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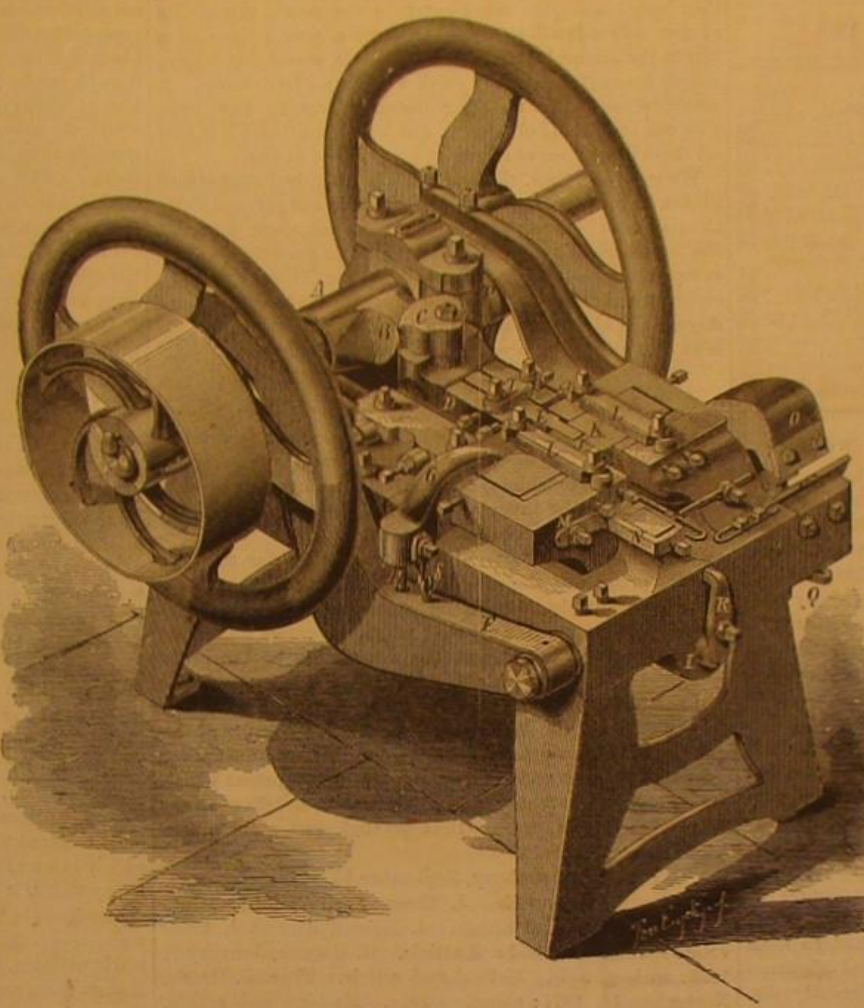
IMPROVED BOLT HEADING MACHINE.

We present herewith an engraving of the Lewis bolt heading machine, an apparatus which is claimed to be capable of making square, hexagon, T, button, countersunk, and, in fact, any variety of bolt head; also boiler rivets, splice bar bolts, carriage bolts and spikes, etc., of any dimensions, from half inch to 20 feet long, or from three sixteenths to one and a quarter inches in diameter. Further, it is stated that the invention, for any length of bolts of the same diameter, accomplishes its work without change of tools; that it can produce a hexagonal or square headed bolt with the same tools, or every alternate bolt may be square or hexagonal as desired, without regard to length, or headed in assorted lengths without the slightest alteration of implements.

In our illustration, A is the driving shaft, running upon bell metal bearings and supporting the two heavy fly wheels, as shown. B is a cam upon said shaft, which takes against the block, C, which actuates the heading ram, D, containing the heading punch or tool, E. Another cam on the shaft, A, which is not represented, lifts the side lever, F, by which the grip lever, G, is moved through the medium of the toggle pin, H. The grip lever or movable die bed, G, vibrates on two steel center pins, one of which is shown at I. J and K are the dies for gripping the blank, and in which the bolts are formed or squared. L L L are clamps which hold said dies and the heading tool. M is an inclined plane or wedge-shaped rubbing block, by which the strain or shock of the heading is thrown on the bed of the machine. N is a steel band for taking up any wear or slack of the last mentioned portions. At O is the shear lever operated by the eccentric, P, and provided with a gage at Q. R is a clamp for taking up the wear of centers, and the hook, S, serves to connect the grip and side levers, and thus insures the opening of the dies.

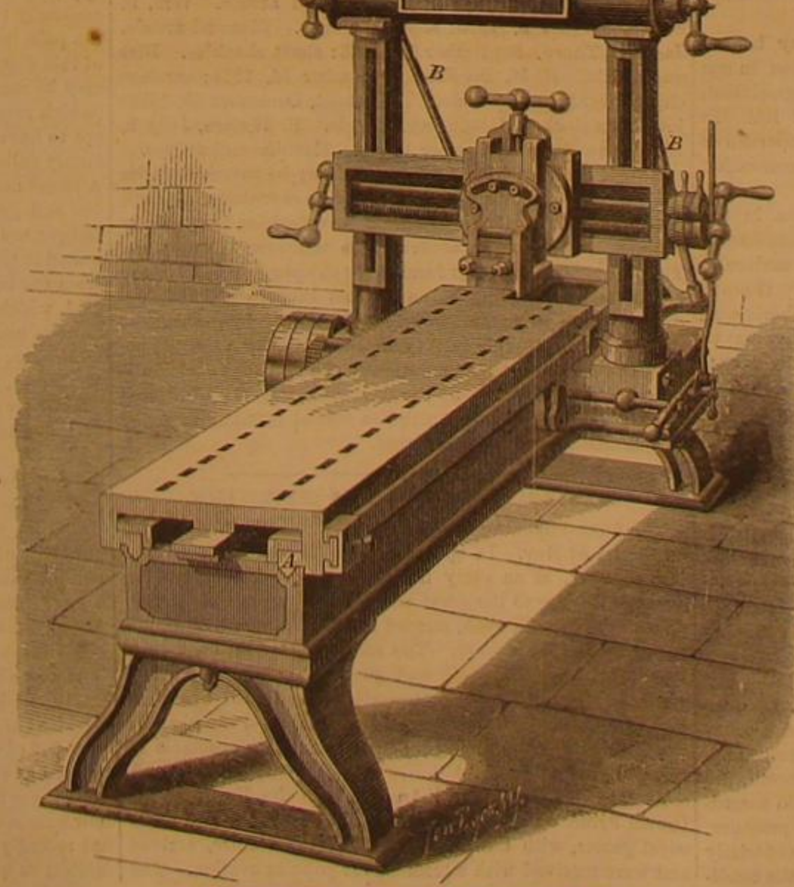


THE LEWIS PATENT BOLT HEADING MACHINE.

The machine is driven by a six inch belt and at about 100 revolutions per minute. The heated blank, on being drawn from the furnace, is placed between the dies. The movable die, J, actuated by the lever, G, then closes and firmly holds the blank until the head is formed by the heading ram, which is immediately set in motion. This operation completed, the same cam that brought the heading block forward strikes a tappet and carries it back. The dies open, the bolt is released and falls into a receptacle placed below; for countersunk, round button heads or rivets, the work is now done. For square or hexagonal heads, the blank is turned, one fourth for the former and one sixth for the latter, for a few turns, when a perfect head is forged, no flash or burr remaining to be dressed off. Very short bolts are headed on the rod and cut off to length by the shears.

Among the advantages claimed for this machine are the length of time which it can be run without repairs, and the provisions made in its construction to prevent breakage in event of an undue strain. It will be noticed that the toggle, H, bears the whole force of the grip, and should the operator, by accident or carelessness, get a blank foul in the dies, the toggle will bend and yield before a casting will break. It can be straightened and replaced, however, in a few moments, as it is but a piece of rough seven eighths round iron, with the ends slightly rounded, and of about four inches in length.

The castings are well fitted up with gun metal and steel, and the metal parts subjected to friction are chilled. The dies are of steel and are so constructed and held in position that they can be dressed down a great number of times. There are no cogs or springs, by the absence of which it is claimed that increased efficiency in many particulars is secured. No special implements are needed for the fabrication of the tools. As regards the amount and quality of work the apparatus is capable of performing, we are informed that, in ten hours, it makes 1,800 square headed bolts of one inch, or from 5,000 to 6,000 of one half inch in diameter, with other sizes in proportion. Experiments at the Cincinnati Exposition proved that one inch bolts, ten inches in length, could be turned out at the rate of eight per minute, or about as fast as they could be heated. For further particulars address the manufacturers, Messrs. Lewis, Oliver & Phillips, Nos. 91 and 92 Water street, Pittsburgh, Pa.



WALBRIDGE'S IMPROVED PLANER.

Pneumatic Foundations.

General W. S. Smith, of Maywood, Ill., recently read before the American Society of Civil Engineers, in this city, a paper on the subject of "Pneumatic Foundations," in which the following conclusions are deduced: In sinking the foundations, the greatest difficulties to be overcome are, first, in keeping the pile vertical; for this it should be made to follow the excavation, without a reduction of air pressure; and, secondly, in righting the pile when inclined; for this, wedging under the bottom, or propping the top on the lowermost side, and drilling through the uppermost side, are the best means yet tried. The "air lift" is the cheapest and most efficient method of removing sand or mud from within a pneumatic pile or caisson.

A strong and reliable pier can always be built of pneumatic piles; their number, diameter, and the thickness of metal, being determined by the conditions of the case. In cold climates, these piles may be fractured by frost, to prevent which a filling below the frost line, from two to five feet deep, of asphaltic concrete is recommended. Where suitable timber and stone are to be obtained at reasonable prices, a single pneumatic caisson can be sunk with greater certainty and at less cost than a pier of three or more pneumatic piles, where it has to be sunk for a considerable depth through a soft material to a hard one. A pier of masonry on such a wooden caisson, cellular, with its walls well drift bolted and its interior carefully filled with concrete or rubble, is the cheapest and best bridge foundation yet devised.

Concrete does not "set" well under air pressure; the water should be let in through a pipe inserted therefor in the cement, to cover the successive layers as put down; usually, cement five feet in depth will seal the pile, the remainder being added in the open air.

IMPROVED PLANER.

It is a fact well known to machinists and tool makers that, in order to insure correct work upon a planer, accurate ways are necessary. It is a common trouble, however, with machines having ways on top of the bed, that such portions, after oiling, become receptacles for dust, chips, and other substances swept from the table, which, as the latter passes to and fro, cause constant grinding and wear.

Our illustration represents a machine in which this difficulty is claimed to be obviated by the use of an arrangement of underneath ways, shown at A, which, while they are, by their construction, protected from dust and chips, allow of the table being made deeper, consequently stiffer, and therefore less liable to bend or lop when it runs off the bed. The device also admits of gibbing to prevent the gear raising the table or in planing underneath a flange. Another improved feature is the mode of constructing the uprights, which, instead of being flat bolted pieces, which often allow the tool and crosshead to dodge sideways when the latter is up to the top, are hollow pillars, and therefore much more rigid. They are supported by the braces, B, from bed to cap, the screws and shafts for raising and lowering passing through the centers.

For further information address the inventor, Mr. A. S. Walbridge, Mystic, Province of Quebec, Canada.

Vermilion.

To the uninitiated, the manufacture of color by chemical processes is one of those astounding mysteries which are most entrancing to witness. Take vermilion, for instance. By subjecting a mixture of quicksilver and sulphur, placed in strong retorts, to heat, a combination is formed, which produces a sulphuret of mercury or bright vermilion, in a powder, the shades varying in depth according to the heat.

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Contents.

(Illustrated articles are marked with an asterisk.)

IS THE EARTH THE ONLY INHABITED WORLD!

The idea that in other worlds life may exist in conditions widely different from those prevailing on this world in which we live, however plausible at first, becomes highly improbable when tested by the light shed on this subject by the accumulated knowledge of modern research in the fields of astronomy, geology, spectroscopy, and chemistry, especially that branch of the latter science pertaining to organic compounds. Thus it has been suggested that—granted even that when the temperature of the moon, and other satellites of planets has been cooled to such a degree as to freeze all water—living creatures may exist there, having a liquid in their arteries and veins as uncongealable as mercury, glycerin, alcohol, etc.; or, inversely—granted that the planet Jupiter is red hot, and the sun much hotter—living beings may exist, consisting of fireproof materials, and of such an organization as to feel happy and comfortable in an atmosphere of superheated steam, as in Jupiter, or even while swimming on a surface of melted lava, surrounded by an atmosphere of white hot iron vapor, as would be the case in the sun.

Astronomy, now so powerfully aided by the modern tools of the scientist, having proved that the terrestrial elements exist throughout the whole universe, only differently distributed, and chemistry having studied the behavior of these elements under extremes of temperature, we know now that the possibilities of the existence of organic life are comparatively within very narrow limits and confined to a range of not much beyond 100° among the 6000° or 8000° to which our investigations have extended. We have learned that the wonderful properties of that common but most marvelous substance, carbon, aided by liquid water, at a temperature below 110°, are the absolute and essential conditions which make the development and continuation of life a possibility. Without these, no life can exist.

It may be objected that in other worlds there may be another substance, as effective in its function as carbon in our regions, and that therefore we cannot make any conclusion as to the necessity of carbon for the existence of life. In order to meet this argument, let us consider the properties of carbon, which, by modern scientists, has rightly been called the great organizer.

A substance, in order to take the place of carbon in the economy of organized existence, must be able to combine in different proportions with itself, to form a complex molecule, in order to enter again into complex combinations. It must exist as a solid, but also easily pass into the atmospheric condition by combination with another substance, equivalent to oxygen, so that all vegetation may be surrounded by an atmosphere containing carbon in such a state that the plant may obtain it, and complete, with this substance as a solid basis, its organic tissues. We may go on and sum up other conditions which this supposed substitute of carbon would have to fulfill, in order to take its place; but then we should in the end be driven to the conclusion that a substance which possesses all the properties of carbon would be carbon itself. But now comes the spectroscope and teaches us that even the comets consist chiefly of carbon dust, and that their purpose may be to supply the planetary atmospheres from time to time with some of this necessary element, when sweeping close along them, as is often the case.

As the latest investigations prove the identity of the elementary matter in our whole planetary system (and this even extends to a great number of the fixed stars), we can come to no other conclusion than to accept a unity of chemical operations, of crystalization, cell building, organic growth, and organic life in general, of course greatly modified in accordance with the conditions of gravitation, atmospheric pressure, distribution of elementary matter on surface, and especially of temperature. If now we look carefully on all the conditions required to make life possible on the surface of a planet, we see that these conditions are very complex, that not only the elementary matter, possessing the different required qualities must be present, but also in the exact relative quantities, in order not to annul the results of this distribution. Let us, for an example, only consider the amount of hydrogen present on our earth's surface. We know that nearly all of this element is combined with oxygen, forming the extensive oceans, rivers, lakes, clouds and moisture in general; in fact, the only source from which we can obtain this element is by decomposing water. This compound is indeed burnt up hydrogen, and this burning up, of course, took place at an early geological period of our earth's history. Therefore all the hydrogen has thus been burned up, consuming an equivalent amount of oxygen; and the latter now forms eighty-eight per cent of all the terrestrial water. But suppose that there had been some more hydrogen, just enough to combine with the small portion of oxygen (21 per cent) contained in the atmosphere; the result of the combustion would then have been some more water in the ocean, raising its surface only a few feet, while no oxygen would have been left in the atmosphere. In this case, life would have been simply impossible, and the earth would now be desolate. It would be easy to adduce other instances proving how complex the conditions of life are, and how improbable it is that all these conditions are fulfilled everywhere at once.

We conclude, then, that our earth is a highly distinguished planet, at present favored above hundreds and perhaps above thousands with conditions which have not alone rendered the existence of vegetable and animal life possible, but developed it to the highest stage of organic existence: namely, civilized and enlightened human races, able to investigate and discuss the highest problems in the universe, which are the laws of its creation, progress and ultimate purposes.

A NEW RULE IN RESPECT TO CAVEATS.

Among the recent decisions of Commissioner Leggett is one restricting the descriptive matter contained in caveats. For instance, in machinery for making lightning rods of a peculiar pattern, the inventor describes the peculiarity of the rod, and the new machinery for its manufacture. Whereupon the Commissioner of Patents decides that the machine and the product of the machine shall be classed as separate inventions, and that, before the papers submitted for caveat can be filed, the party must elect which invention he wishes protected by the caveat, and the description of the other invention must be struck out.

It has been a common practice of the Patent Office to require a model of the machine used in the manufacture of the *article* on which a patent is sought, and it is not unusual for the office to grant under a single application a patent which covers both the machine and the article. The following are a few examples of patents thus granted, and many others might be cited.

J. S. and T. B. Atterbury, September 15, 1868: glassware. Process, mold and article. J. Treat, April 7, 1868: volute spring. Method and article. J. Hobart, August 4, 1868: volute spring. Method and article. G. Hopson, January 7, 1873: spring heads. Method and article. Theo. E. Harris, November 14, 1871: shingle straps. Machine and article. S. N. Smith, September 13, 1870: shoe stays. Machine and article. W. Acheson and W. H. Ridley, May 28, 1872: manufacture of hoes. Machine and article. Thomas C. Croven, May 21, 1872: gin teeth. Method and article. J. C. Richardson, June 15, 1869: fork blanks. Method and article. C. T. Beebe, December 19, 1871: barn forks. Method and article. Jacob Reese, July 10, 1869: bands for shingle machines. Machine and article. Wm. A. Lewis, October 10, 1871: wagon axles. Dies and article. Wm. H. Knowles, June 27, 1871: carriage clip. Dies and article. Wm. B. Smith, August 9, 1870: shackle blanks. Dies and article. Jas. P. Thorp, September 18, 1866: shaft shackles. Dies and article. H. M. Beecher, September 12, 1871: carriage clip. Machine and article. T. Diebold, December 10, 1872: jeweller's stock. Machine and article. E. Waters, July 9, 1861: manufacture of paper boxes. Machine and article.

Now if both machine and article may be patented under one patent fee, they may legitimately be caveated under one caveat fee. The Commissioner's new decision is evidently erroneous, and from it, we trust, he will gracefully recede. The patent laws were not formed for the purpose of exacting double fees or drawing revenue from inventors, but to encourage them in making original discoveries by granting to them every reasonable facility in securing, for a limited period, the fruits of their inventions. The present decision is contrary to the spirit of the laws. It imposes additional burdens, and needlessly multiplies official ceremonies in the simple business of filing a caveat.

OPENING OF THE VIENNA EXPOSITION.

The formal opening of the Vienna Exposition took place on the 1st of May. In spite of the overcast and threatening weather, at an early hour a vast crowd thronged the avenues leading to the great edifice, and, when the twenty doors were thrown open, surged into the immense hall, filling every available space. The scene is described as one of wonderful impressiveness and grandeur; the motley costumes of the multitude, representative of almost every nation, the brilliant decorations of the throne and the gigantic proportions of the building together forming a spectacle of imposing magnificence.

At noon the Emperor of Austria, with the Empress, the Crown Prince of Germany, the Prince of Wales and other royal guests, with the high officials of the empire, arrived and were received with a tremendous popular ovation. The Arch-Duke Charles Louis, Patron of the Exposition, opened the proceedings by delivering an address, which was responded to by the Emperor, who, in a few words from the throne, welcomed the visiting nations and declared the Exposition open. Other speeches, by the President of the Imperial Council and the Burgomaster of Vienna, concluded the ceremonies, when the Imperial party made a tour of the building and departed.

As is usually the case in great fairs, the preparations for the opening day were far from complete. The bare frescoed walls were covered with an oozing dampness and but very few of the exhibits had been finally arranged in their places. Many were still covered with their cases and wrappings, and in nearly all the departments confusion and misplacement seemed to be the general rule. The American section was closed and is described by a correspondent as "looking battered and dingy, like an abandoned railway town on the plains." Even our flag was ominously hoisted with the union down. Judging from the mismanagement which has characterized the doings of the suspended commission and the obstacles in shape of inexperience and the absence of records with which the body which has superseded it in its labors has had to contend, a not much better condition of affairs could have been anticipated. As matters now stand, the new officials, aided by the exhibitors, are doing all possible to organize and complete the United States arrangements. The displaced commissioners protest vehemently against the summary action of the government and assert their innocence of the charges. A recent cable dispatch exonerates all the members but two, but no definite details of the offences alleged, or the evidence sustaining the same, have as yet been received.

As regards the probability of the United States, through the various causes which have occurred to discourage exhibitors and produce other unfortunate results, falling below other nationalities in the variety and magnitude of its representation, we do not acquiesce in the desponding view taken by many of our contemporaries. Already some seven hundred exhibitors have entered goods; and even if more do not take advantage of the month's extension of time granted by the Director of the Exposition, enough to fill up our allotted space, the country will be fully represented by large numbers of the articles contributed by other nations. It is a well known fact that nearly all of the most important American inventions are manufactured extensively abroad, and the quantity and variety of these, which are sure to be displayed, even if made by foreign workmen, will be ample to demonstrate to the world the industrial genius and advanced progress of our people.

A NEW SPECIFIC FOR RHEUMATISM.

Rheumatism, notwithstanding that it is one of the most obstinate diseases, some forms of which baffle the skill of the most eminent physicians, is, from a medical point of view, highly interesting; the late Dr. Valentine Mott used even to say that "it is one of the beauties of rheumatism that it shows itself in such a great variety of forms." It is a fact well known among the medical profession that many rheumatic patients, in the impatience produced by their affliction, change from one physician to another; at length the disease has run its course, the patient gets well, and the last doctor whom they then happen to have, earns the credit of the cure.

Without intending to trespass on the domain of the physician, it may be well to give, for the benefit of all, some information concerning the nature and treatment of this malady.

As it is a constitutional disease, proper diet and close attention to the general health are of more benefit than local applications, which may be useful in exceptional cases, but generally they give only temporary relief, and often drive the pain from one part of the body to another. In all cases of this disease, the blood is in an abnormal condition, and may be considered to be poisoned; persons who live high (which means, live on rich and highly nitrogenized food) are apt to have this disease in a peculiar form, which is commonly called gout, of which the chief seat is in the joints. A lower mode of diet is then advisable. Persons who live low and get this disease by exposure, combined with over fatigue, are apt to suffer from the so called chronic form chiefly seated in the muscles, and in these cases, the system may suffer from one of two opposite causes, an excess of either alkali or acid, which, when neutralized, ends the disease. Hence the curious and formerly unexplained fact that sometimes acid treatment, as with lemon juice, and at other times alkaline treatment, as with Rochelle salt, etc., has produced a cure.

