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IMPROVED DIAMOND STONE SAW.

It is only necessary to recall the fact, that of all the trades, that of the stone cutter was practically the most lacking in labor-saving inventions, to appreciate the vast progress accomplished therein by the utilization of the diamond as a cutting tool. Days of slow grinding by the sand saw are giving place literally to minutes of swift penetration by the diamond blade. Numerous ingenious applications of the carbon to industrial uses have already appeared in these columns, and it is presumed that the reader is tolerably familiar with the effect of the diamond tool upon materials far more refractory than the metals. In proceeding to examine, therefore, another machine based upon a similar utilization, the questions of adaptation of the diamond to its work, so as to secure the best results, and that of the construction of apparatus to conduce to such an end, are the matters which present themselves most prominently to our investigation. So far as certain points of construction are concerned, to which reference will be made as we proceed, the invention we are about to describe is new; with regard to its essential features, however, the test of experience has been applied, and successful operation over some two years has well demonstrated their efficiency. The machine is a single blade stone saw. Its uses are to divide blocks into slabs, bed ashlar, edge coping, sills, and the like, square up blocks, and all but finish moldings, accomplishing all this with a remarkable rapidity of execution. Its essential feature is that the diamonds are made to act upon the stone in such a manner as to receive pressure or blow in one direction only. Without this provision, it is found by experience that no amount of ingenuity or care in the setting of the diamonds can prevent their being displaced from the sockets by the alternate reverse action of the blade.

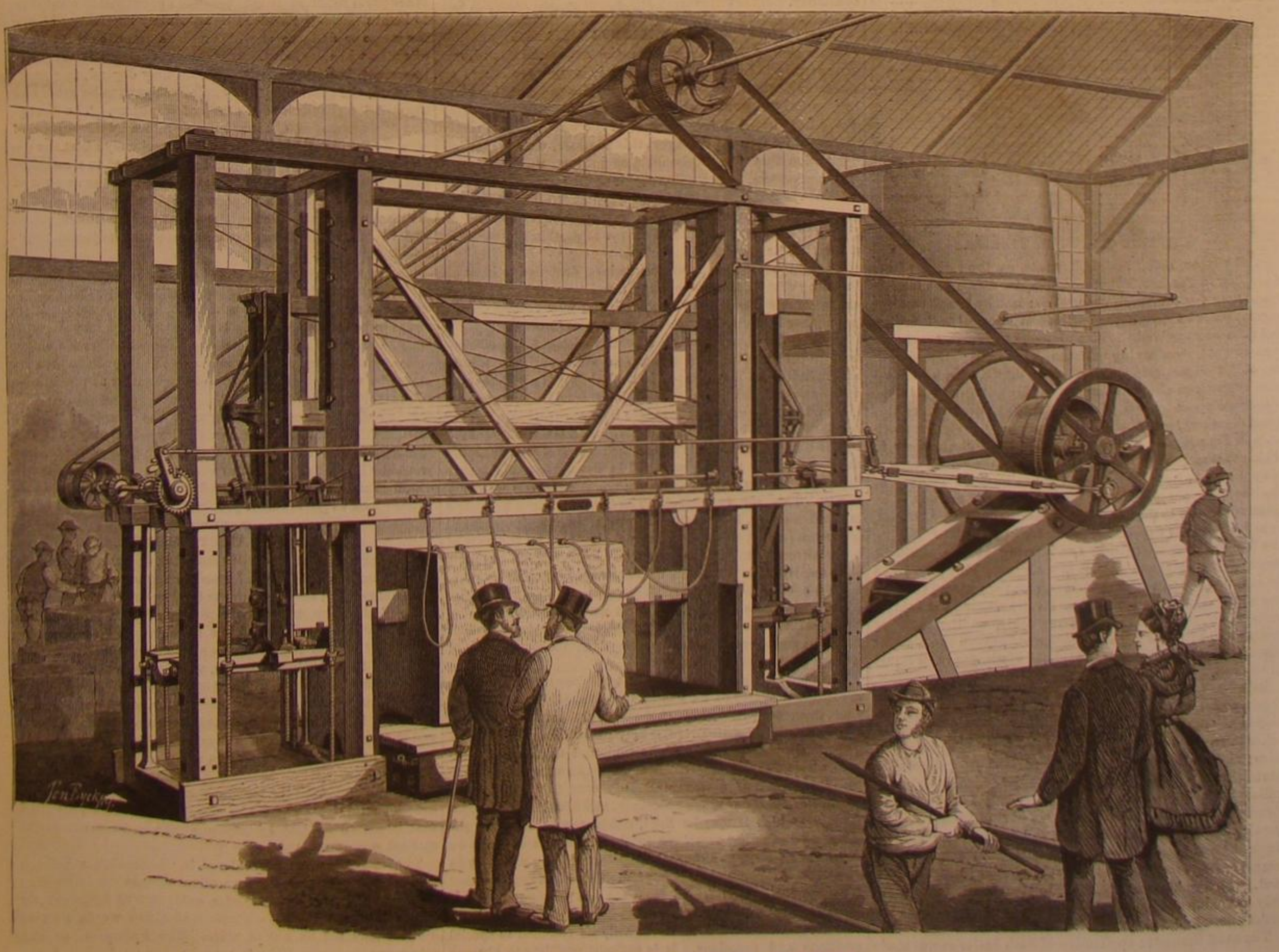
It is first necessary to glance at the mode of securing the carbons in the teeth, as the square bits of steel which are inserted in recesses in the blade, and there held by soft rivets, may be termed. At proper points along the lower edge of the teeth, indentations are made to receive the diamonds; these, inserted, are firmly bound in place with wire, and while thus temporarily secured are brazed-in in the usual way, the wire being afterwards removed. This operation, we are assured, fastens the borts or carbons in with certainty, so that no trouble is experienced through their working loose and falling out, so long as the saw is caused to cut, as above noted, in but one direction.

In the machine represented in the annexed engraving, there is a timber frame formed of eight posts, planted in a concrete foundation and strengthened with the necessary horizontal and transverse bracing. The sash frame is carried by horizontal slides between the posts, and supported on the nuts of eight screws, all of which screws are connected together by gearing to which motion is given by a separate pulley and belt. The effect of turning the screws in one direction is to lower the horizontal slides, and so feed the saw down to its work, the reverse action of course producing the opposite result. The gearing may all be moved, by hand or by belt, when it is desired to adjust the blade vertically; but when the mechanism is feeding, its operation is automatic through suitable arrangements whereby it is moved with the proper degree of rapidity. The horizontal slides above referred to are provided for the sash frame to travel upon; the blade, being mounted in the latter and tightly held by buckles, receives its reciprocating motion from the pitman connecting the crank with the sash.

We have stated that the blade cuts in one direction only. This important point is gained through depressing the saw when it begins its forward motion and then raising it on the return stroke. The mechanism for this purpose is extremely simple, and consists of an eccentric on the crank pin of the pitman, which, through a connecting rod extending along the latter, actuates certain levers and cams, the effect of which is to push the saw down against its own natural spring at the beginning of the stroke, and so to hold it at a given point of depression until the end. The resilience of the metal, of course, when the pressure is removed, carries the blade back to its normal position, and so lifts it clear of the bottom of the kerf, during the return stroke.

The above, though general as regards detail, is sufficient for the comprehension of the device, to the performances of which attention may next be directed. From those using the machines, we gather the following statement of its average downward feed per hour in various kinds of stone, the figures presented having, in many instances, been borne out by trials under our own examination: Connecticut brown stone, from 2 to 3 feet; Dorchester, N. B., stone, 2 feet 6 inches to 3 feet 6 inches; Amherst, O., 3 feet 6 inches to 4 feet 6 inches; Lockport limestone, 14 to 18 inches; Marblehead, O., limestone, 2 to 3 feet; Canaan, Conn., Westchester, N. Y., or Lee, Mass., marbles, 12 to 16 inches. In the harder kinds of slate, with quartz veins, the saw cuts from 2 feet 6 inches to 4 feet per hour, and so on in proportion to the hardness and impenetrability of the rock. Red Scotch granite we have seen cut at the rate of 3 inches per hour. The kerf made is from $\frac{5}{32}$ to $\frac{3}{16}$ of an inch, leaving a perfectly smooth surface. Slabs to almost any desired degree of thinness may be sawn. The work generally, it is claimed, is accomplished at a speed from ten to thirty times faster than the best apparatus hitherto employed. It is also asserted, by those using the saws, that the cost for the diamonds and setting is less than for the sand and iron required to do the same quantity of work by the old method. The machine is coming largely into use in this city and vicinity, and meeting, wherever employed, with the highest commendation.

Messrs. H. and J. S. Young were awarded, for it, the highest premium of the American Institute two years ago, and its progress and history since certainly show the propriety of that acknowledgment. Mr. Hugh Young, 546 East 117th street, New York, is the proprietor and manufacturer.



YOUNG'S DIAMOND STONE SAWING MACHINE

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NEW YORK, SATURDAY, JANUARY 30, 1875.

Contents.

(Illustrated articles are marked with an asterisk.)

ELECTRIC EARTH BATTERIES.

In the year 1838, Steinheil made, on the railroad from Nürnberg to Fürther, an experiment in using the rails as conductors for telegraph despatches; but he found that the current passed through the earth from one rail to the other, and then he conceived the idea of using the earth for the return current, thus saving half the wire. He found that it not only worked perfectly, but better than a wire for the return current, as the earth and one wire gave only half the resistance given by two wires, which were used before this great discovery, which was of the utmost practical importance to the progress of the telegraphic art. The manner in which this method of using the earth for the return current is applied is to bury, at each of the two terminal stations of the line, a copper plate in the moist earth, and connect it by means of a wire to the telegraph apparatus or battery. Gauss, in repeating this experiment, conceived the idea of leaving the battery out altogether, and burying at one station a large copper plate and at the other a large zinc plate; and he found that a powerful electric current then passed through the wire. This arrangement is evidently nothing but a single voltaic pair, constructed on a large scale, as the layer of moist earth of a few miles in thickness between the metallic plates replaced the layer of acidulated cloth, paper, or liquid in the cell.

Bain applied this arrangement to his telegraph, so as to obtain a current of long duration and constant quality. He buried a series of zinc and copper plates, opposite to one another in the moist earth, and connected them by insulated wire; and so obtained a current of sufficient strength to work his telegraph. According to the same principle, a variety of voltaic batteries or generators of electricity have been constructed, by means of which Bain, as well as Robert Weare, kept his electric clocks in constant and very regular motion. Such an earth battery remains in similar activity until in the course of time one of the metals has become entirely oxidized, which oxidation, according to experience, takes place only very slowly when large plates are buried deep in the moist ground.

The most extensive application of such batteries was made by Steinheil on the railroad from Munich to Nanhofen; the line was 22 miles long, and the earth battery was completely successful in performing not only the service required on the road itself, but also in serving for the sending of despatches for the public. The metal plate in Munich was of copper, of 120 square feet, while in Nanhofen a zinc plate of the same size was buried; both plates were sunk so deep as to reach the level of the subterranean well water of the locality, and connected with isolated wires to the air line. The current thus established was used to effect the deviation of a magnetized needle in a galvanometer, which Steinheil used as the basis of his system of signals, a system requiring only a very feeble electromotive force, a force entirely insufficient to move the electromagnets of the Morse system, or the hand of a dial telegraph.

The construction of such earth batteries, easy and simple as it appears to be, has never become a settled practice, for reason of the laborious digging required, it being much easier to plunge plates in cups and renew them after a while than to dig up the oxidized zinc plates in order to replace them by new ones. However, when a river or brook is at hand, the practice can be recommended; as in that case a zinc plate has only to be sunk at a convenient and safe spot. Then at any time, if the current becomes weak, the plate may be easily replaced by a fresh one; while in place of the copper, a quantity of coke may be buried in the moist earth. The great objection to this form of battery is, however, the unavoidable total lack of intensity; as the latter quality depends on the number of cups, and the earth or water acts as but one single cup, and thus the burial of several plates is equivalent only to the immersion of them in a single cup. If the plates are connected for quantity, that is, all the zincs together and all the coppers or cokes together, the series will act like a single pair of which the surface is equal to the sum of the individual plates, and thus as one pair of large surface; if, however, the plates are connected for intensity, that is, every alternate zinc to the next copper, only the two plates at the extremes of the series will be of use, because the several intermediate pairs discharge mutually all the electricity generated into the moist earth, through their metallic connections: which shows the fallacy of the advantage claimed for some earth batteries lately constructed and even patented.

Of all the batteries thus far constructed, the most constant appears to be that of Leclanché; it is to a certain extent an imitation of an earth battery. It consists of a large piece of coke surrounded by coarsely pulverized manganese and coke, all contained in a porous cell and surrounded by amalgamated zinc plunged in a solution of sal ammoniac. This battery has, during the last ten years, been more and more used in France; and according to the testimonies of the telegraph operators there, it far surpasses all others, for reliability and constancy.

TORPEDOES FOR HARBOR DEFENSE.

Approaching New York from the sea or the Sound, one can scarcely fail to observe, printed in very large letters on the faces of the forts which command the passage, the warning words: "TORPEDOES: DON'T ANCHOR."

We have heard the significance of the warning, frequently discussed by fellow passengers this summer, with a growing conviction that few implements of modern warfare are so little understood by peaceable people as the torpedo. "There's a lot of them stored in the fort, I suppose" (said one passenger to another the other day, in response to the question, "why not anchor?"), "and of course it wouldn't be safe for a vessel to lie alongside."

That torpedoes are submarine engines, designed to blow up invading vessels, is more commonly understood; but how they are made and placed, how exploded, and why vessels should not anchor in their vicinity, fewer seem to know.

It is natural that this should be the case. As an efficient weapon of defense, the torpedo is comparatively a new affair; indeed, it may almost be said that it is altogether an experimental affair; and though it is confidently predicted that, when the next great struggle between maritime nations comes off, it will be found that a revolution has been wrought by the torpedo in methods of conducting naval warfare, only the few who are actively engaged in developing this future decider of battles know very much about its character or capacity. This, too, is natural. The torpedo, like a mine or a masked battery, is valuable in proportion to the enemy's ignorance; and it would be simply foolishness on the part of any government to develop a torpedo system at great expense, then nullify their work and its advantages by spreading too minute a knowledge of it. Still, a general idea of torpedo operations can be gained from facts which are common property, without reference to any particular system of harbor defense; and a general idea is quite as much as the most of us care for in cases of this sort.

Distributed in a narrow passage, torpedoes are intended to arrest the progress of an enemy's vessels, either by compelling them to pause through fear of unseen danger—thus keeping them longer under fire of powerful land defenses—or by destroying them by direct explosion should they venture within the torpedo-defended area. In construction, the torpedo consists of a strong metallic case filled with gunpowder or other explosive substance, and fitted with an apparatus by which it may be fired, either mechanically by the shock of a colliding vessel or by the action of some one on shore. The first, or automatic exploder, is the simplest in construction and action, but has the great disadvantage that it cannot distinguish friend from foe. A passage defended by self acting mechanical torpedoes is therefore closed to all vessels, and their use must necessarily be confined to special positions and occasions. It is perhaps needless to observe that such a system of defense would not answer in channels thronged with peaceful shipping, like those which lead into our harbor. In cases of this sort, the thing needed is obviously something that will lie safely on the bottom or securely moored below the reach of passing vessels, completely under control by some one on land, and with no risk of untimely explosion.

The earliest torpedoes to be operated from the shore were arranged to be fired by a friction tube attached to a cord communicating with the land: a plan partially successful where the channel was narrow and the period of the firing line's exposure comparatively brief, but quite unsuited for permanent defenses and long ranges. During the Crimean war, the Russians first employed electricity as a means of exploding torpedoes, and the same method was adopted in some instances in the South during our "late unpleasantness." Since then the electrical system, both automatic and volitional, has been developed by numerous experiments in various countries, a very interesting series of them being just now in progress at Portsmouth, England, in connection with an experimental ironclad called the Oberon, the design being not merely to ascertain the destructive effect of torpedo explosions, but various other important questions touching the working of torpedoes arranged on what is known as the network system. By this plan any number of torpedoes may be placed in electrical communication with a firing station on land, so that the condition of each and all can be determined at a glance and any one of them exploded at will, without affecting the others. The connecting cable contains strands of copper wire insulated by gutta percha and covered by a protecting envelope of hemp and coiled iron wire. The copper wires lead from a galvanic battery on shore to the signalling and firing arrangements within the torpedoes, the one indicating to the operator the presence of a vessel within the destructive area of a torpedo, the other enabling him to explode the sunken mine by touching a key. In other cases the firing circuit is so arranged that it can be closed mechanically by the action of the signalling apparatus, thus making the torpedo automatic. The firing is effected by an electric fuse, commonly that known as the platinum wire fuse, in which a strand of platinum wire is made red hot by the electric current on the completion of the circuit. It is evident, as a writer in the London *Times* observes, in justification of the expensive experiments going on at Portsmouth, that a complete system of torpedo defense, embracing more complicated details, cannot be brought to perfection without extensive and exhaustive trials. "There are a multitude of problems connected with the subject which can only be solved by experiment. The action of the circuit closers may or may not be influenced by the rate of the tide in particular positions; the presence of sharp rocks may render electrical torpedoes impossible; the laying and raising of the cables and other parts require constant practice under various conditions to insure efficiency; lastly, it is absolutely necessary to know the range or distance at which a given torpedo ceases to be effective when exploded. This latter question is the more important, because upon its solution may depend, in a great measure, the quantity of the explosive agent to be used, and the relative positions of a group of torpedoes. The disruption of a number of other submarine mines by the explosion of a torpedo in their vicinity would seriously affect the defensive arrangements, and would probably lead to a complete gap in the line. It is therefore advisable that the amount of the explosive agent in a torpedo should be regulated so as to insure the maximum destructive effect upon a hostile vessel with the minimum disruptive effect upon the adjacent torpedoes."

The experiments carried out on the Oberon are said to show that comparatively large charges cannot be exploded without compromising other mines within the effective area. It remains to be decided which is best: to use large torpedoes far apart, and thus diminish the area of danger to hostile ships, or to use a smaller charge and moor the torpedo so that its explosion will occur in contact with or as near as possible to the vessel to be destroyed.

It is scarcely necessary to recur to the warning: "Don't Anchor." What the arrangement of torpedoes may be in the forbidden areas, it is not needful to know; a dragging anchor would be likely to disturb the nice arrangement of electric communication, and might possibly prove disastrous to private as well as government property.

SOMETHING ABOUT BALLOONS.

A reference to our files will show that we have endeavored to keep our readers fully informed in regard to the progress of aerial motors; for although the final success of the problem is far from being assured, the earnest labors of scientists augur well for the future. We have received so many inquiries, of late, in regard to the elementary principles to be observed in designing balloons, that it seems advisable to devote some little space to their consideration. Information of the kind sought for, simple as it may seem, can scarcely be found in any of the published literature of the subject; and the general solution of the question given in this article appears now for the first time in print, so far as our knowledge extends.

The general formula for the proportions of a balloon is somewhat intricate, and we have endeavored to simplify it so that it can be applied by any one who understands arithmetical operations.

The first point to be considered is what makes a balloon rise. We receive numerous questions such as the following: "What is the lifting force of a cubic foot of hydrogen, in pounds?" from which we infer that a few words on this subject may not be out of place. The hydrogen, or any other gas, however light it may be, has no lifting force

On the contrary, if it possesses the least weight, this weight is a force which would cause it to fall, unless it were buoyed up by something else. If it is sufficiently light, however, its tendency to descend is counteracted by the buoyant force of the air, and it ascends. Placed in a vacuum, it would immediately fall. Some illustrations may be introduced, to render this point plain. Suppose that a cubic foot of some substance, weighing in the air 400 pounds, is wholly immersed in water, which weighs 62 pounds per cubic foot. By the immersion, a cubic foot of water is displaced to make way for the substance, and, by its effort to return, presses upward against the substance, with a force of 62 pounds; so that the body, if weighed during immersion, will be found to have its original weight diminished by 62 pounds, and will balance the scale at 338 pounds, instead of the 400 required when weighed in the air. Now if, in place of this heavy body, we immerse a cubic foot of some other substance, which weighs only 40 pounds, the water, as before, will press up with a force of 62 pounds; and as the body only exerts a downward pressure of 40 pounds, it will rise, under the influence of the unbalanced upward pressure of 22 pounds. The action of the air on all bodies immersed in it is precisely similar to that of the water, except that most bodies are so much heavier than equal bulks of air that the effects are not ordinarily noticed. For instance, a cubic foot of air of ordinary pressure and temperature weighs about $\frac{153}{2000}$ of a pound; so that a substance, one cubic foot in capacity, which weighs 400 pounds in the air, will weigh $399\frac{1847}{2000}$, or practically the same, in a vacuum. It is obvious, however, that there is some difference in the weights as estimated in the air and in a vacuum; and since the weight of the air varies somewhat at different times, the absolute weight of a body is its weight in vacuum. Of course, the weight of a body in the air is ordinarily sufficiently accurate, and it is only in delicate scientific researches that the method of weighing in vacuum is employed.

From the foregoing considerations, we are led to conclude:

1st. If a body is wholly immersed in any fluid, it will be pressed upward by a force equal to the weight of a volume of the fluid equal to the volume of the body.

2nd. If the upward pressure is less than the weight of the body, the latter will have a tendency to fall, under the action of a force equal to the difference between the body's weight and the weight of an equal volume of the fluid.

3d. If the upward pressure is equal to the weight of the body, the body will have no tendency either to fall or rise.

4th. If the upward pressure is greater than the body's weight, the body will have a tendency to rise, due to a force equal to the difference between the weight of a volume of fluid, equal to the volume of the body, and the weight of the body. These principles are a concise statement of the theory of a balloon's action. If we have a body whose weight per cubic foot is less than the weight of a cubic foot of air, the body will rise with a force equal to the difference between the body's weight and the weight of an equal volume of air. For instance, if a balloon is filled with hydrogen, the air will exert a lifting force of about $\frac{7}{100}$ of a pound for each cubic foot in the volume of the balloon, so that, if the weight of the balloon and car is less than this lifting force, the balloon will ascend. If common illuminating gas is used in the balloon, the lifting force will be about $\frac{1}{25}$ of a pound for each cubic foot of the balloon's volume. The weight of the material in a balloon varies greatly, of course, according to the construction, some balloons only weighing, with the net work, about $\frac{1}{20}$ of a pound per square foot of surface, or even less, and others weighing as much as $\frac{1}{5}$ of a pound per square foot of surface. The ordinary shape of a balloon approximates closely to that of a sphere, which it is commonly assumed to be in making calculations. An example is appended to illustrate the application of the preceding statements:

A balloon has a diameter of 40 feet, the weight of the material and netting is $\frac{1}{8}$ of a pound per square foot of surface, the weight of the car and contents is 600 pounds, and the gas which distends the balloon is subject to an upward pressure of $\frac{1}{25}$ of a pound per cubic foot.

The volume of the balloon is 33,510 cubic feet, so that the upward pressure due to the air is about 1,340 pounds. The surface of the balloon is 5,026·5 pounds, so that the weight of material and netting is about 628 pounds, to which must be added the weight of the car, making a downward pressure of 1,228 pounds; hence the unbalanced upward pressure, which causes the balloon to ascend, is about 112 pounds. It will now be evident, we think, that the lifting force of a balloon is entirely due to the air, and is impeded, instead of being assisted, by the gas; so that it would be better, if it were practicable, to make a balloon with a vacuum in the interior.

It must be remembered that, as a balloon ascends above the earth's surface, the air in which it is immersed grows continually less dense, so that the lifting force becomes less and less, unless the volume of the balloon is increased. Thus at about 18,000 feet elevation, the air is only about half as dense as at the sea level; at 36,000 feet elevation, $\frac{1}{4}$ as dense, and so on. Hence balloons are rarely filled at the surface, as we have explained in former descriptive articles. We have also detailed the methods of manufacture, varnishes employed, etc., so that it only remains to explain the manner of calculating the size of a balloon required to fulfil given conditions.

In making the estimate for a balloon, one can generally ascertain the weight of the car and contents, the difference of weight of a cubic foot of air and of the gas to be employed (which may be called the buoyant effort), and the weight of the balloon with its ropes and network per square foot of surface. It is then required to find the diameter of a balloon which will have a tendency to *rise* with a given force. The calculation by which this is determined is somewhat complex, but it will be found explained at length below, an example being added for the purpose of further illustration. The following quantities must first be ascertained:

1. The buoyant effort, or difference between the weight of a cubic foot of air and of gas.

2. The weight, which includes the weight of everything except the material of the balloon and the netting, together with the lifting force.

3. The superficial weight, or weight of the material and netting, per square foot of the balloon's surface.

The operations for finding the required diameter are as follows

(*a*). Divide twice the superficial weight by the buoyant effort.

