Answer: B was right. The solar focus would be practically the focus for parallel rays of the lens mentioned.

S. H. S. asks: 1. If green hams are put into a tank filled with brine (ham pickle) and a strong pressure put on the brine, will the meat take up the brine and cure faster than if there were no pressure? Will the brine be forced into the meat? 2. Are there any methods of curing hog meat in pickle, other than the one now used, namely, brine made of water, salt, saltpeter, molasses and saleratus? 3. Will honey mix with above brine and not be deleterious to same? 4. Can a flavoring be added to such a pickle, as lemon, vanilla, orange, etc.? Answers: 1. The brine will be forced into the meat at a greater or less depth, according to the pressure. 2. There are various recipes for pickle. The following is said to give a fine red color and superior flavor to ham: Bay salt, 3 lbs., saltpeter 2½ ozs., moist sugar 1 lb., allspice and black pepper, of each, bruised, 1 oz., water 9 pints; simmer together in clean covered iron or enameled vessel 7 or 8 minutes; when cool, remove scum and pour it over the hams. 3 and 4. Yes.

W. M. R. says, in relation to the idea published on page 132 of our current volume: Applying a 30 inch magnifier to a telescopic image is a good thought. I once looked at the image of my Gregorian with a spy glass, and saw things on the moon. I could not hold it still, but I wished that I could put them together properly. Answer: The ordinary compound microscope is "under-corrected" for use as an eyepiece, and must be specially made for the purpose. The small telescope is used for viewing the spectrum of the sun's chromosphere. The combination of collimator, prisms, and small telescope is attached to two parallel balance rods, one on each side of the large telescope.

H. G. says: Our power is a turbine wheel; and with the head and fall, we have, according to the makers' estimate, about 15 horse power. There are 2 lengths of shafting, each 40 feet, connected by 2 feet bevel gears, and at the extreme end of the said shaft, 80 feet from the wheel, the greatest amount of work is required of it. Upon the machine driven is a 5 feet drum, and this is connected with the main shaft by a 10 inch belt running over a 20 inch pulley. We use a tightener to keep the belt down. The distance from center to center of pulley and drum is 11 feet. There are eight journals or bearings in the entire shafting. When there is nothing to drive but the machine, what amount of power do I get, and do I not lose power by using the tightener? Answer: We could not answer this question without more data. It ordinarily takes some power to drive a tightener; but as it prevents the belt from slipping, there is a gain of useful effect.

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

E. D. L.—The mineral specimen you send is apparently antimony.

V. E. H.—Beryl, a mineral composed of silica, alumina and glucina, and allied in composition to the emerald.

W. F. S.—Selenite, a transparent variety of gypsum.

E. W. T.—Pyrites in ferruginous quartz.

W. K. S.—Chrysocolla, a silicate of copper.

C. G.—Sandstone with the imprint of some fossil animal, or perhaps a vegetable nut.

G. W. S.—One is charcoal and the other pyrites.

T. B. J.—Ferruginous quartz.

A. G.—The green mineral occurring in spots in the specimen you send resembles malachite, a carbonate of copper.

G. A. F.—Your specimen of limestone is hard and compact enough for lithographic stone.

R. T.—Iron pyrites, only of value when found in large quantities.

L. M. L.—The mineral is sulphide of zinc or blende, a valuable ore of zinc.

COMMUNICATIONS RECEIVED.

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

On Indelible Pencils. By R. B. F.

On Meteorology. By E. J. M., Jr.

On the Million Dollar Telescope. By J. H. S., and by J. S. P.

On the Cumberland Gap Cave. By A. L. S.

On the Bursting Strain on a Balloon. By T. W. B.

On Steel and Quill Pens. By W. V. R.

On the Compass on Board an Iron Ship By J. S.

On Lunar Acceleration. By J. H.

On Down Draft in Stoves. By C. W.

Also enquiries from the following:

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

Correspondents who write to ask the address of certain manufacturers, or where specified articles are to be had, also those having goods for sale, or who want to find partners, should send with their communications an amount sufficient to cover the cost of publication under the head of "Business and Personal," which is specially devoted to such enquiries.