There is one very severe form of rheumatism called acute or inflammatory, which is a most formidable disease, and which in olden times was treated by blood letting. This disease has the remarkable feature of suddenly leaving one part of the body to appear in another. If, by blood letting, the heart receives a sudden shock by the withdrawal of a quantity of blood, the malady is very apt to settle there and produce disease of the heart, which is a very common cause of death among persons who once have been treated for rheumatism by blood letting. The latter operation relieves the patient; but, considering the often fatal results, it is now abandoned by all enlightened physicians, and the treatment by colchicum wine and opiates is used instead. Besides the derivatives of opium, morphine and codeine (see page 273 of our current volume), sal ammoniac has been often praised as an effective remedy when others failed; but perhaps these derive their efficiency from their similarity to a new substance, a derivative of opium and ammonia, which has recently been found as effective a specific against rheumatism as quinine is against fever and ague. This substance is propylamin. It is a volatile, watery liquid, with a strong odor of herring pickle, and was found by Dr. Winckler in distilling a watery extract of ergot with potassa, also in distilling cod liver oil with ammonia. But the most effective way of obtaining this substance is that of Wertheim, who prepared it by the decomposition of narcotine and codeine by alkalies. Its name is based on its chemical composition; it is a combination of the third member of the hydrocarbon series (methyl, ethyl, propyl, amyl, etc.) with a derivative of the ammonia (amidogen, mentioned on pages 20 and 144 of our current volume). There is, however, still some doubt about its true chemical composition, so that some chemists suppose it to be trimethylamin; in the mean time, its specific effect on most forms of rheumatism has been established. By taking five drops in a tablespoonful of peppermint water every two hours, the pains usually abate after twelve doses.

NATURE AND ART--THE MYSTERY OF THE MAGNETO-ELECTRIC MACHINE.

In the SCIENTIFIC AMERICAN, volume XVI, page 406, we quoted from an English contemporary a description of the electric machine of Professor Wheatstone; and a reader, who evidently preserves his copies of our paper, requests us to explain the action of that class of machines more fully.

The development of a current of electricity by a machine without either a voltaic battery or preëxisting magnetism as its primary source is so remarkable that our correspondent is justified in viewing it with wonder and in considering the mystery to be equal to that of the Giffard injector, described on page 48, current volume, and we are justified in the endeavor to make its operation clear.

The generation of electrical currents by the relative motion of a conductor and a magnet was discovered many years ago, the earliest known "magneto-electric machine" being constructed in 1832 by Pixie; and improvements were made by Ritchie, Saxton, Clarke, Henry and others, all of whom used permanent magnets, in front of which they rotated bobbins wound with conducting wire, covered with silk or other material to secure proper insulation of the several portions of the wire from each other. Subsequently, Siemens devised an improved form of bobbin, on which the wire was wound longitudinally, instead of transversely. This invention is a cylinder of soft iron having deep grooves cut on opposite sides, and the two grooves are connected at each end by similar transverse cuts. The insulated wire, forming the conductor, is wound upon the core in these grooves, and lies buried in the cylinder, confined by three or more bands; a brass disk, at one end, carries the commutator, by means of which the currents, which reverse their direction at each half revolution of the bobbin, are so sorted out that the same external wire always conducts from the machine a current of the same kind while the machine continues in motion in one direction, the positive currents going through one conductor and the negative through the other.

This form of bobbin allows the use of a large number of small magnets, side by side, in place of one very large; and since small magnets are far more powerful in proportion to their magnitude than large ones, it follows that the Siemens armature allows the machine to be made far more efficient.

The next important step in the improvement of these machines was made by a British inventor, Mr. Wilde, who constructed machines of, until his time, unprecedented power. Instead of using directly, the induced current of electricity, which he obtained from the permanent magnets, he led it through the coils of great electro-magnets, thus producing a new set of magnets, for induction, of immensely greater power. This current, obtained from the new "magnetic battery," was, in one instance, used in a similar manner upon a still larger electro-magnet, and this process of intensifying the power of the machine could of course be carried to any extent. The current generated in the armature of the last set of electro-magnets was applied to the production of light or heat, or in electro-plating, as might be desired. From the largest of Mr. Wilde's machines, a powerful electric light and tremendous heating effects were obtained. This machine had coils 4 feet high and 10 inches thick on the large electro-magnet, the coils containing 1,400 pounds of copper wire. The armatures were driven by a steam engine of 15 horse power.

The electric light obtained from the machine was so powerful as to cause the flame of the street lamps of Manchester, (England) to cast a shadow at the distance of a quarter of a mile (London *Athenæum*). The heat could be felt at a distance of 50 yards, and long wires and thick rods of iron, a foot long and two tenths of an inch in diameter, were raised to a white heat and melted by the current. A rod of platinum, the most infusible of all metals, was melted down. Several of these machines were used, or proposed to be used, in foreign lighthouses, but the expense of the apparatus and of its accompanying steam engine, as well as the necessary skilled attendance, were serious objections.

The well known electrician, Moses G. Farmer, in a letter addressed to us and published in the SCIENTIFIC AMERICAN, pointed out the fact that, could this method of producing light be perfected so far as to avoid the loss of more than three fourths of the energy condensed in each pound of coal, the electric light would cost but about one tenth of a mill, per candle power per hour. He estimates that a pound of coal carbon, converted into light without loss, would, if burned in one hour, yield a light equal to that of 12,410 candles.

It is evident that inventors who are familiar with the science of electricity have before them a field in which they can labor with profit to the world, if not to themselves, and we expect ere long to see the pound of coal which, consumed in one hour today, gives us about 15 or 20 candles, made to surrender a much larger percentage of the figure, given above as possible.

Improvements in the construction of the magneto-electric machine have progressed as described, but a single step remained to be taken to bring it to the latest form now known, is that which appears so mysterious in its operation.

Professor Wheatstone and Mr. Siemens both suggested, at about the same time, that, if a part of the induced current were diverted and made to excite a separate small electro-magnet, the latter might be substituted for the equally feeble permanent magnets, in which the whole energy of the apparatus originated, and thus a machine might be made of equal efficiency and without permanent magnets. Such a machine would, at first glance, seem very like a perpetual motion apparatus, and the scheme a most absurd one. The thing was done, however, by the invention of the Wheatstone-Siemens machine, as built by Mr. Ladd, of London. It consists simply of an electro-magnet, with a Siemens armature, containing two bobbins, of different sizes. The wire from the smaller bobbin connects with the electro-magnet, its current keeping that excited, while the current induced in the larger bobbin is used for other purposes as may be desired. The armature is driven at a high speed by means of a crank and a band wheel carried in bearings on the electro-magnet.

The electro-magnet almost invariably contains enough residual magnetism to start the action of the machine; and, during its operation, it simply furnishes an illustration of the conversion of the mechanical energy into electricity, light and heat. We cannot, however, as in the case of the Giffard injector, trace every step in the process with mathematical exactness; and the conversion of the one form of energy into the other is to us, and to men of science, as well one of those great mysteries of nature which we are every-day fathoming more and more deeply, and which still present as wonderful a depth of the unknown as ever.

THE MOVEMENTS OF THE STARS.

We are but upon the threshold of the vast store house of which that most wonderful of modern discoveries, the spectroscope, has given us the key. Each day brings us nearer and nearer to the solution of problems which have vexed the master minds of the world for centuries, and science is permitted to advance still further into the realms of the unknown, pressing closer upon those which it is impossible for the human mind to transcend. We have placed other worlds as it were in the balance and weighed them by our infinitesimal standards; by the aid of light originated when our earth was but an unpeopled mass, we have recognized the components and structures of orbs beside the magnitude of which we are as a grain of sand; we have determined and set bounds to the wanderings of the vagrant spheres which circle round our sun; extending further into the infinite, we have looked upon the nebulous chaos which was in the beginning, and lastly, armed with precepts drawn from analogy and theory, we have boldly traced, to a glimmering star in the Pleiades, the central point of our material universe.

With the erratic motion of the planets astronomers have long been familiar, and the name itself, derived from the Greek verb meaning to wander, was given in contradistinction to that of those stars to which the term "fixed" was applied. But later discovery overthrows this discrimination. The fixed stars are known no longer to be motionless, but to travel over distances so great and at such rapidity that the mind fails in their contemplation; and yet the observations of centuries have failed to detect real changes in position other than are extremely small—so minute indeed that only about 30 stars have, by astronomical calculation, been shown to have moved more than one second of arc annually, while in others a motion of but a few seconds in a century has been detected. In the year 1868 Mr. William Huggins, a noted English astronomer, while comparing the spectrum of Sirius with that of hydrogen, by means of a spectroscope of large dispersive power, found that a line on the stellar spectrum was displaced by about $\frac{1}{250}$ of an inch. This displacement occurring toward the red end of the spectrum, showed that the refrangibility of the light of Sirius was diminishing, as the red rays are the least refrangible. The star, therefore, was receding from the earth. Following out the calculation and allowing for the movement of our sphere, Mr. Huggins found that Sirius was moving through space, directly away from us, at the rate of 24½ miles per second, or, taking the resultant of this motion with the transverse movement of the star, previously observed and approximately calculated by other means, the real motion of Sirius was computed at 29 miles per second, or 900,000,000 miles per year, while its distance is estimated at over 128 trillions of miles—numbers of which we can obviously form no conception.

The want of instruments of sufficient delicacy and exactitude has until quite recently prevented further researches, but the necessary implements have at length been made, and we are in possession of the more accurate results. The motion of Sirius has been determined as less than that above given—22 instead of 29 miles per second—the difference being due to the more perfect instruments. Other stars, however, however, have also been examined and their movements relative to the earth fixed. The lines of sodium and magnesium were compared with similar lines which indicated the presence of these terrestrial substances in the spectrum of Betelgeuse, (*α Orionis*), and the star was found to be receding at a velocity of 22 miles per second. The spectrum of Rigel was compared with that of hydrogen and indicated also retrograde motion, of 15 miles per second. The double star Castor, Regulus, *β* and *δ Leonis*, *β, γ, δ, ε, ζ*, and *η* of the Great Bear, Spica, *α* in *Corona Borealis*, were all examined in connection with the spectrum of hydrogen and found to be receding at rates varying from 15 to 22 miles per second. In the case of the stars that appear to be approaching the earth, the velocity is much greater. Arcturus, the spectrum of which was compared with that of magnesium, travels at the rate of 55 miles per second: Vega at 50 miles; *α Cygni*, 39 miles; Pollux, 49 miles; *α* of the Great Bear, 61 miles; and *γ Leonis*, *ε Bootis*, *γ Cygni*, *α* and *γ Pegasi*, and *α Andromedæ* were undetermined. *γ Cassiopeiæ* is believed to have a very slow movement from the earth. In making the calculations the velocity of light was taken at 185,000 miles per second, and it is stated that the above given velocities, in relation to the movement of the stars relative to the earth, are equally true as to their motion in regard to the sun. It is interesting to notice that in general the stars which the spectroscope shows us are receding from the earth (Sirius, Betelgeuse, Rigel, Procyon) are situated in a region opposite to the constellation toward which the sun is advancing, while those near to the former (Arcturus, Vega and others) are approaching our globe. "There are, however," says Mr. Huggins, "exceptions to this rule:" and in his memoir to the Royal Society, he points out that the movement of the sun is not the only nor even the principal cause of the true or apparent motions of the stars. "It is hardly possible to doubt," he continues, "that the stars have two distinct motions, one common to all stars of a certain group, and another confined to each particular star. Remarkable examples of this fact are shown in the group *β, γ, δ, ε, ζ*, of the Great Bear, which have a common movement, while *α* and *η* of the same constellation have a proper motion in an opposite direction. Again and more remarkable is it that the five first mentioned stars recede from the earth, while *α* is approaching; and *η*, although apparently receding, is at too great a distance from *α* to permit us to consider the two stars in connection.

SCIENTIFIC AND PRACTICAL INFORMATION.

AN EXPERIMENT WITH PHOSPHATE OF LIME.

If a small quantity of phosphate of soda is added to a dilute solution of chloride of calcium, a white precipitate is formed which dissolves on stirring. The addition of more phosphate of soda forms a permanent precipitate; if now a current of carbonic acid gas be passed into the liquid in which the precipitate is suspended, the precipitate dissolves again, in the same way as carbonate of lime does in water containing excess of carbonic acid. The addition of a fresh quantity of phosphate of soda produces a fresh precipitate, which can be again dissolved by carbonic acid. There is, however, a limit to the operation, for having repeated it a few times, crystals form which do not dissolve, and which may be caught on a filter and washed. They consist of the bibasic phosphate of lime with four molecules of water of crystalization. If these crystals be put in water freed from carbonic acid by boiling, and frequently shaken for 24 hours, a salt is formed which contains three equivalents of phosphoric acid to four of carbonic acid (4 CaO, $3PO_5$): a salt richer in phosphoric acid than the bibasic salt with which we started, yet not so rich as a monobasic salt.

ACTION OF SULPHUROUS ACID UPON INSOLUBLE SULPHIDES.

Langlois having proved that alkaline sulphites are converted into hyposulphites by the action of sulphurous acid, another chemist named Guerout has repeated the experiment with the sulphides of other metals, and finds that the sulphides of copper, silver, gold, platinum, and mercury are not attacked. The sulphides of manganese, zinc, and iron readily dissolve in a strong solution of sulphurous acid, being at the same time converted into hyposulphites. The sulphides of cobalt, nickel, cadmium, bismuth, tin, arsenic, and antimony are slightly soluble and undergo the same change into hyposulphites; varying quantities of sulphuretted hydrogen are evolved, and sulphur separates. Further experiments, however, indicate that the sulphides are not converted directly into hyposulphites, but are first converted into sulphites which are afterwards changed into hyposulphites.

This easy and rapid method of preparing hyposulphite of iron, zinc, etc., having been discovered, it remains to apply it to new and important uses, and such we doubt not will soon be found.

THE PHOTO-HELIOGRAPH.

A correspondent of the *Photographic Bulletin* describes a new instrument made by Dallmeyer, of England, and called the photo-heliograph. It is to be used during the coming transit of Venus, and consists in a telescope, mounted for photography, about eight feet in length and having an object glass of four inches in diameter and five feet focal length. At the focus is placed an instantaneous shutter which serves to increase or diminish an aperture, behind which is placed a combination of lenses, corrected for the chemical rays. The image passing through is enlarged to four inches. The instrument is mounted on an equatorial stand and actuated by suitable clock work. Five have been ordered by the British government, to be supplied to the different observing stations.

OZONE.

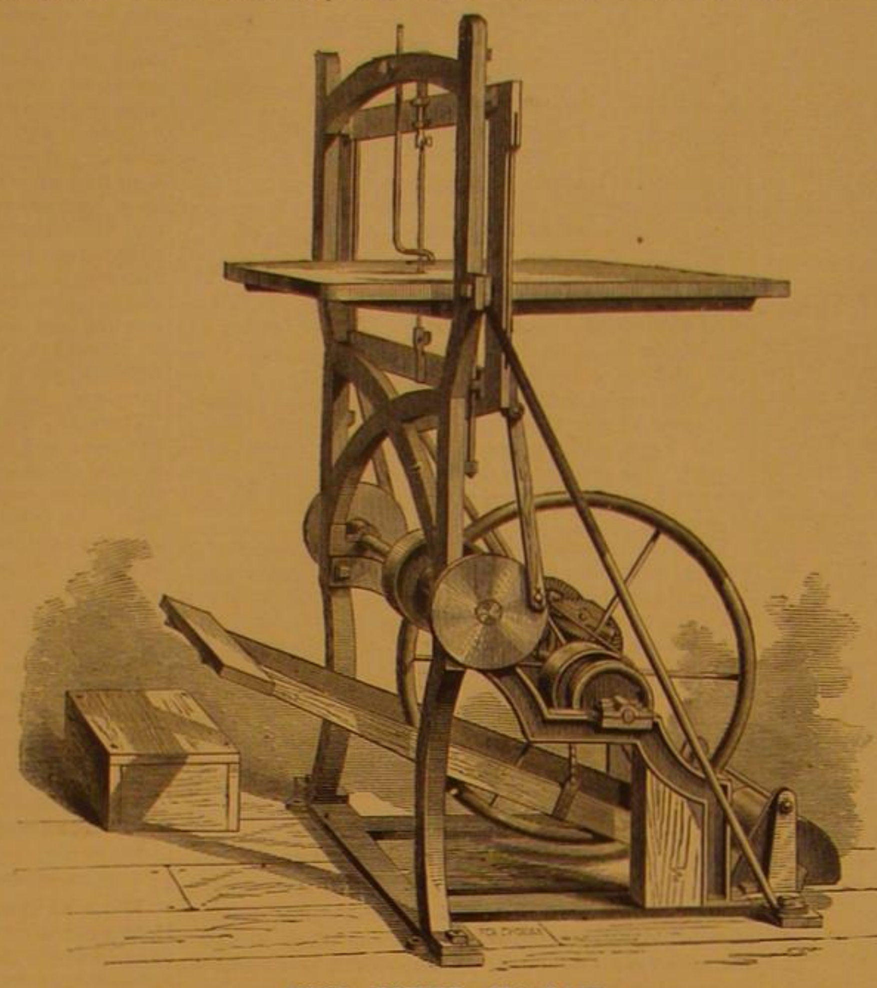
M. Boillot, on submitting pure oxygen and atmospheric oxygen alternately to the action of the electric current, has discovered that 58 cubic inches of pure oxygen yields but ¼ of a grain of ozone, while the same amount of atmospheric oxygen gives ½ of a grain. Oxygen mingled in the air is therefore in a condition more favorable for its transformation into ozone.

FOOT POWER JIG SAW.

It will be remembered that, towards the beginning of the present volume, we presented an application of the "vertical multiplier" to the band saw. We now lay before our readers still another arrangement of the same ingenious and labor-saving device, this time, however, in connection with the jig saw.

The machine is fully represented in our illustration; and as a detailed explanation of the multiplier, without the aid of which the operation by foot power of the saws to which it is applied would be practically impossible, can be found in Volumes XXII. and XXVI. of this journal, we have only in the present article to refer to the general capabilities of the invention. Forty steps of the treadle produce 546 and a fraction movements of the saw; or, in other words, the motion transmitted by the gearing is as 1 to 13·6, about. At a trial in our presence the blade made its way through work of two inches in thickness, hard ash wood, with great rapidity, and was actuated by the sawyer merely throwing his weight upon the treadle, a motion which, we were informed, could be continued for a long period without fatigue.

This device, as indeed are all applications of the multiplier, is especially designed to meet the wants of shops in which there is no steam power. It occupies but two and a half by three and a half feet of floor space, has two feet swing, is four and a half feet high, and is strong and durably constructed. The low price at which the manufacturers offer it will render it particularly adaptable to the needs of amateurs and mechanics and cabinetmakers. For further particulars address the Combined Power Company, No. 23 Dey street, New York city.



FOOT POWER JIG SAW.

Uses of Bisulphide of Carbon.

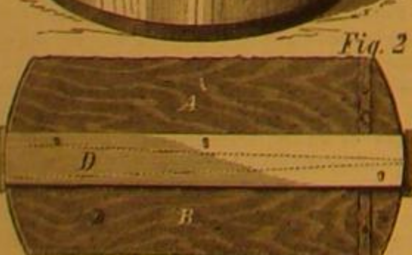
Until the year 1850, the only industrial application of bisulphide of carbon was the dissolution and vulcanization of india rubber. Since that time it has been applied to the following uses: 1. The complete extraction of the fatty matter from bones used in the fabrication of bone black. 2. The extraction of oil from grain and olives. 3. The removal of sulphur from earth in which it is contained and also bitumen from bituminous rocks. 4. The scouring and elimination of greasy substance from wool by the Seyferth and similar processes. 5. The extraction of the soluble principle of spices. 6. The fabrication of yellow prussiate of potash, and of sulphocyanide of ammonium, for making Pharaoh's serpents. 7. The preparation of Greek fire; a solution of phosphorus in the bisulphide is used for filling inflammatory rockets or shells. 8. For silver plating; a small quantity placed in the bath increases the brilliancy of the deposit. 9. For the destruction of vermin. 10. For filling glass prisms, on account of the brilliancy of the colors of its spectrum. 11. For driving by its vapor all classes of engines, with or without expansion.

TAYLOR'S PATENT FIRKIN HEAD.

Our engraving represents an improved firkin head which

Fig. 1

Fig. 2



is claimed to save cooperage and to facilitate inspection of the contents, a fact of importance when the latter contains butter, fruit, or other perishable substance. It is depicted in the illustration as applied to a butter keg, which may be thus caused to serve as a "return pail," an especially advantageous arrangement for shippers and commission merchants. The invention is equally adapted for barrels, etc.

The head consists of two pieces of wood, A and B, cut as indicated by the inner dotted lines in Fig. 2. At one end and underneath, they are connected by a strip of springy wood, C. To the piece, A, are secured the cleats, D, below and, E, above the device. The portion, B, is held only by the wood spring, C, and a single nail passing through both cleats, and shown at the right in Fig. 2, so that it is movable and may be brought nearer or further from the part, A, thus narrowing or widening the space between. On the upper side of this part, B, is pivoted a button, F, the inner end of which is rounded and takes against the edge of the cleat, E. By moving the outer extremity of the button, its inner end pushes upon the cleat, E, and thereby forces the two portions of the head apart.

To operate the device, a groove is previously made as usual, within the inner upper part of the barrel. The hand grasps the head, as shown in Fig. 1, the button, F, being turned parallel to the cleat, E, and the fingers pressing the parts, A and B, together. When the head is placed in the groove, it is expanded as above described by moving the button, F, so that it lies at right angles to the cleat, E. The edges of the cover are thus forced tightly into the groove, and the apparatus thus completely closes the barrel, effectually preventing the entrance of dirt or insects. A screw or nail through the outer end of the button, F, holds all the parts firmly in place during transportation. To remove the head, the operation above described is simply reversed.

Patented March 26, 1873. For further particulars relative to sale of rights, etc., address the manufacturers, Messrs. Taylor & Co., Ashland, Va.

The Loss of the Steamship Atlantic.

We continue to receive a multitudinous correspondence on this subject, and are pleased to find that our editorial, on page 241 of the current volume, has elicited the attention of inventors. We make the following extracts from letters received during the past few days:

F. D. J. suggests the construction of boats, one for each passenger, of rubber, with sides and ends of double material, air tight, with a tube for inflating the bag-like parts above the water line, all around the boat. Stationary ribs (of rubber?) could be stretched from gunwale to gunwale, and a passenger could secure himself in the boat, and be thrown into the sea or swim away from the wreck, and continue to float even when perfectly exhausted.