(*b*). Divide 8 times the cube of the superficial weight by the cube of the buoyant effort.

(*c*). Divide 0·95493 times the weight by the buoyant effort.

(*d*). Multiply 15·27888 times the cube of the superficial weight by the weight, and divide the product by the fourth power of the buoyant effort.

(*e*). Divide 0·91188 times the square of the weight by the buoyant effort.

(*f*). Add together the quantities obtained by rules (*d*) and (*e*), and take the square root of the sum.

(*g*). Add together the quantities obtained by rules (*b*), (*c*), and (*f*), and take the cube root of the sum.

(*h*). Add together the quantities obtained by rules (*b*) and (*c*), subtract the quantity obtained by rule (*f*), and take the cube root of the difference.

(*i*). Add together the quantities obtained by rules (*a*), (*g*), and (*h*). The sum will be the diameter required.

Example: It is required to find the necessary diameter of a balloon, the following data being given:

The weight of the car and contents is 475 pounds, of the valve 25 pounds, and the air is to exert a lifting force of 100 pounds. The gas in the balloon is to be such that the difference between its weight and that of a cubic foot of air shall be 0·04 pound. The weight of the material and netting is to be 0·12 pound per square foot of balloon surface.

Pursuing the same steps as indicated in the preceding rules, we find:

1. The buoyant effort = 0·04 pound.
2. The weight = 475 + 25 + 100 = 600 pounds.
3. The superficial weight = 0·12 pound.

(*a*). $2 \times 0{\cdot}12 \div 0{\cdot}04 = 6$.

(*b*). $8 \times 0{\cdot}001728 \div 0{\cdot}000064 = 216$.

(*c*). $0{\cdot}95493 \times 600 \div 0{\cdot}04 = 14{,}324$.

(*d*). $15{\cdot}27888 \times 0{\cdot}001728 \div 0{\cdot}00000256 = 6{,}187{,}946$

(*e*). $0{\cdot}91188 \times 360{,}000 \div 0{\cdot}0016 = 205{,}173{,}000$.

(*f*). $\sqrt{(205{,}173{,}000 + 6{,}187{,}946)} = 14{,}538$

(*g*). $\sqrt[3]{(216 + 14{,}324 + 14{,}538)} = 30{\cdot}75$.

(*h*). $\sqrt[3]{(216 + 14{,}324 - 14{,}538)} = 1{\cdot}26$.

(*i*). $6 + 30{\cdot}75 + 1{\cdot}26 = 38{\cdot}01$ feet, required diameter.

This explanation will doubtless render the method plain to all who are sufficiently interested to devote a little attention to the matter; and such readers would do well to work out other examples from assumed data.

As there are many who like to know the reasons for a result, we have added the method by which the rules are obtained, which can readily be verified by those who are familiar with algebra. Let

b = buoyant effort, W = weight, and a = superficial weight.

The balloon is to have sufficient volume that the upward pressure of the air, which is the volume of the balloon multiplied by the buoyant effort, shall be equal to the weight, increased by the product of the superficial weight and the surface of the balloon. Assuming that the balloon is in the form of a sphere, this condition is expressed by the following equation, calling x the diameter of the balloon:

$$0{\cdot}5236 \times b \times x^3 = W + 3{\cdot}1416 \times a \times x^2$$

From which we deduce:

$$x = \frac{2a}{b} + \left[\frac{8a^3}{b^3} + \frac{0{\cdot}95493\,W}{b} + \left(\frac{15{\cdot}27888a^3W}{b^4} + \frac{0{\cdot}91188W^2}{b^2}\right)^{\frac{1}{2}}\right]^{\frac{1}{3}} + \left[\frac{8a^3}{b^3} + \frac{0{\cdot}95493W}{b} - \left(\frac{15{\cdot}27888a^3W}{b^4} + \frac{0{\cdot}91188W^2}{b^2}\right)^{\frac{1}{2}}\right]^{\frac{1}{3}}$$

the same value as was given in the foregoing rules.

It will be evident, by inspecting the equation of condition, that the same method can be applied to any form of balloon whose volume and surface can be expressed algebraically.

SENATE CONFIRMATIONS.

We are informed that the nominations of Captain J. M. Thacher as Commissioner of Patents, and General Ellis Spear as Assistant Commissioner, have been confirmed by the Senate, and also that of Major Marcus S. Hopkins as a member of the Appeal Board

It is gratifying to be able to say that they are all gentlemen of the highest personal character, possessed of ability and experience. The duties committed to their charge are of great importance, and will, we trust, be discharged with unswerving fidelity. They have before them a splendid opportunity, by an honest and liberal-minded administration of the Patent Laws, to secure the public confidence, and win for themselves individually, an honorable and widely extended fame.

WE are requested to state that the case of the rotary blower, illustrated and described in our last issue, is formed of cast iron, bored out true, and bolted firmly to the heads of the machine. The mention of "light boiler iron, formed up very truly and inserted into the heads of the machine," is an error.

SCIENTIFIC AND PRACTICAL INFORMATION.

A NEW VARNISH FOR METAL WORK.

A late Italian patent contains the following recipe for a varnish for protecting metal work: A paste is made of finely pulverized quartz, carbonate of potash, or oxide of lead and water according to the color required. A thin coat of this is applied with a brush to the object, which is then placed in a muffle, and heated to 1,495° Fah. The articles emerge covered with a sort of polished glass, which resists blows and which does not split nor scale off, while it serves perfectly to protect the metal against oxidation.

RUSSIAN RAILWAYS IN PERSIA.

Since the revoking of the concessions obtained by Baron Reuter from the Shah of Persia, for the construction of the railways in that country, Russia has been negotiating for the privilege, and the success of her diplomacy is now announced.

Russian capitalists will furnish the funds, and the line to be built will connect the Caspian and Black seas through Tiflis and the port of Peti. The Shah guarantees 6 per cent of the cost of such portions of the road as enter his dominions.

ELECTROPLATING ON CHINA.

M. Hansen has recently patented in France the following process for electroplating on a non-conducting material: Sulphur is dissolved in the oil of *Lavendula spica* to a sirupy consistence. Sesquichloride of gold or sesquichloride of platinum is then dissolved in sulphuric ether, and the two solutions are mingled under a gentle heat. The compound is next evaporated until of the thickness of ordinary paint, when it is applied with the brush to such portions of the china, glass, etc., as are desired to be covered with the electrometallic deposit. The objects are baked in the usual way before immersion in the bath.

IMITATION GOLD.

An alloy having a very fine and malleable grain, susceptible to a high polish and impervious to rust (which, while closely resembling gold, may advantageously replace that metal in a variety of cases), is made of 100 parts pure copper, 17 parts tin, 6 parts magnesia, 3·6 parts sal ammoniac, 1·8 parts quick lime, and 9 parts bitartrate of potassa. The copper is melted first, and the magnesia, ammonia, lime, and tartrate are successively added in small quantities. The tin in small pieces is then placed in the crucible, and the whole brought to fusion for 35 minutes, after which the alloy is allowed to cool.

EFFECT OF FLAME ON AN ELECTRIC SPARK.

Mr. S. J. Mixter notices a curious effect of a gas flame on the current of a Holtz machine. The jet consisted of a glass tube drawn out to a point, and the flame had a length of about an inch and a diameter of only an eighth of an inch. Inserting this between the two terminals of the machine, the length of spark obtainable was at once increased from less than ten inches to over twelve, the full distance to which the balls could be separated. The same increase was not obtained on simply inserting a conductor between the two terminals, a ball an inch in diameter only lengthening the spark about an inch.

A NEW GALVANIC BATTERY.

A new battery is manufactured by Messrs. C. & F. Fein, of Stuttgart, which is said to be remarkably cheap and to have a constant current, with high electromotive power. It consists of a three-necked jar, similar to a Woolff bottle. In one of the side orifices is inserted a charcoal plate, and in the other a strip of amalgamated zinc, the last covered with cotton. By means of the center tube, pieces of coke and peroxide of manganese are inserted until the bottle is about two thirds full. The remaining space receives a concentrated solution of sal ammoniac. The center tube terminates above in an inverted flask, the neck of which is extended down to the level of the liquid. The flask is also filled with the sal ammoniac solution, and, by affording a continual supply, provides against loss by evaporation. The contact between the charcoal and the copper conducting wire is made by platinum plates. The battery remains constant for a year, and is said to be easily cleaned and renewed.

HIPPOPHAGY IN FRANCE.

During the fall of 1874, Paris ate 1,555 horses, asses, and mules. A horse, which, for his skin, hoofs, etc., alone, is worth but about five dollars, brings as food, in the markets of the French capital, five times that sum.

Gas from Crude Petroleum.

In a reply recently given to one of our correspondents in respect to this subject, he was informed that many attempts had been made to employ crude petroleum for the manufacture of illuminating gas, some of which are in progress, and that, as yet, the various inventors have not succeeded in perfectly overcoming the practical difficulties.

The Ashtabula *News*, Ohio, objects to this reply, because, it says, Ashtabula is now and has been for more than a year lighted by gas made from crude petroleum by a process invented by Dr. Wren of Brooklyn; that the process is entirely successful and very economical; and that among other places which are now using this gas we may name Shelbyville, Indiana, and San José, California.

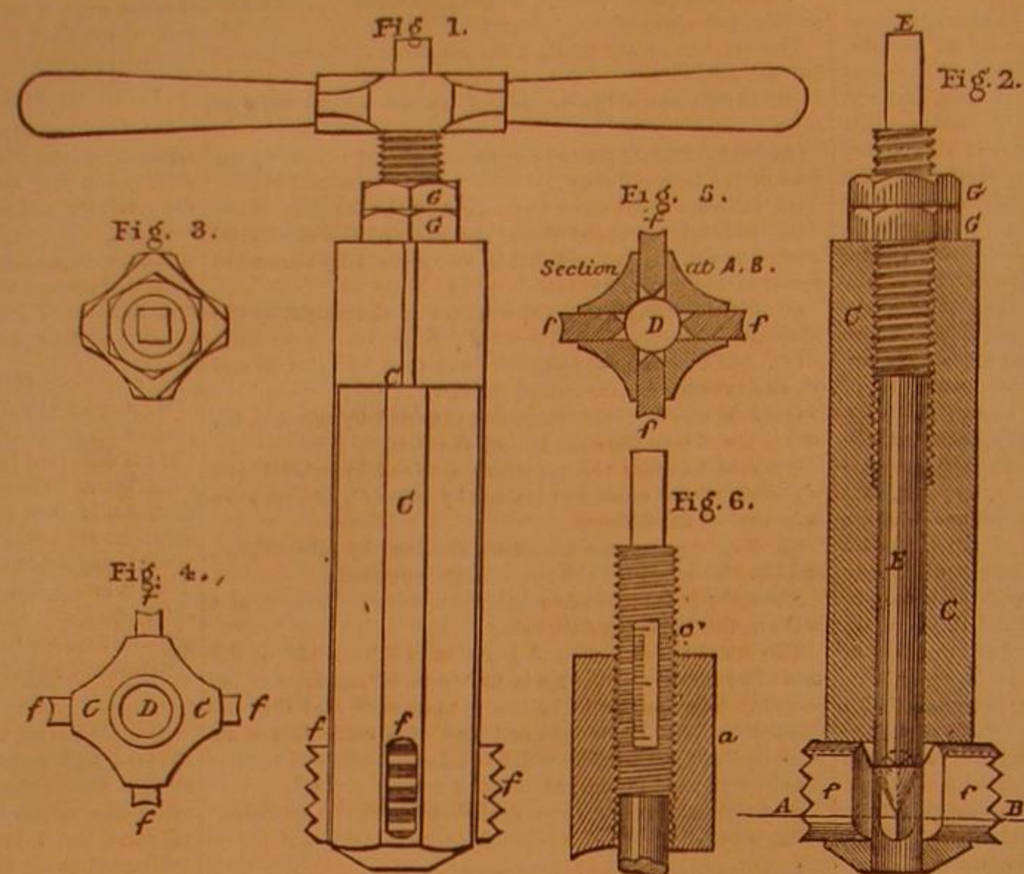
We are glad to record these evidences of successful progress in the use of crude petroleum, and we hope that gas engineers in all parts of the country will send us reports of what they are doing in that line. Crude petroleum is a very cheap, abundant, and valuable natural product. Its successful, economical use for gas illumination will be of great advantage to the country.

IMPROVED DIE TAP.

This is a new form of tap for screw cutting, the arrangement of which is clearly shown in our engraving. It will be seen that the main body tap, C, remains much the same as in the old standard, minus the thread, but that it is pierced through its centre with a round hole, tapped for a part of its depth; and that into this hole is screwed a pointed spindle, E. At the lower end of the tap, it will be observed, are four screw-cutting dies, *f f f f*, fitting into a corresponding number of slots radiating from the center of the tool. These dies have knife edges on the inside, their upper corners being chamfered for the reception of the point of the adjustable screw or spindle referred to.

In the engraving the dies are shown to have been forced out by the adjustable screw to their largest working diameter. To draw them back it is necessary to elevate the screw, E, and gently tap back the dies until they are flush with the turned part of the tap. In this position they close the central hole, leaving only a small pointed indenture at the top formed by the chamfered corners already mentioned. The dies, it will be seen, are concave on their cutting faces. By setting the check nuts, G G, Figs. 1 and 2, on the spindle, E, a large number of holes can be tapped to the same size. A graduated scale can also, if desired, be added for facilitating the adjustment, as shown in Fig. 6. The dies being adjustable, the diameter of the screwed hole can be regulated to $\frac{1}{100}$ inch, and even less. Further only one tap is necessary to cut a full thread, as compared with two and sometimes three used in the ordinary way. Again, the dies, being removable, can be easily re-sharpened, or they may be replaced by others of a different thread. This tap has been found to be specially useful in the cutting of threads in steel tyres of locomotive and carriage wheels (where the tapped bolt fastening is used), also for tapping gas pipes, and in renovating stripped or worn threads.

Mr. John McFethrie, of Kovroff, Russia, is the inventor.



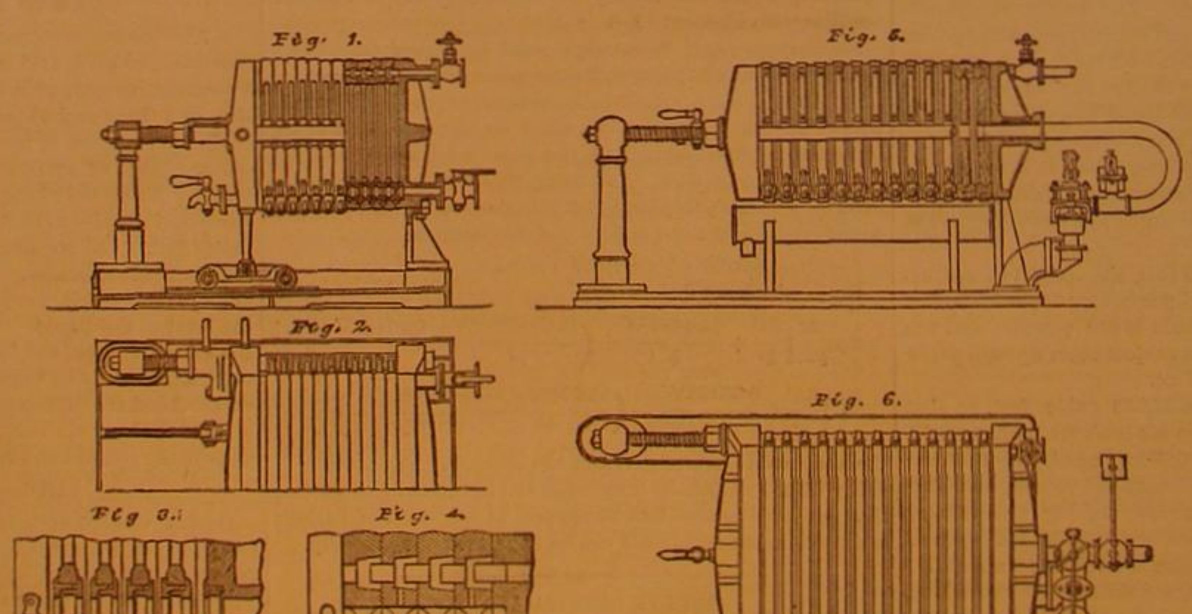
McFETHRIES' UNIVERSAL DIE TAP.

FILTRATION UNDER PRESSURE.

A very important economy is effected, in paper making, sugar refining, and other processes wherein matters are held in suspension in liquid, by forcing the fluid through a filter by pressure, thus recovering valuable material from waste and washings that would not pass through any filtering substance by the mere action of gravity. Mr. A. L. G. Dehne, of Halle, Germany, has introduced several inventions for this purpose, two of which (especially adapted for sugar refineries and chemical works) we illustrate herewith.

The first of these presses, shown in Figs. 1, 2, 3, 4, has a horizontal central admission for the material to be filtered, and is called by the manufacturers a refining press for the claying of sugar, and is used for the filtration of the sirup, as a substitute for the sack or bag filter, the preliminary filtration through bone black and the further filtration of the residue of blood coagulation and juice being omitted.

This press consists of the customary chambers of iron, but no special pump is required for forcing in the matter, as in most cases the pressure of a certain hight is sufficient. An apparatus of this kind used at Halle does the mechanical filtration of a thick solution, of about 55 per cent, of about from 800 cwt. to 900 cwt. of raw sugar in 24 hours, in the most satisfactory manner, without the use of any pump, but through the pressure from a reservoir placed about 7 feet above the press.



FILTER PRESSES FOR CHEMICALS AND SUGAR.

The residue in the chambers does not form cakes, but exists only in the form of slime, which is easily removed after the filtration has been completed by opening the cock in the front plate. The filter cloths may be changed every 24 hours, and this operation, together with the edulcoration, does not require more than half an hour's time, while no attendance is required by the press during the time of filtration. The general construction of the press will be easily understood from the engraving, the details of the chamber being shown in a larger scale in Figs. 3 and 4. The very handy arrangement has been adopted of carrying the front cast iron plate on rollers, whence the taking out of the chambers, and of the filtering cloths; becomes a matter of the greatest ease and simplicity. The method of fastening together of the chambers and plates is obvious in the engravings.

The second press is represented by Figs. 5 and 6, and has also a horizontal central admission. It has lately been much adopted in works where a quick separation of mud, slime, or chemical precipitates from fluids has to be made. This apparatus consists of a system of chambers made of wood, or occasionally of brass castings, with sheets of drill cloth placed between them. The fluid to be filtered is forced into the chambers by means of a pressure pump, a separation of the fluid from the mud, slime, etc.; then taking place. The fluid is tapped off perfectly clear, and with a continued forcing in of fluid, the filtration goes on until the residue in the chambers become solid. The emptying of the apparatus is very simple: the cakes, having formed in the chambers, are easily removed, or fall out when the apparatus is unscrewed. The general construction and fastening of the plates is the same as in the press described above.

Useful Recipes for the Shop, the Household, and the Farm.

Three bushels of clean sand, mingled with half a bushel of good lime and half a bushel of cement, makes an excellent mortar which is not liable to be dislodged by storms.

Dark purple and green slates are the best for roofing; others are liable to fade unequally and produce a disagreeable appearance.

If hammering continually is done in an upper story to such an extent as to be annoying on the floors below, the sound may be deadened by sheet india rubber cushions placed under the benches or anvils.

It is very dangerous to allow acid substances, used as food, to stand for any length of time in copper vessels. Preserves, when made in pots of that metal, should be emptied out as soon as possible after cooking.

Do not bring lights near empty whisky, alcohol, benzine, or coal oil barrels. The vapor of the fluid, mingled with the air within, is a dangerous explosive mixture.

Lamp chimneys may be, in a measure, prevented from sudden cracking by immersion in cold water in a suitable vessel, the last being set on the stove until the water boils. The chimney is then removed and allowed to cool slowly.

In painting, do not apply a succeeding coat before the previous one is dry. Do not use a lighter color over a darker one, nor add dryers long before using. Use as little dryers as will do the work.

Gall soap, excellent for washing silks or ribbons, may be made by heating one pound of cocoanut oil to 60° Fah., into which half a pound of caustic soda is gradually stirred. To this half a pound of Venice turpentine, previously warmed in another vessel, is added. The kettle is allowed to stand for four hours, subject to a gentle heat, after which the fire is increased until the contents are perfectly clear. One pound of ox gall, followed by two pounds of Castile soap, is then mixed in, and the whole allowed to cool, when it may be cut into cakes.

Never try to extinguish a kerosene fire with water. Smother the flames with blankets or rugs.

Benzole magnesia, a simple paste made of calcined magnesia and benzole, will take grease spots out of almost everything, however delicate. A paste of soda and quicklime is good to take oil stains from wood floors.

To detect adulteration in tea, burn the ashes. Pure tea, of any grade, will not leave over five per cent of ash, while the adulterated article will yield as high as 45 per cent.

Chloride of calcium or glycerin, added to shoe blacking, will prevent the latter's drying in the box.

It is said that half an ounce of a mixture of 100 parts logwood ground with 1 part of bichromate of potash, will make, with water, a pint of good ink.

Painters estimate that about 1 pound of paint per square yard is required for filling new work, and nearly half a pound for the second coat. The proportion is about half white lead and half oil of turpentine for the filling coat.

A good white cement for marble is made of 8 parts resin and 1 part wax, to which, when well melted together, 4 parts plaster of Paris are added. Use while hot.

Cements in general are comparatively brittle, therefore use as little as possible, so that dependence may be made upon its adhesion to the surfaces, and not upon the cohesion of the cement alone.

In using the flat drill, the cutting point should be made thin, so as to penetrate easily, and its form should be such as exactly to fit the inner angle of the try square, which is 90°.

A wash of lime, salt, and white sand is said to afford protection to shingle roofs against accidental conflagration from sparks, etc.

The following are two recently patented recipes for welding copper. The first, by Messrs. C. L. Schurr and W. G. Rehbein, consists in heating borax until all moisture is expelled. The dry residuum is pulverized and applied between the surfaces of the copper, which are formed in a lap joint. The metal is hammered together cold, then heated and dipped first in fine salt, and then in human feces, for the purpose of excluding the air. Welding may then be easily accomplished. In the second plan, the ends of copper to be welded are hammered out to form the lap. The pieces are then heated, dipped in powdered borax to clean the surfaces, and heated a second time. After the second heat the pieces are dipped in powdered cryolite (or any other anhydrous fluoride or similar salt, which, when heated, will form a liquid flux), and then hammered together on the anvil. The latter is the invention of Mr. E. Renaud, of Washington, D. C.

If a defect on a steam cylinder cannot be reached for plugging or melting-in a composition, stop the hole with 2 parts sal ammoniac and 8 parts fine iron filings. No sulphur need be used.

RATS EXPELLED.—A gentleman in Burlington, Vt., of an investigating turn of mind, a week or two ago determined to try it again with the rats which infested his house. He purchased a supply of coal tar at the gas works, and placed small quantities of it in the rat holes in his cellar and elsewhere in their runways. The rats, bedaubing themselves, became disgusted with the manner of their entertainment, and speedily left the premises, and have not been seen or heard from since.

The best way to use up scrap brass is to melt it in with new brass, putting it in with the zinc after the copper is melted.

THE UNDERGROUND RAILWAY, NEW YORK CITY.

NUMBER VIII.

Continued from page 4.

At the north side of 98th street commences the stone viaduct, which extends to a point midway between 115th and 116th streets, forming the third division of the work; it was constructed under the supervision of Mr. George S. Baxter, C.E. This viaduct is built across the marshes known as the Harlem flats, and is, in all respects, a remarkably substantial work. Its total length is 4,563 feet, its greatest hight above street grade, which occurs at 104th street, 31 feet 1 inch, and its width in the clear, at railroad grade, 48 feet. The grade of the road across the viaduct, as will be seen by a glance at the profile (page 308, Vol. XXXI.) is by no means level. Between the south and north ends there is one continual fall of 40 feet per mile, the south end being 41 feet 3 inches higher than the north end. The work consists of an earth embankment contained between two retaining walls of first class rubble masonry, laid in cement mortar, with vertical and horizontal joints, and battered on the outer face one inch to the foot. The hight, breadth, and depth of foundation vary. Thus, at 100th street the dimensions are: Hight 9 feet, breadth of wall at foundation 6 feet, breadth of parapet 4 feet; at 102d street, 21 feetx11 feetx4 feet; at 103d street, 25 feetx11 feetx4 feet; at 104th street, 29x13x6 feet, and at 115th 2x4x3 feet.