Correspondents in different parts of the country ask: Where can I obtain sulphuret of sodium? Who makes steam road carriages? Who builds really economical coal-burning portable engines? Where can I obtain Mushet steel? Who makes the best piston for steam engines? Where can I obtain a lathe for turning axe and broom handles? Is there a successful machine for separating pebbles or gravel from clay for brickmaking? Who makes steam engines at a cost of $20.00 each and under? Makers of the above articles will probably promote their interests by advertising, in reply, in the SCIENTIFIC AMERICAN.

[OFFICIAL.]

Index of Inventions

FOR WHICH

Letters Patent of the United States

WERE GRANTED FOR THE WEEK ENDING

September 2, 1873,

AND EACH BEARING THAT DATE.

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APPLICATIONS FOR EXTENSIONS.

Applications have been duly filed, and are now pending for the extension of the following Letters Patent. Hearings upon the respective applications are appointed for the days hereinafter mentioned:

26,339.—WATER WHEEL.—J. P. Collins. Nov. 19.

26,401.—DEFECATING SUGAR.—N. P. Brashear. Nov. 19.

EXTENSIONS GRANTED.

25,239.—ELASTIC HOSE TUBING.—John C. Boyd.

25,343.—STOVE.—E. M. Manigle.

25,344.—WIRING JOINTS.—A. C. Mason.

25,373.—PAPER BOX MACHINE.—S. B. Terry.

DESIGNS PATENTED.

6,832.—TAILOR'S GOOSE.—J. Hargrave, Cincinnati, O.

6,833.—FABRIC.—C. H. Landenberger, Philadelphia, Pa.

6,834.—CHAIR FRAME.—J. H. Travis, Charlestown, Mass.

6,835 to 6,864.—SHAWLS.—F. Wink, Philadelphia, Pa.

6,865 & 6,866.—CARPETS.—J. Crabtree, Philadelphia, Pa.

6,867.—ESCUTCHEON PLATE.—W. Gorman, New Britain, Ct.

6,868.—TOY RAIL CAR.—W. A. Harwood, Brooklyn, N.Y.

6,869.—CAPE.—M. Landenberger, Philadelphia, Pa.

6,870.—VAILS.—S. M. Meyenberg *et al.*, Paterson, N. J.

6,871.—OIL CLOTH.—C. T. Meyer *et al.*, Bergen, N. J.

6,872.—CAN.—H. G. Shook, New York city.

6,873.—BELT BUCKLE.—J. E. Smith, Waterbury, Conn.

TRADE MARKS REGISTERED.

1,430.—PENCILS.—American Lead Pencil Co., N. Y. city.

1,431.—HAIR PREPARATION.—M. T. Clackner, Baltimore.

1,432 & 1,433.—FERTILIZERS.—Dugdale & Co., Baltimore.

1,434.—MEN'S FURNISHING GOODS.—Fisk & Co., N.Y. city.

1,435 & 1,436.—STEAM PACKING, ETC.—J. Glanding & Co., Philadelphia, Pa.

1,437.—AXLE GREASE.—Palm Oil Axle Grease Co., Charleston, S. C.

1,438.—BRUSHES.—C. C. Thum, Philadelphia, Pa.

1,439.—WHITE LEAD.—Beymer & Co., Pittsburgh, Pa.

1,440.—FERTILIZER.—G. Dugdale & Co., Baltimore, Md.

1,441.—CLEANING POWDER.—Wright & Co., Keene, N. H.

SCHEDULE OF PATENT FEES:

On each Caveat	$10
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On appeal to Commissioner of Patents	$20
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To the Editor of the Sun:

I was afflicted for over thirty years with rupture. I twice endured the anguish and danger of inflamed and strangulated hernia, and once was subjected to the critical operation of the knife. But having found permanent relief in Dr. Sherman's method of cure, I feel most happy in making it known to others unfortunately ruptured. I had been in correspondence with the doctor for some three years, intending to go to see him at his office, 697 Broadway, New York, to obtain his treatment, but fortunately for me his visit to San Francisco last year saved me the time and expense of that long journey. I applied to him, received his treatment, and the result has been that I have been restored to the most perfect health.