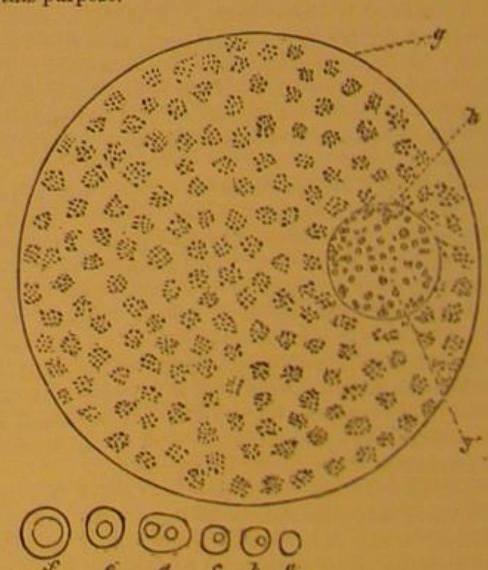
"A Riveter" speaks of the much vaunted water-tight compartments of which ship owners talk largely in advertisements. He worked in a ship-building yard at Port Glasgow, Scotland, for ten years, and he states that he has never seen a ship built with water-tight compartments. With regard to one vessel in particular, every one employed on her expected she would sink; and when finished, she sailed for India with a cargo of railroad iron and went down four days after leaving port. Another ship built in Glasgow, in 1865, was described by the men employed on her as "a coffin for somebody;" she was built of bad iron and badly put together. The correspondent has also worked on coal boats, built at Chester, Pennsylvania, which were constructed with poor materials and workmanship. He speaks highly of the metal used in iron boats built at Buffalo, but utterly condemns their workmanship. He also censures the building of the steamers of the American line from Philadelphia to Liverpool, stating that they are not well riveted, and that some of them are not caulked above water line, and that their bulkheads will not be water-tight. Putty is used in coating them, and the writer would not like to risk his life in the vessels.

J. L. G. dissents from our opinion that boats are not to be depended on, and would limit our statement to boats heretofore in use. He censures the lifeboats carried by ocean steamers, as they do not right and bale themselves instantly; and asks us to publish a description of any that fulfills these requirements. "But it may be said that the difficulty exists in launching the boat safely. Very truly, a life boat to be depended upon must have the capacity of launching itself; or, in other words, an officer must be able to launch the boat safely and instantly, with himself and several seamen in it, in any kind of sea, in such a way that there is no possibility of mishap either in crushing the boat against the side of the vessel, in swamping, or in carrying a line. Some four years since, another inventor and myself turned our attention to this subject, and, by costly experiments and great labor, finally succeeded in doing two things; the first was the production of such a boat and means of launching it, as above described in every respect, to the entire satisfaction of the Board of Supervising Inspectors of Steam Vessels, who said in their report that the boat was perfect in all that the inventors claimed for it. The second thing we accomplished, still more effectually, if possible, was to so thoroughly impoverish ourselves that any further inventions from us are out of the question, as is also pressing our invention into use: although its superiority is not questioned by any who see its operation, nor are we able to resist the attempt, that has been and is now being made by government officials, to appropriate the result of our labors to their own credit. From this showing, you will see that you are wrong in the last two sentences of the article referred to, that, 'after being invented and proved capable, the law is strong enough to compel its introduction into general use.'"

THE WONDERS OF THE EGG.—SECOND LECTURE.

[BY PROFESSOR AGASSIZ.—CONCLUSION.]

If we pass now to the bird, we find in the ovary eggs which can in no way be distinguished from those observed in the ovary of the mammal, only we find in the former a much larger number. Besides those very small ovarian eggs, there are larger ones—eggs rising to dimensions so considerable that they are not only visible to the naked eye, but may be handled with facility. A mature egg in the ovary of the hen is about the dimension of a small walnut. It has no shell, no white; but it is a bulk of yolk inclosed in a vitelline membrane, containing a germinative vesicle with germinative dots. The amount of yolk is very great. If we examine the yolk, we find that its whole substance is made up of cells. This fact at once suggests a further inquiry as to the constitution of the fluid contained in the vitelline egg of the mammalia. The question would be answered differently by different investigators. But unquestionably the mature ovarian egg of the bird differs from that of the mammal in the larger amount of yolk it contains, and in the fact that the whole mass of yolk consists in the accumulation of cells in such numbers that they are counted by myriads. These cells may be traced under the microscope. In absence of a well drawn hen's egg, I give a mature ovarian egg of the snapping turtle, which may answer for this purpose.



(a, b, c, d, e, f, Mesoblasts or contents of Purkinjean vesicle, magnified 100 diameters. g, Vitelline membrane. h, Purkinjean vesicle. i, Contents of Purkinjean vesicle.)

Suppose I should represent an ovarian egg of the hen enlarged so that the germinative vesicle alone would appear as large as a whole ovarian egg at the time of maturity: we should find that the whole of the yolk consists either in little granules or in little vesicles resembling each other so much as almost to force us to the conclusion that these vesicles are only granules which have swollen and become hollow. By the side of these smaller vesicles are others somewhat larger, containing themselves a vesicle and granule, that is to say, having the true character of ordinary cells. The whole mass of the yolk consists of such granular vesicles and true cells. The yolk is, in fact, an accumulation of cells in various stages of growth. This large yolk, this large ovarian egg of a hen, with its contents, was itself at one time so small as to escape the natural power of the human eye. We can place a portion of the ovary of the hen under the microscope and have at the same time in the field small eggs which cannot be seen with the natural eye and other eggs perceptible in different degrees; and we find that the smallest are just like the eggs of mammalia, containing a transparent fluid with granules floating in it, while others contain cells already to be distinguished, and others are full of cells so large as to make the whole mass opaque. The peculiar color of the hen's egg in all its stages leaves no doubt that the cells—at least those within the egg—are formed by the swelling of the yolk particles and their subsequent growth into larger vesicles containing a fluid in which the elements of a perfect cell are finally matured. We are certainly justified in saying that they are cells, and that the vitelline cells are of the number which arise from the enlargement of solid granules, these granules being animal particles secreted by the organs in which they arise.

At this stage of the ovarian egg, that is, when it has acquired the vitelline membrane, the germinative vesicle and germinative dot also acquire certain dimensions differing in different animals and are or may be fecundated. This fecundation consists in the contact of sperm cells with the yolk bag. What the influence of that contact is, nobody has been able to trace. (The way in which the spermatic particles reach and penetrate the egg we shall consider hereafter.) It is from that time that the changes date which lead toward the formation of a new being. But the egg of the hen when fecundated has not yet completed its growth. The hen's egg, as we know it, has a shell, and a delicate membrane lining the shell, and a layer of white albumen surrounding the yolk. All these parts are formed after the egg has been fecundated. So you see that the life of the egg, in this class of animals, is something independent, as it were, within certain limits, from the growth of these essential portions of the egg which lead to the formation of the new being. Why is it that the egg must be laid in that condition in order to lead more directly to the growth of the young: why it is that in the bird the germ lies dormant in the egg, after the egg has been laid, until a certain temperature is applied to it: I cannot explain, but those are conditions which always accompany the formation of the germ in birds, and its final development into a new being. In mammalia—to show you how great a contrast exists between these two classes—the ovarian egg is not dropped when the germ begins its growth, but is retained until the germ has acquired certain dimensions, a certain stage of development which varies according to species. Every one knows that our opossum brings forth young so delicate and so imperfectly developed that they require protection from the mother long after birth. They become attached to the teats of the female and hang there for a number of weeks before they are capable of shifting for themselves. Other animals are born already covered with hair, but are blind, as in the case of cats; while others are born so that they are capable of walking away at once, as is the case with horses or cattle. However great may be the similarity between the eggs of different animals, there are marked specific differences in their subsequent development. And these are not variable features; they are implied in the very existence of the species in which they occur. They are specific differences in the growth and development of animals, as characteristic as any ultimate differences in their adult condition. Let us now pass to the class of reptiles. The scaly reptiles—that is, turtles, lizards, and serpents—bring forth eggs similar to those of birds. They arise in the ovary in a similar way and produce by successive growth yolks of a similar bulk, as do the birds. While, however, all these eggs are surrounded with a shell after fecundation, the egg is not necessarily laid, as in birds, in order to bring forth the new being. The bird brings forth its young by incubation, setting upon the eggs, and transmitting to them by its own warmth the temperature needed for their final development. For the egg of the reptile, that temperature is usually derived from surrounding conditions. It is true that a few kinds of reptiles, the python for instance, set upon their eggs and transmit to them a higher temperature from their body; but this is not usually the case. Some reptiles deposit their eggs in the sand, where they are hatched out under the influence of the summer heat; others do not lay their eggs until the young have completed their growth, when the new being is born, and the egg shell afterward or about the same time. Others lay eggs from which the living young are hatched in a very short time. The European viper can readily be made to lay its eggs or to retain them and bring forth living young, by a simple increase or diminution of the temperature to which it is exposed at a certain stage in the growth of the germ. The egg-laying animals are called oviparous; but those reptiles which bring forth living young are as much oviparous as the rest, for the process of growth is the same, whether the egg is hatched out in the mother or not. The other reptiles, such as frogs and salamanders, spawn. That is, they lay eggs of small dimensions in large numbers, surrounded only by the albuminous envelope, without a shell, and these eggs are fecundated after they are laid. You see here what a marked difference there is between those naked reptiles and the scaly reptiles. On account of this and other differences, they have been separated into two classes—the scaly reptiles as reptiles proper, and the naked reptiles as batrachians or amphibians.

When we pass to the eggs of fish, we find there marked differences also, and the most striking are those to which I have already alluded, among the sharks, skates and chimeras, the eggs of which are enveloped in a horny covering, formed after fecundation. We have among these animals the same differences as obtain among scaly reptiles, namely, that with some the egg is laid, and the process of hatching takes place a considerable period after the laying, while in others the egg is not laid until the young has completed its growth and may be born in a condition capable of swimming.

EGG OF THE CALLORHYNCHUS.

I will show you some of these curious eggs. This is an egg of the callorhynchus, the central part of which is pea shaped or cylindrical, as is the cavity in which the yolk is contained, and there is a flat appendage to the egg case by which the egg is enabled to attach itself to submarine bodies. In a good many of the sharks and skates, as already remarked, the egg is not laid before the young has completed its growth and so far completed it as to have acquired its full form. The yolk may then hang like a bag below the body, and be gradually absorbed into it, serving as nourishment for the young until it entirely disappears. [This was illustrated in the last lecture, page 276.] You may see here the intimate connection which exists between the egg and the embryo, and you may that say the embryo grows out of the yolk. In those animals which have coverings or shells protecting the yolk, there are always peculiar organs to secrete these cases. In sharks and skates, for instance, there is a peculiar gland upon the track of the oviduct in which the egg envelope is formed. The egg is received in the sack in which it is first surrounded by only half the shell case, then the other half is formed, and the egg is complete.

STEVENS INSTITUTE LECTURES.—GOLD MINING IN CALIFORNIA.

BY PROFESSOR SILLIMAN.

The third lecture of the spring course before the Stevens Institute of Technology was by Professor Silliman, of Yale College, on the "Dead Rivers of the Sierra Nevada and Hydraulic Mining for Gold." He began by describing the characteristics of the country, along the line of the Union Pacific Railroad, through which the traveler passes in his journey to the gold regions of the far West. Our notions of the Rocky Mountains receive a rude shock on beholding the almost insensible slope which leads us for more than 800 miles along the valley of the River Platte, where the ascent is not over 12, 14 or 16 feet to the mile, and we advance towards the summit without being aware of mounting unless we have perchance an aneroid barometer to tell us so. Yet our government was induced to pay a subsidy of $16,000 per mile for the construction of the Union Pacific Railroad on account of imaginary difficulties. This was as far as Cheyenne, where, it was agreed, the Rocky Mountains really began. From that place to the Black Hills, the subsidy amounted to $32,000 a mile; but the traveler, unaided by the barometer, would be utterly unable to discover the fact that he was not upon a level plain. Passing through the Great American Desert, we come to the continental divide at Sherman, about 9,000 feet above the sea level, to the head waters of the Green River, and arrive in the plain of the Great Salt Lake, joining the Central Pacific at Ogden, still over 4,000 feet above the level of the sea. On examining the sloping banks of the great basin before us, we can distinctly trace the successive outlines of the ancient shores of the great inland sea, which must have risen about 1,200 feet above the present level, and whose waters, by concentration of their saline matter, have produced the present Salt Lake. Continuing our journey, we pass lofty ranges of mountains, some of them 10,000 feet high and running parallel in a northeastern and southwestern direction. Finally we come to the majestic snow-capped wall of the Sierra Nevada, which separates us from the Pacific Ocean. This region we find characterized by precipitous ascents, majestic pine forests and deep cañons. Here we meet with real engineering difficulties. In a country where a slight fall of snow is 16 feet and a heavy one 100 feet deep, and where huge avalanches slide down the rocks, the railroad tracks have to be protected by means of snow sheds of solid timber, which, however, as effectually shut out the view from the passenger as though he were a letter in a mail bag. Smooth and rounded rocks everywhere bear witness to the action of glaciers, which existed there on a vast scale. Along these rugged mountains, the perseverance of the early miners constructed roads for the transportation of all the necessaries of life to the seemingly inaccessible regions where their claims lay, and these roads will ever be monuments to their herculean energy.

In one of the basins left by an ancient glacier, is situated that magnificent sheet of water known as Lake Tahoe. So clear are its waters that fish can be seen swimming in it at a depth of fifty feet, and the photograph exhibited upon the screen by the lecturer clearly showed the boulders on the bottom. Von Schmidt has contrived a plan to supply San Francisco with water from this lake, whose surface is over 6,000 feet above the level of the Pacific.

Passing, in our downward course, through the Bloomer Cut, we see rising above us on both sides huge walls of gold-bearing gravel; but gold is present in such small quantities that a cubic yard scarcely yields over twenty cents' worth. Before considering the means by which even so small a proportion is made to pay, the lecturer threw on the screen pictures of the early methods employed by the California miners. At first, a pick, a shovel, an iron pan and a rifle were all the necessary outfit, and the gold seeker would take his panful of gravel to the nearest running water. Here the gravel was washed out and the grains of gold, which sank quickly to the bottom of the pan by reason of their greatly superior weight, were gathered. Sometimes the gravel was winnowed in a blanket, where water was scarce. The first improvement was to separate the coarse from the fine by means of a rocking sieve, through which running water washed the gold into a trough beneath filled partly with quicksilver. The gold combined with this, and the sand was carried off by the water. When enough gold was collected in the quicksilver, it was strained through a buckskin bag, and then the gold which remained in the bag was separated from the remaining portion of the mercury by heat.

It soon struck the more intelligent miners that they were only gleaning in a field where nature herself had reaped before; that the streams of water in those regions had been cutting their way through auriferous rock and washing it on a grand scale; and that, by turning these rivers from their course, they would find the results of nature's washings. This grand conception was carried out in many instances, and the professor's views upon the screen amply illustrated the immense labor expended in the construction of ditches for turning rivers from their course and laying dry their former beds. The water of the rivers being forced into a narrower channel accumulated sufficient force to drive water wheels for pumping out the deep places of the river beds and laying bare the accumulated treasures.

When we come to the valley of Dutch Flat, we see for the first time extensive operations for the working of deep lying hill diggings or "placers." Enormous amounts of money have been expended in bringing from a distance the water power which is so necessary everywhere for the washing of the gravel. Sometimes flumes or aqueducts were constructed, 140 feet high upon timber, each stick of which represented the full length of a mountain pine. Water companies were formed, which derived enormous incomes from the rents paid by miners to whose placers the water was distributed. Now, however, the precarious wooden structures have been replaced by huge pipes of boiler plate iron; and with the supply from these, the miner washes out the gravel of his claim clear down to the solid rock, using what is called the "water gun," a knuckle-joint nozzle throwing a solid stream six inches in diameter for a distance of 200 feet, with about one tenth the velocity of a cannon ball. The washed out gravel is no longer sifted by hand; it passes along its natural course with the water through sluices made of wooden blocks and furnished with quicksilver, into which the gold rapidly sinks, while the sand moves on.

The lecturer then cast upon the screen a drawing of the famous Table Mountain of Calaveras, whose steep walls reminded me of the Palisades. This flat mountain is composed of basaltic rock, filling up the channel of an ancient river which formerly rolled over golden sands. The Table Mountain may be considered as nature's monument to this "dead river." The hidden river channel was discovered by some of the earlier miners; and, by a divination which was almost inspired, these untaught men formed correct notions as to the geological character of the mountain, and expended thousands of dollars in getting at the gold on the river bottoms by means of laboriously constructed tunnels through the hard rock.

The deposits of auriferous gravel are so vast in extent as to be almost inexhaustible; but so small is the percentage of the gold they contain that the adventurer no longer finds any chance of getting rich quickly, and the deposits can be worked profitably only by associate capital, where a legitimate outlay of money will bring a legitimate return.

The lecture was profusely illustrated by means of views upon the screen.

SCIENCE RECORD.—NEW EDITION.

The first editions of 1872 and 1873 having both become exhausted, a new edition of each has just been published. The demand for the work has been very great, and universal praise has been bestowed upon it. Condensed descriptions and engravings of the most important inventions and discoveries in science in the years 1871-2, with steel plate portraits and biographies of a number of men distinguished in science, are contained in these annuals, of over 500 pages each. Price by mail, cloth, $2.00; library binding, $2.50. In ordering, state for which year. Price for both, when ordered together, cloth, $3.75; library, $4.50. Address Munn & Co., publishers, office SCIENTIFIC AMERICAN.

OIL OF VITRIOL.—The manufacture of Nordhausen sulphuric acid is still going on in Bohemia, at the works of Von Starcu, where large quantities of iron pyrites are transformed into so called "stone of vitriol," from which the oil of vitriol is derived by distillation in clay retorts. About 1,500 tuns are annually produced

PAPER MAKING.

Mr. Carl Hofmann, of 406 Walnut street, Philadelphia, late superintendent of paper mills in Germany and in this country, has recently published a valuable and exhaustive work on the manufacture of paper. He has not only drawn upon a long practical experience for his facts, but has gathered an immense amount of information by visiting all the prominent paper mills in the United States. The work, the price of which is $15, will doubtless form a complete guide for those desiring to build mills, as it contains descriptions and engravings of every variety of new and improved machinery, prepared in many instances with the elaboration of working drawings. We cull from its pages the following interesting particulars:

STRAW PAPER.

One of the best articles of this description is made by the Manchester Paper Manufacturing Company, near Poughkeepsie, N. Y. Rye straw, delivered by farmers from the adjoining country in perfectly clean bundles, is exclusively used. It is first chopped in pieces of about three fourths of an inch in length, by means of a cutter, during which operation all weeds and impurities are removed by hand. Cleaning, to get rid of grain and dust, follows, and then the straw is passed through a pair of heavy iron press rolls, which open out the tubes and knots. It is then passed into horizontal rotary boilers, in each of which is sixty gallons of a solution of caustic soda for every hundred pounds of straw. These boilers are walled in, heated by direct fire to a pressure of about sixty pounds above the atmosphere, and kept so for six or eight hours. The stuff is discharged into a tub with a drawer bottom, where the liquor is washed out, and thence to a chest serving as a reservoir to a Kingsland engine, in which any knots or bundles of fiber, which may remain, are completely removed. It is then conducted into drainers, where it remains until dry, when it passes to an ordinary washing engine, in which it is rewashed, bleached with a solution of chloride of lime, and sent to a second set of drainers. Mixing with size, color, and clay follows, then another passage through a Kingsland engine, and, lastly, the material is run over a Fourdrinier paper machine.

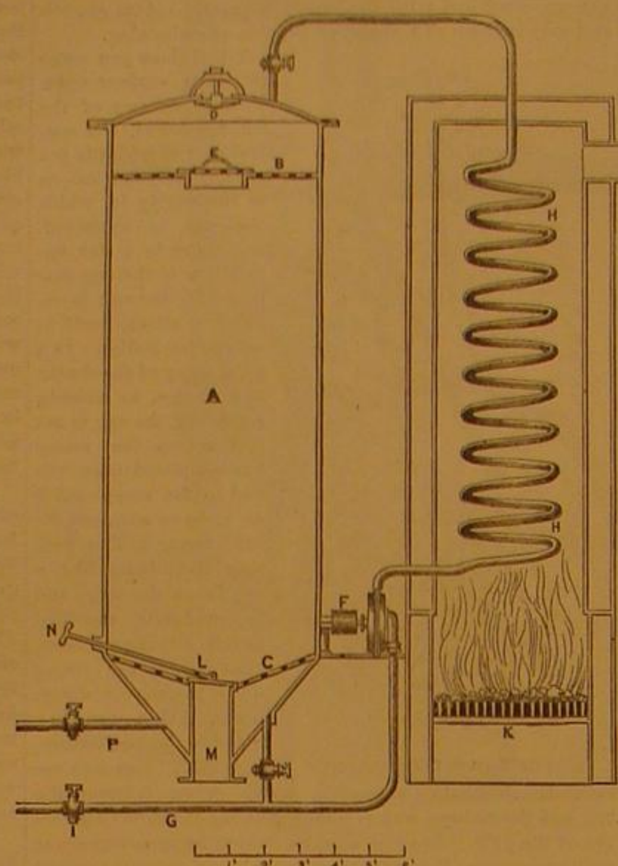
The paper made by this process is soft, clean, and white, and finds a ready market for book printing. Since the works of the company above referred to have been reconstructed, superheated steam is used instead of direct fire in the boilers. Nearly fifty per cent of paper from straw and sixty per cent from esparto is obtained. This is a very extraordinary yield, as it is the experience of many manufacturers that not over thirty-three per cent in good white paper can be obtained from straw in the rough condition in which it is received at the mills. The author considers that there are but two ways in which fifty per cent of white paper can be obtained from straw alone: either by the production of paper of inferior quality, containing much of the inter-cellular matters, or by not counting the clay and size which have been added in sufficient quantity to make up for the lost fibers.

STRAW BOILER.

We select from the pages of the work under examination the accompanying engraving of Dixon's straw boiler, which, the author states, has been found practically successful. The boiler, A, is cylindrical, stands upright, and is carried by flanges riveted to the shell in any desired place and supported on solid framework or walls. It is located so that its upper part projects a few feet above the floor, where the straw is stored, and a man standing there can easily open the man hole, D, lift the cover, E, from a corresponding opening in the upper diaphragm, B, and fill the boiler through them alternately with straw and caustic liquor. The straw, which has been previously cut, is supported by the lower funnel-shaped diaphragm, C, and broken down to such an extent while being packed in, that a boiler of six feet diameter and fifteen feet hight between diaphragms will hold from 4,000 to 4,500 lbs. A rotary pump, F, fed from the liquor tank through the pipe, G, forces the balance of the caustic solution through the coil, H, to the top of the boiler above the diaphragm, B; and after the apportioned quantity has been pumped in, the communication with the tank is cut off by closing the stop cock, I. The caustic solution percolates through the straw, collects under the diaphragm, C, and returns through pipe, G, to the pump, F, which forces it again through the coil and on top of the diaphragm, B. The coil, H, is made of extra heavy two inch wrought iron pipe, placed in a brick furnace and heated from the grate, K. The steam which is thereby raised creates a pressure which can be regulated by the fire, and observed on gages and safety valves connected with the upper part of the boiler. The boiling being finished, the slide valve, L, is opened by means of the handle, N, from the outside, when the contents empty themselves through the channel, M, into the chest or tank below. A pipe, connecting with the steam boiler, enters below the diaphragm, C, and is opened whenever the compact mass of straw requires to be loosened; it is also used before the circulation of the liquor is retarded, and facilitates percolation, as the steam penetrates through and raises the straw bodily.

WOOD PAPER.