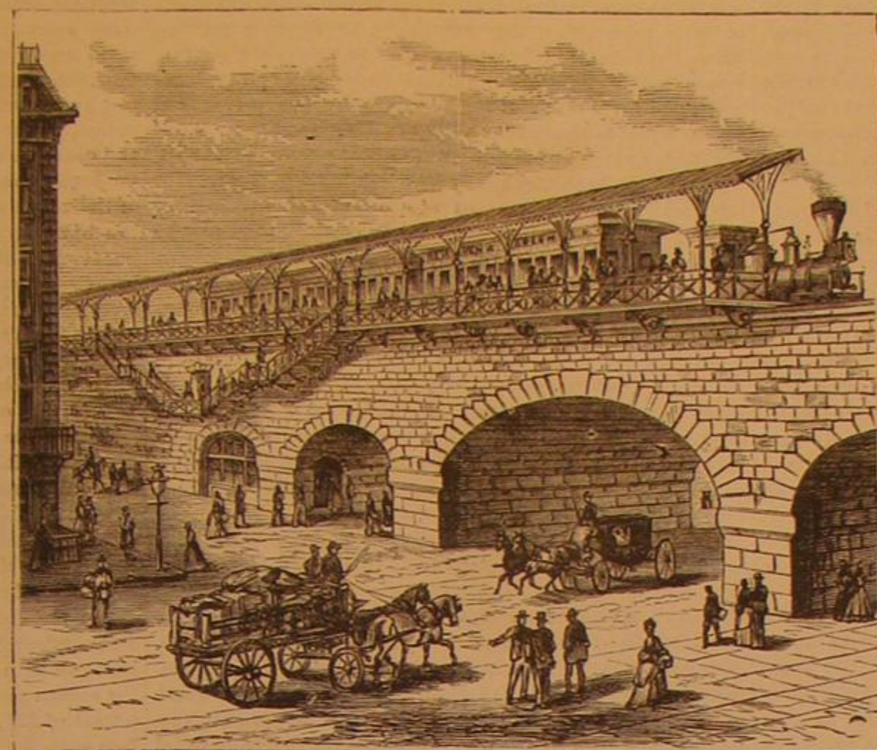


Fig. 19.—THE UNDERGROUND RAILWAY, NEW YORK CITY.—THE VIADUCT AND PASSENGER STATION AT 110th STREET.

In laying the foundation of such a massive structure in such soft ground, considerable difficulty was encountered. By far the greater part was laid either in concrete or on piles, the latter being used very generally under the piers and abutments of the bridges at the street crossings.

The piles (of which 198,900 linear feet were driven) were of white oak and spruce, from twelve to fifteen feet in length and twelve inches diameter at the butt, and were driven two feet six inches from center to center till they reached hard bottom, or till a ram of 1500 lbs., falling 30 feet, did not settle them more than half an inch. The tops were then sawn off level, at the proper hight, and capped with two courses of white oak timber laid crosswise and treenailed to the piles; and on these was laid the foundation. Wherever concrete was employed, it was quickly mixed and deposited in layers of from four to nine inches, and settled by slightly ramming, sufficient to flush the mortar to the surface. The viaduct is carried over the cross streets on arches, the first series of which is at 102d street.

Fig. 19 shows a portion of the viaduct in perspective, and also the passenger station, which is built in part within the viaduct. Fig. 20 shows an end elevation of the viaduct. Fig. 21 is a side elevation in part section, showing the character of the arches at the street crossings.

The foundations of these arches are first class gneiss rubble masonry, and project one foot beyond the line of the superstructure of the piers and abutments. On these foundations is placed a bridge of three arches, two of them semicircular arches, of 10 feet span and 5 feet rise, and 20 inches thick, which span the sidewalks, and one elliptical arch, 30 feet span and 17 feet rise, and 24 inches thick, placed between the two small arches and spanning the roadway. The piers are 8 feet by 5 feet by 56 feet, and the abutments 8 feet by 6 feet by 56 feet. The faces of the abutments, spandrels, wing walls, piers, and arches, are built of freestone well dressed, and (with the exception of the arch stones, which are cut to long ⅜ inch joints) are all cut to lay half inch joint. The backing of the walls, abutments, and hearting of the piers is first class gneiss rubble masonry, well tied to the face with face headers. The abutments are carried up five feet above the springing line of the arches on the outside; and from the top of this backing to the crown of the main arch, the spandrels are filled with concrete, plastered with half an inch of cement. The bridge at 103d street does not differ

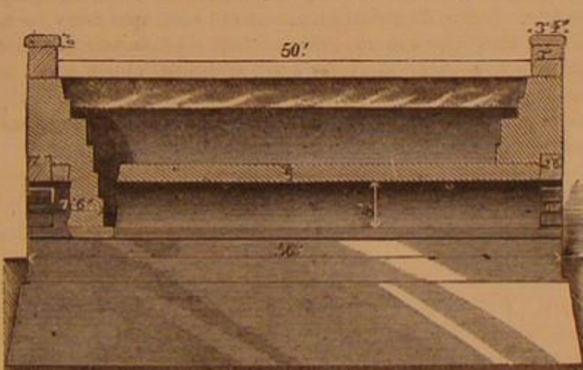


Fig. 20.—THE UNDERGROUND RAILWAY, NEW YORK CITY.—END ELEVATION OF THE VIADUCT.

from the one just described, except that its rise is but 15 feet. The foundations for the bridge and walls at this point are from 10 to 12 feet deep, good bottom being found without going below the water level. From this north to 106th street, the foundations were laid dry. At 106th street, a wide street, there are four arches, one over each sidewalk, twenty inches thick, 15 feet span and 7½ feet rise, and two 24 inches thick, 26 feet span, and 13 feet rise. The two outside piers are 5 feet 6 inches by 9 feet by 56 feet, and the middle pier and two abutments 7 feet by 9 feet by 56 feet. Like all the bridges, it is built of freestone, the material in this case being obtained from the old bridge, which was carefully taken down, and the stones cleaned and, where necessary, re-dressed. The north pier and abutment foundations were put down about 9 feet below high water to a good sand and gravel bottom.

In the block between 106th and 107th street, the foundation of the retaining walls was put down to a depth of some 12 feet below high water, thus giving the foundation at this point a hight of 23 feet. The excavation was made through six to eight feet of black mud and about four feet of a black clay-like material, which was very probably the mud in a compressed state. The earth was taken for a distance of four feet outside of the foundation lines, and the excavation sheet piled and braced with heavy timbers. For the west wall, guide piles were driven on the water side to hold the sheet piling in place, and outside of these an earth dam was thrown up. On the east side the place of the dam was supplied by the embankment of an old road. The excavation, into which the water ran slowly, was easily kept dry by a steam pump, except on one or two occasions during the full moon tides.

It will be observed on the profile (page 308, Vol. XXXI.) that at 112th and 113th streets the grade of the railway approaches so near to that of the avenue that sufficient headway could not be obtained for stone arches. Their places are therefore supplied by double wrought iron Post truss bridges, capable of supporting 3,000 lbs. per linear foot of track, independent of their own weight, their factor of safety being 5. In the bridge at 112th street, the trusses are 8 feet high, 52 feet in the clear between the outside trusses, and 63 feet span. It is supported on stone abutments 7 feet thick at street grade, 4 feet at top, and 15 feet high by 58 feet long. These abutments are returned on each side to the retaining wall. The bridge at 113th street is the last in the viaduct.

The retaining walls from 98th street to 115th street are surmounted by a parapet wall (rock faced on the outside) 2 feet 6 inches in hight, 2 feet at bottom by 18 inches at top. Upon this is placed the coping of pene-hammered granite, 10 inches by 3 feet four inches. The coping and parapet are anchored to the retaining walls by wrought iron galvanized rods, 1½ inches in diameter and 6 feet long, with a head and washer on the bottom and a nut and cast iron washer on top.

At 110th street is one of the way stations, built in part within the viaduct, as shown in exterior view in Fig. 19. It consists of a waiting room built in the north abutment of the 110th street bridge, and two iron stairways which rise, on the outside of the east and west retaining walls of the viaduct, from the waiting rooms to two covered landings on top of the viaduct. The waiting room is on a level with the street grade, and consists of a vaulted room 10 feet broad, 3 feet 6 inches long, and 12 feet 7 inches from floor to the crown of the roof, and running parallel to the axis of the north archway of the bridge, into which it opens through a groined archway of freestone, 12 feet broad by 5 feet

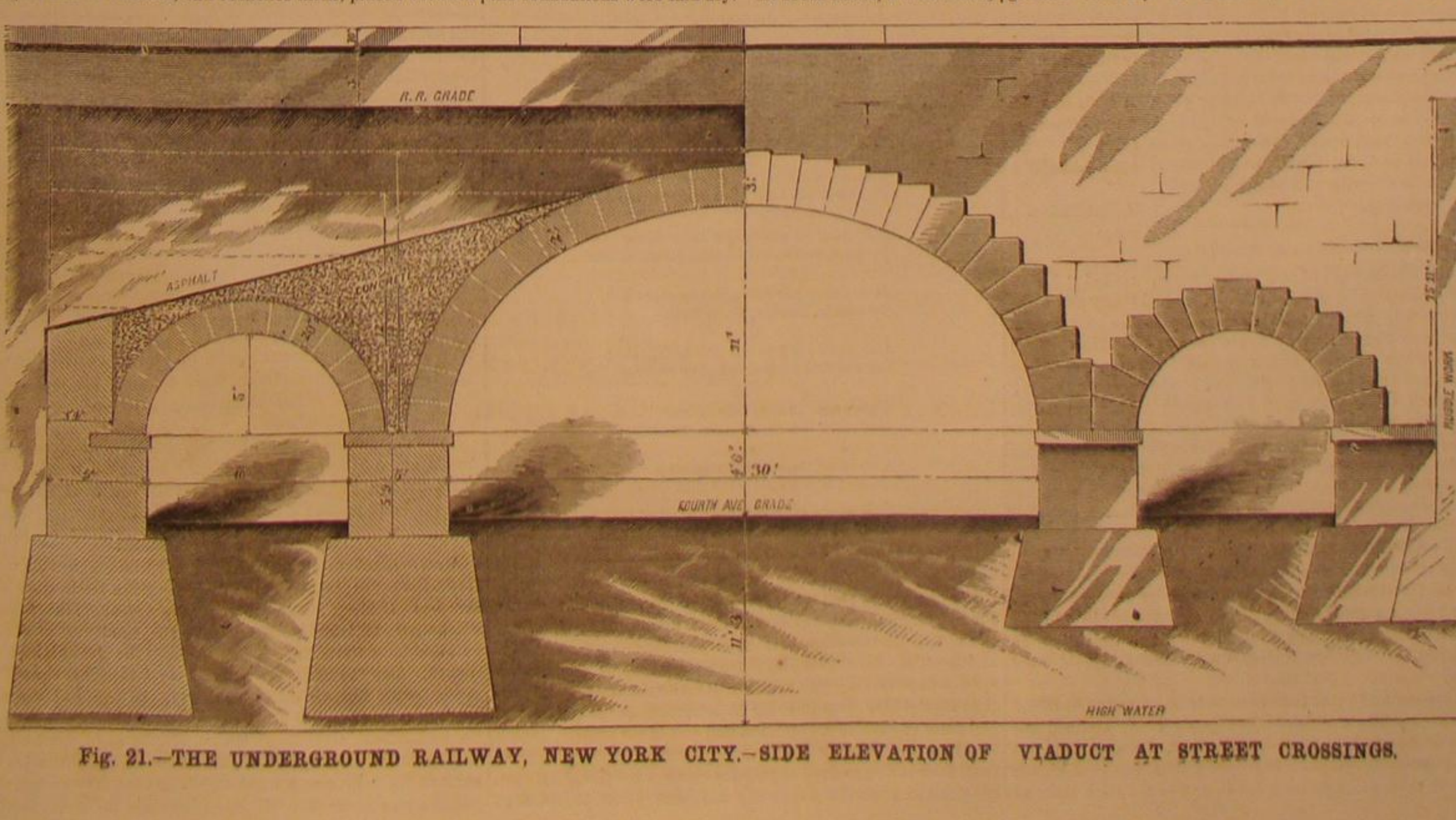


Fig. 21.—THE UNDERGROUND RAILWAY, NEW YORK CITY.—SIDE ELEVATION OF VIADUCT AT STREET CROSSINGS.

thick, and placed 22 feet from the outside of either retaining wall.

The arch is semi-circular, and of brick, 20 inches thick. This room is lined with brick and plastered, and closed at the east end by a large semicircular arched window (see Fig. 19.) Two flights of steps rise from this room through two brick-lined segmental arched ways, 6 feet broad by 8 feet high, to points on the outsides of the retaining walls 17 feet above street grade, from which iron stairways lead to the covered platform on top of the viaduct. Of these passage ways, the one leading to the west side of the viaduct passes out from the west end of the waiting room and forms almost a continuation of it. That leading to the east side of the viaduct is placed to the north of the waiting room, and parallel to it, but separated from it by a masonry wall 4 feet 6 inches in thickness.

At the outside of the retaining walls, at each of the openings of the arched stairways, just mentioned, is placed a wooden platform, 3 feet by 6 feet, from which are two flights of iron steps, one to the north and one to the south. These steps are 3 feet wide, with yellow pine steps, cast iron risers and string, supported by 9 inch heavy H beams built into the solid masonry of the retaining wall. They lead to the covered landing beside the track. These landings consist of wooden platforms resting upon six rows of longitudinal wooden beams, supported, in turn, by iron beams, 8 feet long, placed transversely on the parapet walls, 7 feet 3 inches apart, and anchored by iron rods extending 6 feet downward through the masonry. The platforms are 130 feet 6 inches long and 8 feet 3 inches broad, thus projecting 2 feet 3 inches beyond the parapet wall on the inside and 3 feet on the outside. The covering railing is of design shown in Fig. 19.

The amount of masonry used in the construction of the retaining walls, foundations, bridges, abutments, wing walls, spandrels, parapets, etc., of the viaduct was 60,047 cubic yards; 2,458 cubic yards of concrete was laid; 198,900 linear feet of piling was driven; and of timber and plank used in platform, grillage, etc., 352,000 feet, B. M., was used, and of iron anchors, 51,000 lbs.

Correspondence.

Crystalization of Carbon.

To the Editor of the Scientific American:

While contemplating the great economy in all departments of Nature, in the utilization of many substances which casual thinkers might think noxious or waste materials, the thought occurred to me that, if Nature were to enter largely upon the manufacture of diamonds, a bed of charcoal would not be melted down for the purpose so long as carbonic acid gas is everywhere escaping and going to waste, from the decomposition of the rock formations. Further, if experiments were to be instituted in this direction, they could best be conducted in connection with the manufacture of stone lime. For example: Let the gas (which always escapes in large quantities from a burning lime kiln) be collected and turned into a retort; or, if found necessary, a series of three or four retorts might be employed, and the gas carried through a refining process, so that nothing but pure carbon should reach the last retort in the series. Should heat or pressure be found necessary, still another retort could be prepared for that purpose; but it is a question as to whether carbon will not readily crystalize as soon as set perfectly free from all other substances.

St. Albans, Vt. CHARLES THOMPSON.

Animal Suicides,

To the Editor of the Scientific American:

In your issue of January 9, you mention a suicidal scorpion. Allow an old reader to say that the scorpion becomes greatly enraged on very slight occasions; and bending its tail in the form of part of a circle, over its back, lashes it furiously from side to side, the sting barely missing its own body at each pass. When it strikes itself, which is not unfrequently, the verdict should read: "Deceased, while carelessly brandishing his weapon, accidentally inflicted upon himself a wound, from the effects of which he died."

New York city. T. B. TOMPKINS.

To the Editor of the Scientific American:

Your article on page 21, current volume, headed "A Suicidal Scorpion," calls to mind a story, related many years ago by my mother, of a suicidal rattlesnake She said that a party of men were removing an old barn in New Hampshire; and among the rubbish, they captured a rattlesnake, which they secured with a forked stick, and commenced tantalizing it. It soon became enraged and would frequently lay its head over on its body and remove it again. Finding its tormentors persistent, it at last threw its head back, thrust its fangs into its body, and soon after died. W. D. CLARK.

Springfield, Ill.

[For the Scientific American.]

THE CRESCENT STEEL WORKS AT PITTSBURGH, PA.

These works, belonging to Messrs. Miller, Barr, and Parkin, are located at Pittsburgh, on the Allegheny river, between 49th and 50th streets. They were established in 1865 by the present firm, with the avowed intention of rivaling, in the quality of their product, the very best Sheffield steel makers.

The methods of manufacture used in the famous Sheffield houses are exactly followed here, merit being claimed for careful and exact working rather than for any quick or patent processes. In order to insure uniformity in stock, the firm have their arrangements for their fine Swedish irons so made that they import direct from the makers, and have secured to themselves an entire brand of Dannemora iron, equal to any ever made, so that in certainty of supply and quality of stock they are not second to the best houses in England. With abundant experience, skilled workmen, the best of material, and machinery in every respect up to the highest standard of the latest practice, the growth and reputation of the concern have been continuous. Established nine years ago, with twelve melting holes, three hammers, and a capacity of three tuns a day, they now have twenty-four melting holes, four Siemens furnaces (equal to ninety-six melting holes) capable of producing thirty tuns a day, six steam hammers, and three trains of rolls. They are thus prepared to make twenty to thirty tuns a day of all sizes and varieties of bar steel, and are making constant improvements in their appliances for a beautiful and exact finish to their work. Not the least of these is the rapid adoption of gas furnaces for heating, making it very difficult for a careless workman to overheat their steel. Having steadily pursued the policy of buying the best stock to be had, and having made its careful working a constant study, their success has corresponded with their efforts. For several years, they have supplied regularly some of the very best ax and edge tool makers in the country, and many of the largest machine works, nail factories, screw cutters, and others where steel has to do the hardest and finest work. They have driven the German rolls and the English die steel out of the United States mint, so that American specie is now rolled and coined on American steel. We are informed that, on account of the especial demand for their steel in Pennsylvania and the West, they had not solicited New England trade to any considerable extent prior to the panic. During the past 18 months, however, through their eastern agents, Messrs. Ely & Williams, No. 1,232 Market street, Philadelphia, and No. 20 Platt street, New York, they have secured the patronage of many prominent steel consumers in the East, and their steel is now sold by the leading dealers in principal cities throughout New England and New York, who pronounce it to be fully equal to the imported brands heretofore controlling the market. In conclusion, we must not forget to say that this firm use largely of the best American charcoal hammered irons, and are engaged in careful tests of new brands, some of which promise so well that they express a confident hope of soon putting into the market an exclusively American tool steel, which shall not be excelled by the combined product of Sweden and Sheffield; in the meantime their abundant supply of the best Swedish irons insures to their customers uniform and good results. Being all young men, none of them yet forty years of age, they propose to continue their studies and practice until such a thing as preference for English steel shall be no longer known. They make tool, machine, roller, spindle, hammer, file, frog, fork, hoe, rake, shovel, cutlery, and cast spring steel. * *

Grammar in Rhyme.

The annexed effusion does not come under the head of new inventions and recent discoveries, in fact we believe it has been published from time to time during the past twenty years. But, as the *Commercial Advertiser* (where it appeared last) says: "The name of the author should not have been allowed to sink into oblivion. On the contrary, he deserves immortality, and the gratitude of generations yet unborn, for we have never met with so complete a grammar of the English language in so small a space. Old, as well as young, should commit these lines to memory, for by their aid it will be difficult, if not impossible, for them to fall into errors concerning parts of speech:"

I.
Three little words you often see
Are articles, a, an, and the.

II.
A noun's the name of anything,
As school or garden, hoop or swing.

III.
Adjectives show the kind of noun,
As great, small, pretty, white, or brown.

IV.
Instead of nouns the pronouns stand,
Her head, his face, your arm, my hand.

V.
Verbs tell us something to be done,
To read, count, laugh, sing, jump, or run.

VI.
How things are done, the adverbs tell,
As slowly, quickly, ill, or well.

VII.
Conjunctions join the words together,
As men and women, wind or weather.

VIII.
The preposition stands before
A noun, as in, or through, the door.

IX.
The interjection shows surprise,
As oh! how pretty—ah! how wise.

The whole are called nine parts of speech.
Which reading, writing, speaking, teach.

The Fog Gun.

For some time past endeavors have been made to secure for coast signal purposes something more suited to the duty than the 18-pounder cast iron gun now used. Major Maitland, R. A., of the Royal Gun Factory, has designed a species of revolving gun which will no doubt answer the purpose admirably. But in order to determine the best material and form of muzzle for the new fog gun, four models, each 2 feet long and capable of containing a cartridge consisting of from four to five ounces of powder, were, says the *Engineer*, constructed upon the following different plans, to be tested from the summit of the proof butts in the Plumstead marshes, at various respective distances: A cast iron gun with a plain muzzle; a cast iron gun with a conical mouth; a cast iron gun with a parabolic mouth; and a bronze gun with a parabolic mouth.

The object of trying both conical and parabolic mouths was to arrive at a decision in regard to the question, which has always been pending among manufacturers of speaking trumpets, as to which is the best shape for transmitting sound. Some assert, that the form of the instrument should be a truncated cone; others, that it should be a truncated parabolic conoid, the mouthpiece occupying the focus. Either form would, in a greater or less degree, confine the undulations of sound (which would otherwise disperse themselves in all directions and cause them to take a direction parallel to the axis. Hence the application of one or the other of them. On the occasion of the recent experiments, the four models were placed in a row upon the summit of the butts, with their muzzles pointing towards Shooter's hill. The weather was cold and clear The observers stationed themselves at various distances in front of the row of guns, from 100 yards to 3,000 yards, moving forwards to a greater distance each time that the whole series of four guns was fired. They were ignorant of the order in which the guns were fired, that being purposely left in the hands of the proof master, so it was impossible for their opinions to be prejudiced. It was decided that the volume of sound emitted by each discharge should be represented as nearly as possible in figures, No. 1 being the highest figure of merit, and No. 5 the lowest. The following results were obtained: Adding together the respective figures of merit of each gun at eight several distances, from 100 to 3,000 yards, it was found that the cast iron gun with the conical mouth gave a total of 10, or, in other words, took the first place as regards the volume of sound produced at all ranges; the cast iron gun with the parabolic mouth a total of 21, thus taking the second place; the bronze gun with the parabolic mouth a total of 22½, or taking the third place; while the cast iron gun with the plain or straight mouth gave 26½, the lowest value of all four. At a distance of 1,000 yards only, the bronze gun with the parabolic mouth took the second place. This was probably due to the superior ringing qualities of the metal, which would be observed at such a short range. Further experiments were then made by observers stationed about two miles off upon Shooter's hill. The figures of merit under these circumstances for the several guns were as follows: Out of six observations, 6 for the cast iron cone, 12½ for the cast iron parabola, 19 for the bronze parabola, and 22½ for the cast iron plain mouth. Thus we see that the great increase of distance is very unfavorable to the bronze model, and that the plain muzzled one is out of the field altogether.

During the above mentioned experiments, trials were made with gun cotton, in order to see whether the sound of its report on explosion would reach to any great distance. Masses consisting of about ten ounces were detonated in the open air upon the butts. The noise made considerably exceeded that of the guns. It must be remembered, at the same time, that the proportion of powder in the gun cartridges bore no analogy to the quantity of gun cotton detonated. The result of the trials was, however, considered so satisfactory that a parabolic reflector is being constructed, in which it is intended to explode pieces of gun cotton.

Evergreens in Orchards.

A correspondent says that the theory of planting evergreens among fruit trees, for protection, mentioned in our Special Edition, recently issued, is wrong.

They impoverish the ground, occupy space, and shade the fruit trees. Fruit from shaded trees is always inferior in quality. To produce a fruit bud, the sun must thicken the sap to a glutinous liquid. Without the rays of the sun, buds will form only to produce leaves. The most perfect fruit is found on the outside of a tree; and therefore, to give light, the pomologist trims and thins out the branches. This explains why wall trees produce such uniformly large and excellent fruit.

A belt of evergreens around an orchard may be beneficial, not because of the heat that is supposed to emanate from them, but because they break the winds and still the air as sweeping winds often dry up the vital sap of both evergreen and deciduous trees.

Alternate heating and freezing are destructive to vegetable as well as to animal life; because the heat starts the sap, and the frost freezes it. The freezing swells the sap, and lifts the bark from the wood, the channels of circulation are strained and destroyed, and the part so affected dies. Well matured wood is not apt to suffer from cold. To save tender trees, let them finish their season's growth before cold weather; and to hasten maturity, give a dry bottom and light and air in abundance.

Some evergreens supposed to be tender (the rhododendron, for instance) will survive the winter better on the north side of a building, unprotected, than on the south of the same protected and sheltered from the rays of the sun.

A Cure For Diphtheria.