And now, with my experience in regard to trusses and rupture, I feel it my duty to humanity to recommend Dr. Sherman's system of treatment to every one who hopes for a sound body. D. W. SAWYER.
WEST POINT, Calaveras co., Cal., Aug. 20, 1873.

Mr. Sawyer is an old subscriber of ours, and we congratulate him on his success, rupture being the most dreadful of all afflictions.—*Editors Sun.*

The afflicted can consult Dr. Sherman at his office, 697 Broadway. His book on rupture, containing valuable information, mailed for 10 cents.

NOTICE TO ENGINEERS, INVENTORS, and others.—The Commission appointed by the U. S. Government to inquire into the causes of Steam-boiler explosions, in order to determine, by actual experiment, the best form and construction of Safety-Valves which shall operate *automatically* in relieving Steam-boilers from the pressure of steam, or, with certainty, *automatically*, prevent any increase of pressure above that at which the valve shall be set, hereby invite persons claiming to have valves of superior efficiency to submit one to the Commission for examination and testing.

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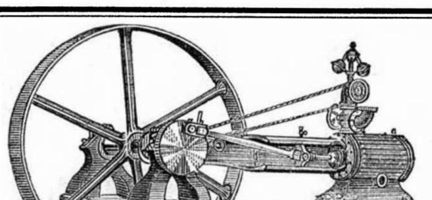

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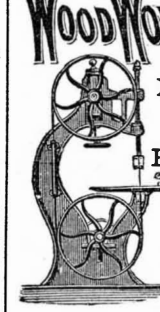

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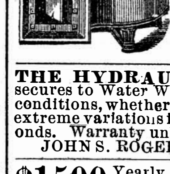

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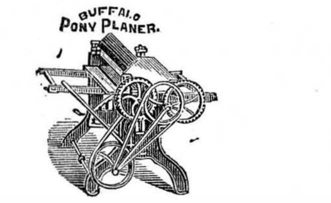

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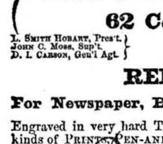

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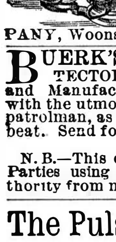

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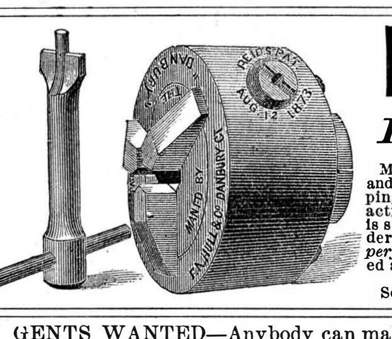

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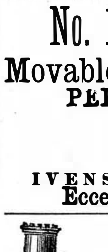

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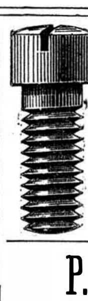

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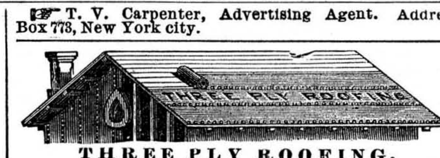

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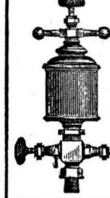

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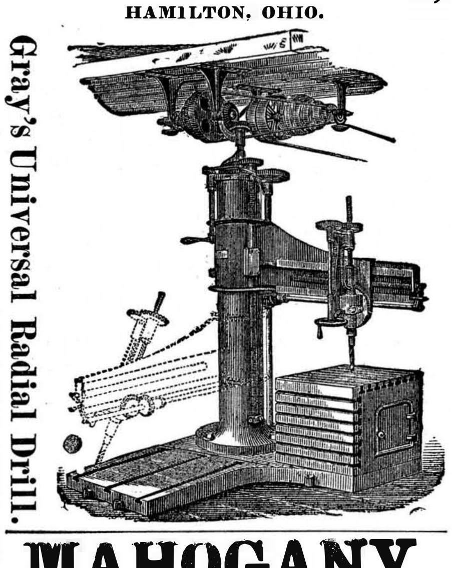

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