The new works of the American Wood Paper Company, at Manayunk, Pa., have a capacity of fifteen tuns of white wood pulp per day. The material is brought to the works as cord wood of five feet length. It is first cut into thin slices of about half inch thickness, and then by large steel knives chopped into small pieces, forty cords being thus treated daily. The material is then boiled with a solution of caustic soda in upright boilers, heated by steam circulated through a jacket, and in which it is confined between perforated diaphragms. To every two boilers is connected, by a capacious pipe, a large sheet iron cylinder, which receives their contents, pulp, liquor, and steam. The liquid solution of pulp flows from these receptacles to flat iron drainers mounted on wheels, each of which is large enough to hold the contents of one boiler. The tracks on which these cars run are underlaid with sewers which receive the

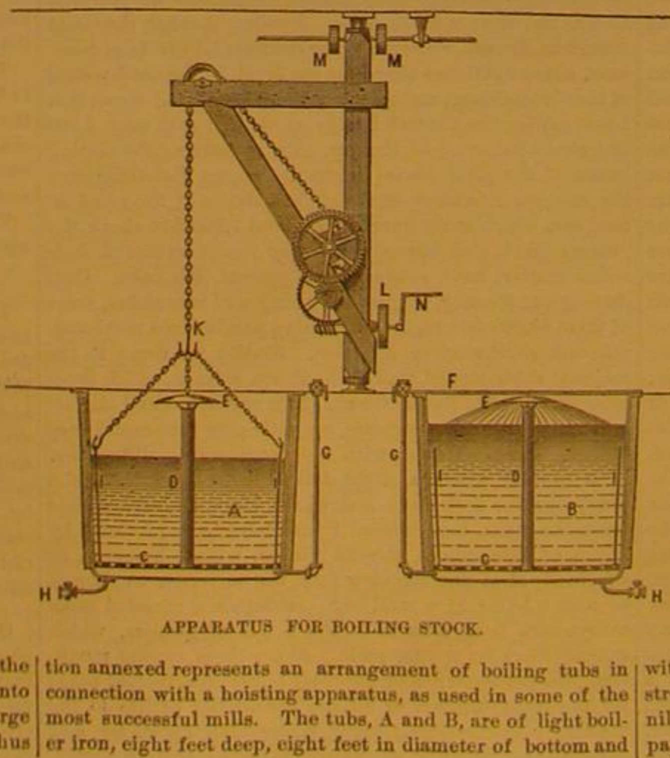


DIXON'S STRAW BOILER.

liquid as it drains off from the pulp. The latter then goes to washing engines, thence to stuff chests, and from there is forwarded by pumps to wet machines, the screens of which retain all impurities derived from knots, bark, and other sources, and the pulp or half stuff so obtained is perfectly clean and of a light gray color. It is bleached in engines with a solution of bleaching powders—like rags—emptied into drainers, and kept there from twenty-four to forty-eight hours. The liquid drained from the pulp is gathered in the pipes under the track and evaporated to regain the soda. The finished pulp is of soft white spongy fiber, and, mixed with rags, is worked into book and fine print paper. Poplar furnishes very white fibers, and is preferred to other woods. Its fibers are, however, short, so that it is often found expedient to mix them with those of spruce or pine. The author adds a tabular statement of the per centage of pulp in different kinds of woods, in which we find that hemlock has 45 per cent, the largest proportion, then dry walnut, 42 per cent, and least of all, lignum vitæ, 15·8 and ebony, 14 per cent. About 28 per cent from young and 30 per cent from old poplar wood, one cord of which weighs from 2,800 to 3,400, lbs. is obtained at the Manayunk works.

BOILING STOCK.

After the materials for paper making are dusted and sorted, the next process is the extraction of ink and fat by boiling. Writing ink can be extracted with water alone, but a solution of soda is required for printing ink. Our illustration annexed represents an arrangement of boiling tubs in connection with a hoisting apparatus, as used in some of the most successful mills. The tubs, A and B, are of light boiler iron, eight feet deep, eight feet in diameter of bottom and eight and a half feet at the top, and are covered with a mantle of wood, which prevents the escape of heat. The false bottoms, C, are perforated, and carry in the center upright pipes, D, overtopped by bonnets, E. The steam enters from the pipe, G, into a coil (not shown) below the false bottom, from which it is evenly spread through all parts of the tub by means of a large number of small holes. The liquid can be drawn off through the pipe and valve, H. A flat iron cover, F, in one or two pieces, is laid over the top.



APPARATUS FOR BOILING STOCK.

The tub is first one quarter or one third filled with a solution of soda; steam is then turned on, and the liquid brought to the boiling point, when, rising through the pipe, D, it strikes against the bonnet, E, and is spread over the whole surface of the tub. As soon as this takes place, the papers are gradually thrown in so that all will be soaked before they reach their resting place. About 4,000 pounds of material can be placed in each tub, in which it is distributed as uniformly as possible.

After the mass is boiled, it is hoisted out by means of cranes. The false bottom, C, is fastened to a strong frame of iron bars and can be lifted clear of the tub by the hooks, K, which connect, by means of chains, with rings or hooks at the upper ends of the rods, I. The pulley, L, of the crane is then connected by a belt with the pulley, M, or the crank, N, is turned by hand, until the whole mass appears above the floor, when the crane is moved around on its pivot to a place where the false bottom can be deposited. Another spare false bottom can be at once attached to the hooks, K, lowered into the tub, and a new operation started. The papers come out as a solid mass, looking like a very large cheese, and the time of the operation varies from fifteen to twenty-four hours.

HOW "GREENBACK" PAPER IS MADE.

All the paper for the money issued by the Government is manufactured on a 62 inch Fourdrinier machine, at the Glen Mills, near West Chester, Pa. Short pieces of red silk are mixed with the pulp in the engine, and the finished stuff is conducted to the wire without passing through any screens, which might retain the silk threads. By an arrangement above the wire cloth, a shower of short pieces of fine blue silk thread is dropped in streaks upon the paper while it is being formed. The upper side, on which the blue silk is dropped, is the one used for the face of the notes, and, from the manner in which the threads are applied, must show them more distinctly than the lower or reverse side, although they are embedded deeply enough to remain fixed. The mill is guarded by officials night and day to prevent the abstraction of any paper.

PAPER BOARDS.

The largest manufactory of binders' boards in the country, and probably in the world, is W. O. Davey & Son's board mill, situated on Jersey City Hights, opposite New York city. The refuse of the oakum factory, which forms part of the establishment, and tarred ropes which cannot be otherwise utilized make up the hard stock. The ropes are cut into pieces by a machine like that used in machine shops for cutting sheet iron. The stock is not washed in engines but ground on elbow plates arranged in an effective and improved apparatus. Three cylinder machines are supplied, on which the pulp is transformed into boards of almost any thickness, which are afterwards subjected to five or ten minutes pressure in a hydraulic press. The boards are then placed in a peculiarly constructed heater which consists of a number of flat hollow plates of metal in which steam is admitted and between which the boards are arranged and allowed to remain until nearly dry. They are then removed to a drying house, which is warmed by steam pipes, and afterwards calendered. About four tuns of boards per day are produced at the above mill. Straw boards, which are now applied to a great number of uses, particularly paper car wheels, are formed, dried, and cut on machines like ordinary paper.

LEATHER BOARDS.

A very hard variety of boards is manufactured partly from leather clippings. The leather for this purpose is cut into small pieces like rags, reduced in the engine with about the same quantity of bagging and waste paper, and made into boards on a cylinder in the ordinary manner. The boards acquire the appearance and to some extent the properties of leather. The material requires considerable time for washing and grinding, and size is unnecessary in its manufacture.

OTHER VARIETIES AND USES OF PAPER.

Roofing paper is made principally from woolen rags mixed with a sufficient quantity of hard stock to give it the necessary strength. The material used is of a porous nature, and its quality depends upon the amount of tar, or similar substance, that it can absorb. Most of the processes of its manufacture are protected by patents. Parchment paper is made from unsized rag paper, the cellulose of which changes its nature if it is for a short time immersed in diluted sulphuric acid and then again well washed; it becomes tough, water tight and transparent, like animal parchment. Tobacco paper for cigarettes is produced by mixing manilla fibers with liquor in which tobacco stems are previously boiled. It burns when dry with a white ash, like a tobacco leaf, which it resembles closely. Cotton waste yields from 30 to 50 per cent of paper of an inferior quality, principally used for blotting. A bogus manilla paper is sometimes made from old wrapping paper and straw, colored with Venetian red in the engine. Real manilla fiber is the strongest known, but the supply is small, and so-called manilla paper is often made from butt ends of jute. Collar paper, for paper collars, is cotton and linen, with a large admixture of the former. Hemp bagging and a small proportion of cotton canvas are used for tissue paper, the fibers of which are very strong. For bank note paper only the best of white linen, imported from Scotland and Ireland, is used. The dried paper is passed through animal size and the sheets are pressed between fine paste board to give them a dead finish.

Sewing on Buttons.

That facetious editor of the *Danbury News*, whose funny sayings are so widely copied, thus describes the male process of sewing on buttons:

It is bad enough to see a bachelor sew on a button, but he is the embodiment of grace alongside of a married man. Necessity has compelled experience in the case of the former, but the latter has always depended upon some one else for the service, and, fortunately for the sake of society, it is rarely that he is obliged to resort to the needle himself. Sometimes the patient wife scalds her right hand, or runs a sliver under the nail of the index finger of that hand, and it is then that the man clutches the needle around the neck, and, forgetting to tie a knot in the thread, commences to put on the button. It is always in the morning, and from five to twenty minutes after he is expected to be down street. He lays the button exactly on the site of its predecessor, and pushes the needle through one eye, and draws the thread after, leaving about three inches of it sticking up for lee way. He says to himself: "Well, if women don't have the easiest time I ever see." Then he comes back the other way, and gets the needle through the cloth well enough, and lays himself out to find the eye, but in spite of a great deal of jabbing, the needle point persists in bucking against the solid parts of that button, and finally when he loses patience his fingers catch the thread, and that three inches he had left to hold the button slips through the eye in a twinkling, and the button rolls leisurely across the floor. He picks it up without a single remark, out of respect for his children, and makes another attempt to fasten it. This time when coming back with the needle he keeps both the thread and the button from slipping by covering them with his thumb, and it is out of regard for that part of him that he feels around for the eye in a very careful and judicious manner; but eventually losing his philosophy, as the search becomes more and more hopeless, he falls to jabbing about in a loose and savage manner, and it is just then the needle finds the opening, and comes up through the button and part way through his thumb with a celerity that no human ingenuity can guard against. Then he lays down the things, with a few familiar quotations, and presses the injured hand between his knees, and then holds it under his arm, and finally jambs it into his mouth, and all the while he prances about the floor and calls upon heaven and earth to witness that there has never been anything like it since the world was created, and howls, and whistles, and moans, and sobs. After a while he calms down, and puts on his pants, and fastens them together with a stick, and goes to his business a changed man.

Is Rowing Healthy?

Dr. J. E. Morgan has recently published, in England, a work entitled "University Oars," in which he considers the hygienic effects of the rowing contests which for the past forty years have been carried on between the great English colleges. The author is not only an eminent and scientific surgeon, but an oarsman himself of no small repute, so that his qualifications are in every respect adequate to the task which he undertakes. The plan pursued in compiling the facts is worthy of notice, on account of the immense labor it entailed in seeking out the men, who have rowed in these inter-university contests, wherever they might be and obtaining their verbal testimony if living, or that of their friends if dead, as to the results, entailed by work at the oar, upon their constitutions and frames: 294 men had thus to be discovered, and Dr. Morgan states that 245 were found to be living. The results elicited by his inquiries he tabulates as follows: Benefited by rowing, 115; uninjured, 162; injured, 17. The benefits considered are increase of strength and stamina, of energy to undertake, and of power to undergo physical exertion: increase of fortitude to encounter and to submit to trials and privations and disappointments. Those termed uninjured are men who state they have "never felt any inconvenience from rowing," while the injured all assert with more or less distinctness that their exertions have proved harmful. It is concluded, on an examination of the latter class and the nature of the evil results, that the proportion is very small when the number of men is taken into consideration, and that no other pastime, hunting, ball or cricket, would, if closely scrutinized, yield so small a percentage of harm.

AN IMPROVEMENT IN VENETIAN BLINDS.—A novel application of colored and ground glass, instead of wood or iron laths, for Venetian window blinds is worthy of notice. The glass strips are bound round with brass, to preserve their edges; and heavy blinds are simply wound up and down with something like a clock key. The play of colors may thus be managed so as to give beautiful effects: outside by night and inside by day, windows with these blinds affixed will look as if they were illuminated. These blinds, we need hardly say, are expensive, compared with those now generally used; but where cost is not a matter of chief consideration, they are likely to be appreciated.—*Hardware, Metals and Machinery.*

WHAT an ass the fellow must have been who made a donkey engine and expected to get horse power out of it!

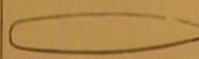
Correspondence.

The Proportions of Ocean Steamers.

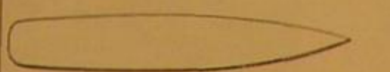
To the Editor of the Scientific American:

In view of the attention now being attracted to the exaggerated length of some of the steamers on the lines between this country and Europe, the annexed diagrams may be of interest sufficient to warrant publication. I have selected the individual ships from the different lines quite at random, and the figures used are taken from Hartshorne & King's "Register." WM. CUNNINGHAM.

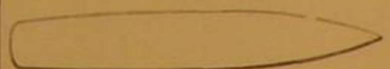
Baltimore, Md.



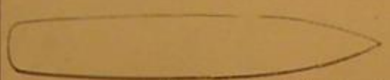
Baltimore, N. G. Lloyds' line—L. 185 ft., b. 29 ft.; length to breadth, 6·38.



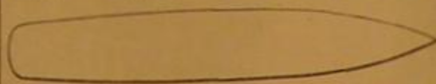
Peruvian, Allan line—L. 270 ft., b. 38 ft.; length to breadth, 7·11.



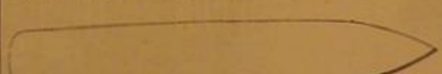
Moravian, Allan line—L. 290 ft., b. 39 ft.; length to breadth, 7·44.



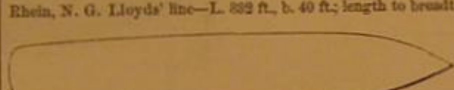
Leipzig, N. G. Lloyds' line—L. 290 ft., b. 39 ft.; length to breadth, 7·44.



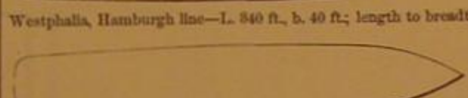
Minnesota, Williams & Guion line—L. 332 ft., b. 42 ft.; length to breadth, 7·90.



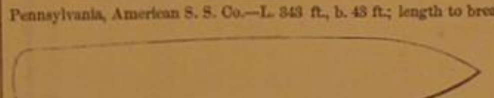
Rhein, N. G. Lloyds' line—L. 332 ft., b. 40 ft.; length to breadth, 8·30.



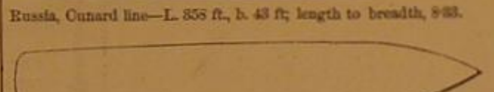
Westphalia, Hamburgh line—L. 340 ft., b. 40 ft.; length to breadth, 8·50.



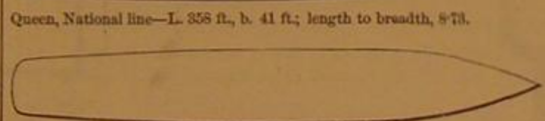
Pennsylvania, American S. S. Co.—L. 343 ft., b. 43 ft.; length to breadth, 7·91.



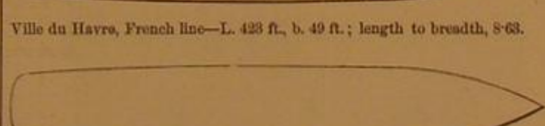
Russia, Cunard line—L. 358 ft., b. 43 ft; length to breadth, 8·33.



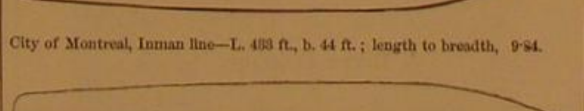
Queen, National line—L. 358 ft., b. 41 ft.; length to breadth, 8·73.



Ville du Havre, French line—L. 423 ft., b. 49 ft.; length to breadth, 8·63.



City of Montreal, Inman line—L. 433 ft., b. 44 ft.; length to breadth, 9·84.



Atlantic, White Star line—Length 435 ft. beam 41 ft.; length to breadth, 10·61.

Appleton's has a timely article on the length of ocean steamers:

"It will be of interest to some to understand how it is that iron, which is between seven and eight times as heavy as the water in which it floats, is not only itself buoyed up, but is able to carry a considerable load in addition. If we place in the water a bar of iron eight feet long, six inches wide, and six inches deep, we know that it will sink at once. But let this bar be rolled into a thin plate sixteen feet long and twelve feet wide, and have an edge turned up all around, forming a box a foot in depth. If it then be placed in the water, it will require to be loaded with a weight of nearly eight thousand pounds before its top edge will sink to the water level. This is because water presses on the bottom of a body immersed in it with a force equal to the weight of the water that the body displaces by its immersion. It is easy to see then, that, with a given weight of material to be used in the construction of a vessel and a given load to be carried, it is only necessary to spread out the material so as to have sufficient surface for the water to press upon and buoy the vessel up.

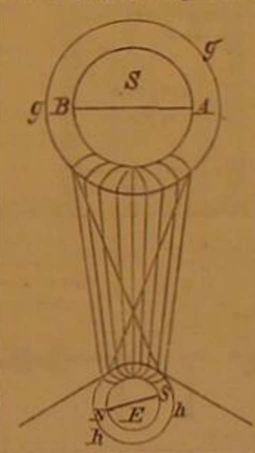
The use to which a vessel is to be subjected will have a great influence on the determination of the breadth. A ferry boat or river steamer, for example, which can have but a limited draft of water, and is loaded mostly above the deck, with varying weights on either side, is generally made of great breadth. A sailing vessel, which is to be propelled by the wind acting on the sails with great leverage, requires sufficient stability to counteract this force. An ocean steamer depending largely on its engine for propelling force and carrying but little sail in proportion to its size, with the greater part of the cargo below deck and with considerable draft of water, can have sufficient stability without great breadth. It is also easy to see that great breadth is far from desirable in an ocean steamer. If the width is great it will take a considerable disturbing force to "heel" the vessel, and it will right itself with great violence also, or, in other words, it will roll very heavily. This can be observed in the case of ferry boats and river steamers, which are occasionally subjected to forces causing them to roll. It seems impossible to build a vessel for ocean service that will not roll under certain circumstances, and it is desirable, especially in the case of passenger steamers, that this rolling motion should be made as easy as possible, and hence great breadth should not be given."

The Concentration of the Sun's Heat upon the Earth's Surface.

To the Editor of the Scientific American:

The usual explanations of the method by which the earth is heated by the sun are unsatisfactory. By many persons the sun is considered to be an incandescent body, diffusing radiant heat; but, while approaching a heated substance the sensation of heat is usually increased, on leaving the earth's surface, to approach the sun, a feeling of intense cold is soon perceived. Neither can the heat on the earth's surface be accounted for on the supposition that the heat rays are reradiated; because, on a hot day, a thin screen interposed between the person and the sun greatly diminishes the sensation of heat.

I think it may be accounted for by the fact that the atmosphere is a lens, whose tendency is to concentrate the rays of heat on that part of the earth's surface which is nearest the sun. This is a lens (convexo-concave) of peculiar refracting power. Its density continually increases from the convex to the concave surface. A ray of heat, then, on entering the atmosphere will be continually passing from a rarer into a denser medium, and will consequently follow a curved line, bending towards the axis of the lens.



S is the sun; B A, its axis; *g g*, its atmosphere; E, the earth; N S, its axis; *h h*, its atmosphere. It is supposed to be winter in the northern hemisphere.

But the atmosphere is also a good reflector; consequently many rays which strike the air at an acute angle will be thrown off, and thus add to the intensity of winter.

If the sun has an atmosphere, the converse of all this would apply to rays leaving his surface. Consequently it would not be necessary that the heating and illuminating substance of the sun should occupy his whole surface, in order that the whole disk should appear illuminated to us. An equatorial belt would suffice.

If these views are correct, the warmth of the surfaces of the planets need not be affected by their relative distances from the sun, and Jupiter and Mercury may have the same degree of heat as the earth.

Newton's explanation of the movements of the solar system is probably correct in theory, but it is deficient in one important particular: it fails to account for the motive power. The attraction of gravitation we all understand; but what is the counteracting force? An original impulse will not answer, for a transient force cannot successfully contend with a constant force of anything like equal intensity. I do not believe that attraction of gravitation is simply due to mass, otherwise a body would weigh heavier at the poles, where there is no opposing force, than it does at the equator. I think that the analogy of magnetic attraction, which depends more on surface, affords the best solution. An equatorial current of magnetism, then, sweeping round the sun from west to east in the plane of the ecliptic, with immense velocity, would account for the motion of the planets in their orbits, and of the sun on its axis. Such a current is no more inconceivable than is the attraction of gravitation, which acts at such great distances and with such vast power. W. F. QUIMBY.

Wilmington, Del.

Clarifying Water.

To the Editor of the Scientific American:

I noticed in your issue of April 5, an article on water in Kansas city, in which you call for a plan for clearin the water of the Missouri river. I think the following would prove successful:

Let there be a reservoir and clarifying tank constructed, the tank on higher ground than the reservoir. Then pump the tank full of water, and put dissolved alum into the water, say at the rate of one pound of alum to twenty-five barrels of water. This will cause the impurities to settle to the bottom; the clear water can then be drawn off into the reservoir, the tank cleaned and the operation repeated. Perhaps it would be best to have two tanks, so that one could be filled while the other was setling. I think this plan will prove successful unless the alum in the water should prove to be unhealthy; and even if it could not be used for cooking and drinking purposes, it could be used for washing instead of the sooty water now used. HARVEY RAY.

COUNTRY HOMES—RURAL COTTAGES.

Homes in most new villages, such as are continually springing up in all parts of the country, lack both taste and convenience in their ornamentation and arrangement. We present herewith a few designs which, though capable of execution at no great cost, show what may be done to make a cottage home an object of beauty and refined taste. Our engravings are selected from a large number in the pages of Downing's "Cottage Residences," an excellent work published by John Wiley & Son, of New York city, which will be found more fully noticed elsewhere in this paper. The object in view in designing the cottage represented in our first illustration (Figs. 9 and 10) is internal convenience. There are many families, some composed of invalids or persons advanced in years, who have a strong preference for a plan giving the kitchen and at least one bedroom upon the

A Cottage in the English or Rural Gothic Style.

Fig. 9.