A correspondent says: "Take a flat iron and heat it a little on the stove; on this apply a very little pitch (not gas) tar; have the iron hot enough to make a good smoke. Then let the patient take into his mouth the small end of a funnel, and have the smoke blown through the funnel into his mouth. Let the smoke be inhaled well into the throat for few minutes five or six times a day. In very bad cases, it might be well to use it oftener. After this, let the patient lie on his back then break up small pieces of ice and put them into his mouth, and let them go as far down to the roots of the tongue as possible. When they have dissolved, put in some more; this will keep down the inflammation."

PRACTICAL MECHANISM.

NUMBER XVI.

BY JOSHUA ROSE.

MOVEMENTS OF PISTON AND CRANK.

Let us now see how the steam in the front end, whose admission in the cylinder is shown in table No. 1, is exhausted. We find in that table that, at 11¾ inches of the stroke, the expansion ends, and the valve, ceasing to be a steam port, becomes an exhaust port.

TABLE NO. 4.

Piston moved inches	Exhaust port open inch
11 7-8	1-16
12	3-8
Piston returned	
1-4	11-16
1-2	full
8 1-4	full
9	11-16
9 3-4	9-16
11	1-4
11 5-8	exhaust port closed
12	port again taking steam

The exhaust for the other end of the cylinder, that is, for the back end (the admission of steam to which is shown in table No. 2), is as follows:

TABLE NO. 5.—BACK END.

Piston moved inches	Exhaust port open inch
11 7-8	1-8
12	3-8
Piston returned	
1-4	5-8
3-4	full
9 1-4	full
9 3-4	3-4
11	7-16
11 5-8	1-8
11 3-4	port closes
12	port again taking steam

Here we find that the average area of exhaust port opening (allowing the full opening of the port for the eight inches cr so of movement, during which the port was fully open, and which are therefore omitted, for brevity's sake, from the tables) is about ⅝ of an inch for the front and about $\frac{108}{160}$ for the back end of the cylinder. Referring again to the admission of steam to the cylinder, and comparing it to the exhaust, we find that the front end had the least opening of steam port, and the back stroke the most, so that the exhaust is the most at the end where it is required to be the least, and *vice versa.*

In order that the value of a small increase in the valve travel may be fully appreciated, we will now take the same engine and alter its eccentric sufficiently to increase the valve travel from 2½ inches to $2\frac{13}{16}$, first noting that the travel of a valve necessary to open both the steam ports full (and allowing that the valve movement were true) is twice the width of each steam port and its lap, or, in other words, the width of each steam port and the lap on each side of the valve added together.

TABLE NO. 6.—FRONT STROKE.

Piston moved inches	Port open inch	Piston moved inches	Port open inch
1	5-8	8	3 4 full
2	13-16	9	5-8
3	7-8	10	7-16
4	7-8	11	1-8
5	7-8	11 1-4	closed and expansion begins
6	7-8	11 13-16	expansion ends
7	7-8	12	exhaust open ¼ inch

TABLE NO. 7.—BACK STROKE.

Piston moved inches	Port open inch	Piston moved inches	Port open inch
1	13-16	8	3-4
2	7-8	9	1-2
3	7-8	10	1-4
4	7-8	10 7-8	closed and expansion begins
5	7-8	11 3-4	expansion ends
6	7-8	12	exhaust open ⅜ inch
7	7-8 bare		

Adding up the area of port opening at each inch of piston movement, and dividing the sum total by the number of inches in the stroke, which will give us in each case the average port area for the whole stroke, we shall find the average for the front end of the lesser valve travel to be ⅝ of an inch, and for the same end of the greater travel to be ¾ of an inch, the average for the back stroke of the lesser travel to be $\frac{94}{160}$, and for the greater to be ⅝.

A glance at the respective tables will also show the admission of steam to be much greater during the early part of the stroke, in the case of the increased valve travel, which is of great advantage. The quarter movements under the increased valve travel will be:

TABLE NO. 8.

Movement of crank	Piston movement	Average port opening
1st quarter	6 3-4 inches	$\frac{138}{160}$
2d "	5 1-4 "	$\frac{9}{16}$
3d "	5 1-4 "	$\frac{134}{160}$
4th "	6 3-4 "	$\frac{83}{160}$

From the above table we find that the increase of valve travel has been more serviceable to the fourth quarter movement than any other, leaving its opening still less than the other, it is true, but still largely increased: which is very important, because it is so much more proportionate to quarter movement No. 2, during which the piston is (as in movement No. 4) moving from full power to a dead center, and further because it is especially desirable that the average area of the port opening should be as large as possible for and during the quarters having the longest piston movement. We also find that the average port opening for quarter movement No. 3 has not been affected by the increase of valve travel; this again is decidedly beneficial, for it was, under the short valve travel, the greatest of all independent of its proportion to the piston movement, and the most disproportionate of all when considered in relation to the piston movement; but under the increased valve travel, it is not only not the greatest, but it is less (as is also its piston movement) than is the average port opening of quarter movement No. 1, the crank (during each quarter movement) having moved from a dead center into full power. These considerations convince us that not only has the increase of valve travel given us a better steam supply, but it has given us one more regular and proportionate to the piston and crank movements.

Now let us examine to what extent and in what way our increase of valve travel has influenced the ports as exhaust ports. Commencing, then, with the front stroke, that is, the port at the front end of the cylinder, which exhausts the steam admitted through the area treated of in table No. 1, we find as follows:

TABLE NO. 9.—FRONT STROKE EXHAUST.

Piston moved inches	Exhaust port opened inch
11 7-8	1-16
12	3-8
Piston returned	
1-4	11-16
1-2	full
9 1-4	full
9 3-4	3-4
10	5-8
11	5-16
11 13-16	exhaust port closed
12	port again taking steam

TABLE NO. 10.—BACK STROKE EXHAUST.

Piston moved inches	Exhaust port opened inch
11 7-8	1-8
12	3-8
Piston returned	
1-4	11-16
9-16	full
9 7-8	full
10 1-2	11-16
11	1-2
11 1-2	1-4
11 13-16	exhaust port closed
12	port again taking steam

Comparing the exhaust opening for the front stroke of both valve travels, we see that the increased travel has given us as free an exhaust in the early part of the exhaust, kept the exhaust port full open during 1 more inch of piston travel, given us a much more free exhaust during the latter part, and finally increased the average of exhaust opening from ⅝ to $\frac{114}{160}$. Comparing the exhaust opening for the back stroke of both valve travels, we find also that the greater travel has given us a greater exhaust opening in the early part of the exhaust, has kept the exhaust port full open during about 1¼ inches more of piston movement, and increased the average of exhaust opening from $\frac{108}{160}$ (which it was under the lesser valve travel) to $\frac{112}{160}$ under the increased travel. Hence our increased travel has been highly advantageous to the opening and keeping open of the ports, both as steam ports and as exhaust ports.

It is here proper to explain how it occurs that the increase of valve travel gives a greater proportionate increase of steam port opening for the early part of the front stroke than it does for the early part of the back stroke, and also a greater proportionate exhaust area during the latter part of the back stroke than during the latter part of the front stroke, the reason for which is that the increase in the travel of the valve (and hence in the throw of the eccentric) increases the lead of the valve; and the altering of the position of the eccentric to take away this increase of lead brings the eccentric into such a position that a line drawn from the center of its bore to the most distant part of its circumference, representing the throw of the eccentric, would be nearly true (if it were circular instead of straight) with the circumference of a circle described from the center of the bolt at the opposite end of the eccentric rod, as shown in Fig. 53, A being

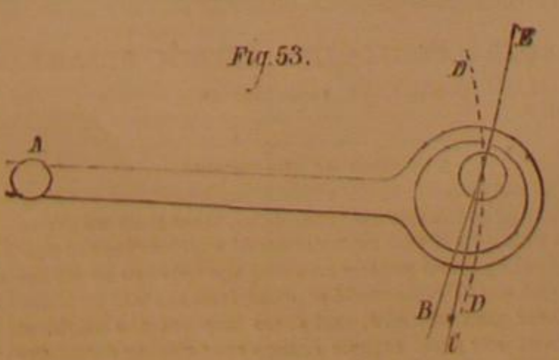


Fig. 53.

the joint of the slide valve spindle and eccentric rod end, B, the line representing the throw of the eccentric, and showing the position in which the eccentric requires to be set in the case of the lesser valve travel, C, a line representing the throw line of the eccentric as it is when the eccentric is made to suit the increased valve travel, and the dotted line, D, a circle struck from the center of A

It is apparent that the nearer the line representing the throw of the eccentric (that is, the line, B in Fig. 53) approaches in its main course to a line struck from the center of the eccentric rod end (D D, in Fig. 53), the less effect will an increase or decrease in the throw of the eccentric have in altering the position of the slide valve spindle (and hence of the valve) either backward or forward, at the time when the eccentric is in the position shown in Fig. 53. And, as the greater the increase in the throw of the eccentric the nearer will the throw line of the eccentric, when the latter is set, approach the line, D D, it follows that the less will the difference in the position of the spindle and rod joint (and hence of the valve) be when the eccentric is in the particular position shown. When, however, the crank has made one half of a revolution, and the throw line of the eccentric stands in the position denoted by the line, E, in Fig. 53, the least alteration in the length of the throw of the eccentric will have a great effect in altering the position of the joint, A, and hence of the slide valve, the effect being to bring the joint, A, nearer to the crank shaft in proportion to the increase, and to throw it farther back from the crank shaft in proportion to any decrease in the throw of the eccentric; which shows why an increase in the throw of the eccentric (or, in other words, of the travel of the valve) makes the difference in the port opening before referred to.

Preparation of Thallium from Soot of Sulphuric Acid Works.

BY FRANZ STOLBA.

In repeatedly working up the soot of two sulphuric acid works in Germany, where pyrites from Meggen were employed, a method was employed for separating the thallium, which depended upon a formation of a thallium alum. The soot is first passed through a coarse sieve to remove the pieces of brick, mortar, and clay mixed with it, and then boiled in water acidified with sulphuric acid. It is next placed on a suitable filter and stirred while carefully washed with hot water until all the acid is removed. The wash-water, after acidifying, can be used for boiling a second portion in, and so on. The first filtrate, which is tolerably concentrated, is evaporated in very shallow dishes to such a degree as to crystalize. Beautiful large reddish crystals of thallium-alumina-iron alum are formed as it cools. To the mother liquor was added some sulphate of alumina, and again evaporated, when a small quantity of mixed alums separated. The last mother liquor, as well as the rinsings from the crystals, when precipitated with crude hydro chloric acid, yielded a surprisingly small quantity of chloride of thallium.

The crystals of thallium-alum were recrystalized twice from water containing sulphuric acid. The alum thus obtained was so pure that it yielded pure thallium when acted upon by pure zinc and pure sulphuric acid, and with pure hydrochloric acid, pure chloride of thallium was precipitated.

The crude chloride of thallium may be prepared in the usual manner, and next converted into sulphate by means of sulphuric acid, and finally, by means of sulphate of alumina, into thallium alum, which can be purified by recrystalization. The first method is, however, more convenient, because it does not involve the troublesome decomposition of the chloride by means of sulphuric acid. As the thallium alum is considerably more soluble in hot than in cold water, the conversion of the much less soluble sulphate into the more soluble alum offers the great advantage that the latter can be recrystalized from a much smaller quantity of water, which is more convenient and requires less time. Beside this, the alum is a compound easily converted into the chloride or iodide, from which the metal is easily obtained.

Horse Car Bell Punches.

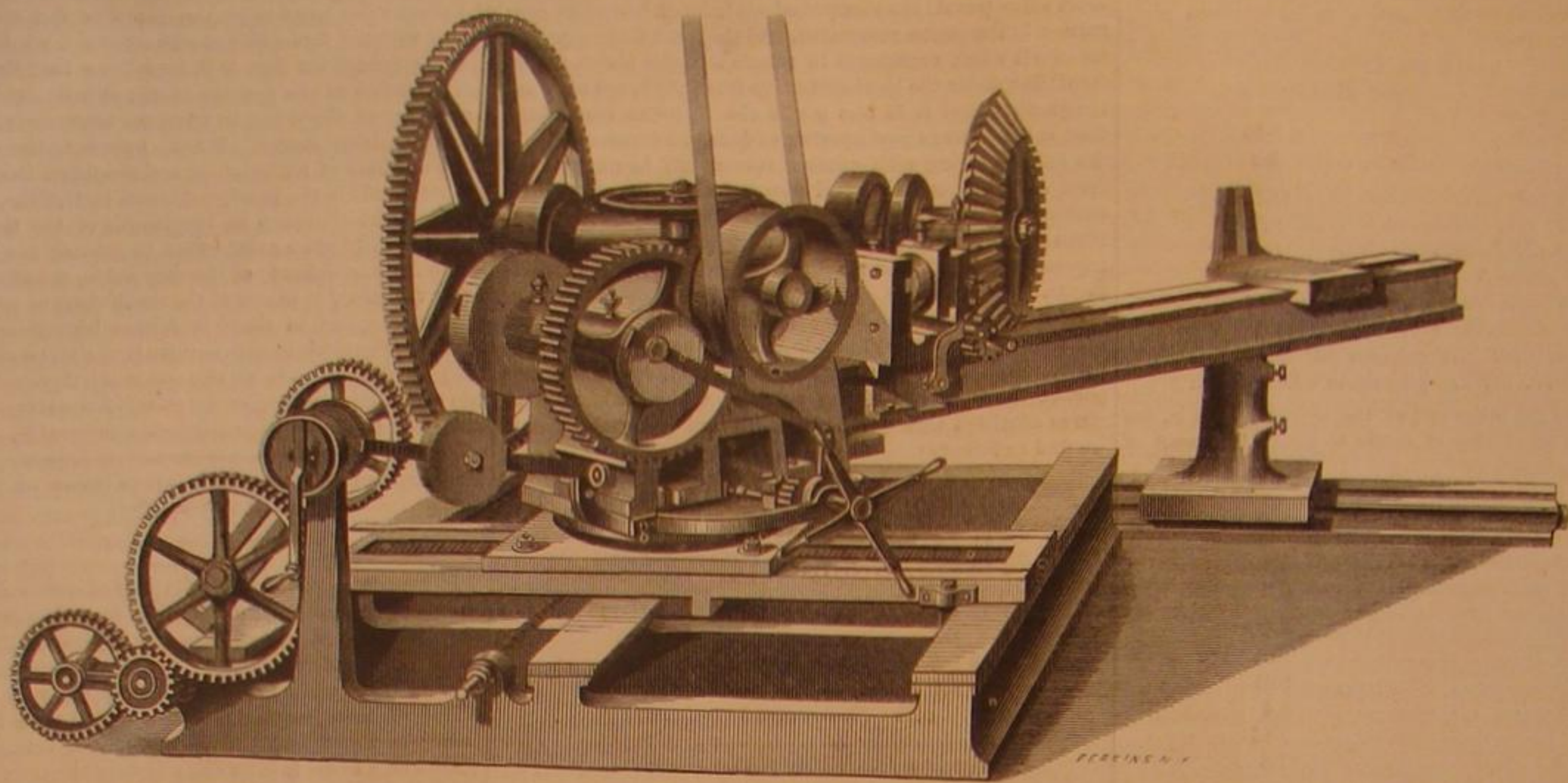
The Hartford *Post* states that the patent bell punches manufactured at Colt's armory are now very extensively used on horse car lines, especially in the large cities. There are about 1,500 in use in New York, 1,600 in Philadelphia, 400 in Boston, 200 in Chicago, 150 in Buffalo, 100 in Providence, 150 in Albany, and 200 in Troy. In London there are 1,600 in use, 1,200 in Dublin, and 150 in Liverpool. These punches are not sold to the companies, but are loaned to them at a fixed rate, and there are two punches for each car. The punch which is used to-day is turned into the office to be reset for tomorrow, and in the meantime the conductor employs the spare instrument. A general rule is that every conductor is compelled to deposit $100 with the company for the safe keeping and fair usage of the punches.

Cruelties of the Seal Fisheries.

Attention has been called at different times to the barbarous practices identified with seal fishing. At the breeding season, the unfortunate animals are swooped down upon in their ice-bound retreats, and both young and old indiscriminately slaughtered. The young seals yield but little oil, and their skins are comparatively valueless; and it is, therefore, from a commercial point of view, inexpedient to kill them, leaving sentiment altogether out of the question. We are glad to observe that there is a probability of an arrangement being ratified which will ensure for the seals a close time, and save them from the extermination which now threatens. The British Board of Trade is moving in the matter, and the opinions of those connected with the trade are being ascertained with a view to ultimate action. It is probable, says the *British Trade Journal*, that an international law, binding on the British, Norwegian, and Swedish Governments, will eventually be agreed on, which will prevent the subjects of those governments from fishing for a specified period of the year

CUTTING GEAR WHEELS.

The Chemnitz firm exhibited at the Vienna Exposition a gear wheel cutter, of which we herewith present an engraving, which clearly shows the construction. The cutting tool is moved on a bed placed diagonally, and supported at the end by a movable rest. As the cut can be varied to any angle, wheels of any dimensions or bevel can be made by this machine; and an ordinary planing tool can be used, turning out gear work of the highest finish and accuracy. The machine is simple in construction; and it seems to be a useful tool, capable of many applications which shop practice will, from time to time, suggest.



GEAR WHEEL CUTTING MACHINE.

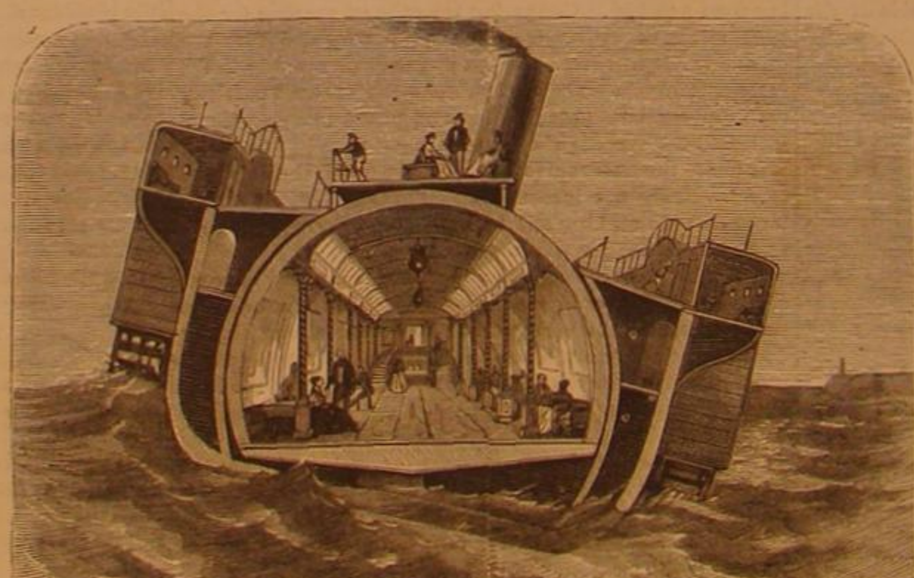
THE BESSEMER SALOON STEAMSHIP.

We illustrate herewith the interior of the steamer designed by Mr. Henry Bessemer, to defeat seasickness and give comfortable transit to persons in delicate health. Among her peculiarities are two pairs of paddle wheels and her freeboard of only 3 feet for 48 feet from each end. A sort of hurricane deck, 254 feet long, extends from bulwark to bulwark, 8 feet above the main deck. Her engines, nominally 750 horse, can work up to 4,600 horse power, which, it is calculated, will propel her at 18 or 20 miles an hour. The two paddle wheel shafts are 106 feet apart, and the swinging saloon, 70 feet long, is placed amidships between them.

Mr. Bessemer designed the apparatus for keeping the saloon perpendicular, an arrangement which possesses several original and ingenious features, which are fully described and illustrated on page 50 of our last issue. The new steamer is built from the designs of Mr. E. J. Reed, formerly Chief Constructor to the British navy.

If the inventor's hopes are realized, a very great stride in steamship accommodation will have been taken. As will be seen from our engraving, which represents a cross section of the vessel, the saloon is very commodiously and elegantly fitted up, and its great size will enable a large number of people to occupy it without suffering from the indescribable stuffiness and nausea inseparable from steamer cabins even of the largest usual dimensions; while for the great number of people to whom a sea breeze is the most enjoyable part of a voyage, the upper deck over the saloon will afford an agreeable promenade, as well protected from the effects of a rolling sea as the elegant apartment below.

The Bessemer started on a trial trip December 21, last. The day was foggy, and the trial was not completed; but the attempt was not altogether unsatisfactory, as it was found that, with a pressure of only 19 lbs., the engine making but 20 revolutions, a speed of over 16 miles an hour was made against a strong head wind. As it is intended to run her with 30 lbs. steam at 30 revolutions, a very good ultimate result may be expected. She answered her helm very readily, turning in a very small circle for a vessel of her length. Mr. Reed was well satisfied with her behavior, her fore deck being seldom covered with waves, in spite of her low freeboard. Another point was satisfactorily solved, namely the manner in which her two sets of paddlewheels worked together. The broken water from the forward pair of wheels was so slight in its action on the after pair that the two never varied more than one or two revolutions per minute from each other, thus showing a very small percentage of slip for the after pair of wheels. The vessel was constructed by Earle's Shipbuilding Company, of Hull, England; and further trial of her engines was in contemplation when our last advices left England.



BESSEMER'S OSCILLATING SALOON STEAMER.

A Scientific Inter-Collegiate Contest.

A college contest in oratory recently took place in this city, in which representative students of six institutions of learning participated. The exercises have excited much interest, and the successful competitors have been awarded substantial prizes. There is no question but that the public regards favorably these trials of intellectual strength among our students, and the effect of the same is naturally to awaken a broader taste for education, and desire for its advancement throughout the country. Why, however, should these competitors be confined to the classical and literary departments of the colleges? Let us have a scientific inter-collegiate contest also. There is the Sheffield school, the Worcester Institute, the Columbia School of Mines, the Stevens Institute, the scientific departments of Union, Cornell, Lehigh University, and of a multitude of other colleges, all of which could furnish contestants. Cannot Professor Draper, or Henry, or any of our foremost scientists, suggest subjects for essays, and will not some of our wealthy citizens who are directly interested in scientific progress join in offering prizes for the best original investigation to be made by any student in any department of science? The essays could be read and passed upon by a competent board of judges, and the researches could be described and fully illustrated or repeated, if possible, by apparatus in presence of the audience.

The End of the World.

If the body's death seems to teach the lesson that modesty is becoming to the scientific speculator, what shall we say as to the prospects of that material frame which is beyond ourselves—the general orderly frame of the universe as we see it around us? People would suppose, from the way in which you hear men talk now, that there was not the slightest chance of any great organic change ever coming across the outward world in which we live. No doubt God works by fixed laws. No doubt the world goes on morning and evening, and summer and winter; but what reason have you to suppose that it will so go on to infinity? Have no great catastrophes befallen the world before now? Does not physical science itself speak of these catastrophes? What is there to prevent other catastrophes, produced by the operation of laws of which at present we are very ignorant, coming athwart the globe on which we live, and a complete change taking place in the relations in which things even in the outward world stand at present, so that in the scriptural sense of the word there may be an end to the world, as there is certainly to be an end of our earthly life? To be sure, things have gone on for a long time in the same way, but is that any proof that they are to go on in the same way for ever? You arise morning after morning in good health and strength, and seem to say to yourself for a time that this will last for ever; but one morning something happens, you cannot explain what; the best physician in the world cannot tell you what; but something has happened that lays you on a bed of sickness, and in two days sends you off to your grave a corpse. Will the experience of the reality of the way in which everything has gone on since you were young, till you have attained maturity, save you from that great mischance? Again, men for centuries had ranged over the mountains in Campagna; they thought that all would go on there, herds and flocks feeding and vineyards growing as they had done for centuries; and suddenly there was a strange sound heard, and a volcano burst forth, and the greatest philosopher of the age came to look at it, and lost his life while he was looking. But neither he nor any of the men who had speculated with him ever expected that these great cities were to be swept to destruction, and their beautiful pastures to become for a time an arid wilderness. I do not say such instances explain or tell us distinctly that such catastrophes will befal the whole globe; but at all events, I think they ought to make us modest, seeing that the wisest know so very small a portion of the laws that regulate God's creation. Surely we may not dogmatically assume that such catastrophes are beyond the range of possible or probable events. It is true, I say, things have gone on for a long time, and men say: "Where is the promise of His coming, for all things continue as they were from the beginning of the world?" But still with Him, with whom one day is as a thousand years, and a thousand years as one day, there may be changes maturing which no philosopher of the present or of any previous age has ever dreamed of, which will bring this great catastrophe to the globe, which will answer, on the whole outward creation, to something as great as is our passage from life to death, and what is beyond it. I do not think there is anything fanciful in such an expectation. I believe that a man, of that modest mind which is the characteristic of true science, will hesitate before he pronounces with any assurance that such a change may not come over the world as has been distinctly predicted in the Scriptures.—*Dr. Tait, Archbishop of Canterbury*

Protective Power of Clothes.