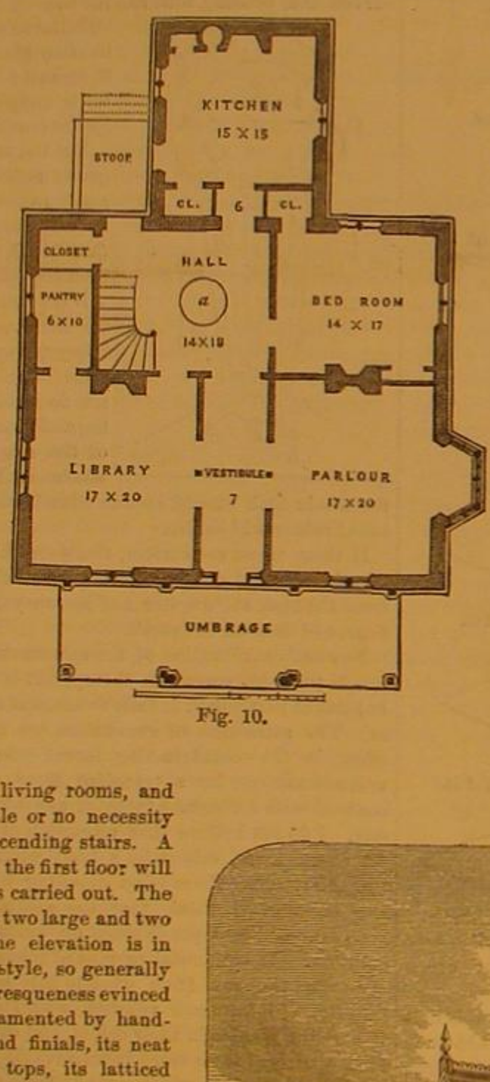
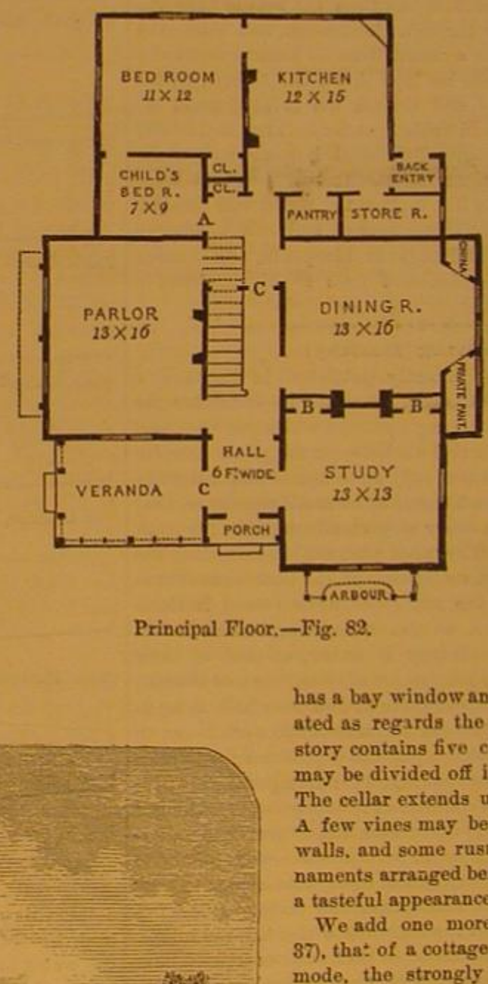


Fig. 10.

A Cottage for a Country Clergyman.

Fig. 81.



Principal Floor.—Fig. 82.

same floor with the living rooms, and in which there is little or no necessity for ascending or descending stairs. A glance at the plan of the first floor will show how this idea is carried out. The second story contains two large and two small bedrooms. The elevation is in the English cottage style, so generally admired for the picturesqueness evinced in its tall gables ornamented by handsome verge boards and finials, its neat or fanciful chimney tops, its latticed windows and other striking features. The material for the construction is brick and cement, colored in imitation of Bath or Portland stone, or smooth brick colored after some soft neutral tint. The window frames, porch, veranda and verge board may be painted the same as the walls, and sanded or else grained in imitation of oak. About an acre and a quarter of ground would be a suitable plot for this dwelling. One half of the area in the rear might be devoted to a garden for fruits and vegetables, and the remainder laid out as a lawn with shrubbery and flower beds.

In our second design (Figs. 81 and 82), a very tasteful and pretty cottage, suitable for a country clergyman, is represented. Here there is a conveniently arranged study opening directly on the veranda, a parlor, dining room, and other apartments, all on the first floor. Above are five good bedrooms with a closet in each. For the exterior of the cottage, to be covered with vertical boarding, a simple rustic style has been chosen. The veranda and trellises over the windows are intended for vines, not merely as supports, but rather as thereby giving an air of rural refinement and poetry to the house without expense. They should be constructed of cedar poles with the bark on, and, if neatly put together, will be much more becoming to such a cottage than the most elaborate carpentry work.

The design headed "a river cottage" (Fig. 132) is, as its name indicates, a very pretty Gothic dwelling intended to be located on the bank of a river or sheet of water. It has, therefore, a road front and a water front; the former having the entrance porch extended out beyond the line of the house, to answer the purpose of a *porte-cochere*, and the latter provided with an ample veranda, connected with the lower lawn by a flight of steps. There is a basement, and above, on the first floor, a large parlor with a bay window to command the view, and also dining room, library, etc. The second story contains six rooms. The walls of the basement are of stone, above which the building is of wood filled in with brick. The detail of the finish, both on the exterior and interior, is intended to be plain, leaving the good effect to depend rather upon well balanced proportions than embellishment.

In the next engraving (Figs. 105 and 106) we present a plan for a plain house where abundance of room is more of an object than elaborate ornamentation. The decorations are few and simple, and in keeping with the general effect of the structure. The veranda at the entrance is very broad, and the entrance hall large and roomy. The dining room

A River Cottage.

Fig. 132.

has a bay window and is conveniently situated as regards the kitchen. The second story contains five chambers, and the attic may be divided off into three large rooms. The cellar extends under the whole house. A few vines may be trained to climb the walls, and some rustic vases and other ornaments arranged before the front will give a tasteful appearance to the building.

We add one more design (Figs. 36 and 37), that of a cottage villa in the bracketed mode, the strongly marked character of which is derived mainly from the bold projection of the roof, supported by ornamental brackets, and from the employment of brackets for supports in various other parts of the building. This mode of construction will be found especially suitable in the Southern States, owing to the coolness and dryness of the upper story during hot weather, afforded by the shade of the peculiar shaped roof. On the second floor are five bed rooms. There is a handsome balcony which is entered upon from a casement window at the ends of the hall in this story, shaded by the broad overhanging roof, and two balconies which accompany, in a similar manner, the large windows in the two chambers at either side of this hall. There are three chambers in the attic story. In the basement story, which is raised about three and a half feet above the ground, are kitchen, laundry, store room, and cellar. The materials for

A PLAIN HOUSE.

Fig. 105.

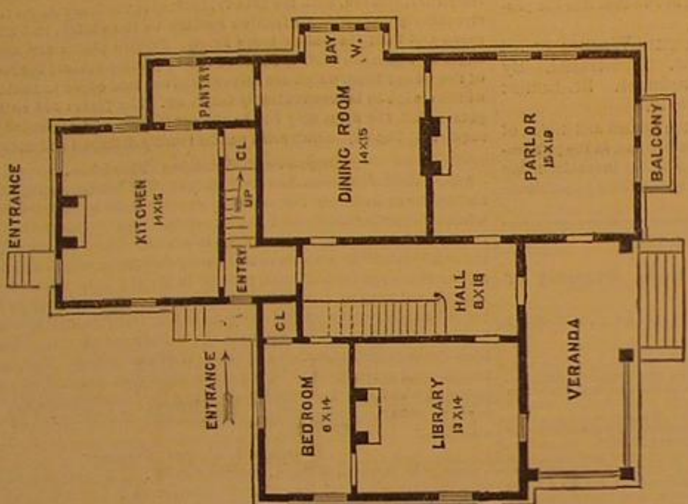


Fig. 106.

A COTTAGE VILLA IN THE BRACKETED MODE.

Fig. 36

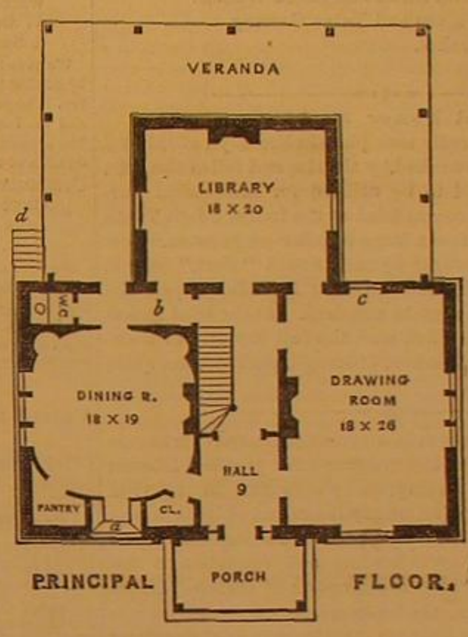


Fig. 37.

construction are brick and stucco or simply wood—the latter being employed with excellent effect.

FRUIT FORK.

This invention is designed to afford a means of conveniently holding ripe fruit, so that in eating the same the juice will not soil the fingers or come in contact with clothes or carpet. It consists of a fork having a suitable number of prongs, of proper length and shape, which project from the middle of a bowl in which the liquid flowing from the fruit is caught. A handle is connected with the lower side or, if desired, with one edge of the cup.

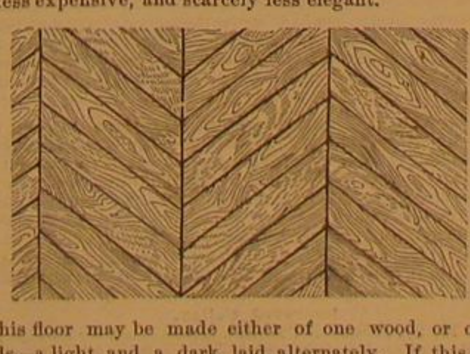
The device may be made of silver plate of any tasteful pattern, and form a very convenient and handsome article of table ware.

It was patented on February 18, 1873, by Mrs. Isabella C. Draper, of corner of 106th street and Third avenue, New York.

Substitute for Carpets.

With properly laid floors, carpets may easily be dispensed with altogether for four or five months in the year in the extreme Northern States, and much longer in the South. With merely a plain floor, a small hall or a small room may be made to look very pretty indeed, and even elegant, by means of a good sized piece of carpet, with a handsome border in the center, and a few rugs displayed here and there. In almost any hall a rug or two will alone be necessary, either for comfort or ornament, if the walls or ceilings are properly decorated, and sufficient furniture of good pattern and a few pleasing pictures are introduced. The following is a style of parquetry that is elegant enough for any house, large or small. It is of course more costly than ordinary flooring, but it is not beyond the reach of persons of moderate means, especially if they conclude to economize in the matter of carpets.

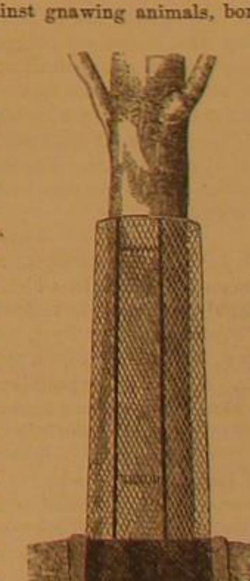
Even this, however, may involve an outlay that some cannot afford, and we accordingly suggest the following as being less expensive, and scarcely less elegant.



This floor may be made either of one wood, or of two kinds—a light and a dark laid alternately. If this is too costly, and a variety is still desired, every alternate board may be stained, so as to look very nearly as well as genuine dark wood. Such a floor as this, smoothly planed and well oiled, is very stylish, and is not difficult to keep clean—indeed, so far as cleanliness is concerned, an uncovered floor has many advantages over a carpeted one. In Europe parquetry floors are polished by being frequently rubbed with wax, and they are much more beautiful when treated in that manner than they are when simply oiled. We need not expect, however, that waxed floors will be common in this country until the servant girl problem is nearer a satisfactory solution than it appears to be at present.—*To-Day.*

TREE PROTECTOR.

Mr. Charles Ayers, of Farmington Center, Wis., has recently patented the device shown in our illustration, for protecting the bark of trees against gnawing animals, boring insects, and the worms which climb and destroy leaves and branches. The invention consists in a wrapper of wire gauze or other reticulated substance, provided with ribs inside to rest against the tree, holding it therefrom, so as to allow a space for the circulation of the air. This envelope is made large enough to overlap considerably, so as to allow of the growth of the tree, and is held together by elastic fastenings. The lower end is sunk a few inches into the ground and packed with wood ashes. For a short distance above the surface, a coating of tar or other adhesive material is applied, to which insects will stick fast. Above the tar, the wire is painted to protect it from the weather.



This device will be appreciated by all farmers and nurserymen, to whom the beauty of the foliage of the trees and the immunity from damage of fruit are important considerations. Patented February 11, 1873.

M. ABERLIN, of Stockholm, places children afflicted with capillary bronchitis or croup in small rooms where there are vessels in which water is kept continually boiling. This treatment, it is stated, if prolonged for days or even weeks, eventually produces a cure. The mortality from the disease in Paris, *Les Mondes* says, has been thus reduced from 48 to 18 per cent.

LYE, OIL, and sugar is the latest patented compound to prevent boiler incrustation.

A. R. M. M. A.

The American Railway Master Mechanics' Association meets this year at Baltimore, Maryland, May 13. The subjects to be reported on and discussed are:

1. Locomotive Boiler Construction.
2. The Operation and Management of Locomotive Boilers, including the Purification of Water.
3. The Comparative Value of Anthracite Coal, Bituminous Coal and Wood for Generating Steam in Locomotives.
4. The Construction, Operation and Cost of Maintaining Continuous Train Brakes.
5. The Relative Cost of Operating Roads of Gages of 3 feet 6 inches or less, and those of the ordinary 4 feet 8½ inches Gage.
6. The Construction and Operation of Solid-end Connecting Rods for Locomotives.
7. Resistance of Trains on Straight and Curved Tracks, and on Wide and Narrow Gage Roads and with Four and Six Wheeled Trucks, and with Long and Short Wheel Bases.
8. The Efficiency of Check or Safety Chains on Engine, Tender and Car Trucks in Lessening the Danger Resulting from Running Off the Track.
9. The Machinery for Removing Snow from the Track.
10. The Machinery and Appliances for Supplying Fuel and Water to Locomotives.
11. The Machinery and Appliances for Removing Wrecks and Erecting Bridges.
12. The Best Form and Proportion of Axles for Cars and Locomotives, also whether there is anything to be gained by the use of Compound Axles and Loose Wheels.
13. Anti-Friction Valves and Valve Gearing.
14. Compression Brakes.
15. Steel Tires.

Tidal Power Machine.

A practical trial recently took place in Brooklyn of Edward W. Morton's machine worked by the rise and fall of the tide, the power thus derived to be utilized for mechanical purposes. The contrivance was tried at the foot of South Tenth street, East River, before a large number of persons interested. The machine works by means of a "float," which, as it rises and falls with the waves or the tide, propels the machinery to which it may be attached. At the trial it was geared to a saw, and worked with the full rapidity of a circular saw run by steam power, although, perhaps, not quite so uniformly.

Professor Henneberg, in a recent sanitary report made at Cassel, makes some observations of a practical interest with regard to water consumption by animals. In the vital process, the water perspiration (by lungs and skin) is in proportion to the water consumption. With increasing perspiration, moreover, there is an increased formation of carbonic acid, and (therefore) consumption of carbon. Hence the more water is taken, the less carbon containing food is utilized for nutrition. Further, the more water drunk by an animal, the more albumen is discharged by the urine. It is, on these accounts, uneconomical and injurious to give animals large quantities of water with their food, or to allow them to perspire in hot stables, etc. Bipeds as well as horses will take notice.

By a new railway law in Massachusetts, all roads communicating with Boston are obliged to run early morning and evening trains for the benefit of workmen, at reduced rates. The working men's train on the Eastern Railroad now runs six cars instead of two, with which it began. The only law of this kind in New York State is the clause contained in the charter of the Broadway Underground Railway, New York city, which fixes a low fare between the hours of 5 and 7, morning and evening.

The Japanese Government has founded a College of Engineers at Yeddo, in which natives of Japan are to be thoroughly instructed in technology and practical engineering. Professor Henry Dyer, formerly of the University of Glasgow, Scotland, has been appointed chief of the new institute. Several other prominent English professors are to assist him. Japan is making rapid strides in the acquisition of practical arts and knowledge.

The postal cars are to be run directly into the basement of the new Post Office building in Boston. The new Post Office building in New York was also constructed, so far as the basement portion is concerned, with special reference to the running of the postal cars over the Broadway Underground Railway, directly into the Post Office. The building has a front of three hundred and forty feet on Broadway.

At a convention in which twenty-seven trades' unions were represented, recently held in New York city, it was resolved to postpone the contemplated strike for eight hours until 1874.

A bill is before the New York legislature to authorize the formation of a corps of sappers and miners, with power to blow up buildings during an extensive conflagration.

A. Birney, of Jersey city, N. J., has patented a new mode of using coal dust as fuel. He blows it into the fire by air pressure, through perforations in the grate bars, which are hollow.

On Church Island, which stands in the middle of Salt Lake, some veins of copper ore have been discovered. If silver could only be found, the salt now wasted on the desert air might be made useful.

NEW BOOKS AND PUBLICATIONS.

Downing's Cottage Residences. By A. J. Downing. New Edition. Edited by George Harney, Architect, etc. Illustrated by numerous Engravings. New York: John Wiley & Son, 15 Astor Place.

On another page of the present issue, the reader will find a selection of cottage designs taken from this excellent work, which may be considered as specimens of the numerous finely executed engravings which embellish its pages. Many of the structures represented have been erected in various parts of the country, so that the author draws from actual experience for the advice and information which he gives relative to their proper construction. Each design—there are twenty-eight in all—is accompanied by plans and such other figures as are necessary to exhibit the details of the work, together with general specifications and builder's estimates of cost. In addition to describing the dwelling itself, the author furnishes valuable hints for laying out and decorating the adjoining grounds, giving plans of paths, roads, beds, &c., lists of flowers, shrubs and trees suitable to different localities, and, occasionally, sketches of rustic arbors, furniture, vases, and other articles of rural ornamentation. The volume is one which we do not doubt will prove a convenient and reliable hand book to all owners of country property desirous of learning how to improve and beautify the same in the cheapest and yet most effective manner. It is handsomely bound, finely printed on heavy paper, and is issued generally in the usual excellent style of the well known publishing house from which it emanates.

Protection against Fire, and the Best Means of Putting Out Fires: with Practical Suggestions for the Security of Life and Property. By Joseph Bird. New York: Hurd & Houghton. Cambridge: The Riverside Press.

We have received advance sheets of this work, in which many little known and interesting facts about fires are collected. The book, when published, may be read with interest by the whole community; and the suggestions in it, if not very original, are practical and have been, for the most part, tested in actual conflagrations.

The Poetry of Architecture: Cottage, Villa, etc. To which is added "Suggestions on Art." By Kata Phusin. With Numerous Illustrations. New York: John Wiley & Son, 15 Astor Place.

We have here an æsthetic treatise on the beauty and grace which may be, by skillful hands, given to the cheapest and lowliest forms of house building. The publishers attribute the authorship of the work to Mr. Ruskin: and the inimitable style in which it is written will justify the assertion. The originality of idea throughout the whole book shows that it is the production of a practical man and a practised writer.

Compound Metallic Columns, of either Wrought or Cast Iron, for Building Purposes. Illustrated. By John A. Kay, Architect and Civil Engineer. St. Louis: H. R. Hildreth, Olive and Second Streets.

We published, on page 47 of our current volume, the system and design of Mr. Kay's improvements in iron building. The author has, in the publication now before us, given an elaborate description of his inventions, and has added tables and data by which architects can adapt them to buildings of all sizes and for all purposes.

DECISIONS OF THE COURTS.

United States Circuit Court,---Southern District of New York.

PATENT FOR GLASS BUTTON.—ALBERT M. SMITH *vs.* WILLIAM W. MCFARLAN *et al.*—SAME *vs.* SAME.

[In Equity.—Before Judge Benedict.]

These were two causes, in which all the parties are glass manufacturers. The complainant claims to be the inventor of a new article of manufacture in the shape of a glass button with a metallic back, of wire cloth or perforated metal, for giving strength to the button. Letters patent were granted to him for this invention, as well as for another, consisting of a die and press for stamping these buttons out of molten glass, January 28, 1873. He claims that one of the defendants was a workman in his employ, and that he, after acquiring all the necessary knowledge about these buttons and presses, left the complainant's factory, and with the other defendant set up a rival manufactory of their own, in which they use presses and make buttons which infringe the complainant's patents. The cases came on, upon a motion for a preliminary injunction to restrain the defendants from using the presses and making the buttons which are claimed to infringe. The defense set up was that the grant of the complainant's patent was of too recent a date for him to have acquired the exclusive possession which the law requires, and that the defendants had made such changes, in the construction of their presses and buttons since the patents were issued, as to avoid the patented features. The proofs submitted by them established this state of facts to the satisfaction of the court, and the motion for an injunction in each case was denied.

J. W. Fisher, for complainant.
B. E. Valentine, for defendants.

Inventions Patented in England by Americans.

[Compiled from the Commissioners of Patents' Journal.]

From April 14 to April 17, 1873, inclusive.

Clipping Machine.—J. W. Guernsey, Winchester, Mass.
Cutting Screw Threads.—P. Hickey, Auburn, N.Y.
Equilibrium Piston Valve.—T. Critchlow (of Baldwin, Pa.), London, Eng.
Pumping Machinery.—E. Cope *et al.*, Hamilton, Ohio.
Raising Weights, etc.—T. A. Weston, Ridgewood, N. J.
Telegraph.—M. Gally, Rochester, N. Y.
Trimming Boot Soles, etc.—S. H. Hodges, Lynn, Mass., *et al.*

Recent American and Foreign Patents.

Improved Ant Trap.

Theodore G. Ames, Kosse, Texas.—This invention relates to a new annular sheet metal pan arranged so that it can be used advantageously for the purpose of catching ants. In use this trap is placed upon the ground over and around an ant hill, and earth is piled around. Within the trap moist soil is by preference piled, the moisture being for the purpose of not choking the entrances into the ant hill. All ants that may attempt to reach the entrance to the hill may, or will, pass over the upper edge and drop into an annular chamber, and all those attempting to leave the hill will pass into the same chamber. On the smooth metallic inner faces of these plates ascent will be impossible to the ants, and they therefore will be securely caught and retained.

Improved Adjusting Attachment to Reversing Levers, etc.

George W. Jordan, Passaic, N. J.—This invention consists of a worm wheel and turning gear to work it, and a toothed face on the quadrant bar for holding the lever of a reversing apparatus, throttle valve, and the like levers, so combined with the lever and the said holding bar that the lever can be shifted by the worm when it is desired to adjust it nicely, while at the same time the worm wheel, which also serves for the holding catch, can be disengaged by the ordinary catch lever, in the same manner that the ordinary catch is, when the principal lever is to be shifted to any considerable extent.

Improved Collar.

Andrew Flatley, Brooklyn, N. Y.—This invention has for its object to improve the construction of linen and other collars to adapt them to receive an ornamental clasp. The invention consists in forming an obtuse salient angle on each of the inner sides of the lappets of a "Byron" collar, thus forming a triangular space above and below the same when the collar is adjusted for wear.

Improved Ash Sifter.

Samuel Smith, Brooklyn, N. Y.—This inventor proposes to furnish to the public an ash sifter supplied with a mechanism by which the dust so annoying in sifting is entirely obviated, and at the same time the danger of fire incident to the present mode entirely avoided. In using this sifter the main vessel is uncovered, the sieve with the ashes to be sifted is placed on the lugs made within, the cover replaced, the hand lever inserted through a slot into the holes provided in the sieve and projecting band, then the sieve is thoroughly shaken till the pieces of coal and ashes are separated, when the hand lever is taken out, the vessel uncovered, the sieve with the unburned coal removed, and the main vessel with the ashes placed in readiness for carting off.

Improved Fire Extinguisher.

John C. Meehan, Springfield, Mass.—The invention consists in the improvement of fire extinguishers. A pipe, connecting with the boiler of any kind in which steam is maintained, is arranged to extend around the room. A valve case is arranged with a cap, having several nozzles pointing in different directions, to deliver the steam escaping from the pipe in jets when the valve is open. The stem of the valve connects with a lever, which is caused to hold the valve shut by a stick placed under its free end, and resting on an adjustable seat. This stick is hollow, and filled with powder or other explosive material, with which a fuse connects, which is to be so extended about the room, and so disposed that it will be ignited quickly in case of fire in the room and explode the stick, so as to free the valve and allow the steam to open it and escape into the room. A bell cord is attached to an extension of the lever for transmitting an alarm to other rooms or frequented places.

Improvement in Incasing Caustic Alkali.

George W. Humphrey, Pompey, assignor to himself and J. Munroe Taylor New York city.—This invention consists of an improvement in the mode of incasing caustic alkali (soda or potash) in hermetically sealed envelopes, so as to secure it most perfectly against atmospheric deterioration and deliquescence, which also renders its highly corrosive nature harmless. The inventor uses for this purpose india rubber cloth, cut into suitable sized pieces. When thus enveloped with india rubber the whole is wrapped with common Manilla paper.

Improved Churn Power.

William A. Lewis, Springfield, Vt.—The object of this invention is to improve the apparatus employed in rotating the dashers of churns, and consists, first, of a clutch by which two gear wheels are fastened so as to revolve together. It also consists in the mode of confining the wheels to the arbor. When it is desired to give the dasher a more rapid motion, the one wheel is detached from the arbor and placed upon a stud, which enables the two wheels to mesh together and increase the motion of the dasher.

Improved Friction Clutch.

Samuel B. Alger, Oswego, N. Y.—This invention has for its object to furnish an improved friction clutch grasping the pulley promptly and firmly. The invention consists in certain combinations of parts, as hereinafter described. The loose pulley is kept in place upon the shaft by means of a collar and by the center piece of the clutch, which center piece is keyed with said shaft, and is made in the form of a disk of a less diameter than the pulley, and has a wide transverse groove formed across the middle part of its outer side. The side edges of the center piece are notched at the ends of its transverse groove to receive blocks, the ends of which are pivoted to the outer edges of the plates of expanding arms. The outer edges of the pivoted blocks are curved to correspond with the curve of the flange or of the pulley, and are, with the groove, formed in the inner surface. This construction gives a greater friction surface to the clutch, and enables it to grasp and hold the pulley more firmly. Double plates are arranged, the edges of which are slightly inclined to fit squarely against the inclined sides of the wedge keys, which are driven between said edges to enable the wear of the clutch to be conveniently taken up. The plates are so secured together that the arms may be readily contracted and expanded, as may be required. The expanding arms can be readily attached and detached.

Improved Washing Machine.

Price C. Dillan, Villisca, Iowa.—This invention has for its object to furnish an improved machine for washing clothes quickly and thoroughly, and without injuring them, and the apparatus may be used as a receptacle for unwashed clothes and as a wash stand. The invention consists in the combination of a concave stationary rubbing surface, and a vibrating rubber of corresponding form, pivoted in slotted bars, which are provided with lateral arms or extensions, hinged to the side of the tub or box so that the rubber may move up and down to adjust itself to the thickness of the clothes. By suitable arrangements the rubber can be conveniently turned back for the ready insertion and removal of the clothes. The machine may be operated when desired by a person sitting at the end of the box, the cover of which may be turned back into a horizontal position to serve as a table to hold the clothes when being put into and removed from the machine.

Improved Horse Power.

George M. Branch, Winona, assignor to W. A. Moore, Magnolia, Miss.—This invention has for its object to furnish an improved horse power for driving cotton gins and other light machinery. To the middle part of the base of the frame of the machine is attached a step in which a pivot formed upon the lower end of a vertical shaft revolves. The upper end of the shaft is pivoted to the upper part of the frame. To the lower part of the vertical shaft is attached a sweep, to the end of which the power is applied. To the shaft and sweep is attached a large horizontal wheel which gears with another wheel attached to a horizontal shaft of which the bearings slide up and down in grooves in the inner sides of upright bars attached to the upper part of the frame. By adjusting wedges the said bearings may be adjusted as required. The teeth of the gear wheel also mesh into the teeth of another small gear wheel attached to a shaft to which is attached the band wheel from which the power is taken to the machinery to be driven. By this construction, the power, being applied to the large wheel, is applied at great advantage, so that more work may be done with a less expenditure of power than with machines constructed in the ordinary manner.

Improvement in Extracting the Juices of Sugar Cane, etc.

George Wilkinson, Antonie L. Possoz, Jean P. Lafargue and Auguste E. Dutreih, Paris, France.—This invention is a process and apparatus for extracting juice from cane and other sugar-containing matter. The cane in the form of chips is fed continuously through vats provided with agitators which carry the chips back and forth. The liquid forming the extract is, by the arrangement, constantly becoming stronger, as the newly admitted liquid comes first into contact with the spent chips of cane or other material. The inventors claim: 1. The mode of extracting the saccharine matter of cane and other saccharine substances, by subjecting the same, when suitably prepared or divided, to the action of heated saccharine juice, followed by washing in a mixture of dilute juice and pure water, said operations being conducted in the apparatus specified. 2. The combination of two or more macerators, substantially such as described, into and through which the prepared cane or other saccharine substance is successively passed, as set forth, the liquids with which said substance is treated during its passage through said macerators being obtained and supplied to and discharged from said macerators. 3. An apparatus for extracting the juices of sugar cane and other saccharine vegetable substances, the parts of which are constructed, combined and arranged for operation.

Improved Upright Piano Action.

George C. Manner, Mott Haven, N. Y.—This invention is an improvement in the class of pianoforte actions wherein what is known as the French action is adapted to upright pianos. The improvement consists mainly in the arrangement of hammer and rebound cushion with the main lever of the French action on which the key operates. The damper, which, in position of rest is held by a spring constantly against the cord, is supported on a lever by a sliding rod so that when said lever is swung up by the action of the key it will in the first place act upon the hammer, secondly, push the damper off the cord, and, thirdly, carry a cushion forward to receive the hammer when it drops back from the cord.

Improved Machine for Cutting Hoops.

Augustus G. Parkhurst, Appleton, Wis.—This invention relates to a new improvement in machines for cutting beveled pieces or sheets from blocks of wood; and consists in the arrangement of the cutting knives in a sliding frame. The piece of wood to be cut is placed on a bed, against vertical ribs, and between adjustable pieces. Short knives are arranged which may be set to any required angle with a long knife. As the knives are brought down upon the piece of wood, the ends are cut to a bevel simultaneously, and then the sheet which is cut from the piece by the long knife will be evenly beveled at each end, so that they may be lapped on each other and fastened when formed into boxes or cylinders for various purposes.

Improvement in Dental Gold.

R. S. Williams, New York city.—In this invention, two or more sheets of plain foil with an outer sheet of frosted gold are rolled into a cylinder over a mandrel, and the lapping edge of foil caused to adhere by passing it over the flame of an alcohol lamp. The frosted gold, by its greater stiffness, will prevent the several folds forming the coil from adhering.

Improved Washing Machine.

George Seymour, Boone, Iowa.—This invention has for its object to furnish an improved washing machine. The sides and bottom of the tub are made of sheet metal, the end edges of which are bent over the curved edges of the lower parts of the vertical ends. The upper edges of the sheet metal are secured to bars attached to the lower edges of the upper side parts of the ends which project beyond the curved sides to enlarge the upper part of the tub. Side boards are attached to the edges of the bars and ends. To a bar at one side of the tub is attached a board, to serve as a shelf and also to prevent the water from spattering out. To another bar is attached an ordinary rubbing board to enable such parts of the clothes as may be very much soiled to be rubbed by hand. In the inner surface of the ends parallel with and at a little distance from the sheet metal plate is formed a groove, which, at the side of the tub next the rubber board extends up to the upper edge of the said ends. Rollers, which are made in the form of cylinders with longitudinal grooves formed in them, are slid into the grooves. Stationary rubbing bars are alternated with the pairs of these rollers. An oscillating rubber is arranged to adjust itself to the thickness of clothes being operated upon, and to turn the clothes completely over at each stroke.

Improved Churn.

Henry A. Hincheer, Hustonville, Ky.—This invention has for its object to furnish an improved churning apparatus. The mode of operation of this invention is as follows: As the dasher moves down and expresses the cream, through a cylinder within the churn, at side perforations which are below the dasher and at the open and raised end of said cylinder, the vacuum created above the piston is filled by the ingress of cream from upper part of churn. The strokes of the dasher following one another in quick succession, a circulation of the cream in currents, in and out of cylinder, is produced and continuously maintained until the butter comes.

Improved Door Spring.

Leonard J. Higgins, Mount Desert, Me.—This invention relates to springs for closing door and gates; and consists in the mode of applying the arm or lever which connects the spiral spring shaft with the door or gate, said arrangement allowing the tension of the spring to be varied to prevent slamming, or to ensure an entire closing of the door or gate.

Improved Lifting Jack.

James S. Haldeman, Kansas city, Mo., assignor to himself and Harry E. Clark, of same place.—This invention has for its object to furnish an improved jack for lifting heavy weights, which shall readily adjust itself to the movement of the end of the heavy body being raised. To lugs formed upon the upper side of the foot plate are pivoted the lower ends of two bars, the upper ends of which are connected and held in proper relative positions by pins which pass through lugs formed upon the edges of said upper ends. The front pin is provided with a roller to prevent friction as the lifting bar is raised and lowered. The lifting bar is made of such a size as to fit into the space between the two bars, and of such a length that its upper end may be kept in place by the roller and pins. To the lower end of the bar is attached a cross pin, the ends of which enter and move up and down in longitudinal slots in the said bars. Upon the forward side of the lower end of the lifting bar is formed a shoulder or step upon which the object to be raised rests, and upon the rear side of the bar are formed ratchet teeth to receive the end of the operating lever to raise the body. The lever is passed through a loop or stirrup pivoted to the rear pin to serve as a fulcrum. A pawl is pivoted to the rear pin and is held forward against the teeth by a spring, to hold the lifting bar in place while the lever is being adjusted for another stroke. Upon the pawl is formed a projecting hook to serve as a support when the bar is to be lowered.

Improved Rice Huller.

Milton E. Stacy, Thomasville, Ga.—The invention consists in the improvement of rice hullers. The bed or mortar is made of a single block of wood or of several blocks secured to each other. In the upper side of the bed is formed a ring groove, the inner side of which inclines toward the center and the outer side rises more abruptly. The block or bed is surrounded by a frame or crib. A shaft passes through and works in a hole in the center of the bed, and its ends work in bearings in the frame of the machine below and above, being so arranged that the shaft may move up and down, as more or less rice may be in the groove. To the shaft above the bed are attached radial arms, to the ends of which are pivoted wheels in such positions as to roll along the ring groove and operate upon the rice in said groove. To arms attached to the shaft is rigidly attached a scraper to push the rice from the inclined middle part of the bed down into the groove, so that all parts of the rice may be operated by the wheels. With one or both the arms is connected a scraper to smooth down the rice in the groove and bring it into better position to be operated upon by the wheels, which may be raised into a horizontal position when desired. The rice is fed into the groove from a hopper. In one or more points a discharge opening is formed in the bed through which the rice when hulled is drawn off, and which is closed with a gate.

Improved Furniture Caster.

Cevedra B. Sheldon, New York, N. Y.—The above inventor has recently patented three inventions relating to the construction of casters for furniture, safes, trunks, and for all the purposes for which casters are used. The first consists in a conical shaped cup, made of a single piece of metal, with an enlargement or channel around the base, and with a cavity at the center or apex. A series of friction balls are arranged around the caster ball, and the screw is fastened to the shell of the caster by means of a square head and a cup shaped nut, which nut screws, by means of an independent screw thread on body of the screw, down on the back of the shell. An elastic lining is provided between the cup and the casing to prevent their contact and lessen noise. The object of the second invention is to improve the means of protecting trunk casters from injury; and it consists in securing the cup, in which the caster ball is placed and customarily revolves, in a cavity formed in the bottom of the trunk, by means of tongues or clips struck up from the sheet metal, lining said cavity. The third invention consists in the arrangement of a series of friction balls in a casing on and above the stand and between said stand and the cap or socket that is applied to the furniture leg, the construction being such that the friction is greatly reduced and the caster wheel made to readily turn and conform to the motion of the piece of furniture moved.

Improved Moth Trap for Bee Hives.

Leroy Gates, Pleasant Hill, Mo.—This invention consists in a new construction of moth box or trap. The base is attached to the brood chamber by hooks. The top of the moth trap forms the lighting shelf or platform for the bees, directly beneath which are the moth entrances. Inclined planes are arranged down which the moths slide to the center, which center is provided with a removable pan containing water or other liquid, or a slide, or both, by means of which the moths are destroyed. The comb cuttings from the brood chamber pass down through an orifice in the top into the moth trap. The bottom of the brood chamber has an orifice of similar size covered with wire gauze, to prevent millers reaching the upper chamber of the hive. The comb frames stand vertically and slide in from the rear on raised wires. Each frame has a groove in its bottom to receive the wire, and on top a projecting wire at each end. At one end the wire enters the front of the hive; at the other end it receives a hinged strap of iron, which is perforated for each wire. The frames are held in a vertical position by this means.

Improved Basket.

William C. Higgins, North Blandford, Mass.—The object of this invention is to furnish a strong and durable basket—one which, while being elastic and yielding, will retain its shape and still be light and handy to use. The body of an ordinary basket is of any desired size and form. The outer stays extend across the bottom and to the top of the basket. The inner and outer stays are arranged opposite each other, and are, consequently, equal in number, and riveted firmly together through the basket. A central band passes around and another band is placed near the bottom of the device. These bands are within the outer stays, and are confined by a nut at each intersection. The basket rim consists of three horizontal thicknesses, and is securely nailed or riveted to the vertical stays of the basket. A sectional band fills the space between the outer vertical stays, and gives a smooth finish to the top of the rim. A foundation cross is fitted over and riveted through the stays, and hand holes are arranged on opposite sides of the basket.

Improved Railroad Rail.

H. Gates Angle, Chicago, Ill.—This invention is an improvement in the class of rails formed of wooden stringers or timbers, and metal angle plates applied thereto. Wood stringers or sleepers are to be arranged along the ties, and butted together end to end to support the rails. These stringers are rounded at their upper inner corner. Angle bar shaped rails are supported on these stringers, the part which is thick and strong being on the top to receive the treads of the wheels, and the part which is thin and light being arranged on the inside of the stringer to receive the lateral thrust of the flanges, and also to sustain the weight of the train. The corner is rounded to correspond to the shape of the tread of a car wheel. A strengthening rib is formed along the lower edge to prevent the breaking laterally by the vertical strain. A lip is turned down on the outer edge and forced into the top of the stringer when the rail is laid, to hold it against working off laterally and in case the bolts work loose; also, to act in conjunction with the bolts for holding them on the stringers. A strong flat plate is let into the top of the stringers flush with the surface where the rails meet to prevent the ends from being forced into the wood as they would otherwise be.

Improved Machine for Turning Bags.

Joseph Martin, New York city.—This invention has for its object to furnish an improved machine for turning bags after they have been sewn, and which shall be so constructed as to take the bag after it has been turned and deliver it in a pile upon the platform or table of the machine. To the forward part of the table and platform of the machine are attached two uprights, in the inner sides of which, near their forward edges, are formed grooves to serve as a way for a frame to move up and down in. To the platform between the uprights are attached two other uprights to receive the bags to be turned. To the upper ends of the arms are pivoted friction wheels to diminish the friction as the bags are drawn over said arms in being turned. The receiving arms are adjustably attached to the platform, so that they may be moved toward or from each other, as may be desired, to adjust them according to the width of the bag to be turned. Upon the outer edges of the upper parts of the arms are formed inclines which, as the bag is turned and the lower parts of the arms pass below the offset of the receiving arms, force apart or spread the lower ends of the said arms spreading out the bag. The tapes pass around the guide rollers and deliver the bag upon the fly, the fingers of which enter the spaces between the tapes as they pass from roller to roller. The fly is operated to deposit the bag upon the platform by a coiled spring.

Improved Wheel for Vehicles.

Michael McNalley, Houston, Texas.—The invention consists in a one piece attachment for wooden hubs. The wooden hub being turned larger in the middle, and the grooves for the bars being cut, a double band is driven on the center of the hub, so that flanges inclose the spoke mortises and support the spokes as they are driven, likewise preventing the wood from checking. Thus, while the spoke tenons will be in contact with the wood, the latter will be supported and strengthened by bars, so that rigidity of the spokes and durability of their sockets or mortises will be attained. The shoulders of the spokes rest both on the wood and metal bars, thereby insuring a firm and enduring yet measurably elastic support.

Improved Lubricating Compound.

Ethan A. Tonner, St. Louis, Mo.—The object of this invention is to furnish a lubricant for car axles and other purposes, which consists of tallow, oil, Tripoli, and lamp black. These ingredients are thoroughly mixed together after the tallow is reduced to a liquid state by the application of heat. The Tripoli and lamp black polish the journal, while the tallow and oil lubricate it.

Improved Furnace Block Press.

Alfred Hall, Perth Amboy, N. J.—The object in this invention is to vary the form of the block by means of a single pair of adjustable plungers in a single mold, and to so arrange the machine or press that the labor will be greatly diminished and the blocks be pressed in a more complete and workmanlike manner. The invention consists in adjustable plungers and changeable bearing presser knobs. The movement of the presser bars is slight, but powerful. The pressure is given at each edge of the block, and, while the thickness is governed by the depth of the mold, the edges are made to conform to the position of the plungers. After the block is pressed it is shoved from the mold by moving up a plunger, and is taken from the platform by hand, when another block is placed upon the platform, and the operation is repeated. The press is operated by two men—one to each pair of levers—who put on and take off the blocks.

Improved Bee Hive.

Amos Deweese, Oak Mills, Kansas.—This invention is an improvement in the class of devices or apparatus for closing the entrances of a series of hives simultaneously. The improvement, consists, first, in arranging the sliding bar, which connects the entrance gates of the several hives, so as to stand in the place of the usual alighting board; and, second, in a peculiar manner of providing the gates with wire gauze ventilators, whereby, when the bee entrances are closed, air may be admitted.

Improved Harvester.

Richard A. Roberts, Salisbury, Mo.—This invention has for its object to improve the construction of an improved harvester dropper for which letters patent No. 128,564 were granted to the same inventor July 2, 1872. The finger bar which is hinged or jointed is secured to the grain divider, and the bar is supported at or near its hinge by a shoe. The inner end of the bar is connected with the frame of the machine. The platform upon which the grain falls is formed of a number of pairs of parallel slats. The outer ends of the slats are secured to the grain divider, and their inner ends are connected with and supported by bars or a framework attached to the framework of the harvester. To belts are attached teeth, prongs, or fingers of such a length as to pass through the slots between the slats and rise above said slats sufficiently to take hold of the cut grain and carry it across the platform and up the inclined part of said platform to the dropper. Curved arms, when lowered, receive the grain and detain it while the dropper is being operated to drop the gavel to the ground.

Improved Washing Machine.

William E. Millegan, McKinney, Texas.—This invention has for its object to furnish an improved washing machine which shall wash the clothes quickly and thoroughly, and without injuring them. In using this machine a lever is raised to bring the rubber block to the upper part of the wash board; a part of the clothes which have been previously soaped and placed in the water in the box is drawn up and spread over the lower part of the washboard. The lever is then moved up and down, which moves the rubber up and down upon the washboard until the said portion of the clothes is washed clean, a bucket, each time the lever is raised, bringing up water from the lower part of the box to wet the clothes while being operated upon.

Improved Wardrobe Bedstead.

Richard W. Frost, New York city.—The invention consists in the improvement of wardrobe bedsteads. The case for inclosing the bed is constructed in the form of a bureau, and has a drawer in the upper part, and a detachable front below, which closes the entrance to the space for inclosing the bed. The mattress is hinged to the bottom of the case and is divided at the middle longitudinally in two sections in order to fold short. The sections are hinged together. The legs may be hinged to the mattress frame to fold down flat on the bottom when the bed is folded up, and have appliances for bracing them when supporting the bed. When folded up, the parts will be secured by hooks and eyes.

Improved Scarf Ring.

John Haack, Hoboken, N. J., and Saintemme Diolot, New York city.—The object of this invention is to supply a scarf ring which, in a neat and efficient manner, attaches and closes securely to the scarf or other object. The invention consists of a broad band, round, oval, or otherwise, with a buckle hinged to it, which supports a hook-like pin entering, through a perforation, to the interior of the ring, and piercing the article to which it is applied, adhering securely thereto.

Improved Blacking Brush.

Charles W. Maguire, Brooklyn, N. Y.—The object of this invention is to strengthen and render more durable the brush used for blacking boots and shoes, and it consists in a blacking brush having the supply brush, polisher, and handle jointed together by dovetail tongue and groove, instead of being attached by screws as ordinarily.

Improved Horse Hay Rake.

Richard B. Sheldon, Canastota, N. Y.—This invention has for its object to furnish an improved sulky or riding horse hay rake, which shall be so constructed that it may be readily controlled by the operator. The invention consists in the pivoted pawls, in combination with the ratchet wheels attached to the hubs of the drive wheels, and with the axle of a horse hay rake; in the hinged form of the semicircular T grooved piece, and in a semicircular T flanged piece, in combination with the axle and thills of a horse hay rake, in order that the weight will always be directly over the axis of the axle, whatever may be the position of the operating parts of the machine; in arrangements to throw said pawls into gear with the ratchet wheels; and also devices to throw said pawls out of gear with the ratchet wheels of the drive wheels automatically. The former pawl mechanism projects the pawls into contact with the ratchet wheels, so that the revolution of the wheels may raise the rake teeth to dump the load. The latter, withdrawing the pawls from the ratchet wheels, allows the teeth to drop to the ground from their own weight. By suitable arrangements, by pressing downward and forward upon the upper end of a lever, the rake teeth will be held down firmly to their work. By moving the upper end of the lever to the rearward and pressing it downward, the teeth will be raised from the ground for convenience in passing over any obstruction. A button may be turned to hold the teeth away from the ground for convenience in passing from place to place.