Clothes protect the body, not by keeping out cold, but by keeping heat in, or more correctly, by allowing through their interstices such ventilation that the nervous system may not be sensible to extremes in changes of temperature. If the first mentioned effect were produced by garments, then the material which is the most impervious to air would be the warmest. A kid glove, for example, would keep the hands more comfortable than thick woolen mittens. Just the reverse, as is well known, is the case.

Dr. Pettenkofer states that equal surfaces of various materials are permeated by air as follows, flannel being taken as 100: Linen of medium fineness 58, silk 40, buckskin 58, tanned leather 1, chamois leather 51.

HIGHLAND AND LOWLAND CATTLE.

Two distinct varieties of neat cattle are indigenous to Scotland; and all breeders are familiar with the races, which, either pure bred or modified by cross-breeding, are to be found in all countries.

The lowland cattle are celebrated milkers, and the well known Ayrshire cow is probably a derivative from this stock. The beauty of this race, when thoroughly domesticated, is well known; and their value to the farmer and the dairyman is highly appreciated in this country, where also their graceful, sleek, good-conditioned appearance adds an ornament to our yards and pastures.

The mountain oxen (or kyloes, as called by the Scotch agriculturists) are generally black, red, or brindled in color; and from the earliest times they have been used to roaming the forests and the hills, holding no connection with tame cattle, and concealing their calves in fens and underwood. Their self-color (free from variegation, an infallible sign of domestication and servitude) still testifies to the purity and antiquity of the race. The animals are by no means large specimens of their genus, but their meat is excellent, and a large portion of the London supply is drawn from the neighborhood of Aberdeen, in Scotland.

We illustrate both these breeds of cattle, the drawings being from the pencil of Mr. Harrison Weir, an English artist and naturalist, whose vivid and accurate pictures of animals are widely celebrated.

Many interesting anecdotes of the sagacity and intelligence of cattle have been related, among which are the following (selected from *The Leisure Hour*, from which we extract the engravings)

A cow once had an aversion to a certain milkmaid in a dairy. If ever she dared to attend, Colly would stand patiently till the process was finished, and then turn round and kick over the full pail with a movement too agile, albeit premeditated, to be forestalled. Another cow held herself the queen of her herd, and would never leave the field unless she went first; so obstinate was she in this matter that, if any or all of the other cows left first, she would refuse to move unless the dairymaid drove the whole of them back again into the field, when, with a graceful bow of the head, she would condescendingly take precedence and march home, the other ladies of her kind meekly following.

There was one cow which was very much attached to a little lass of some eight summers. This cow grazed in a large field with many others. When the child entered, if at the farther side, the cow would at once perceive her, and run to meet her, lowering its head with its formidable horns, in a manner which would have been frightening to a stranger. The little girl would hold out her dimpled arms and run as eagerly to meet her old friend in a warm embrace. It was a pretty sight to see the child's arms round the cow's great neck, while she kissed its brindled coat, and the gentle animal licked with its rough tongue the bairn's golden curls.

On Saturday evening, just after a heavy rainstorm (in Manor Township, Pa.), little Henry Goff was saved from a grave by a cow which he was driving home. A number of cows were pasturing on the farm of Thomas Seachrist, in Manor Township, and had crossed a small run which passed through the premises. The boy, who is very young, was sent for the cows, and he had to cross the run, which was very much swollen, on a small foot bridge. Two of the cows proceeded along quietly and passed through the run, but the third would not cross it, notwithstanding the little boy urged her on determinedly. Seeing that she refused to go across, the boy thought he would eave her where she was, and drive the other cows to the barn. He stepped upon the frail bridge; and just as he was near the middle, the structure snapped asunder, and precipitated him into the swiftly flowing waters below. The cow seemed to comprehend that the boy was in danger of being drowned, for she instantly plunged into the stream below the bridge; and as the little chap floated up to her, she appeared to wait for him, an advantage he was not slow to take. He clasped her round the neck, and was drawn hastily to shore, terribly frightened, but not much the worse off bodily by his experience.

LOWLAND CATTLE.

HIGHLAND CATTLE

Anointing with Cocoa Butter for Scarlet Fever.

Upon the recommendation of Schneeman, the anointing of the body with fat has been extensively practiced in Germany during the past ten years, with the view of lowering the temperature and hastening the desquamation. Dr. Bayles suggests, in this connection, the employment of cocoa butter, as producing a more cooling and refreshing effect upon the patient, and emitting a more agreeable odor in the sick chamber. This agent, on account of its solid consistence, is more readily applied than either fat or oil, and is more easily absorbed by the skin. Furthermore, it is thought to afford the system a certain amount of nourishment.

In severe fevers, the entire surface of the body should be rubbed with this substance every hour, or at least once every four hours. Its application is also recommended in typhoid fever, in cases where the patients manifest a dread of water, or where the application of water is impossible; likewise in other inflammatory diseases, especially the severer forms of inflammatory rheumatism and tuberculosis.—*Herald of Health.*

[Some years ago an acquaintance of ours had several children very sick with scarlet fever. After their recovery he communicated his recipe, which was published at the time in this paper; he had kept his little patients well anointed with the rind of smoked hams. He believed his treatment to have saved his children; and we remember to have received at the time a number of letters from persons who had practised the method after our publication, commending the ham remedy as important to the community.—EDS.

The Bottom of the Sea.

Among scientific puzzles is one which has long perplexed geologists, namely, the existence of large areas of rock containing no sign of life, side by side with formations of the same period which are full of fossils—relics of primeval life. Why should one be so barren, and the other so prolific? There is now an answer to this important question, and readers who take interest in the exploring voyage of the Challenger will be glad to learn that the answer comes from that ship, in a paper written by Dr. Wyville Thomson, chief of the scientific staff on board. This paper was read last month at a meeting of the Royal Society. It contains the results of deep sea soundings which have revealed the existence of vast areas of barren clay at the bottom of the sea, in depths varying from two thousand two hundred to four thousand fathoms and more. In other parts, the bottom is composed of the so-called *globigerina*, which live near the surface, and sink to the bottom when dead. There they accumulate, building up chalk for ages to come, when land and sea shall once more change places. But it is remarkable that, at the depth of two thousand two hundred fathoms, the *globigerina* thin off and disappear, and the gray deposit merges into the barren clay above mentioned. The explanation is that, below two thousand fathoms, the tiny shells of the *globigerina* are dissolved by some action of the water, and that the minute quantity which they contain of alumina and iron goes to form the areas of barren clay. The extent of these areas is so great that it exceeds all others as yet known at the bottom of the sea, and it is the most devoid of life. In this respect, the red clay now forming resembles the schist which at present occupies so large a part of our earth's surface.

We are all more or less familiar with chalk and with rocks that show no sign of fossils; and to be thus, so to speak, made eye witnesses of the process by which chalk and rock were formed is unusually interesting. An eminent naturalist declares that this paper alone is worth all the cost of the Challenger expedition.—*Chambers' Journal*

(Translated from the Official Reports upon the Exposition.)

THE VEGETABLE FIBERS AT THE UNIVERSAL EXPOSITION VIENNA.

BY PROFESSOR DR. JULIUS WIESNER.

Number II.

In the English colonial exhibit, furthermore, there were displayed two East Indian fibers, up to the present time quite unknown to European commerce. We refer to the *yercum* fiber and the *jetee* fiber, which, so far as tenacity is concerned, throw all the vegetable textile fibers with which we are acquainted into the shade. The first is the fibrous bark of *calotropis gigantea*, and the latter that of *Marsdenia tenacissima*. A comparative estimate of strength is afforded by the following example: A jute cord of given size will support, say 140 lbs., while a cord of *jetee* fiber of the same diameter will support a weight of 248 lbs., the ratio of strength being very nearly as one to two. For the manufacture of ropes and cordage needing great tenacity, the above named fibers are therefore deserving of high recommendation.

The fiber *sunn*, finally, is worthy of some attention on the part of our hemp and coarse flax manufacturers. This is a very strong fibrous material obtained for many years in India from the *crotalaria juncea*, extensively cultivated in India, Java, and Borneo. Since its first introduction to European manufacturers, which occurred at the Paris Exposition in 1867, the *sunn* has been to some extent employed in England. The appearance of this material is not very prepossessing, the commercial product resembling tow more than anything else. This is, however, to be attributed to the method of its preparation. By the employment of a more complete mode of separation, the fiber could be much improved in fineness and homogeneity. Strength and great ability to withstand alternations of wet and dry are its chief characteristics.

In one qualification—namely, its want of hygroscopic properties—the *sunn* surpasses every known fiber; and whereas the last named raw materials are able to absorb from 16 to 22 per cent of moisture from the air (and some are known that take up as much as 40 to 50 per cent by weight of moisture when exposed to a damp atmosphere), the *sunn*, under ordinary circumstances, contains only 5 to 6 per cent of water, and can absorb, from an atmosphere charged with moisture, only 10 to 11 per cent. As these raw products are sold by weight, and no account is taken of the weight of moisture absorbed therein, this property of the *sunn* is worthy of consideration.

The colonial exhibits were likewise rich in their display of manilla hemp and cocoanut fiber; to these, however, it is unnecessary to do more than simply refer, inasmuch as our manufacturers are already sufficiently familiar with their qualities. The material called *pite*, the fiber of certain *agavæ*, has been introduced in Vienna within the past few years under the name of *fibris*, and so largely employed, in the manufacture of brushes and the like, that it may be of interest to name the countries that make exhibits of the raw material. These are: Martinique (*agave Mexicana*) Guadeloupe (*a. Americana* and *a. faltida*), Guiana, Brazil, Venezuela (the exhibit of this country, called *cocuisa* fiber is closely allied to the *pite*; it is the product of *Fourcroya gigantea*), India, Mauritius, Réunion, Algeria and others. Central and South America, however, are the chief producers of this fiber. The *piassava* of Brazil, with which we are already familiar, was likewise well represented at the Exposition.

Before passing over to the consideration of the vegetable silk and wool, and of the vegetable horsehair displayed at this exhibition, it will be well to enumerate some of those vegetable textile materials, thus far entirely unknown to commerce, but which are largely utilized in their native countries, and may in time play an important *rolé* in our textile industries. In this enumeration belongs the bark fiber of numerous species of hibiscus (*h. cannabinus, tiliaceus, sabdariffa*, etc., found and utilized chiefly in India); the genuine *aloes* and *ananas* fibers; and the *vacoa orracoua*, consisting of the leaf fibers of the pandanus, and produced chiefly in Réunion, Mauritius, and the French colonies.

The so-called vegetable silk, the seed tufts of numerous *asclepiadaceæ* and *apocynaceæ*, were happily not so strongly represented as at the recent Paris Exposition. At that time the French colonies presented such a quantity and variety of these products that one was tempted to regard them as wares of much importance.

In spite, however, of the beauty and eminent luster of these silks of the vegetable world, their technical value is very small. The fiber is both weak and brittle, and therefore poorly adapted for woven fabrics. And unfortunately these are the varieties that might be placed in the market in unlimited quantities: the seed tufts, for example, of *asclepias gigantea* and *curassavica*, that are least valuable for industrial purposes. In this connection, the seed tufts of *Beaumontea* (East Indies) appear not to have received the attention that the material deserves, inasmuch as its comparatively greater strength would appear to render it more adaptable for utilization than those previously named.

The vegetable silk appears to be far better adapted for the manufacture of artificial flowers and similar artistic work—in which direction it has been considerably employed—than for textile uses. It has likewise been suggested as a substitute for down in filling bolsters, pillows, and the like; but for this use, the brittleness of the fiber will be likely to prove a serious objection. The samples of this product at the Exposition were almost exclusively from the French colonies; and in the published catalogue of their exhibits its merits were placed in the most flattering light.

More modest in its pretentions was the vegetable wool. It was nowhere exhibited save as an article shown in practice to be an excellent substitute for mattrass filling. This fine material consists of the seed tufts of several trees of the family *bombaceæ*. Of these raw materials we noticed the following varieties on exhibition: *paina limpa*, from Brazil (seed tufts of *bombax heptaphyllum* and *b. ceiba*); the *kabok*, from the Dutch colonies (obtained from *eriodendron anfractuosum*); the *Edrédon végétale*, from the West Indian French colonies, called also *patte de lièvre* (from *Ochroma lagopus*); Venezuela exhibited, under the name of *laine végétale*, the wool of both *O. lagopus* and *B. cumanensis*. The wool of *O. lagopus* is brown, while that of the several bombax species is white, or only slightly colored. All of the vegetable wools above enumerated consist of a delicate, not brittle fiber, which forms when in bulk a soft, elastic mass, well adapted for the purpose to which it is applied (see above).

In Holland, the *kapok* is very largely introduced; and in Germany, likewise, the wooly product of *eriodendron anfractuosum*, under the name of vegetable down, has recently been introduced. The statement, occasionally met with in books, that these vegetable wools, either alone or in mixture with cotton, could be satisfactorily made into woven fabrics—upon which point, I have on a former occasion expressed my doubts on account of the weakness of the fibers—appears to be quite erroneous; at all events, no such goods were at the Exposition, nor were any of the exhibitors aware that this result had ever been accomplished; in addition to which, all the exhibits were entered as bedding materials.

In addition to the above, a number of coarse vegetable fibers, generally characterized as vegetable horsehair (*crin végétale*), are deserving of notice. The desirability of securing a cheap substitute for the expensive horsehair, which should possess similar properties, and resemble it closely enough to be mistaken for it on cursory observation, has long been felt in several important branches of industry. In Austria and Germany, the leaves of *carex brizöides*, brought into the market from Upper Austria and certain quarters of the Grand Duchy of Baden, is used in enormous quantities as a substitute for horsehair. The material in question is but slightly elastic and not very durable, and affords only an indifferently good substitute.

The *crin d'Afrique* (called also *crin Aversing*) of the French, the split leaves of the dwarf palm (*chamærops humilis*), is a far superior article for this purpose, and it is now being imported into Europe from Algeria in large quantities. The same material has lately been brought into the Vienna market for bedding, and colored black (the natural color of the product is green); it is known by the name of Afrik, and is employed for a great variety of uses. The introduction of the *crin d'afrique* has unquestionably been of great utility to numerous industries. Despite its excellent qualities, however, the leaf of the dwarf palm is by no means the best substitute for horsehair with which we are acquainted. Of far greater value for this purpose, inasmuch as they possess the properties of horsehair to a much higher degree, are to be mentioned the three fibers *ejoo, pitool*, and *caragate*. The *ejoo* fiber, called also *gomuti* fiber, is the product of a very common sugar palm of India (*arenga saccharifera*), and occurs in the form of a black horsehair-like mass, growing on the stems where the leaves have been attached. This fiber remains behind when the leaves fall off. The black fiber *kitool* has a similar origin. It is derived from the palm species, *caryota mitis* (Réunion) and *c. urens* (India, Ceylon). The best substitute for horsehair, however, is without question the fiber *caragate*, called also tree hair. This fiber is a portion of the aerial roots of a parasitic plant (*bromelinceæ*) infesting certain trees, and occurring in Tropical America. It attains a length of 8 or 9 inches, and in appearance, elasticity and tenacity approaches so closely to the genuine horsehair that an ordinary observer will scarcely be able to distinguish the difference. By burning one of the fibers, however, its vegetable character may be readily established by the absence of the characteristic odor of burning horn, which accompanies the combustion of horsehair and similar animal matters. The following very essential difference between the two materials, which is observable upon close inspection, will serve to distinguish them apart quite readily: The horsehair consists of one single fiber throughout its length, while the *caragate* consists of a succession of branched fibers. At the present time Guiana is perhaps the most important producer of this valuable material, and the only objectionable feature incident to its introduction is found in the fact that dealers employing it cannot resist the temptation of representing their goods as being made of the genuine article.

The coarse fibers were represented at the Exposition by the *esparto* fiber, and another obtained from Spanish cane, by mechanical disintegration. Ropes, cords, etc., made from the last named material, were amongst the novelties of the Exposition, having been exhibited for the first time. Ropes, and the like of the *esparto* formed one of the features of the Paris Exposition of 1867, and their reappearance at Vienna demands no special notice in this report.

Permanence of Vital Power.

In clearing away the refuse from the ancient silver mines of Laurium, in Greece, a large number of seeds of a papaveracea of the *glaucium* genus were found, which must have been buried there for at least fifteen hundred years. Exposed to the beneficent influence of the sun's rays, they rapidly took root, flourished, budded, and blossomed, their yellow corollas being beautiful in the extreme. This interesting flower, unknown to modern science, is particularly and frequently described in the writings of Pliny and Dioscorides, and is thus again resuscitated, after having disappeared from the surface of the globe for more than fifteen centuries.

Nature of Nerve Force.

In one of Jean Paul Richter's novels—if our memory serves us rightly, in that one called *Der Comet*—the hero is said to have had, when a boy, a peculiar light visible around his head when in a darkened room, something like the aureole or nimbus with which the old painters used to represent divine or saintly personages. Richter, who in such matters faithfully followed the extraordinary in Nature, gives, as his wont is, various references to medical works wherein such a phenomenon is mentioned. There is indeed no question of the correctness of such observations. But the explanation of the phenomena has been insufficient.

Dr. Brown-Séquard, in a recent lecture, quotes an analogous phenomenon. He remarks that there are animals which are phosphorescent, and which are so under an act of their wills, so far as we can judge, and under the influence of the nervous system; so that light also can be evolved as a transformation of nervous force. There are cases of consumption in which light has come from the lungs. The fact has been pointed out by Sir Henry Marsh and other physicians. The light appears not only at the head of the patient, but it may be radiated in the room. It has been considered that the light was only a peculiar effect of the mucus that came from the lungs of the patient. Dr. Brown-Séquard continues: —"It is not likely that this is the case, because mucus in greater quantity is evolved, and all sorts of mucus, from the chests of the people, every day, without any such phenomenon. I have read the history of each individual case of the kind, so far as I have been able to get it, and in every one of the cases, the patient, I find, was in a terrible state of nervousness."

If this were shown beyond a peradventure, our theories of nerve force would undergo material alterations, as it would at once come into the category of the *forms of motion*, and be seen to be a correlate of light, heat, etc. To this investigation seems tending, but no one can aver that it has been proven.—*Medical and Surgical Reporter.*

DECISIONS OF THE COURTS.

United States Circuit Court.--Eastern District of Pennsylvania.

PATENT LOCOMOTIVE TRUCK.—THE LOCOMOTIVE ENGINE SAFETY TRUCK COMPANY *vs.* THE PENNSYLVANIA RAILROAD COMPANY.

The patent in suit (patent of Alba F. Smith, February 11, 1862) was for the pilot truck of a locomotive engine, resting on a bolster, and connected with it by a king bolt, on which it oscillated; the bolster being suspended from the truck frame by links diverging outwardly, so that when the engine moved laterally in passing a curve it was raised on that side, and its weight tended to bring it back to its normal position.

This arrangement was found to have been previously in use upon railroad cars; but in applying it to the pilot truck of an engine, the operation and effect of it were held to be essentially different and useful, and the patent was sustained.

It appeared that a pilot truck had been previously patented in which the engine rested upon, and was bolted to, a curved block, which moved on either side in a curved slot in the truck frame, so that the engine would oscillate around a point in rear of the truck, which was the center of the curves. Either the king bolt or the curved block might be made to rest on inclined planes, so that a lateral movement would raise the engine, and it would tend to settle back. Though these devices were regarded as the equivalents of those described in the plaintiff's patent, it was nevertheless held valid, because the previous patent made no provision for the oscillation of the engine on the king bolt.

Imperfect and crude descriptions of an invention imparted to others are no evidence of an intention to abandon it.

Neither is the use of an invention for the purposes of experiment, though made in public from necessity.

Neither does such use debar from a patent, although it takes place more than two years before the application.

In closing the case, Judge Strong says:

My conclusions, then, upon the whole case, are as follows:

1. The combination claimed by Alba F. Smith, and described in his specification, was a patentable invention.

2. The patent granted to him on the 11th day of February, 1862, is not void for want of novelty of the invention. The invention had not been anticipated.

3. There is no sufficient evidence that the patentee abandoned the invention.

4. The patent is not invalid because the invention was in public use, or on sale, with the allowance of the inventor, more than two years before his application for the patent.

The only question that remains is whether the defendants have been guilty of infringement. In regard to this there is no controversy. An infringe- is very clearly proved. I shall, therefore, order the injunction prayed for in the bill, and decree an account, etc.

Let a decree be prepared accordingly.

[*Charles M. Keller* and *Charles F. Blake*, for complainants.
J. H. B. Latrobe and *Chapman B ddle*, for respondents.]

United States Circuit Court.---Southern District of Ohio.

[October Term, A. D. 1873.—Rehearing October Term, A. D. 1874.]

PATENT BAKING OVEN.—HOSEA BALL *vs.* GEORGE K. WITHINGTON AND O. M. LANGDON.—SAME *vs.* JOHN BAILIE.

EMMONS AND SWING, *J. J.*:

OPINION OF THE COURT.

EMMONS, *J.*:

The bills charge infringement of letters patent granted to complainant September 23, 1856, for an "Improvement in Ovens," reissued October 12, 1869, and, a second time, June 14, 1870, and extended for seven years from September 23, 1870.

By agreement of counsel, both cases were argued together, and the decision to be delivered governs both.

The reissued patent, upon which the bills are founded, contains three claims, but the first, which is as follows, is the only one in controversy:

1. One or more swinging bread holders, suspended from the arms or end plates of a rotating reel, in combination with a furnace so arranged and connected that the products of combustion will pass into or through the chamber within which the bread holders move.

We prefer to rest this judgment solely upon the ground that the original patent did not warrant that part of the claim, in the reissue, which includes the direct application of heat to the bread chamber. We say the direct application of heat, because we thus construe the words "products of combustion."

The only significance which we can give to that part of the claim is that the rays of heat from the fire must be radiated directly into the baking chamber.

The reissued patent, as we construe it, claims a device which will accomplish this result. The infringement is said to depend upon the fact that the defendants' apparatus applies the "products of combustion" directly to the baking chamber, and that, as the reissue claims this feature, there is an infringement. That it does so is entirely clear; all the "products of combustion" which ascend at all move upward and around the swinging bread-holders.

There is no proof, nor is there any suggestion from counsel, that there is any "product of combustion," heat excepted, which is efficacious in the baking of bread. Conceding—which we much doubt—that there are what may be called two principles in a legal sense in the application of heat to the baking of bread, we can draw the line between them only as follows:

The one, that used by the defendants, and which we suppose complainant's reissued patent to claim, radiates the heat directly from the fire into the chamber, with no intervening wall or medium, the air excepted, between them. The other heats the baking chamber by heating its external walls, or by carrying heated currents of air into it, but excluding all the direct rays of heat from the fire. The former mode greatly economizes fuel. The fire is in close juxtaposition to the baking bread, which is rotated in the chamber above the directly ascending and, therefore, greatest possible amount of heat which can be economized from a given amount of combustion. This mode defendants' device employs to the full. Turning to that of the complainant it completely excludes the employment of the principle, if principle it be. Not a single direct ray, radiated from the furnace, can enter the chamber. Its bottom is solid, and completely shuts off the fire of the furnace. The flues by the side of the bread chamber are so far removed and so cut off from the fire of the furnace that nothing but heated currents of air can pass into the former, through the apertures in the side walls. There is not only not a word in the original patent calculated to hint at the leading idea or principle employed by the defendant, but the drawings and model suggest a mode of operation wholly different. They rely upon heated walls and heated currents of air to bake the bread, and must have been contrived at a time when fuel was used, whose unconsumed gases and smoke were noxious, and which, therefore, had to be conveyed away without contact with the dough. So far from suggesting the defendants' device, or the unwarranted claim made in the reissue, had a baker been about to adopt the device of the defendants and believing that that of the complainant embodied the best application o heat, he would have abandoned his own in the belief that it was worthless. We do not think the case one where a beneficial idea has been appropriated by another in a different form.

The complainant delayed rather than hastened the direct application of heat employed by the defendants.

It may be said the claim necessarily uses the terms "product of combustion" in a sense other than that imputed to them by the court, as they were used in reference to a device in which the direct radiation of rays from the fire was impossible, necessarily they must have contemplated something else: what this something else is is not stated. The court is asked to presume there is some unknown "product of combustion" beside heat, which can be conveyed through the apertures in the side walls upon the bread.

It is argued, if the court will but imagine some such improved incident to combustion, then the original device embodied a mode in which it might be employed in baking, and thus it would lay the foundation for the claim made in the reissue. The answer is: We know of no such quality; all the product of combustive material in this process is the heat evolved, and, as the original patent provided no mode for its application, the subsequent claim for it is void.

Although our judgment goes upon another ground, and we have not, therefore, fully considered whether the patent for this combination is void because no invention is involved in making it, still such is our strong impression. We apprehend the new mode, which dispenses with smoke flues and separating walls surrounding the baking chamber, depends far more upon the modern use of fuel, which can, without injury, be consumed directly beneath the dough, than in any discovery on the part of the complainant or any one else in the application or law of a new principle of heat to baking. But, however this may be, previous patents had, in express terms, pointed out the mode and claimed as a benefit the direct application of heat to a baking chamber. The attention of those engaged in this department of industry had been directly challenged to this subject, and, what we deem somewhat material upon the mere question of invention, they had combined a furnace and chamber for the direct application of heat with an endless chain or apparatus for moving the bread over the fire. The reel is an old and familiar device. We should feel that we were carrying the doctrine which protects slight inventions to the last limit, if we were to hold the combination of the reel and furnace in this case involved invention. We have no disposition to deprive this species of property of its due protection. When a meritorious invention is presented, every disposition is felt to protect it from spoliation by the employment of other devices, where it is apparent the idea of the complainant has been employed. We decide this case against the complainant because convinced that not only had the patentee no notion whatever that he had included in his device what is claimed in the reissue, but because neither the patent, specification, nor model would have suggested it to any one else.

The bill will be dismissed with costs.

[*S. S. Fisher* and *John E. Hatch*, for complainant.
Edward Boyd, for defendants.]

NEW BOOKS AND PUBLICATIONS.

MANUAL OF DETERMINATIVE MINERALOGY, WITH AN INTRODUCTION ON BLOWPIPE ANALYSIS. By George J. Brush, Professor of Mineralogy in the Sheffield Scientific School. Price $3. New York city: John Wiley & Son, 15 Astor Place.

Professor Brush and Professor S. W. Johnson have for many years had control of one of the most important of our technical schools; and the Sheffield students are well grounded in the methods described in this volume, the greater part of which was compiled, some time ago, especially for their use. It is a work of the greatest practical value, and the classification is very exact and descriptive, and yet simple and clear. Although much has lately been written on the subject of blowpipe analysis, it is not probable that the branch of study is nearly exhausted; and Professor Brush's treatise carries it down to the latest date, exemplifying the processes with well executed illustrations. We recommend this work to the attention of the scientific world.

A NEW TREATISE ON THE ELEMENTS OF MECHANICS, ESTABLISHING Strict Precision in the Meaning of Mechanical Terms. Accompanied with an Appendix on Duodenal Arithmetic and Metrology. By John W. Nystrom, C. E. Philadelphia: Porter and Coates, 822 Chestnut street.

Mr. Nystrom has published a work which is likely to be of value to engineers and students of mechanical physics. It contains numerous problems in statics and dynamics, many of which are new to Science, and are solved with clearness and originality. Most of the solutions are illustrated by diagrams. The treatise is exhaustive, and contains the author's researches into the statical condition of the heavenly bodies. The appendix contains some remarkable speculation as to the use of systems of numeration with other bases than 10, such as the duodenal (base 12) and the sexidenal (base 16); but the disadvantage of making a change in a matter of such everyday usage is far greater than anything that can be gained by a more symmetrical method, especially when (as we recently showed in the case of the French meter) the supposed improvement is merely theoretical.

BOOK-KEEPING SIMPLIFIED: THE DOUBLE ENTRY SYSTEM BRIEFLY, Clearly, and Concisely Explained. By D. B. Waggener. Price $1 in cloth, 75 cents in boards. Philadelphia: D. B. Waggener & Co.

This is a neat and useful little work, written with clearness and illustrated with specimen pages of the various account books.

Inventions Patented in England by Americans.

[Compiled from the Commissioners of Patents' Journal.]

From December 19 to December 24, 1874, inclusive.

BOILER FURNACE.—W. C. Ford, Brooklyn, N. Y.
CAN.—F. D. Brodhead, Boston, Mass.
LIFE PRESERVING BULWARK.—R. W. Newbery, New York city.
NEEDLE.—H. M. Jenkins *et al*, New York city.
PUMP CYLINDER, ETC.—G. F. Blake, Boston, Mass.
SPRINGS.—R. Vose, New York city.
STEAM BOILER.—W. C. Ford, Brooklyn, N. Y.
SURGICAL NEEDLE.—H. M. Jenkins, New York city.
VAULT LIGHT COVER.—J. T. Foley *et al.*, New York city.

Recent American and Foreign Patents.

Improved Sulky Harrow.

David Salgeon, Wattsburg, Pa.—The harrow is made in three sections, each section being formed of three S-shaped parallel bars, connected by cross bars. The S-bars are secured to each other, at their points of intersection, by the shanks of the harrow teeth, which pass through holes in the said bars, and are secured in place by nuts screwed upon their upper ends. The nut of the central tooth of the next to the rear cross bars of each section is made with a loop, to which is secured a chain. The other ends of the three chains are so connected that all the sections may be controlled by a lever at the driver's seat. There are also devices whereby the point of draft attachment may be adjusted as required, and also whereby the sections are allowed to conform to irregularities in the ground.

Improved Range.

Edwin O. Brinckerhoff, New York city.—The invention consists in the combination of the circulation and exit flues in connection with an elevated boiler, to adapt it to be heated by the products of combustion as they pass from the range to the chimney; in the arrangement of the circulation and exit flues in connection with the elevated oven to adapt it to be heated by the products of combustion, as they pass from the range to the chimney; in the arrangement of the circulation and exit flues of the elevated ovens, in connection with each other, to enable the products of combustion to be conducted around both or either; in the arrangement of the base dampers, in connection with the base flues of the elevated boiler, to enable the direction of the products of combustion around the boiler and ovens to be controlled as desired; in the arrangement of the top dampers in connection with the exit flues to enable the direction of the products of combustion through said flues to be controlled as desired.

Improved Harvester.

George Foster, Clarksville, Neb.—The essential feature in this device consists in an arrangement of knives, fingers, and endless bands, whereby the grass, after being cut, is deposited at the inner side of the platform in the rear of the drive wheels, so as to be out of the way of the machine at its next round.

Improved Railroad Switch Signal.

Hiram Conrad, York, Pa.—This is a railroad signal consisting of one or more torpedoes, which are moved upon the rail by the switch mechanism.

Improved Grain Weighing Apparatus.

William N. Julian and Joseph H. Bussert, Tarlton, Ohio.—There is a platform for the bag to rest on, and a ring for holding the mouth of the bag. They are suspended from the short arm of a scale beam, so as to have a slight rising and falling motion, and the platform is jointed to the frame. By suitable construction, when the receiving hopper on the scale beam goes down, the spout will be closed, and when the weight goes down it will be opened, so that the grain may be continuously spouted into the hopper while the filled bags are removed and empty ones put on, and the beam is caused to work a rock lever by a rod and arm, to turn a system of registering disks.

Improved Safety Guard for Wagons and Carriages.

Thomas Joyce, New York city.—This is a metal frame secured to the axle near each hub, and suitably braced. Should the axle break or a wheel be crushed in, or otherwise break down, the guards will come in contact with the ground and slide along it, preventing the wagon body from dropping so low as to throw out those riding, and enabling the wagon to be drawn home or to the repair shop without trouble.

Improved Horse Hay Rake.

Joshua Evered, Hopewell, N. Y.—In this wheeled horse hay rake the pivoted wire teeth are elevated by a lifting bar. The teeth slide through the staples, and turn on a fixed rod, while the bar makes a quarter revolution around the axle as a center, until the driver disengages pawls and ratchets by reversing a lever, when the teeth and lifting bar resume their former position.

Improved Wheel for Vehicles.

William M. Hoffman, Topton, Pa.—A wedge-shaped and notched metallic key is applied to the end of the spoke at a point near the side facing a beveled cushioning block, and is forced into the spoke end on the driving in the spoke by resting on the iron axle box. When the spoke is set completely in the hub mortise a sufficient portion of the spoke end is carried sideways to lock or bind with the beveled block, so that a perfectly secure fastening of the spokes is produced, while at the same time, by the wooden cushioning side blocks, a certain degree of elasticity is obtained.

Improved Car Coupling.

John C. Sauserman and George W. Anthony, Newport, Pa.—The coupling link is formed in the shape of an arrow, with spear-shaped head and wider slotted rear part, that is coupled by a strong vertical pin, passing through perforations of the drawhead whenever it is desired that the link shall project far enough to couple with the adjoining drawhead. The retention of the link in this position is secured by means of its concaved rear end, which rests against a second lighter pin. The middle part of the link is acted upon by the rounded-off jaws of vertical lever frames, which are firmly pressed against the link by strong springs. The entering spear head of the link strikes against the jaws, forces them sideways till the head has passed the same, when they lock firmly on the link and couple the same.

Improved Press.

Benjamin J. Day, Evansville, Ind.—The follower has a couple of bars sliding forward and backward horizontally under the feeding hopper and in the press case. The bars have a toothed rack, with which the driving shaft gears. The said shaft is geared to the main driver in order to work the follower forward and quickly, to utilize it for a beater, and also to apply great force for compressing the beaten hay. There is a head to the case, constructed in sections to admit of fastening the hoops after the bale is pressed and before it is released. The said sections are hinged to the case, and provided with weighted catches to hold them closed, and to automatically fasten them. The invention also consists of a fork, which closes over the opening through which the hay is put into the pressing case when the pressing begins, to hold the loose hay with which the hopper may be filled during the pressing, until the follower goes back behind it. Comb bars are combined with the follower and the press case, to prevent the matters to be pressed from gathering between the follower and the top of the press case. Lastly, a straining device is combined with the block attached to the baling band and the press head.

Improved Cutter Head.

Benjamin Pearson and Horace W. Pearson, Newburyport, Mass.—This invention consists of a rotary cutter, in which two blades are arranged side by side, and separated by a disk of thin metal projecting from the face of other disks, all so contrived that the cutters may be used for cutting the gains in the end of the felly for the ferrule by which they are connected. The disk of thin metal between the cutters runs against the ends of the felly, to gage the cutters to the felly lengthwise, and the disks from which the cutters project serve to regulate the depth of the cut.

Improved Method of Forming Metal Seams.

Mort'mer M. Camp, New Haven, Conn.—This is a method of uniting or seaming the edges of a shell or pipe by means of a grooved flexible metal bar, the edges being inserted in the grooves, and the metal clamped or compressed thereon.

Improved Portable Cover for Vapor Bathing.

Frank Leslie, New York city.—This cover is a tube made of any suitable kind of flexible material, tapering from the base ůpward, and having a hoop at the ends to expand the tube to the proper diameter, and one or more intermediate hoops or bands to keep the cover expanded when in use, and allow it to collapse after the manner of a Chinese lantern, to enable it to be compressed and carried in a trunk or bag by travelers, and be used as occasion may require. The head of the bather is protruded through the aperture, and leather, serving as a collar, is drawn tightly around the neck. Straps set upon the shoulders of the bather, and serve to relieve the neck of the bather of the weight of the cover. The vapor is generated within the cover by means of a suitable apparatus.

Improved Egg Carrier.

Wendelin Weis, St. Paul, Minn.—This invention consists of securely interlocking strips, forming the cells for the eggs, in connection with a hinged and protecting top partition applied thereto. The hinged top part folds readily over the folded-up cell strips, so that not more space for return shipment is required than heretofore.

Sugar Cane Stubble Digger and Cultivator.

Henry Von Phul, Jr., and James Mallon, Holly Wood, La.—This is an improved stubble digger and cultivator, which can be readily adjusted to the width of rows, and to different depths. It consists of rotating disks, with pivoted curved prongs or teeth, being placed loosely on lateral shafts, which turn in suitable side bearings, being adjustable therewith in vertical direction on the supporting frame by crank-shaft, rack, and lever mechanism.

Improved Sulky Plow.

John A. Knoedler, Grant, Pa.—This is an arrangement of cranks whereby by operating a lever the driver can lower and raise the forward ends of the plow beams to cause the plows to work deeper or shallower in the ground, or to cause them to run out of the ground. By operating another lever, the plows may be raised from the ground, and held suspended while turning, and while passing from place to place.

Improved Wagon.

Jacob Becker, Jr., Seymour, Ind.—This invention relates to nove means whereby the rear wheels of a vehicle may be made to track with the front wheels while turning, as well as at other times, but yet they are not permitted to make too short and abrupt a turn.

Improved Strainer.

John Lipman and Martin Friedberg, Toledo, O.—This is a concave perforated, or reticulated, strainer, having a rim fitting closely to the interior circumference of the tumbler or other vessel, and fastening spring hooks for retaining the strainer firmly thereon. The device prevents the pieces of lemon or other substances from being carried into the mouth, and admits, therefore, the more convenient drinking of iced beverages.

Improved Attachment for Whiffletrees.

Richard Mansfield, New York city.—This improved mode of attaching whiffletrees is designed for street cars, in which the strain is mainly thrown on the staples or clevis connecting the whiffletrees to the draft eyes of the sway bar or car, so as to cause their rapid wearing out. It consists of a clevis attached by a cross bolt and nut to a recessed clip or band encircling the whiffletree or sway bar, to be connected by a detachable draft eye, attached by a screw nut through a square perforation of the socket bolt, to the ends of the whiffletree, or by a link to the car.

Improved Steam Cylinder Lubricator.

Joseph Kukelkorn, Brooklyn, N. Y.—This is an improved lubricator for steam cylinders, which consists in a reservoir with a central tubular stem, surrounded by a sleeve of the cover or top part. The sleeve is provided with an adjustable screw plug, having air channels for conveying a greater or smaller quantity of oil to the stem, or interrupting the supply of oil altogether. A grooved steam-acted valve and stationary bottom plug of the lubricator are provided, so that any required quantity may be fed in connection with the stroke of the piston.

Improved Wall Paper Striping Machine.

Jacob J. Janeway, New Brunswick, N. J.—This improved machine for striping paper hangings is so constructed as to enable the paper passing through the machine to be readily clamped and released without stopping the machine, and will heat and partially dry the middle part of the paper, so that the work may be done more rapidly, and so that the paper may dry evenly when hung upon the rack, thus adapting the machine to be run by power.

Improved Ice Receptacle for Corpse Preservers.

Friedrich Wesemann, Brooklyn, N. Y.—The ice receptacle is applied on ordinary corpse preservers by means of detachable supporting slide pieces and projecting lugs. The cover serves for the preserver and for the ice receptacle, being made in one piece, with a central smaller lid for inserting the ice into the ice box. As the cold air descends from the ice receptacle and settles on the corpse, it causes the rapid and complete cooling of the same along every part, and not at special parts only, keeping the body thereby in a perfect state of preservation.

Improved Windmill.

Thomas J. Ingels and Millard F. Ingels, Atchison, Kan.—In this invention a supplementary pivoted vane is so connected with the revolving wings or sails as to throw them out of the wind when the latter is too violent. There is an arrangement of parts, whereby a single-toothed bar connects with and operates devices for adjusting and regulating the position of the wings or sails.

Improved Water Closet Apparatus.

Archibald McGilchrist, New York city.—This is an improved water closet apparatus, so constructed as to render the use of a trap unnecessary, and at the same time to prevent any unpleasant odor from escaping through the pipe. It shuts off the water automatically and guards against an overflow, while allowing a sufficient amount of water to flow in after the valve has been closed. When a ball valve is raised, the contents of the basin and case will flow off through the sewer pipe. As the water lowers in the case, a float contained in a separate case sinks and opens a small valve, allowing the water to flow into an upper valve chamber. The arrangement of the valves is such as to cause the water to flow into a siphon-shaped pipe, and through it into the basin. When the ball is lowered into place, the water rises in the case, raises the float, and shuts off the water pressure.

Improved Scrubbing Brush and Mop Holder.

Michael Bigler, Marr, Pa.—This invention consists in conjoining two scrubbing brushes by a plate having a median neck which is grasped by a pair of gripper jaws that may be detached and used to hold the mop rag.

Improved Hemp Dressing Machine.

George Davis, Elizabeth, N. J.—For automatically varying the motion of the delivering rollers according to the quantity of material passing, the shaft has cone pulleys, which are geared with corresponding reverse cone pulleys on the driving shaft by an independent belt for each. The pulleys have loose belts with which tighteners are arranged to act alternately, the tighteners being on a rock shaft, which is held by a weighted lever when the hemp is running light so that the belts of the two smaller pulleys run loose, and the motion is given by the largest pulley; but when the quantity increases and raises the upper roller, levers connected to it raise the weighted lever, which first tightens the belt of the smaller pulleys in succession, giving a faster motion. By the diminution of the quantity passing through the rollers the weighted lever falls, and the reverse results are obtained.

Improved Car Coupling.

Thomas L. Shaw, Laurinburgh, assignor to himself and Hugh G. Fladger, Lilesville, N. C.—The top part of the drawhead is provided with a central vertical guide recess, which is concentric to a round lateral pin, and extended slightly into the interior bottom part, for the purpose of admitting a tumbler. The tumbler swings with its concave part around the pin, and serves as a support for the raised coupling pin, when resting in nearly vertical position on the bottom part of the drawhead. The pin drops into the usual top and bottom perforations of the drawhead, and is guided along a vertical concave front recess of the tumbler guide pin. The hook extension of the tumbler projects from below into the recess of the guide pin, and retains thereby the pin in raised position ready for coupling. The entering link strikes the lower front part of the tumbler, and carries the same in the guide recess in upward direction until it assumes a nearly horizontal direction, closing completely the upper part of the recess. The coupling pin is raised for uncoupling by hand, and causes, by the withdrawal of the link, the instant forward sliding of the tumbler, until the same assumes a nearly vertical position on the bottom part of the drawhead, and supports on its forward projecting hook end the pin in raised position, ready for coupling automatically on the entrance of the link.

Improved Brick and Tile Machine.

Hiram L. Huntington, Keyport, N. J.—In this improved brick and tile machine, there is a series of contracted throats radiating from the axis of the mud-mixing shaft below the mixer, through which throats the mud or clay is forced into receivers by pushers, which, in forcing it through, press it sufficiently for the bricks and tiles. When a receiver full of clay has been pushed out, a wire cutter rises up in front of the mouth of the throat and separates the mass in the receiver from the remaining portion; then the bottom of the receiver rises and carries the pressed clay against a series of wire cutters extending across the receivers, and separating the clay into bricks, which are then removed, the receiver bottom goes down, and the pusher goes back, ready for another operation. Each set of apparatus is operated in succession, and all the moving parts are worked directly from the extension of the mixing shaft below the mixer.

Business and Personal.

The Charge for Insertion under this head is $1 a Line.

Notes & Queries

M. E. W. can remove fruit stains by using the means described on p. 283, vol. 31.—E. G. F. will find full directions for mounting maps on p. 91, vol. 31.—T. A. R. must send a sample of the paint, before we can tell him what it contains.—W. S. V. will find directions for polishing shells on p. 122, vol. 27.—W. L. will find that we published a recipe for a copper dip on p. 90, vol. 31.—G. W. E. Jr. will find the formula for safety valves on p. 107, vol. 31. For information on small boilers, see the same page.—Y. will find directions for mitering frames on p. 342, vol. 30. For polish for walnut wood, see p. 315, vol. 30. For filling, see p. 347, vol. 31.—E. M. will find a recipe for coloring gold on p. 43, vol. 30.—M. will find the needed information as to removing superfluous hair on p. 229, vol. 28.—G. R. will find recipes for colored fires on p. 219, vol. 31.—J. C. S. will find directions for making marine glue on p. 43, vol. 32.—G. G. will find descriptions of Puscher's and other methods for painting on zinc on p. 116, *Science Record* for 1874.—A. P. will find a recipe for boot blacking on p. 45, vol. 31.—W. L. D. will find directions for making cement for joining glass on p. 379, vol. 31, and p. 90, vol. 30.—E. A. N. will find directions for making molds for plaster casts on p. 58, vol. 24.—P. W. will find a formula for calculating the size of a cylindrical vessel on p. 281, vol. 25.—G. W. R. will find a recipe for metal for models on p. 11, vol. 31.—R. V. T. will find a recipe for waterproof shoe grease on p. 155, vol. 26.—C. A. K. will find directions for nickel plating with a battery on p. 171, vol. 30. Mucilage is described on p. 202, vol. 31.

(1) C. W. M. asks: How can I make varnish for gilt work? A. Take gum lac 125, dragon's blood 125, annatto 125, saffron 32 parts. Dissolve each resin in 1,000 parts absolute alcohol; two separate mixtures must be made with the dragon's blood and annatto, in 1,000 parts of such alcohol; and a proper portion of each should be added with the gamboge to the varnish.

(2) M. H. K. says: I am putting up a short line of telegraph wire; on account of difficulty in getting a good ground connection, I think of using two wires. Can you tell me how to join them, cable fashion, in some simple and inexpensive way, so as to get the benefit of their united strength for some long stretches? I must secure insulation properly. A. Use steel wire covered with kerite for your wires, and you will have both strength and insulation. 2. My battery consists of carbons, porous cups, zincs, and containing vessels. What is the best and most lasting solution to use in them? A. For your battery, use nitric acid in the porous cups, and sulphuric acid diluted with ten parts of water for the solution containing the zinc.

(3) A. F. asks: What metal would answer best for covering the frame of a bread-delivering wagon, to carry the warm bread and leave it unaffected? A. Metal would be unsuitable. Painted cloth is usually employed for the tops of bread wagons.

(4) J.C.C. asks: 1. If I start from New York at noon of May 25, and travel westward, keeping exact pace with the sun, and I meet a man every ten miles, where will I meet the first man who will tell me it is noon of May 26? A. In longitude 180° west from the place in which time or longitude is reckoned.

How is the diurnal revolution of the earth demonstrated by the vibration of a pendulum? A. If a pendulum is set swinging in a north and south plane, at any place other than the equator, the plane of swing will be shifted.

(5) J. W. asks: When were surnames first used? A. Among the Romans, date unknown. They were used about A. D. 900 in France; and in England in the time of Edward II.

Why does plunging red hot steel into water make it harder, when the same process makes copper softer? A. It has never been satisfactorily explained.

What would be the length of the longest board, 3 feet wide and square on the ends, that could be placed diagonally across the floor of a room 12x16 feet? A. In general, a problem of this kind can best be solved by approximation. The solution would occupy too much space for insertion here.

(6) I. Z. asks: Can very thin sheet iron scraps be used for making iron bars by the usual process for making bars with the common scrap? A. Yes.

(7) T. A. G. says: 1. I have a small engine, ¾x2 inches stroke. Can it be made to run a sewing machine? A. Yes. 2. How large a boiler would it take to run it for 5 hours at a time, the boiler to be made like a kettle and hang down in a small arch made on purpose? A. It should hold from 15 to 20 gallons of water. 3. What would be the best metal for such a boiler? A. Copper.

(8) S. J. says: I have a plan for the purpose of propelling a balloon. How much weight will a cubic foot of gas, such as is used for the purpose, raise? A. A cubic foot of gas will not raise any weight; but if it weighs less than the air, the latter will exert a lifting force equal to the difference of weight between equal bulks of the air and gas.

(9) R. A. B. says: In No. 18 you recommend a good heater and frequent blowing. What do you consider frequent blowing? A. It will depend upon the quality of the water, and the way the boiler steams. In ordinary cases, twice a day will answer.

In No. 59, same date, the last equation is: $v = 8·025 \times \sqrt{\frac{h}{F}}$. I cannot read the fraction with certainty; please put it in words. A. Divide the hight by the friction, take the square root of the quotient, and multiply it by 8·025.

(10) G. S. asks: What is power? A. The amount of work done in a given time.

(11) J. G. A. asks: What is a good method for curing and drying figs to be put up in boxes? A. In the East, they are dried in the sun, or occasionally in ovens.

With what can I varnish a paper balloon, so that it will hold hydrogen gas? A. Boiled linseed oil.

(12) E. P. C. says: I am running a high pressure propeller with a cylinder 20x20 inches. The main valve has ⅛ inch lead and ⅝ inch lap on the steam side; but when the valve is in the center of its stroke, the exhaust port opens into both steam ports ⅛ of an inch. Do you think that, if I put two strips in the exhaust port of the valve to fill up the clearance, it would be an improvement to the engine? If so, how much would you advise me to put in? The engine makes 106 revolutions with 80 lbs. of steam, following half stroke. A. Put in enough to keep the exhaust open for about ¾ of the stroke.

(13) G. B. asks: 1. How is roofing tar prepared, to be used with paper and gravel? A. See the specifications of patented processes. 2. For what purpose is the gravel put on? A. To give consistence.

(14) E. A. asks: Would the draft of a street car be increased by connecting the whiffletree at 24 inches from the front of the car, instead of at 12? A. If the line of draft were parallel to the plane of the rails, in the two cases, there would be no difference. If this line were oblique to the plane of the rails, the draft would be easier for that position which had the greatest component of force resolved in a direction parallel to the plane.