Improvement in the Manufacture of Traveling Bag Frames.

James B. Blakslee and Charles F. Blakslee, St. Petersburg, Pa.—For making the sheet metal angle bars comprising the frames for the top and ends of traveling bags, the inventors propose to take a flat strip of metal of the length required and wide enough for the two bars of a bag, and first punch the holes for sewing the cloth or leather portions of the bags to them, and shape the ends for the blanks of the hinges, to be subsequently completed for jointing the ends of the frames together. The strips are then bent into proper form by dies which are male and female, in the form of right angled blocks with beveled sides, each succeeding set used being more acute in the angles of the beveled sides than the preceding set.

Improved Rotary Printing Press.

Calvert B. Cottrell, Westerly, R. I.—In continuously revolving cylinder printing presses, there is considerable inaccuracy in the registering of the sheets on the cylinder. The difficulty is owing to the high speed of the gripers when they close upon the paper, which is at rest, the gripers being on the cylinder and revolving with it, and the paper lying on the table, which causes the gripers to slip a little on the paper while closing upon it and before seizing it with sufficient force to overcome the *vis inertia* and set it in motion. This slippage varies with every variation of the speed of the cylinder; also, with different conditions of the paper and by other causes. It is proposed to overcome the difficulty by having the gripers cease to revolve with the cylinder at or before the taking of the paper and be at rest, or nearly so, relatively to the cylinder while closing upon the paper, and also be gaged relatively to the paper at the same time by the instrumentality of a device independent of the cylinder, but in such relation to the table whereon the sheets of paper are presented to the gripers that the latter will always come to the paper exactly the same, irrespective of the speed of the cylinder. To this end, the gripers swing or slide or otherwise move forward on the cylinder just before coming to the place for taking the paper—say at the time of discharging or releasing the printed sheet—so as to gain time for a slight period of rest, and then fly back against the aforesaid gage or stop, and rest while closing upon the paper, thereby enabling them to gripe it firmly and securely, and always in the same relation to the table before being set in motion with the cylinder again.

Improved Combined Bureau, Wash Stand, and Wardrobe.

Thomas W. Moore, New York city, assignor to Fannie N. Moore, of same place.—This invention consists of an upright wood case, divided vertically in two principal compartments, one of which is devoted to the purposes of a wash stand in the lower part and a bureau in the upper part, and the other is, by preference, devoted to the purposes of a wardrobe, but may have drawers instead. The wash stand part is provided with supports for the wash bowl and the soap dish, which swing out from under the drawers above when a door which incloses the front is opened; also, with special places for the other articles of crockery ware appertaining to a dressing room. A door is also provided for the wardrobe when used as such. The object is to combine either two or three of the principal articles of the furniture of a room in one, so as to economize space and expense.

Improved Rock Drilling Machine.

Ferdinand Johnson, Toledo, Ohio.—The object of this invention is to construct a drill for boring for water or oil, which, by a rapid succession of strokes and turns, accomplishes quick and effective work, and which may be easily raised and lowered as the exigencies of the work require it. The invention consists, mainly, in a spring lever connection of the drill, which imparts a strong force to the same in connection with grooved rollers with a slide arrangement for the purpose of lifting and guiding the drill.

Improved Gun Lock.

Walter J. Morris, New York city.—This invention consists of improvements in pistols and other small arms which have or are intended to have the hammer working behind the breech of the barrel or recoil block and between the sides of the lock or sides of the feed arms. The invention comprises a cover, over the lock and the opening in the breech block through which the firing point enters, to intercept any object that might fall into the lock or into the opening in the breech block, and a device on the hammer for throwing off any objects lodging on the cover. To stop the hammer after it has penetrated the priming at the right point, and to protect the firing point from wedging in or striking against the walls of the opening through the recoil block, the hammer is made inside of the lock, so that when it has moved forward as far as it is intended to go it will be stopped by a point or points which are provided in it or on the lower, middle, and rear parts of the recoil block.

Improved Feeder and Filter for Boilers.

John G. Fulton, Toledo, Ohio.—The object of this invention is to exclude from steam boilers all those impurities that are usually contained in the feed water supplied to them. The invention consists, more particularly, in the arrangement, within tanks that contain the feed water, of a flexible piece of pipe which is connected with floats that hold the end of said pipe in the upper and therefore purer part of the water contained within said tanks, so that the water flowing through such flexible pipes into the boiler will be comparatively pure, inasmuch as the sediment settled within such tanks will not be allowed to enter the pipes. The invention also consists in the arrangement of stirring devices within such tanks, for agitating and stirring the sediment that will settle on the bottom of the tanks, so that such sediment will run out when the necessary cock is opened to discharge the accumulated impurities.

Improved Thill Coupling.

John Martin, Henry city, Ill.—The invention consists in a thill coupling which is a simple countersunk jaw coupling with the horizontal bolt passing through, so that when it wears loose the slightest turn of the bolt nut makes the coupling tight and firm.

Improved Oiler.

Cyrus E. Grandy and Ziba B. Grandy, Stafford Springs, Conn., assignors to themselves and William D. Heald, of same place.—This invention consists of an oil vessel into which extends a tube. Within the tube is a second tube, the lower end of which is closed. The first tube has orifices made in it, near the point of its junction with and inside the vessel. The inner tube sliding within is arranged in connection with a lever and spring so that it may be operated from without to open and close said orifices and so to allow or prevent the escape of oil from the spout.

Improved Strap for Street Cars.

Mahlon Warne, Philadelphia, Pa.—The object of this invention is to furnish an improved form of hand support for passengers who are compelled to stand in street or other railway cars or omnibuses, so constructed that it shall also serve as an advertising medium; and it consists in a metallic frame (incidentally adapted for containing advertisements) suspended from the hand rail by a swivel connection, and in a hand strap attached thereto. The frame is so constructed that the cards or advertisements can be readily changed from time to time, as may be found necessary.

Notes & Queries

S. asks for the best mode of preparing caustic lye, for soap making, from soda ash.

F. E. H. asks for the best means of cleaning light kid gloves.

A. R. asks: What can be mixed with clay that will harden it, without using fire?

F. D. H. asks: How can I make good liquid stains to imitate black walnut and oak?

A. H. G. asks: How can I stereotype from wood cuts? What is used for molds and how is the metal poured so that all the lines will be perfect?

W. H. H. asks: How can I make a waterproof tarpaulin cover to throw over a wagon in case of an unexpected shower?

H. D. T. asks what kind of varnish is best for transferring prints on to wood? Can colored prints with their various colors be transferred to hard wood?

S. asks: Why will a piece of cold iron covered with grease remain at the bottom of a kettle full of melted iron, while a piece that is not greased will rise to the top?

A. A. asks: Is it safe to carry a pressure of 20 lbs. to the square inch in a boiler well made of 1-16 inch copper, the dimensions of the boiler being 12 inches long x 6 inches diameter?

E. H. R. says: I have just finished building a brick kiln, and I would like to know what degree of heat it will require to dry lumber, such as flooring, etc., in the shortest possible time without injuring it?

R. B. says: I want to paint an engine. There is a good deal of grease on it, and I want to know: 1. How I can get it off best? 2. What kind of paint is best to stay on where it is hot? What kind of paint is used to make new engines look glossy?

J. P. H. asks for a practical plan for boring or scraping out the cylinder of a portable engine, without detaching it from the boiler. "Cannot scrapers be set in a wooden shaft and on paper backing to raise them to their work, the shaft being turned to fit the cylinder, which is of 6½ inches diameter?

J. M. asks: What is the cause that we cannot keep the wings on a blower which we use for cleaning grain? It is a suction blower, 1 foot diameter x 8 inches high, and it runs at 1,600 revolutions per minute. It is made thus: A ¾ inch iron shaft with a block of wood 3 inches square. The wings are of heavy sheet iron, nailed on to the block; and they tear off the nail heads. If we put them on with screws, the screws break off close to the wood.

G. W. K. says: I have a number of heavy muslin or canvas coverings which are made waterproof by being saturated with boiled linseed oil. The trouble is that when they are folded and packed away, they stick together so tightly that it requires the strength of several men to pull them apart. What can be put on and mixed with the oil to prevent sticking and yet keep them soft enough to bear folding without injury? Is there anything that is cheaper and better than the oil?

W. & Co. ask: Can any of your correspondents give us a recipe by which we can make a shingle roof fireproof? The roof is felt, composition, and sand; it has been on for 5 years and is so much bother to keep tight that we have to put on a new roof, and would much prefer shingles provided we can make them so that the danger from fire is not increased. We propose painting or dipping the shingles before they are laid.

C. J. H. asks: What is the best thing to do to work an oil deposit most advantageously? The following are the circumstances: The bore shows about 10 feet of soil, then from 7 to 15 feet of sand saturated with petroleum, then various strata of gravel, sand, clay, each with more or less petroleum, going down to a depth of 130 feet. From this, down to 380 feet, the gravel, sand, and clay continue. The sand yields on distillation about 30 gallons, and, from the bore, a barrel or so of oil is pumped daily. Should the bore be continued? Would it be practicable to mine the chalk where there is so much gas? The chalk samples yield from 30 to 35 gallons superior oil. The chalk oil at 60° Fah. showed 922, but contains very little tarry matter. After once running, the gravity was 905, and the analysis showed: Burning oil at 60°, gravity 822, 23·2 per cent. Heavy (blue) oil, gravity 918, 63·2 per cent. Solid paraffin, a trace. Loss on refining, 2·5; by acids and alkalies, 8·5; by distillation, 2·5.

Answers to Correspondents

H. S. will find full directions for making Alaska scenery on p. 123, vol. 28.—C. C. can work out his problem by following the instruction on p. 257, vol. 29.

THE BOUNDARY LINE BETWEEN ARITHMETIC AND ALGEBRA.—There are many problems which can be solved as well by the arithmetical as by the algebraic method; but there are others which, although they appear to consist of conditions belonging simply to the field of arithmetic, require for their solution the algebraic mode of calling the unknown quantity by some sign, say x, and treating the resulting expression after the regular rules taught by algebra; then the solution, which otherwise is highly intricate, becomes a work of mere manipulation of signs. A problem of this kind was recently sent us by a correspondent of Cambria, Wis., who states that some persons claim that it is utterly insoluble, while others think that there is a solution, if only they could find it; he says further that the Normal School at Oshkosh cannot solve it, meaning, we presume, that some of the students were unable to do so. The question is this: "A merchant has two grades of wheat with 25 cents difference in their value; a customer buys one dollar's worth of each grade, mixes them, and finds that he has exactly two bushels of the mixture. At what rate per bushel did he pay for each grade?" The following is the solution: Call the price per bushel of the cheapest wheat x cents, then that of the better quality is $x+25$ cents, which, when expressed in dollars is $\frac{x}{100}$ and $\frac{x+25}{100}$ of a dollar. As now the quantities obtained for the same amount of money are in an inverse ratio of the price, the relative quantities of wheat which the customer buys for one dollar each will be $\frac{100}{x}$ and $\frac{100}{x+25}$, and as the two quantities are stated to be 2 bushels, we have the equation $\frac{100}{x}+\frac{100}{x+25}=2$. Bringing these two fractions under the same denominator, by multiplying numerator and denominator of the first by $x+25$ and of the second by x, we obtain $\frac{100x+2500}{x^2+25x}+\frac{100x}{x^2+25x}=2$ or $\frac{200x+2500}{x^2+25x}=2$. Multiplying each term of this equation by x^2+25x, we obtain: $200x+2500=2x^2+50x$; divide by 2, $100x+1250=x^2+25x$, or $x^2-75x=1250$. This reduces the whole problem simply to the solution of this equation of the second degree, which we do by adding to each number the square of the half of 75, or $37{\cdot}5^2=1406{\cdot}25$, which gives $x^2-75x+37{\cdot}5^2=1250+1406{\cdot}25=2656{\cdot}25$. The square root of this equation is $x-37{\cdot}5=\sqrt{2656{\cdot}25}=51{\cdot}54$, and $x=51{\cdot}54+37{\cdot}5=89{\cdot}04$ cents, which is the price of the inferior wheat per bushel; while the better quality costs $89{\cdot}04+25$ or $114{\cdot}04$ cents. We have given the operation here with much more detail than is customary in such solutions, but this is for the benefit of those not very familiar with such algebraic operations; for the satisfaction of the same we will now test the solution: The amount of wheat worth 89·04 cents per bushel, which can be had for one dollar or 100 cents, is evidently equal to $\frac{100}{89{\cdot}04}$ bushel, and for the same reason, that of 114·04 cents is equal to $\frac{100}{114{\cdot}04}$ bushel. If now we bring these two fractions under the same denomination we obtain $\frac{11404}{10154}$ and $\frac{8904}{10154}$; and adding them together, we have $\frac{20308}{10154}$ bushels, which is exactly 2 bushels.

J. asks: Will heat affect the attractive power of a permanent magnet? 2. Are oxygen and nitrogen gases combustible? Answers: 1. Heat diminishes the attractive power of magnets. 2. Oxygen supports combustion. Nitrogen does not.

C. J. C. asks for a process for tempering trap springs. "I want full directions for hardening and drawing the temper, and the best method of heating. Will a common blacksmith's forge answer, or will a Lehigh fire do?" Answer: Heat to a bright cherry red, either in a furnace, so constructed that they will not come in contact with the coal or flame, which are liable to contain sulphur or other base minerals, or they may be heated over a charcoal or coke fire. Harden by plunging, when hot, into a bath of pure whale oil (be very careful that it is not adulterated). To every gallon of oil, add 6 lbs. of rosin, 1 lb. beeswax, and 2 lbs. mutton tallow, and you may add 1 lb. pine pitch. Melt the rosin first, then add other ingredients, and melt together, and stir into the oil when hot. The vessel containing the hardening bath should be surrounded with cold water to prevent overheating. Be sure that the springs always harden to a silver white, so that a file will not cut them. After hardening, clean off the loose oil with fine saw dust, brushing off that which remains loose. Then draw the temper slowly until the oil is all burned off and stops smoking. This may be done best in an open wire cylinder over a charcoal fire in a sheet iron furnace, similar to that used for roasting peanuts or browning coffee, or it may be done in a well constructed hot blast oven, or even over a charcoal or coke blaze. Let them cool off in the atmosphere. The mixture for hardening can be kept up by occasionally adding rosin, beeswax and tallow. The principle of always getting a good spring temper is to first get the steel hardened thoroughly, without overheating or fire cracking it; then, by drawing it down to a dead blue, or until the oil is burned off. Four years experience in tempering cavalry sabers and swords taught me this.—J. E. E.

M. P. The idea of propelling canal boats by wheels running on the bottom is very old.

J. G. asks if there is any machine invented for felling large timber trees, which will save the great loss consequent upon felling with the common axe, or that will perform the work in a shorter time. If so, what is it? Answer: Several devices for this purpose have been published in the SCIENTIFIC AMERICAN, and some of them illustrated.

S. B. E. asks: When did James Watt complete his first engine, and when and to whom was the first patent given for a steam boiler? Answer: James Watt completed and patented his first engine in the year 1768-9. Papin used a steam pressure boiler in 1695, and Savory patented a steam engine with a pressure boiler in 1698.

H. A. B. asks: What proportion of burnt clay should be mixed with quick lime after the lime is slaked, to make good water lime cement? Answer: Our correspondent should read page 411 of Miller's "Elements of Inorganic Chemistry." The subject is too large to be discussed in our columns.

L. R. asks for further instructions on tempering steel, asking us to select a recipe suited to his case. This we are unable to do, as we have no knowledge of his requirements. We have lately given much space to this subject: and on page 283 of our current volume the matter is discussed at full length.

W. A. S. says: 1. I enclose a piece of scale from our boiler. Will you please tell me of what it is composed, and what I had better use to prevent it? 2. How long ought a stationary boiler to last with careful use? We blow off twice a week and clean out twice a year. 3. Can you give me a rule for finding the strength of any section of malleable castings or for cast iron? Which is the stronger? 4. What is the cheapest and most convenient article for making cloth or rope fireproof? 5. I have also a little invention on hand. Is there any place in Boston where I can get access to the Patent Records, that I may see if I have got anything new? Answers: 1. The scale is composed of sulphate of lime principally, with some magnesia, sand, clay, and iron oxide, and a little salt. If the incrustation does not collect with considerable rapidity, chloride of barium is a good preventive of its deposition in this dense and hard form. The scaling hammer, properly used, where the deposit is accessible, takes it off most effectually and inexpensively. 2. We have known steam boilers of the plain cylindrical class to last thirty years. Marine tubular boilers are expected to last 6 or 8 years, but sometimes are kept running more than twice that length of time. 3. The best cast iron, such as is used for ordnance, bears a tensile pull of 30,000 pounds per square inch, or more. Ordinary metal has about two thirds that strength. Malleableized cast iron has a strength of from 25,000 up to 45,000 pounds per square inch according to quality. 4. Tungstate of soda. 5. The Public Library.

M. H. B. says: I have a little engine with a cylinder 3 inches in diameter and 6 inch stroke; ought it to take about 20 lbs. of steam to run it? When I take hold of the fly wheel, it is about as much as I can do to turn it with both hands. The boiler is an upright, 6 feet high and 26 inches in diameter, with 22 two inch flues. How many horse power would that be? Is it a good idea to have nothing but a thin place in the eccentric rod to overcome the up and down motion? How long ought a boiler and the engine, made as above stated, to last? Answer: The engine is decidedly in need of attention. It ought to run, without load, with four or five pounds of steam. The eccentric rod is often so made and answers very well on very small engines. A plain boiler, well taken care of, should last many years, and the engine much longer than the boiler. Some of James Watt's engines are still at work.

G. T. R. says: A friend states that an ordinary wooden pump, placed in a well with a tight oaken platform, over which a layer of three feet of yellow clay has been tightly tamped, will work perfectly and permanently. I do not believe it will, as the water is elevated by atmospheric pressure, which in this case would be partly or wholly removed. Which is right? Answer: If the well were made absolutely air tight, the pump would not work. We think it probable that, even where arranged as described, sufficient air would enter the well through the surrounding soil or the top to allow of its operation.

C. M. D. asks: Is corn a profitable fuel at 20 cents a bushel, when wood is $5 per cord, say for a 10 horse power engine? Answer: It requires about 50 bushels of corn to weigh as much as a cord of wood; 40 will weigh as much as a cord of soft pine. The chemical constitution of wood and grain is about the same, and they therefore should be of about equal heating power, pound for pound. We can therefore conclude that, if wood is worth $5 per cord, a corresponding weight of grain at 20 cents per bushel would cost $8 or $10. Burn your wood and sell your grain.

I. W. F. asks: Can you inform me how they grind old razors, and what the machinery used is? Answer: By means of fine stones, the same as other cutlery.

C. W. O. says: In your issue of April 19, A. M. says: "I am running a saw mill making 500 revolutions per minute;" and after giving size of mandrel, kind of box, etc., he goes on to say that "the box next to the saw runs hot in spite of all efforts"; in answer to which you give a method of lining a box to prevent said heating, namely, by putting oiled paper around the journal while pouring off the Babbitt metal. Now as we are running quite a number of saws, large and small, I should like further light on this subject. We have at present a 50 inch saw on a 3 inch mandrel, making 825 revolutions per minute, in boxes lined precisely as you advise, in which it has been running for several months, during which time the box next to the saw has not run cool for a single day, though the box on the other end of the mandrel, made in the same way, runs very nearly cold. The power for driving the saw is obtained by a 12 inch belt on a 24 inch pulley at the side of the last named box. Now why does the journal at the end next the saw heat, and the one on which the weight, caused by the tension of the belt, rests run cool? The boxes have been relined three or four times in two years, and always with the same result. The motion is steady for 11 hours per day, stopping one hour at noon; and the best of oils are used. Answer: Saws unevenly ground or filed out of shape are out of balance; this will cause the box at the saw end of the mandrel to heat. When the saw is in the cut, there is little or no weight on the lower part of the box, unless the belt draws downward; or, in other words, when the saw teeth are in the cut, the tendency is to lift the mandrel and throw the pressure against the cap or upper part of the box; and the pressure of the timber against the teeth forces the arbor back against the side of the box, so that the pressure of the journal is con stantly changing from one position to another, which tends to heat the box more than if the pressure were in one direction.—J. E. E.

W. W. B. says: I use small malleable iron castings, and would like to make them bright by rolling them in what I call a tumbler. I see that others in the same business make them very bright; but I am unable to get the same "shine" on them. Can you tell me how to manage it? Answer: Castings are polished by rolling them in barrels with plumbago.

J. J. B. asks us to inform him as to the best method of rendering solid a liquid stove polish. Answer: Let it stand in an open vessel until the liquid evaporates.

A. W. G. says: I have a large pile of cinder, or scale, such as is usually found in rolling mills. It comes from under the rolls, and is quite full of small particles of iron. Would not a magnet be the best way to get the iron from the cinder? Where can I obtain a cheap magnet? It should be quite broad. Answer: You can obtain magnets at toy stores. As to treatment of cinder, to separate iron therefrom, read the description of the Henderson iron process, heretofore published in the SCIENTIFIC AMERICAN.

A. J. D. says: When a very heavy charge of powder is fired in an ordinary shot gun (very nearly all the gun will stand without exploding), will all the charge burn, or will part of it be dropped at the muzzle of the piece without igniting? Answer: If the charge is excessive, a part of the powder will be burned after leaving the gun. Where the gun is short and the charge heavy, a part may even escape unburnt; and, on firing the gun over a smooth or, particularly, a snowy surface, the grains may sometimes be seen. The best charge for a gun should always be found by trial, and will sometimes be found to be apparently very small. Excess of powder increases greatly the strain in a gun and its recoil, without any gain.

F. A. U. asks: How can a shingle roof be kept from leaking around the chimneys and flues, where they are on the side of roof, that is, not at the comb? Answer: If the chimney is yet to be built, make a projection of the brickwork, put on a cant board and cant the shingles up under the brick projection. But to repair a present chimney, use step flashing of painted tin or zinc, a piece of the metal under every course of the shingles, turned up against the brick and worked into the joints of the brick work. Put them in as you would a flexible shingle, letting the bottom of the upper one cover the top of the lower one, with the wooden shingle continued over it to the chimney; but drive no nails through the metal except at the top of each piece. Fill in the joints of the brick with paint skins or putty, where the metal enters them. They will enter on the horizontal joints, only, and break down at every piece like a flight of steps. This method applies to the sides of a chimney, where the roof crosses it at an angle equal to the pitch; but where, as at the top and bottom, the roof meets and leaves the chimney on a level line, ordinary flashing will do, running under the shingles and turned up and into the brickwork. If the shingles are canted up against the chimney well on every side, a cap flashing will sometimes do, worked into the joints of the brickwork, and lying down on the top of the shingles. The step flashing is also very good for the valleys of a roof.