(15) D. N. asks: How can I calculate the extra pressure of steam above the pressure in the water cylinder of a steam pump? I want a steam pump to throw water at 180 lbs. pressure per square inch; and if the water cylinder is 14 inches in diameter (area nearly 154 inches), 154×180=27,720, total pressure in pump; and if the steam cylinder is 24 inches in diameter, and the steam 62 lbs., the area is 452×62=28,024, which is a little over the total pressure in the pump. If they were both alike, the pump would stand still. How can I calculate how much extra pressure it will require to drive it at 50 or 100 strokes per minute? A. It is a matter that can only be determined by experiment, and the constants will vary for different kinds of pumps. The simplest way to make the experiment is to take indicator diagrams from the steam and water cylinders of the pump.

(16) G. A. M. says: We bought an engine, and it is claimed that it gives 3 horse power without using steam power high enough to make it dangerous. The boiler is upright, with one flue 7 inches in diameter; while the diameter of the shell is 23 inches, and hight 5 feet from ash pan to top of dome. The thickness of shell is 3-16, and the shell is of very pure iron. The boiler leaks with 80 lbs. steam. The engine is vertical, standing on separate base. The cylinder is of 3 inches diameter×4 inches stroke, making 200 revolutions per minute, with a plain slide valve, cutting off at about ⅞ stroke. Engine exhausts into smoke pipe. I cannot make this nearly 3 horse power by any rule you have ever given. A. We scarcely think that the engine is working up to 3 horse power.

(17) D. K. says: D. S. T. says that he has been running for 18 months an engine with 10x16 inches cylinder, and some of the bolts that hold the face plate to the steam chest and the cylinder head are being cut away as if by acid. You reply that it was probably caused by water being carried over with the steam. I have been running 8 and 10 inch engines for the last 12 years. I have had considerable trouble of the same kind, but I do not think that it is caused altogether by wet steam. I am now running two engines from one boiler; the first engine is in the same house as the boiler, and has a short steam connection. About 18 months ago, I commenced using tallow as a lubricant in the cylinder; and after using it about six months, the pistons began to leak steam. On taking off the cylinder head, I found that the rings on the piston did not fill the cylinder, being too small in diameter. On taking the follower off the piston, I found that the bolts were half eaten away on the part that passed through the follower; and the whole surface of the inside arm, and inside surface of the outside ring, together with the whole inside surface of the piston head, which was exposed to the action of the tallow, were eaten away very badly. The surface of the metal seemed to be dissolved, so that I could scrape a portion of it away with my thumb nail. I then cleaned all the dirt off the piston, and packed between the rings with tin until the outside ring was large enough to fill the cylinder, put them to their places, and put a ring of tin against the edge of the rings so that the followers would press against them. Then I put the follower on, with new bolts, and started the engine, using lard oil as a lubricant for about six months. Then I examined the piston again, and found that it had not been eaten away at all. A. This is very useful information on a subject to which we have frequently called attention before, namely, the evil effects of the acid and other deleterious ingredients in impure tallow. Good tallow, so far as our experience goes, does not injure an engine; but it is so difficult to obtain the pure article, that many engineers prefer (as our correspondent does) to use oil, and we think that their precaution is a wise one.

(18) D. I. F. says, in reply to J. C. & Co., who asks how much should the tail end of a 20 foot bolt be lower than the head: All first class millers claim that ¼ inch fall to each foot in length is enough. A. We are much obliged for this information, which will doubtless be useful to many of our readers. We would be glad to hear from other millers.

(19) H. B. I. says: On p. 10, vol. 31, J. G. H. says: "To run a saw mill, we have an engine 14x36 inches stroke with an 8 feet driving wheel, belting to a pulley on the main countershaft of only 3½ feet diameter, surface 15 inches. This pulley is so small (in order to give the necessary speed) that the belt will slip. Can we (by putting in another countershaft) improve the mill by belting from the engine and then to the present countershaft, thereby giving an opportunity to increase the pulleys to a size that will prevent slip? The engine is said to be 60 horse power. It is argued that this extra shaft would take so much more power that the engine would not drive the mill. Can you tell us about how much power it would consume to drive this extra countershaft, it being about 8 feet long?" To which you answer that the change would be a decided improvement, and, instead of a loss, more of the power of the engine would be utilized than at present. For this I cannot see any reason. The difficulty seems to be that the transmitting power of his main belt is not sufficient either for the strength of his engine or the work he has to do. How is he to increase the transmitting power of his belt by only enlarging his leading pulley, or by adding two wheels and a shaft to his already overloaded belt? In my practice, I have found that a 15 inch belt will sometimes slip when driven by a 14x18 engine and 8 feet driving wheel, which, with twice the number of strokes per minute, would transmit double the power that his arrangement will. I would recommend, therefore, that, if he must use a 36 inch stroke engine, and cannot get a 16 foot driving wheel in, he put on two fifteen inch belts side by side, if he has room to increase the width of his pulleys sufficiently. For a circular mill, I use a 14x18 engine and 8 feet driving wheel, or 14x13 and 6 feet driving wheel, with a 15 inch belt. For some years past I have recommended these dimensions, preferring the latter, and with no countershaft at all for either of them. They make a cheap, simple, and powerful mill. A. The reason for the advantage would be that he could use larger pulleys. If you run a large pulley at the same number of revolutions per minute as a small one, the velocity of the belt is greatest in the first case; and as the same power is transmitted as before, the tension of the belt does not need to be so great.

(20) G. M. B. asks: How can I construct a receptacle in a garret for water from the roof of a house? It must not let the water be frozen in winter or spoiled in summer. A. Make your garret tight; and the water in an ordinary tank of 2 inch plank, grooved, dowelled, and lined with sheet lead, will not freeze in an occupied house, nor spoil in summer, if well ventilated and occasionally used. Make the tank broad on the floor and not very high, and place it where there may be some support beneath the floor.

(21) N. C. P. asks: If I take two screw-drivers with similar points and handles, and one of them is 6 inches longer than the other, I have more power with the longer, and can turn a screw with it that I cannot with the short one? Why is this? A. It is because a screw driver is generally inclined somewhat, when in use, so that, in the case of the long screw driver, the force acts at the end of a longer lever arm. If both tools were secured so that they had to be held at right angles to the plane of the work, one would be as efficient as the other.

(22) G. B. asks: How is roofing tar prepared for use, with paper and gravel? A. Spread the paper upon the roof and secure the edges with large tacks; heat the tar in an iron vessel and spread it upon the paper when in a fluid state; before the tar cools, apply the gravel, the coarser size first and then the finer. The gravel must be washed clean before being used.

I propose to construct a henery, which I wish to ventilate. The uprights are to be ceiled on both sides, and the roof also. There is to be no plate on the uprights; there will be a space between the uprights connected with a cupola, through space between rafters, which I wish to use for the ventilating shaft. Where should the openings in said shaft be? A. Make small openings both at top and at bottom, and be careful to have openings to admit fresh air direct from the outside, which openings may be at bottom. You will require some plank ties across the building at the eaves to prevent the roof from spreading.

(23) J. M. H. says: Our city reservoir is situated at a distance of 2½ miles from my office; there is a fall of 250 feet. The water enters the building through a 1½ inch (inside) pipe, but escapes through a short nozzle (⅜ inch) opening, turning an enclosed water wheel, escaping thence through a 5 inch pipe. Now under the most favorable conditions, namely, a perfectly straight pipe or connections from reservoir, how much water can pass through this ⅜ inch opening per hour? The city meter charges me 15,000 gallons daily. The 1½ inch pipe connects with street mains, distant about 100 feet. A. You omit to state two of the most important elements required in a calculation of this kind; first, the size of the main pipe, which is 2½ miles long, and second, the extent to which it is tapped to supply other buildings before it reaches yours. Friction in pipes is a very material impediment to the flow of water, and increases inversely to their size; and of course every tap reduces the pressure. But none of these conditions would have to be regarded, provided the flow of water at the nozzle was determined by experiment. Note the quantity discharged, say for the first fifteen minutes of each hour of the day, and divide the

sum by the number of hours taken; the quotient will be the average flow per quarter hour, and from this the discharge per day may be correctly ascertained.

(24) R. R. S. asks: How can I join the facia and crown at the foot of the rake and side rafter, where they are in line, and the foot of the rafter is cut square? A. We presume the difficulty arises from the fact that the facia or corona of your raking cornice is vertical on the face, and that of your level cornice is inclined on the face at a right angle to the pitch of the roof. Where the upper line of your crown molding on the rake meets that of the crown molding on the level cornice, commence a regular miter, returning the raking cornice in toward the building on a level, but with the facia set at right angles to pitch of roof; then let the level cornice of the building die against this return, which it can do, leaving a small triangular piece of the return exposed, and still have the upper line of its crown molding on a line with that of the raking cornice. If we have rightly comprehended your difficulty, this will be a solution of it.

(25) H. E. E. says: A neighbor has a water mill, with brick walling. I think common mortar was used, and the walls leak. What kind of cement is used in cementing cisterns, and how can I mix and apply it to this wall? Must we turn off the head of water and wait till the wall is dry, or can it be applied while wet? A. Sylvester's method for expelling moisture from external walls consists in using two washes or solutions for covering the surface of brick walls; one is composed of Castile soap and water, and the other of alum and water. The proportions are: Three quarters of a pound of soap to one gallon of water, and half a pound of alum to four gallons of water; both substances to be perfectly dissolved in the water before being used. The wall should be clean and dry, and the temperature of the air should not be below 50° Fah. when the compositions are applied. The first, or soap wash, should be laid on when at boiling heat with a flat brush, taking care not to form a froth on the brickwork. This wash should remain twenty-four hours, so as to become dry and hard before the second (alum) wash is applied, which should be done in the same manner as the first. The temperature of this wash may be 60° or 70°, and it should also remain twenty-four hours before a second coat of the soap wash is put on; and these coats are to be repeated alternately until the wall is made impervious to water. This process was adopted by William L. Dearborn, C. E., on the brick face walls of the gate house of the 86th street reservoir, in Central Park, New York, where an infiltration had shown itself; the application was successful, the walls proving impervious to the entrance of water under a pressure of 36 feet head, and they remained so for 6½ years when reported by him in 1870. In an experiment, four coatings rendered the bricks impermeable under the pressure of 40 feet head.

(26) W. B. C. asks: What is the simplest method of smelting lead ore, containing some silver and copper? A. The galena is smelted in a reverberatory furnace and the pig lead is remelted and refined, the silver being extracted from the pig lead and not from the ore.

(27) J. J. K. asks: How can I polish tinware? A. Rub with rottenstone and sweet oil, and then with soft leather.

(28) G. T. L. asks: What makes corn pop, that is, burst open and swell up to a white, spongy mass? A. The conversion of the water (contained in grain) into steam.

(29) J. S. asks: How can I make soluble blue, for laundry use? A. Grind indigo into an impalpable powder, and make into a paste with powdered starch.

(30) P. L. V. H. asks: Which was the first steamship that crossed the Atlantic? A. The Savannah, in 1819 built by Crocker and Fickitt, of New York city.

(31) M. D. H. asks: 1. What do scene painters use for sizing canvas? A. Try a thin glue size. 2. With what are the colors mixed? A. Water, size, and turpentine. Use the ordinary pigments. 3. What is a good work on the art of painting in water colors? A. Rowbotham's.

(32) C. K. asks: What substance is used to harden lithographic crayons? A. Melt them up and add a little shellac.

(33) L. K. Y. asks: Of what shape is the Leclanché battery, and of what metals and chemicals is it composed? A. See p. 362, vol. 31.

How can I make a fine powder to give burnishers a high polish without scratching them? A. If you refer to agate burnishers, use putty powder or tripoli.

Please give me a recipe for solder for white metal. A. See p. 251, vol. 28.

(34) C. D. B. asks: How can I make gunpowder? A. Take crystalline flour of saltpeter, free from chlorine, 75 parts, refined sulphur in rolls 6 parts, willow charcoal 15 parts. Grind the sulphur and charcoal together, add the saltpeter, mix, damp, press into cakes, dry, and granulate.

(35) G. B. M. asks: Why do various text books give different melting points for the metals? A. The melting points of the various metals have not been satisfactorily determined, for which reason there are several authorities. Wagner's "Technology" is a recent work, and is probably as good an authority on the subject as can be consulted. Watt's "Chemical Dictionary" will give you several melting points for each metal without specifying the most reliable. In such case each person must satisfy himself, by the estimation he holds of the several experimentors and the general character of their work.

(36) A. B. C. says: I have a thick coat of a blue color, which has gone quite rusty in places. What shall I do to get it to its proper hue? A. The best method would probably be to have it dyed.

(37) P. B. P. asks: How can I make an ormolu dip? A. Brush on a thin paste of nitrate of potassa, alum, and oxide of iron, colored with any soluble pigment.

How can I make a solution of sal ammoniac? A. Sal ammoniac (chloride of ammonium) is quite soluble in water.

What is gray iron? A. The lower grades of cast iron are so called from their grayish color.

(38) E. S. V. asks: 1. What is a good method of keeping ink from freezing? I have tried placing alcohol one quarter inch thick all around the bottle, but it freezes through it. Is there any substance known, either in a liquid or a dry state, that is a perfect non-conductor of heat? If so, would it, if placed around a bottle of ink, keep it from freezing? A. There are no perfect non-conductors, but the loss of heat may be retarded by surrounding the bodies to be protected by wrappings of such excellent non-conductors as cotton, woolen, or similar fabrics. All such bodies of a light and porous character, including in their cavities air in a state of rest, are among the best non-conductors. 2. Why does not alcohol itself freeze? It certainly is not a non-conductor of heat, else it would not let ink freeze through it. If it be a conductor of heat, why does it not part with its own heat, and freeze up? A. Because its freezing point is lower than the temperatures to which it can be exposed. At a temperature of —166° Fah. it thickens, and at a still lower temperature would freeze.

(39) J. A. C. asks: How is copperas made? A. Protosulphate of iron (copperas, or green vitriol) is prepared by dissolving 1 part of pure iron (or 1½ parts of its sulphide) by the aid of heat in 1½ parts of oil of vitriol diluted with 4 parts of water. On filtering the solution quickly, it deposits beautiful, transparent, bluish green crystals on cooling. These effloresce in a dry air, and form a white crust, which soon becomes of a rusty brown color, owing to their absorption of oxygen.

What acid will eat iron the fastest? A. Nitric.

(40) W. D. K. asks: How is the fulminate put into the common copper cartridge? A. The fulminate is made into a thick paste, and the requisite quantity forced into the cap, which is then carefully and thoroughly dried, and covered with a coat of varnish to protect it from the weather.

Please give me a good recipe for coloring woolen cloth a permanent black. A. Wool is dyed black by the following process: It is boiled for 2 hours in a decoction of nut galls, and afterwards kept for 2 hours more in a bath composed of logwood and sulphate of iron, kept during the whole time at a scalding heat but not boiling. During the operation it must be frequently exposed to the air, because the green oxide of iron of which the sulphate is composed must be converted into a red oxide by absorbing oxygen before the cloth can again acquire a proper color. The common proportions are 5 parts nut galls, 5 parts sulphate of iron (copperas), and 30 parts of logwood for every 100 of cloth. A little acetate of copper is commonly added to the sulphate of iron, to improve the color.

(41) C. V. asks: Is there any known solvent for mica? A. The different forms of mica are double silicates of alumina, which contain in addition a small quantity of water and some alkaline fluoride. It is soluble in a mixture of hydrofluoric and sulphuric acids.

(42) J. B. & B. ask: What is the best powder or composition to use for polishing or burnishing German silver moldings? A. Putty powder is much used for this purpose.

(43) W. B. asks: 1. Are pure hydrogen and oxygen gas, combined, explosive? A. Yes. 2. How can I produce and combine them on a small scale? I have a solid piece of steel about four feet square and three inches thick. I wish to make an aperture in it about four inches in diameter. Can I, with the above gases, bring heat to bear on the spot, intense enough to allow of cutting through with a bit? A. The hydrogen may be obtained by the action of dilute sulphuric acid upon zinc scraps, in a close vessel. The oxygen may conveniently be obtained by heating, in an iron or copper bottle, a quantity of chlorate of potash mixed with one quarter its weight of black oxide of manganese (powdered). Perhaps the best instrument for your purpose would be the ordinary concentric oxyhydrogen blowpipe, in which the oxygen is made to enter the center of the hydrogen flame, something on the principle of the argand burner, only on a very small scale. The action of this flame on your steel plate would be to speedily burn its way through the plate.

(44) F. P. L. asks: 1. What is used in giving canvas for oil painting the first coat? A. The filling or ground is generally made by painting the canvas with coats of thin oil color, which must completely cover the threads of the fabric, which latter must be free from projecting lines and knots. The color of the filling is a matter of great importance, as it is impossible to paint a richly colored picture on a dull, unsuitable ground. Upon the whole, a white filling is to be preferred, but inexperienced artists are apt to produce a cold and poor effect on a white ground by laying on the colors unskillfully. Pale cream and warm drab are other colors much used for filling canvas. 2. What will keep the canvas from wrinkling after the first coat is applied? A. The canvas must be strained on a wooden frame before any filling is put on.

(45) W. F. H. asks: How can I bleach or whiten leather that has been tanned in the ordinary way, without injury to the material? A. It is doubtful whether this can be accomplished, as the same agents which will preserve the coloring matter will affect the leather.

(46) F. C. R. asks: Will wine keep its natural flavor if shipped across the Atlantic Ocean? A. Wines are sometimes improved by an ocean voyage.

(47) J. G. M. & Co. ask: How can we lacquer tin to a blue color? A. Use Prussian blue ground in pale shellac varnish.

(48) I. L. asks: What is the best flux for reducing photographer's waste? A. Carbonate of soda.

What is a good method of japanning tin, for use for outdoor signs? A. Grind the pigment of the required color in shellac varnish.

(49) J. C. asks: 1. Please give me a recipe for making stove polish. A. Use finely powdered graphite. 2. How can I make a stove polish which, applied with a brush, produces a gloss while drying? A. Fuse 2 lbs. asphalt in an iron pot, add 1 pint boiled oil; mix, remove from the fire, and add a little turpentine when cool. Some makers add dryers.

(50) R. K. says: I have a lot of leaves for making manure. Can you tell me of anything to mix with them, to make them rot faster than water and wood ashes? A. A certain degree of moisture and air is necessary; and hence the gardener should turn the heap over frequently and apply water when the process appears impeded, excluding rain when the heap is chilled with too much water.

(51) W. H. B. asks: What is meant by "proof," in connection with alcoholic liquids? A. Alcohol is said to be proof when, at 60° Fah., it has a specific gravity of 0·92. If above this gravity, it is said to be below proof.

(52) A. B. W. asks: What is a vinaigrette? A. A small box or bottle, used as a smelling bottle, for holding aromatic vinegar contained in a sponge, or smelling salts.

1. Would not the drinking of vinegar (cider or wood) act as a disinfectant to the disagreeable odor given off with the breath? A. No. 2. Would such a remedy be healthy? A. If excessively used, no. 3. Would the effect be only temporary; and if so, about how long would it last? A. The effect would be temporary upon the breath; the period of its effect upon the stomach would vary with different constitutions. Bad breath is generally due to one of two causes, unclean teeth or imperfect digestion (dyspepsia). Cider vinegar certainly would not remove the first cause, and the second would not be improved by it.

(53) B. H. S. says: You state that aqua ammonia will take nitric acid stains out of cloth. I think you are mistaken; as I have tried it as soon as the acid has touched the cloth. A. If the coloring matter is not destroyed, aqua ammonia will in all probability restore it, as we have tried it hundreds of times with success. In case the coloring matter is destroyed by the nitric acid, neither aqua ammonia nor anything else can restore what is not there.

(54) S. W. C. asks: Having an iron safe, the fireproof material of which has broken loose, I wish to know how to replace the filling? A. Mix plaster of Paris with a strong solution of alum water, and use quickly.

(55) N. L. C. asks: Can you tell me of any substance resembling flour or corn starch that will always remain white after being sifted into gum arabic and exposed to the air? A. If otherwise suitable, some unalterable body, like finely pulverized barytes, would keep better than organic bodies such as corn starch, etc.

(56) F. N. B. asks: 1. Please give me a test for sulphur in well or spring water. A. Saturate a slip of paper with sugar of lead (lead acetate), and expose it near the surface of the water for a short time. If the paper is discolored, it shows the presence of sulphuretted hydrogen. Another method is to take a small quantity of the water, into which pour a small quantity of a strong solution of sugar of lead; the darkening of the water is proof of the presence of sulphuretted hydrogen. 2. Can water and sulphur be united artificially, to form what is known as "sulphur water?" A. Yes; sulphuretted hydrogen gas is very soluble in water, and may be obtained by the action of dilute sulphuric acid on sulphide of iron.

(57) C. B. asks: What is the cause of the sound on a cold night, imitating explosions of a light nature? I suppose it to be from the freezing of the ground. A. It is probably due to the freezing of the sap in green wood, such as the trunks of trees, etc., and is attributed to the expansion of the liquid on freezing, causing a rupture of the fiber.

(58) L. N. L. says: In the Agricultural Report for the year 1868, I find the following statement: "Wheat contains some lime, one ounce in a bushel of grain (and a little more in the straw), while it contains rather more soda than lime, about five times as much magnesia, nearly nine times as much as potash, and more than thirteen times as much phosphoric acid." Is this correct? A. We find that 100 parts of the dried grain give 2 per cent of ashes, and 100 parts of the dried straw give 4 per cent of ashes. In the following table you can compare the amount of the inorganic matters of the grain and straw. 100 parts of the ashes contain:

	Grain.	Straw.
Potash	30·02	17·98
Soda	3·82	2·47
Lime	1·15	7·42
Magnesia	13·39	1·94
Phosphoric acid	46·79	2·75
Oxide of iron	0·01	·45
Sulphuric acid	——	3·00
Silica	3·89	63·89
	99·97	100·00

The composition of wheat (grain), organic and inorganic constituents included, is: Carbon 46·10, hydrogen 5·80, oxygen 43·40, nitrogen 2·20, ashes 2·41. In an ounce of phosphoric acid, there are about 210 grains of phosphorus.

(59) A. W. asks: Which is the best acid for etching on lead? A. Use dilute nitric acid.

(60) G. F. P. says: I have seen very fine specimens of etching on lithographic stone, the hollows being as regular and even as though cut with a chisel. How is this accomplished? A. The design is transferred to the stone, which must be previously perfectly clean; the surface of the stone is then moistened with dilute nitric acid, to which a small quantity of gum arabic has been added to prevent the roughening of the stone.

(61) J. E. W. asks: What should I do with a canary that has lost his voice? He seems in good health, except that at times he will sit and pant as though he had some difficulty about his breath. A. We know of no remedy. We judge, from your description, that the bird has the asthma.

(62) R. M. asks: Are there any chemicals that will produce gas in a boiler fast enough to run a ⅛ horse power engine? A. No.

(63) C. H. C. says: In Dick's "Practical Astronomer" there is an account of a telescope invented by Messrs. Wilson and Rogers of England. It contains an intermediate glass called a corrector, composed of a plano-convex lens of crown glass and a plano-concave lens of flint glass, placed in the cone of rays that come from the object glass; it lengthens the focus to six feet, where a perfectly achromatic image is formed. Could I obtain a patent on such telescopes, or make them to sell, without a patent? A. C. F. Gauss, in his "Dioptrische Untersuchungen," 1840, says: "The dialytic telescope has, instead of the flint lens, a combination of flint and crown placed close together. This combination is not achromatic, as the violet image, if in the same focus as the red, is larger than the red. This defect is unavoidable, but it may be compensated by proper calculation of the oculars. But the dialytic lenses being movable toward the crown objective, the requisite difference of focus for each ocular may be attained." As the eye is not achromatic, the secondary spectrum of a good object glass is of slight importance. We cannot recommend the dialytic telescope as an object of study, but the usual forms might be profitably constructed.

(64) A. H. T. asks: How long should the focus of an eight inch objective lens for a telescope be? A. One hundred and fifty feet.

(65) R. D. asks: Will grapes grown in New Jersey serve for making raisins, and what is the process? A. A monthly report of the Department of Agriculture, of 1872, says: Several grape growers of California have succeeded in producing raisins of fine quality. Growers sowing a vineyard, on the foot hills near Nevada City, have produced, from 450 lbs. grapes, 150 lbs. raisins of superior flavor, claimed to be equal to the best Malaga, and worth 24 cents per pound. This furnishes a fine margin for profit, as it secures 8 cents per pound for grapes, which is a very remunerative figure for California. We think that the climate in the vicinity of New York is entirely too cold for the production of raisins.