R. H. asks: What is the difference between hydraulic and steam pressure? If there is any, what makes it? Answer: There is no difference, *so far as* simple pressure is concerned. The effect of testing a boiler, with cold water in one case and hot in another, may be quite different, however. Hot water, by expanding the metal, may close up seams and prevent leaks, under tests, where cold water might reveal an unclosed lap. Hot water will also produce strains due to expansion which might not exist where a cold water test was adopted. A cold water test we regard, therefore, as the best test of the tightness of a boiler, while hot water gives us the severest test of its strength to resist the the usual strains of a boiler in use.

W. & S. say: We intend building a wood working manufactory, 50x70 feet, this summer, and put in a new boiler, engine, etc. We are at loss to know just what to build and buy, and not waste our money. 1. The shop will stand on the bank of a river, and all of the foundations will rest on solid rock. We have from 25 to 27 feet of water in the spring freshet. We want to put the lower floor 27 feet above the bed of the river, and wish to know how thick the wall ought to be from the bottom to the first floor (27 feet high) to stand against the high water. We can let the water in or keep it out, if we knew what strength to build in both cases. The building will be 3 stories and a half above the first floor. 2. In a wall 50 feet long, 27 feet high, which would stand the most pressure from water, a certain number of perch of stone laid regularly, or put in the form of buttresses every 8 feet or so, making the rest of the wall proportionately thinner? 3. We put in steam two years ago for power and heating; we think that we use more fuel under our boiler to heat our building than we formerly did in the air tight coal burning stoves, all the time, even when we are not running our engine at all, and use live steam. Yet we are told that we can heat by steam cheaper than by good stoves and furnaces. We want to see it in that light also. Can you put us in the way of some satisfactory experience? 4. Does not the additional back pressure cost all the difference between using exhaust steam for heating instead of live steam? We have 3 inch pipes in our shop. 5. Three weeks ago we read in your paper that steam at 120 was economical. One of our boiler makers here thinks that 60 lbs. gives more satisfactory results than when used higher, and it will not cost as much to keep the steam up; which is the nearest right for a common factory? Our boiler and engine are large enough to do the work at 60 lbs. easily. Answers: We should build the wall, if in stone, of selected material, paying particular attention to the quality of the cement, which should be quite strongly hydraulic, and should not attempt to carry such a head of water. To do so, would necessitate building walls of similar proportions to those of any other dam walls. The thickness of base would be about 12 feet. Allowing the water to flow inside at high water, the walls need be but little thicker than ordinarily, if the cement be good: say 36 inches. 2. Buttressed wall. But do not reduce the thickness to less than the figure just given. In such a case as the one under consideration, too great care cannot possibly be taken, if the pressure of the water is to be carried, to get a perfectly sound wall through which or under which, the water cannot find a crack which will allow its entrance. A stream once started through the wall may do serious injury when not suspected. 3. Equally efficient and thorough warming of large buildings should cost less by steam than by stoves. Is not the building more completely and more highly heated than before? 4. Yes, if the pipe is not made large. We should generally anticipate that, unless the area of heating pipe were made very great, live steam would be most economical in a cold climate. 5. The higher the steam pressure, the greater is the amount of expansion allowable. An engine too large for its work is wasteful, but, even in that case, high steam throttled down is more economical than low, if the boiler, steam pipes and engines are all carefully protected against losses of heat by radiation and conduction.

M. F. asks: How much larger will each of our four hydraulic pumps have to be bored in order to give us the capacity of two more (six instead of four) pumps? The outside diameter of pump is 4¾ inches, diameter of plunger, 1¾ inches, diameter (or bore) of pump, 1⅞ inches, length of stroke, 8½ inches. Answer: A pump 4¾ inches diameter has a cross area of plunger of 13¾ square inches. Six such plungers would have a combined area of 80 inches, and this, divided among four plungers, again would require each to have an area of 20 inches, or a diameter of about 5⅙.

K. solves E. C. M.'s problem as follows: Question: A body weighing 5 lbs. descends vertically, and draws a weight of 6 lbs. up a plane whose inclination is 45°. How far will the first body descend in 10 seconds? In this problem, the motive force is 5 lbs. and the retarding force is 6 lbs. × ·7071067812 = 4·2426406872. Hence the motive force or power, P, is to the retarding force or weight, W, as 5 lbs. is to 4·2426406872 lbs. Now if a body weighing 4 lbs. were acted on by a motive force of 40 lbs., the accelerating force would be ¼ of 40, or 10 lbs.; or, were the retarding force 5 lbs. and the motive force 100 lbs., then the accelerating force would be 100÷5=20 lbs.; and so in all cases the accelerating force may be found by dividing the motive force by the retarding force, it being expressed by P over W. In this problem, the retarding force would be the greater, and would drag the other down the plane, were it not that a portion of its force is expended on the plane, whilst the entire force of the motive power is exerted in pulling W up the incline. Now the law of mechanics relating to the inclined plane is this: The power is to the weight as the hight of the plane to its length. Consequently the retarding force diminishes as the angle of elevation diminishes, and, in the same proportion, the accelerating force increases. Now in this case, the hight of the plane is to its length as 1 is to the square root of 2. And in this and in all cases, the hight is to the length as the sine of the angle of elevation is to 1. The sine of 45° = the square root of ½ = ·7071067812; hence on this plane, P, 5 lbs., is to W, 6 lbs., as ·7071067812 is to 1. If, in this proportion, we multiply together the extremes and means, we get 5 lbs. for the motive force, and 4·2426406872 for the retarding force. Hence the accelerating force will be found by dividing 5 by 4·2426406872, which gives 1·1785113. Had this quotient been unity, or 1, it would have shown that the motive and retarding forces were in equilibrium, and that they would consequently remain at rest. But as the motive force exceeds the retarding by the decimal ·1785113, this decimal will express the relative rate of motion of the motive force, compared with what it would be were it left to fall freely. Now if the power, P, were to fall freely without obstruction of any kind, it would descend 16·083 feet the first second, and its total descent in any given number of seconds would be found by multiplying 16·083 by the square of the time expressed in seconds. Hence in 10 seconds it would descend 100 times 16·083 feet, or 1608·3 feet. But the accelerating force is only ·1785113, and consequently it will fall only ·1785113 of 16·083 feet in the first second, that is 16·083 × ·1785113 = 2·8709972 feet. But as gravity acts similarly on the excess of the motive over the retarding force, the law of increase in the acceleration of the descending motive power will be the same as though it fell freely: and hence the distance fallen through the first second, 2·8709972 × 100 (the square of the time) gives us the required answer, namely, 287·1 feet, nearly.

O. A. B. says, in reply to E. M. C.'s question on the velocity of a body descending vertically, being acted on by a weight on an inclined plane: Cosine 45° = 0·7071 = force or resistance of any weight on the inclined plane. 0·7071 × 6 = 4·2426 lbs. = the static resistance of 6 lbs. weight, or the amount of 5 lbs. weight required to to balance the same. 5 − 4·2426 = 0·7574 lbs. = excess of 5 lbs. weight, which, if it had nothing but its own inertia to overcome, would fall 1608·5 feet in ten seconds: but it has to move a mass of 11 lbs. Hence $1608 \cdot 5 \times \frac{0 \cdot 7574}{11}$ = 110·75 feet = the answer.

W. R. S. sends a solution of E. C. M.'s problem: A weight of 5 lbs. draws a weight of 6 lbs. up an incline of 45°; required the distance the 5 lbs. would fall in 10 seconds. Answer: Six pounds on an incline of 45° would be balanced by 4·28 lbs. hanging vertically, according to well known laws of inclined planes. Therefore the weights 5 lbs.+6 lbs.=11 lbs., are acted on by a force of only 5−4·28=·72 lbs. Or ·72 lbs. has to move a weight 15·28 times heavier than itself, and consequently its rate of movement and total fall made in 10 seconds would be only $\frac{1}{15 \cdot 28}$ of its own fall by itself, provided the directions were both vertical. A body would fall in 10 seconds $10^2 \times 16\frac{1}{12}$ feet = 1608⅓ feet, and under above circumstances only 1608⅓ ÷ 15·28 = 105·25 feet in the same time. But the 6 lbs. moves up an incline of 45°, and, according to the laws of inclined planes in mechanics, would again diminish the fall of the 5 lbs. in the proportion of 5 to 7, nearly; therefore the 5 lbs. would only fall ⅚ of 105·25 feet, or nearly 75·18 feet in 10 seconds. No allowance is made for friction.

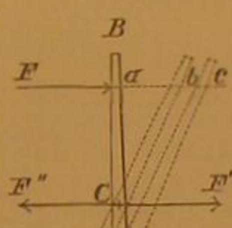
V. J. S. says, in reply to E. C. M., who asked for a solution of a problem on the acceleration due to a force: I give below the formula required: The acceleration due to a force is equal to the moving force, divided by the mass moved. In the case given, the moving force is equal to 5 sin. 45° and the mass moved is equal to 5+6; hence, denoting the acceleration by g', we have the equation g' = (5+6 sin. 45°) ÷ (5+6) = [illegible] = ·06881g. The equation for the space passed over by a falling body is s = ½gt², in which s = space, g = gravity, and t = time. Applying this formula, and substituting, for g = gravity, g' = acceleration, we have s = ½g't² = [illegible] × 10² = 3·4409 feet.

J. B. H. says, in answer to A. W. T., who asked how to polish walnut wood: Walnut, well sandpapered and then varnished with furniture varnish (to be bought at any furniture store), has a very elegant appearance; it dries in from 15 to 24 hours.

A. says, in reply to F. A. S., who asked how to drill a hole in a pane of glass without a diamond: I have done it with a common drill, moistened constantly with spirits of turpentine.

J. E. E. says: On page 406 of your volume XVI., there is an article under the head of electrical light, which gives an outline of Professor Wheatstone's electric machine. I do not understand how the horseshoe-shaped soft iron is arranged with the revolving helix. The regular electro-magnetic machine is made by arranging a permanent magnet in a box with an electro-magnet or helix, revolving at the poles. This new machine by Professor Wheatstone dispenses with the permanent magnet, which is a great thing when expense is an object. Can some one give me information on the subject? Answer: See our editorial pages of this issue.

H. B. says, in answer to E. W. H.'s problem: A rigid body, A, B, is supposed to be without weight and in a state of rest in space, uninfluenced by any external forces. Required the motion imparted by a given force, P, applied at any point, as A, supposing there be no resistance of the air. 1. If a rigid body at rest in space is acted upon by a force, directed towards its center of mass, it will attain a progressive motion in the direction of the force, which, after the impulse ceases to act, will continue in the same direction and with uniform velocity, but so that the body will remain parallel to its primary position. 2. If a couple of forces act upon a body, which before was in a state of equilibrium in space, they will tend to impart a rotary motion upon it, the axis of rotation going through the center of mass. This axis will at the same time be right angular to the plane of the couple, if the body should happen to be in a running balance on this axis. In every other case, the resulting rotation will be of a double character, as is that of our earth, which revolves on its axis between the two poles, while this very axis does not remain parallel, but again revolves on an axis, inclined to the former, thus causing the polar mutation of the stars. (Being unacquainted with astronomical terms, I am not sure whether this last phrase expresses my meaning, which is, the motion of the polar point in the system of stars in a large circle, in a period of many centuries.) In this latter case, the calculation of the rotary velocity, attained by the action of a given couple in a given time, is of a most difficult nature, while in the first case it is very easy, if the momentum of inertia of the body on the axis of rotation is known. 3. If the force, F, acts upon the body, B, (see engraving) one can imagine two forces F' and F'' acting upon the center, C, of the body in opposite directions, both being equal and parallel to F. This measure can evidently not affect the result. The forces, F and F'', form a couple, which impart to the body a rotary motion, while the remaining force, F' in the center, produces a progressive one. Hence the one force, F,



having the same effect as the three considered forces together, produces a progressive and a rotating motion, the latter of either a single or double character. If, in the two cases considered under 1 and 3, equal forces act for the same length of time, the progressive motion will be the same in either case; but the entire inertia imparted upon the body will be greater in the latter case, because the force acts through the space, a c; but in case 1, it acted only through the space b c. This difference is taken up by the momentum of rotation. If, however, in these same cases, the forces act through equal spaces before they cease, the progressive motion in the second case will be smaller than in the first one, in the same ratio as b c is to a c. The comparative results will be similar if the forces act till the points of application have a given velocity. A specific calculation in any one given case requires knowledge of the dynamics of forces in relation to the momentum of inertia.

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

R. D. M.—It is tin. We should be glad to see a specimen of the ore which yields it.

S. E.—The rock is limestone, and the minute "golden" particles are iron pyrites.

S. L.—It is a very pure galena, or lead ore.

W. A. L.—Iron pyrites.

J. H. P.—It is pure galena, (lead ore) and probably came from the veins once worked at Martinsburgh.

G. C. W.—It is of no value; it consists of minute crystals of pyrites.

H. P. I.—It is plastic clay—ferruginous and blue. We are not aware that it is put to any special use in this country. It is unusually rich in iron.

F. C. H.—They are specimens of chalcedonic quartz not hard enough for watch jewels.

S. B. D.—It is galena, the rich ore of lead, in a vein of calcite.

J. S. G.—The specimen is too minute for determination, but it resembles zinc blende.

T. P. Y.—The specimen contains galena, but not to any workable amount.

J. I. J.—The specimens are brown and yellow ocher, or oxide of iron, frequently used for rough painting.

J. A. H.—The brilliant "metal" in the clay is iron pyrites, and valueless.

COMMUNICATIONS RECEIVED.

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

On the Million Dollar Telescope. By D., by J. E. E., by B. F., and by S. H. M., Jr.

On Exhibiting the Carbon Poles. By T. W. D.

On the Wreck of the Atlantic. By E. W. F.

On the SCIENTIFIC AMERICAN. By J. B. C.

On the Spanish Inquisition. By H. G.

On Searching for Metals. By C. G.

On Transportation of Produce. By S. S.

On Worm Eggs in Apple Trees. By J. J. W.

On a Cure for Girdled Trees. By A. D.

On Power Transmitted by Belts. By A. M. S.

On Tannate of Soda. By J. G. R.

On Turning Leaves of Books. By J. W. K.

Also enquiries from the following:

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

[OFFICIAL.]

Index of Inventions

FOR WHICH

Letters Patent of the United States

WERE GRANTED FOR THE WEEK ENDING

April 15, 1873,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

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Wrench, railroad track, P. L. Gibbs	137,910

APPLICATIONS FOR EXTENSIONS.

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

24,898.—PUMPING ENGINE.—H. R. Worthington. July 2.
24,865.—SEWING MACHINE.—E. A. Goodes *et al.* July 9.
24,947.—JOURNAL BOX.—J. A. Montgomery. July 16.
24,963.—FLOUR PACKER.—S. Taggart. July 16.

EXTENSIONS GRANTED.

23,650.—BOILER FURNACE.—J. Amory.
23,665.—COOKING RANGE.—B. W. Dunklee.
23,701.—MAKING DRAIN PIPES.—B. S. & M. B. Pierce.
23,707.—HARVESTER.—S. Ray & M. B. Shalters. (A)
23,707.—HARVESTER.—S. Ray & M. B. Shalters. (C)
23,716.—STOVE.—S. B. Sexton.
23,716.—HEATING STOVE.—S. B. Sexton.
23,735.—SEAMING MACHINE.—J. Wilson, *et al.*
23,736.—CORRUGATING METAL.—J. Wilson, *et al.*

DISCLAIMERS.

23,716.—STOVE.—S. B. Sexton, Baltimore, Md.
23,716.—STOVE.—S. B. Sexton, Baltimore, Md.

DESIGNS PATENTED.

6,586.—PARLOR STOVE.—W. Doyle, Albany, N. Y.
6,587.—GLASS DISHES, ETC.—J. Hobbs, Bellaire, Ohio.
6,588.—CARPET.—A. Heald, Philadelphia, Pa.
6,589.—BADGE.—H. A. Oesterle, Philadelphia, Pa.
6,590 & 6,591.—CARPETS.—J. Powell, Kidderminster, Eng.
6,592.—COFFIN HANDLE.—J. S. Ray, East Haddam, Conn.
6,593.—CARRIAGE MOUNTINGS.—A. Searls, Newark, N. J.

TRADE MARKS REGISTERED.

1,211.—FRILLINGS, ETC.—F. Browett & Co., Coventry, Eng.
1,212.—LUBRICATOR.—Gerdom, Cook & Co., N. Y. city.
1,213.—CORN MEAL.—Kipe & Townsend, Chadd's Ford, Pa.
1,214 & 1,215.—LINIMENTS.—Merchant's Gargling Oil Co., Lockport, N. Y.
1,216.—PILE REMEDY.—J. P. Miller, Baltimore, Md.
1,217.—PRINTS.—J. R. Osgood & Co., Boston, Mass.

SCHEDULE OF PATENT FEES:

On each Caveat	$10
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On appeal to Commissioner of Patents	$20
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On an application for Design (7 years)	$15
On an application for Design (14 years)	$30

VALUE OF PATENTS

And How to Obtain Them.

Practical Hints to Inventors

PROBABLY no investment of a small sum of money brings a greater return than the expense incurred in obtaining a patent even when the invention is but a small one. Large inventions are found to pay correspondingly well. The names of Blanchard, Morse, Bigelow, Colt, Ericsson, Howe, McCormick, Hoe and others, who have amassed immense fortunes from their inventions, are well known. And there are thousands of others who have realized large sums from their patents.

More than FIFTY THOUSAND inventors have availed themselves of the services of MUNN & Co. during the TWENTY-SIX years they have acted as solicitors and Publishers of the SCIENTIFIC AMERICAN. They stand at the head in this class of business; and their large corps of assistants, mostly selected from the ranks of the Patent Office: men capable of rendering the best service to the inventor, from the experience practically obtained while examiners in the Patent Office: enables MUNN & Co. to do everything appertaining to patents BETTER and CHEAPER than any other reliable agency.

HOW TO OBTAIN *Patents*

This is the closing inquiry in nearly every letter, describing some invention which comes to this office. A *positive* answer can only be had by presenting a complete application for a patent to the Commissioner of Patents. An application consists of a Model, Drawings, Petition, Oath, and full Specification. Various official rules and formalities must also be observed. The efforts of the inventor to do all this business himself are generally without success. After great perplexity and delay, he is usually glad to seek the aid of persons experienced in patent business, and have all the work done over again. The best plan is to solicit proper advice at the beginning. If the parties consulted are honorable men, the inventor may safely confide his ideas to them; they will advise whether the improvement is probably patentable, and will give him all the directions needful to protect his rights.

How Can I Best Secure My Invention?

This is an inquiry which one inventor naturally asks another, who has had some experience in obtaining patents. His answer generally is as follows, and correct:

Construct a neat model, not over a foot in any dimension—smaller if possible—and send by express, prepaid, addressed to MUNN & Co., 37 Park Row, together with a description of its operation and merits. On receipt thereof, they will examine the invention carefully, and advise you as to its patentability, free of charge. Or, if you have not time, or the means at hand, to construct a model, make as good a pen and ink sketch of the improvement as possible and send by mail. An answer as to the prospect of a patent will be received, usually, by return of mail. It is sometimes best to have a search made at the Patent Office; such a measure often saves the cost of an application for a patent.

Preliminary Examination.

In order to have such search, make out a written description of the invention, in your own words, and a pencil, or pen and ink, sketch. Send these, with the fee of $5, by mail, addressed to MUNN & Co., 37 Park Row, and in due time you will receive an acknowledgment thereof, followed by a written report in regard to the patentability of your improvement. This special search is made with great care, among the models and patents at Washington, to ascertain whether the improvement presented is patentable.

Reissues.

A reissue is granted to the original patentee, his heirs, or the assignees of the entire interest, when, by reason of an insufficient or defective specification, the original patent is invalid, provided the error has arisen from inadvertence, accident, or mistake, without any fraudulent or deceptive intention.

A patentee may, at his option, have in his reissue a separate patent for each distinct part of the invention comprehended in his original application by paying the required fee in each case, and complying with the other requirements of the law, as in original applications. Address MUNN & Co., 37 Park Row, New York, for full particulars.

Value of Extended Patents.

Did patentees realize the fact that their inventions are likely to be more productive of profit during the seven years of extension than the first full term for which their patents were granted, we think more would avail themselves of the extension privilege. Patents granted prior to 1861 may be extended for seven years, for the benefit of the inventor, or of his heirs in case of the decease of former, by due application to the Patent Office, ninety days before the termination of the patent. The extended time inures to the benefit of the inventor, the assignees under the first term having no rights under the extension except by special agreement. The Government fee for an extension is $100, and it is necessary that good professional service be obtained to conduct the business before the Patent Office. Full information as to extensions may be had by addressing MUNN & Co., 37 Park Row, New York.

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Foreign designers and manufacturers, who send goods to this country, may secure patents here upon their new patterns, and thus prevent others from fabricating or selling the same goods in this market.

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On the first of September, 1872, the new patent law of Canada went into force, and patents are now granted to citizens of the United States on the same favorable terms as to citizens of the Dominion.

In order to apply for a patent in Canada, the applicant must furnish a model, specification and duplicate drawings, substantially the same as in applying for an American patent.

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American inventions, even if already patented in this country, can be patented in Canada provided the American patent is not more than one year old.

All persons who desire to take out patents in Canada are requested to communicate with MUNN & Co., 37 Park Row, New York, who will give prompt attention to the business and furnish full instruction.

Foreign Patents.

The population of Great Britain is 31,000,000; of France, 37,000,000; Belgium, 5,000,000; Austria, 36,000,000; Prussia, 40,000,000, and Russia, 70,000,000. Patents may be secured by American citizens in all of these countries. Now is the time, when business is dull at home, to take advantage of these immense foreign fields. Mechanical improvements of all kinds are always in demand in Europe. There will never be a better time than the present to take patents abroad. We have reliable business connections with the principal capitals of Europe. A large share of all the patents secured in foreign countries by Americans are obtained through our Agency. Address MUNN & Co., 37 Park Row, New York. Circulars with full information on foreign patents, furnished free.

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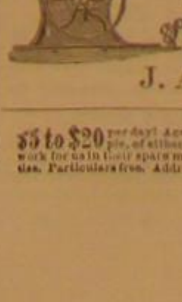

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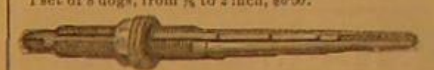

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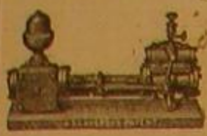

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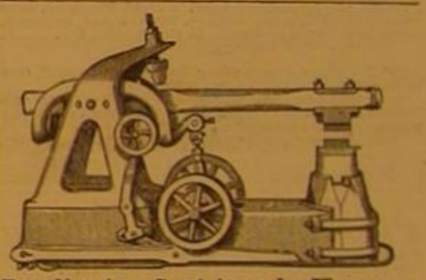

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