(66) R. S. G. asks: 1. What is the latest and most approved method of generating oxygen gas? A. Heat together in a flask 1 part by weight of black oxide of manganese and 4 parts of chlorate of potash. 2. What is the proportion of carbonic acid gas to ordinary air, to produce asphyxia? A. Anything exceeding 4 per cent.

(67) H. D. asks. 1. Does the ordinary gun or rifle powder in use give perfect satisfaction? A. No. 2. Wherein is it defective? A. The principal objections are the large volume of smoke, and the incomplete combustion, which necessitates the frequent cleaning of the gun. 3. How does the white gunpowder injure the mechanism of guns, as it is claimed to do? A. Of this powder there are several grades, the highest and most powerful of which is not suitable for a gun or rifle powder; and if so used is injurious on the same principle that gun cotton, dynamite, or nitroglycerin would be if used for the same purpose.

(68) A. M. says: While viewing a drop of water, the size of a pin's point, through a microscope, the animalculæ gradually became motionless and dim, and upon examination I found that the water had evaporated and left a stain on the object glass, which I wiped away. 1. I would like to know what became of the animalculæ that I had seen in the drop. A. The animalculæ could not have evaporated; they undoubtedly remained upon the glass. 2. Did any remain in the little dry stain? A. We should say so. 3. Did I terminate their existence by wiping away that stain? A. Yes. You had only to examine the glass again with the microscope to prove the presence or absence of the animalculæ. 4. What book is best suited for an amateur microscopist? A. Beale's "How to Work with the Microscope" is one of the standard authorities, being plain, simple, and easy to understand. It fully explains all the requisite details.

(69) S. N. M. says, in answer to R. O. B., who asked: Is there any rule by which a person can find the radius when the arc and chord are given? There is no formulated rule, but I can tell how to find the diameter from the given data, if the arc is not greater than a semicircle. By taking pains and a day or two of time, a table can be calculated, showing the lengths of the arcs of any number of degrees and parts of a quadrant, corresponding to the natural sines in the common tables, when R = 100,000, and also the ratio of a sine to the arc. Thus: 360° : $2R\pi$ :: any number of degrees and parts : length of the arc. Divide the length of the arc so found by the natural sine (of the tables); it gives the ratio of the sine to the arc. Example.—Given the length of arc = 2·6; length of chord = 2, to find diameter. Having made my table, I find this ratio, 1 : 1·3, to be the sine and arc of 70°. By the formula above: 360° : 6·2832 ($2R\pi$) :: 70° : 1·22173, length of the arc, when R = 1. Then $\frac{1·22173}{·93979}$ = 1·3 = ½ the given arc. Then 70° : 1·3 :: 360° : 6·6857 = circumference of the required circle, and 2·128 its diameter. If the ratio of the sine to arc is

greater than 1:1·5708, the arc is greater than a semicircle, and indeterminate by this means. As the ratio of the arc to the sine increases slower in the first half of the quadrant than in the last half, the number of degrees may be approximately estimated by the given lengths of the ½ arc and ½ chord; and by a few trials, the ratio can be found without going through the long process of making out a full table of the quadrant. A. This is not a new method, but is worth investigation.

(70) J. N. McC. says, in reply to several correspondents, who ask as to burning slack: "My experience is that slack requires the grate bars to be very open. I have always used the widest I could get, not less than an inch between the bars; I have used bars with openings of 1½ inches. The only secret in using it with any kind of a furnace is to have the grate bars open enough, so that the fire can be kept open from the underside of the grates, with the poker. Some coal, of course, will go through at first; but coarse coal or wood can be used to start with, and you must rake out what falls through the grate, and put it in again. The coal will soon cake so that it will not waste. To build a furnace for the purpose, I would make it wider than usual, with doors in the side of the front, similar to furnaces for burning sawdust. For some varieties of coal, it will be found beneficial to wet the coal before throwing it into the furnace; it helps it to run together. Then put in the coal at the side doors, and let it alone till it cakes; then take your poker and roll it into the center of the fire. It will then be in large lumps and will not waste; and you will always have a good fire in the center. Never smother it with fresh coal."

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

R. B.—A very highly siliceous slate, perfectly compact and homogeneous.—J. E. E.—Your specimen does not contain silver.

J. E. D. asks: How can I make cream candy for feeding weak colonies of bees during the winter? How is the granular condition of the sugar overcome?—E. W. H. asks: How are honey locust seeds prepared for sowing?—N. N. asks: Can you tell me how to color coral after it has been burned? —P. W. says: I have a tame frog which in summer lives on flies. What shall I give it in winter?

COMMUNICATIONS RECEIVED.

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

On Steam Boiler Explosions. By C. R. C. and by S. G. H.
On Brass Bearings. By T. J. B.
On Utilizing Water Power. By H. C. K.
On a Cheap Locomotive. By F. G. W.
On Springs and Wells of Water. By ——.
On Tunneling. By J. H. S.
On a Flying Machine. By M. B. E. and by L. S.
On Phosphorus. By ——.
On Multiplication and Division. By G. B. G.

Also enquiries and answers from the following: E. S. V.—K.—M.—J. B.—L. R. C.—W. E. L.—T. A. J. —P. B. S.—L. W.—I. E. N.—C. O'B.

HINTS TO CORRESPONDENTS.

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

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

Hundreds of enquiries analogous to the following are sent: "Who makes balloons? Who sells machines for hulling barley, and also for grinding oatmeal? Where can machines for marking boxwood rules be obtained? Are there any makers of railway ticket printing machines in the United States?" All such personal enquiries are printed, as will be observed, in the column of "Business and Personal," which is specially set apart for that purpose, subject to the charge mentioned at the head of that column. Almost any desired information can in this way be expeditiously obtained.

[OFFICIAL.]

INDEX OF INVENTIONS

FOR WHICH

Letters Patent of the United States were Granted in the Week ending December 29, 1874,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

Air and gas, carbureting, A. W. Porter	158,184
Ammonia, manufacture of, L. S. Fales	158,265
Atomizer, hydrocarbon, C. E. Robinson	158,316
Auger, earth, Hitchings and Eynon	158,776
Augers, twist, W. Tucker	158,337
Bags, filling, J. D. Platt	158,306
Bale tie, W. G. Cain	158,343
Barking wood, machine for, O. W. Clark	158,247
Barrel heads, planing, E. and B. Holmes	158,213
Beefsteak crusher, J. W. James	158,280
Beer barrels, vent plug for, J. A. Nunn	158,308
Beer cooling house, etc., J. J. Schillinger	158,319
Belt shifter, Hill and Proctor	158,173
Biscuit board, A. P. Forman	158,366
Blind stop, W. A. Clark	158,300
Boiler, agricultural, J. G. Smith	158,322
Bolt, door, F. W. Brocksieper	158,341
Boot and shoe chan el opener, F. D. Ballou	158,232
Bread, compound for, J. C. Pooley	158,183
Bridge, truss, L. L. Buck	158,197
Bridge, truss, J. B. Winters	158,347
Buckle, harness, P. Burns	158,198
Burner, lamp, J. Curson	158,254
Butter bucket fastening, etc., Thielepape et al.	158,334
Cap, etc., knitted, P. L. Slayton	158,321
Car axle box, Fryer and Hall	158,169
Car coupling, G. R. Moore	158,219
Car coupling, E. Stone	158,330
Car coupling, W. H. Ward	158,227
Car coupling, C. C. Wilson	158,346
Car, dumping, J. E. Bemis	158,236
Car, dumping, R. Eaton	158,262
Car freight, R. Eaton	158,261
Car spring, J. W. Cochran	158,248
Carriage, child's, Bein and Ulrich (r)	6,199
Carriage handle, child's, C. F. Lauer	158,288
Churn power, F. Rauh	158,311
Cigar mold, L. Prentice	158,309
Clocks, striking mechanism of, E. Clark	158,165
Clod crusher, D. B. Barnet	158,233
Column, iron, L. Kirkup	158,285
Cooler, lard and liquor, A. F. Chesebrough	158,246
Cooler, water, W. F. Garrison	158,269
Cotton worm poison distributor, W. T. Willis	158,345
Culinary steamer, W. M. Smith	158,323
Cutlery, manufacture of, W. H. & G. W. Miller (r)	6,195
Dash board, W. C. Peel	158,182
Dental engine flexible shaft, E. T. Starr	158,324, 158,325
Dental engine hand piece, J. W. Gilbert	158,170
Derrick for fluid cans, S. N. Blodgett	158,196
Desk, school, F. M. Gilchrist	158,271
Digger and cultivator, potato, A. Crosby	158,251
Door plate, E. Avey	158,230
Drill tube clamp, J. Fleming	158,168
Drying animal charcoal, L. Colwell	158,166
Egg carrier, J. L. Stevens	158,327
Elevator safety attachment, H. E. Bathrick	158,234
Elevator safety lock, H. Carlile	158,244
Embankments, construction of, E. Bush	158,242
Engine and pump, rotary, Smith and Robichon	158,222
Engine, stationary, C. S. Crane (r)	6,194
Engine, balanced valve, E. Wright	158,191
Engine governor, M. Muchin	158,300
Eye cup, P. S. Stephens	158,224
Eyeleting machine, J. E. Wiggin	158,343
Faucet, beer, Steves and Brederlow	158,326
Fence picket machine, I. Levy	158,291
Fence, portable, J. W. Hartley	158,210
Fifth wheel, S. B. Hitt	158,212
Fire arm, breech-loading, F. Smith	158,221
Firemen's shield, E. Low	158,217
Flour bolt, G. T. and A. Smith (r)	6,197, 6,198
Fork, egg, C. A. Read	158,312
Fruit drier, W. S. Plummer	158,308
Furnace and stove, J. B. Thompson	158,335
Furnace, boiler, J. C. Ramsden	158,310
Furnace boiler oven, blast, H. Harris	158,209
Furnace grate, R. A. Hutchinson	158,279
Furnace, hydrocarbon, C. E. Robinson	158,315
Gas, coal, M. W. Kidder	158,216
Gas regulator, Detwiler and Fajen	158,255
Gas retorts, lining, E. G. Wellman	158,228
Glass, duplex dressing, H. S. Wood	158,349
Grain cleaner and scourer, A. Hough	158,278
Grate, M. Mahony	158,293
Grate, fire place, J. S. Lester	158,289
Grater, almond, J. Levy	158,290
Griper, lifting, H. H. Stuart	158,332
Hammer, bush, R. K. Carpenter	158,199
Harvester, J. P. Manny	158,177
Harvester rake, T. G. Glover	158,272
Hay tedder, H. Moore	158,180
Hinges, cover for butt, H. T. Blake	158,237
Hoe and chopper, combined, C. H. Gaylord	158,270
Hog-holding implement, A. L. Hill	158,274
Hook, snap, G. Reynolds	158,22
Horse power, R. Stiles	153,329
Horseshoe, Kintzing and Hopper	158,284
Hydrocarbon atomizer, C. E. Robinson	158,316
Indicator, T. S. Kennard	158,281
Insect destroyer, F. A. Eldridge	158,263
Knife, cheese, Phillips and Young	158,304
Knife-grinding machine, Hill and Proctor	158,172
Knitting machine, Reed and Mulligan	158,313
Knitting machine, P. L. Slayton	158,185
Leather, etc., beading, Walden and Platts	158,190
Lens-selecting device, G. Meyer	158,179
Lock, door, J. H. Kinsman (r)	6,196
Lock, seal, and indicator, J. L. Howard	158,174
Loom for pile fabrics, J. Cochrane, Jr	158,202
Loom picker rod, Kent and Parker	158,282
Lubricator, M. Evans	158,264
Lubricator, picker spindle, W. Taylor	158,189
Malt crusher, A. Dobler	158,257
Mill spindle, W. S. Bacon	158,192
Mirror attachment, H. S. Wood	158,348
Mower, lawn, A. Grosch, Jr	158,273
Needle blanks, etc., swaging, W. Trabue	158,225
Nut lock, A. F. Dimond	158,256
Organ reed board, R. Burdett	158,164
Paper and twine holder, B. F. Eaton	158,203
Paper articles, forming, J. W. Jarboe	158,215
Paper, ruled, H. D. Cone	158,249
Paper-winding machine, B. F. Eaton	158,204
Photographic plate, P. Neff	158,331
Pipe coupling, C. E. Dulin	158,259
Pipes, joint for lead, C. F. Mayer	158,297
Plane, bench, C. Nordell	158,302
Planter, seed, J. R. Sample	158,318
Pliers, cutting, T. P. Farmer	158,205
Plow, H. D. Smith	158,186
Plow, gang, M. S. Curtiss	158,253
Plow, wheel, I. R. Gilbert	158,207
Pocket, safety, P. Smith	158,187
Power by fluids, transmitting, H. Picq	158,305
Press, hay, J. Wiley	158,344
Printed sheets, dry pressing, C. H. Weston	158,340
Pruning shears, J. J. Bristow	158,240
Pump, G. H. Laub	158,287
Pump, force, W. W. Green	158,171
Pumps, bucket for chain, W. C. Barker	158,19[illegible]
Pyrometer, E. S. Hawley	158,21[illegible]
Range, E. O. Brinckerhoff	158,23[illegible]
Screw taps, cutting, W. Tucker	158,338
Screw-threading device, C. W. Roberts	158,314
Separator, grain, G. & J. R. Beachler	158,235
Sewing machine, T. S. Huntington	158,214
Sewing machine needle bar, G. A. Fairfield	158,167
Sewing machine welt gage, F. D. Ballou	158,231
Shoe, C. F. Hill	158,275
Shoe fastening, G. Merrill	158,178
Sleigh fender, J. J. Cobb	158,201
Sleigh thill, L. Lyon	158,176
Soap, making, R. Freeland	158,26[illegible]
Soda fountain, J. W. Tufts	158,226
Soda water cock, H. Fraser	158,267
Spinning mules, clearer for, S. Mock	158,218
Spinning ring, J. G. Lamb	158,286
Spring torsion, R. Dudley	158,258
Springs, manufacturing door, C. S. Van Wagoner	158,339
Stone, dressing, F. L. King	158,175
Stool, foot, E. H. Crooker	158,250
Stop-doubling machine, etc., W. Masterson	158,295
Stove, J. H. Blake	158,195
Stove, heating, M. Curtis	158,252
Table, folding, N. S. Tiemann	158,336
Table slide, extension, J. Pleukharp	158,307
Thill coupling, O. J. Shannon	158,320
Timber frame joint coupling, E. Martin	158,294
Trap, fly, J. W. & T. S. Bray	158,238
Trunk hinge and stay, A. Romadka	158,317
Trunk, traveling, Moore & Mills	158,299
Twine, balling, I. A. Stringfellow	158,331
Valve, globe, J. N. Matlock	158,296
Valve, hydraulic safety, J. F. Taylor	158,333
Valve, slide and steam, J. Anderson	158,229
Vehicle wheel, A. B. K. King	158,283
Vehicle wheel, W. Montgomery	158,298
Vehicle wheel, A. Wietlisbach	158,342
Vent plug for beer barrels, J. A. Nunn	158,303
Vests, device for laying out, J. Bauer	158,194
Washboard, W. Whitford	158,344
Washing compound, J. Braddock	158,163
Washing machine, E. Nafziger	158,181
Watch dust cap, O. F. Stedman	158,223
Waterproofing compound, A. Starr	158,188
Water wheel, W. H. & D. V. Holcomb	158,277
Weather strip, W. O. Chamberlain	158,245
Weather strip, Lynch & Stowell	158,292
Well boring horse power, M. Steward	158,328
Wheel, traction, G. W. Fitts	158,206
Whip hanger, W. Hall	158,308
Yoke and pole, neck, M. Dunham	158,260

DESIGNS PATENTED.

7,957 & 7,958.—SODA WATER APPARATUS.—G. F. Meacham, Newton, Mass.
7,959.—BUCKLES.—V. Price, Woodside, N. Y.
7,960.—STATUARY.—J. Rogers, New York city.
7,961.—MARTINGALE RINGS.—H. F. Corning, Hartford, Ct.
7,962.—PAPER, ETC.—B. Lawrence, New York city.
7,963.—STOCKING FABRIC.—W. Martin, Philadelphia, Pa.
7,964.—COAL SCUTTLE.—C. H. Morse, Rochester, N. Y.
7,965.—HEATING STOVES.—N. S. Vedder, Troy, N. Y.
7,966.—HANDLE TIPS.—H. W. Wright, Glastonbury, Ct.
7,967.—SAD IRON HANDLES.—W. J. Reagan, Royer's Ford, Pa.
7,968.—PEN.—R. E. Cannon, Lexington, Ky.

TRADE MARKS REGISTERED.

2,140.—LABELS.—Allen, Lane & Scott, Philadelphia, Pa.
2,141.—CIGARS.—Goldsmith & Newburgh, Cincinnati, O.
2,142.—JET.—Holzinger & Bruckheimer, New York city.
2,143.—BITTERS.—V. Keck, New York city.
2,144.—CLOTHING.—A. Nicoll, Brooklyn, N. Y.
2,145.—CIGARS.—W. H. Romerman, Jacksonville, Ill.
2,146.—SHIRT BOSOMS.—S. Sibley, Boston, Mass.
2,147.—ROOFING.—A. H. Soden, Newton, Mass.
2,148.—CORSETS.—Comfort Corset Co., Boston, Mass.
2,149.—VARNISHES.—Hyatt & Co., Newark, N. J.

SCHEDULE OF PATENT FEES.

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On application for Design (7 years)	$15
On application for Design (14 years)	$30

CANADIAN PATENTS.

LIST OF PATENTS GRANTED IN CANADA, DECEMBER 28 to DECEMBER 29, 1874.

4,205.—H. Smith, Hamburg, Waterloo county, Ont. Improvements in wind wheels, called "Smith's Improved Wind Power Wheel." Dec. 28, 1874.

4,206.—J. Tesseman and P. Smith, Dayton, Montgomery county, Ohio, U. S. Improvements in valve gear for steam engines and pumps, called "Improvements in Steam Pump Valve Gear." Dec. 28, 1874.

4,207.—F. P. Mackelcan, Montreal, P. Q. Improvements on a machine for pulling stumps, called "The Farmer's Stump Machine." Dec. 28, 1874.

4,208.—W. G. P. Cassels, Toronto City, Ont. Improvements in stoves, called "The Improved Water Evaporator." Dec. 28, 1874.

4,209.—M. G. Wilson and J. H. L. Wilson, Sherbrooke, P. Q. Improvements in boilers, called "Wilson's Vegetable Boiler." Dec. 28, 1874.

4,210.—H. D. Gibbs, Batavia, Genesee county, N. Y., U. S. Improvements in devices for connecting the neck yoke with the draft poles of vehicles, called "Gibbs' Improved Neck Yoke Clasp." Dec. 29, 1874.

4,211.—F. H. C. Mey, Buffalo, Erie county, N. Y., U. S. Improvements on grain and malt dryers, called "Mey's Grain and Malt Dryer." Dec. 29, 1874.

4,212.—G. White, London Township, Middlesex county, Ont. Improvements on parts of carriages, called "White's Improvements on Carriage Axles, Springs, Shaft Couplings, and Tyres." Dec. 29, 1874.

4,213.—T. Gavin, Montreal, P. Q. "Ameliorations aux boites a tamiser les cendres de charbon de terre, par Thomas Gavin," called "Improvements in Sifters for Sifting Coal Ashes." Dec. 29, 1874.

4,214.—D. W. Siprell, Rivière du Loup, Temiscouata county, P. Q. Improvements on rack reamers, called "Siprell's Improved Reamer." Dec. 29, 1874.

4,215.—F. H. Date, Niagara, Lincoln county, Ont. Improvements on the manufacture of illuminating gas, called "Date's Manufacture of Illuminating Gas." Dec. 29, 1864.

4,216.—C. M. Clinton and L. Wood, both of Ithaca, Tompkins county, N. Y., E. C. Gregg and C. P. Gregg, Trumansburg, Tompkins county, N. Y., U. S. Improvements in wheeled horse rakes, called "Clinton and Wood's Improved Horse Rake." Dec. 29, 1874.

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IT a year, postage included, and following its PAYS
IT plain, practical directions, he got *all the above* PAYS
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IT nished him agreeable exercise and change PAYS
IT from shop confinement. His Wife had lots of PAYS
IT flowers in addition. Tens of thousands of PAYS
IT others have had similar experience—and YOU PAYS
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IT paid. It is full of GOOD THINGS for YOUR- PAYS
IT SELF, YOUR WIFE, and CHILDREN. You PAYS
IT and 3 neighbors can have the paper a year for PAYS
IT $5.40, post-paid. ORANGE JUDD COM- PAYS
IT PANY, Publishers, 245 Broadway, New York. PAYS

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GOOD Thirty-three years ago two brothers set- BOYS
GOOD tled as Farmers, side by side. One of them BOYS
GOOD subscribed for the *American Agricultu-* BOYS
GOOD *rist*, and occasionally bought a book or two BOYS
GOOD about his business, the whole costing him BOYS
GOOD only $6 a year. His Boys read and *thought* BOYS
GOOD about their work, became interested in BOYS
GOOD and *respected* it, and were happy in their BOYS
GOOD toil because they had something to think BOYS
GOOD about. They grew up intelligent, and set- BOYS
GOOD tled as good prosperous farmers, respected BOYS
GOOD and influential......The other brother BOYS
GOOD "couldn't afford papers and books"; (he BOYS
GOOD could afford 6 cents a day, or $20 a year, BOYS
GOOD for tobacco, beer, etc.) His boys worked BOYS
GOOD sullenly by day, and "skylarked" at night; BOYS
GOOD they despised and hated their work, which BOYS
GOOD for them was only exercising brute force, BOYS
GOOD with little mind applied. When old enough BOYS
GOOD to escape parental restraint, they quit the BOYS
GOOD farm, one for this, and another for that, BOYS
GOOD and *none* of them have ever amounted to BOYS
GOOD anything. Six dollars a year would have BOYS
GOOD made a wonderful difference—would have BOYS
GOOD changed their whole course of life. Would BOYS
GOOD it have paid?....Farmers, study the above BOYS
GOOD cases, and Try the Experiment this year BOYS
GOOD of having the *American Agriculturist* in BOYS
GOOD *your* family, for yourself, as well as your BOYS
GOOD boys. It will cost you but $1.60, sent post BOYS
GOOD paid. Volume 34, just beginning, will BOYS
GOOD furnish you over 1000 Columns of good BOYS
GOOD things, useful, valuable information for BOYS
GOOD YOURSELF, YOUR WIFE, and YOUR BOYS
GOOD CHILDREN, including over 400 fine BOYS
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GOOD Publishers, 245 Broadway, New York. BOYS

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IT no more upon it than he had previously paid PAYS
IT for rent and garden stuff, but he continued PAYS
IT fixing it up solely according to hints and sug- PAYS
IT gestions in the *American Agriculturist*, which PAYS
IT cost him $1.62, postage included. These im- PAYS
IT provements so changed the place that he sold PAYS
IT it to a city gentleman for $20,000. *He credits* PAYS
IT *the Agriculturist with $14,300 profit*, while it PAYS
IT cost him but $9.72 for 6 years. A multitude PAYS
IT of others have had a somewhat similar expe- PAYS
IT rience. The paper is full of *plain, practical* PAYS
IT suggestions, that wonderfully help every one PAYS
IT who owns a farm, or garden, or even a little PAYS
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HUMBUGS *can Agriculturist* has investi- SHOWN UP
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HUMBUGS way it is now saving to its SHOWN UP
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HUMBUGS lars. It is full of *good, trust-* SHOWN UP
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NOT Hundreds of Thousands of Persons STRANGE
NOT have constantly read the *American* STRANGE
NOT *Agriculturist* during the whole 33 STRANGE
NOT years of its publication, and that it is STRANGE
NOT quite as popular to-day, as ever. (*It* STRANGE
NOT *is better than ever before.*) It is full of STRANGE
NOT GOOD THINGS for every MAN, STRANGE
NOT WOMAN, and CHILD in City, STRANGE
NOT Village, and Country. It gives for a STRANGE
NOT small price over 400 Beautiful, In- STRANGE
NOT structive Engravings, and over 1000 STRANGE
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NOT can be collected, and sifted, and con- STRANGE
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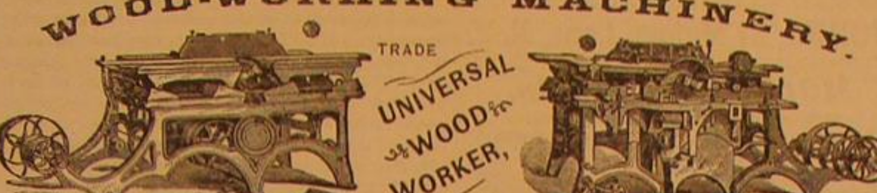

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