SCIENTIFIC AMERICAN

A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

Vol. XXXVII.—No. 25. [NEW SERIES.] | NEW YORK, DECEMBER 22, 1877. | $3.20 per Annum. [POSTAGE PREPAID.]

THE TUTTLE FAMILY KNITTER.

We present herewith three illustrations of the new Tuttle family knitting machine which embodies many valuable improvements, which consist mainly in its method and devices for knitting the hand rib stitch, in connection with plain and fancy stitches.

The machine as shown in the illustrations is similar to any circular knitter, having one perpendicular needle cylinder, used as a base, into which is introduced a conical needle cylinder held in position, so that by the rotation of the perpendicular cylinder, the needles in the cone cylinder are made to cross these in the straight cylinder while both are knitting, thereby producing a hand-rib stitch. This cone cylinder, when introduced into the perpendicular cylinder, is supplied with needles (being self-operating) taken from the perpendicular cylinder without removing the stitch from the same, thus turning the outside stitch which was knit on the perpendicular cylinder on to the inside of the work, precisely as in hand knitting. The inside or conical cylinder is so arranged that no more rib stitches are made than are desired; for instance, if it is required to knit just a few rib or seam stitches on the instep of the stocking, this can be done and the machine immediately changed back to plain work at the will of the operator.

The usual mode of knitting rib top hosiery on this machine is to remove every other needle (or as many as desired) from the outside or perpendicular cylinder and place them in the conical cylinder and knit as far as may be required for the top of the stocking, and then change or return the needles from the conical to the perpendicular cylinder swing, the cone out of work and go on with the plain stitch for the leg. When the ankle or instep is reached the conical cylinder may be returned to work and the ribbing performed, either upon one side or all the way round at pleasure. It will be readily seen that the ribbing may be continued all the way down the leg or foot. Very unique and fanciful styles can be produced in this method of ribbing by alternating the plain and rib stitches. Mittens can be made with rib on the back of the hand and plain in the palm of the hand, and *vice versa.*

This machine has a compound motion and can be run either way, backwards orforwards. Thus the work may stand still while the cylinders revolve, or the work revolve while the cylinders stand still. Each machine is provided with a register which accurately counts every full revolution of the machine whether turned either way.

Fig. 1 shows the conical cylinder or ribber at work, Fig. 2 the ribber when thrown out of work, and Fig. 3 exhibits the operation of transferring a needle from one cylinder to another. The machine is adapted to the manufacture of all kinds of hosiery and for family use.

Patented April 14, 1874. For further information address the Lamb Knitting Machine Company, Chicopee Falls, Mass.

Fig. 1.

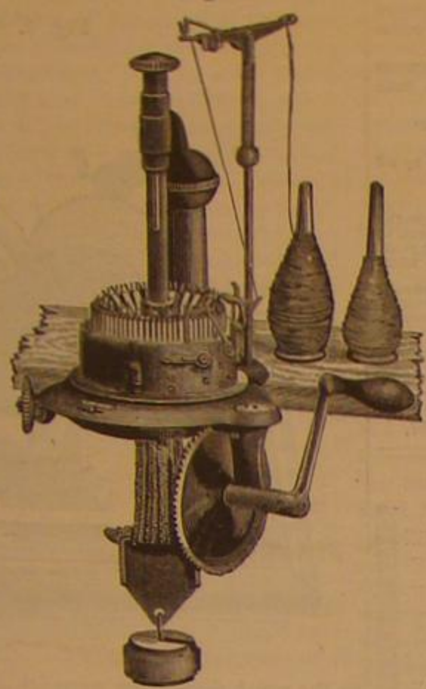


Fig. 3.

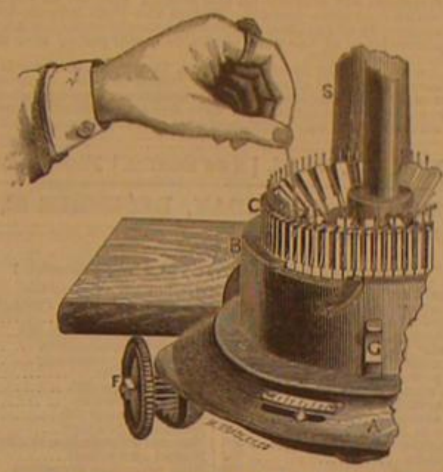
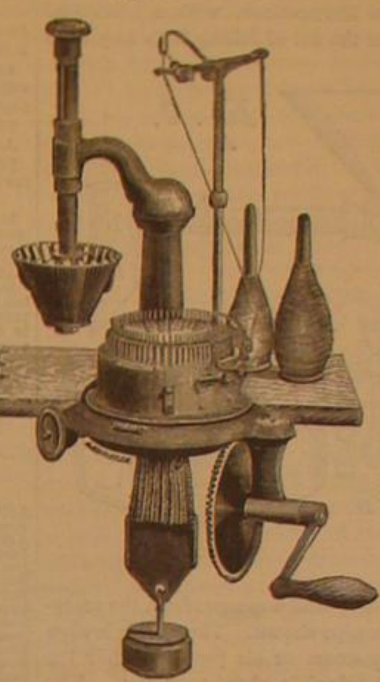


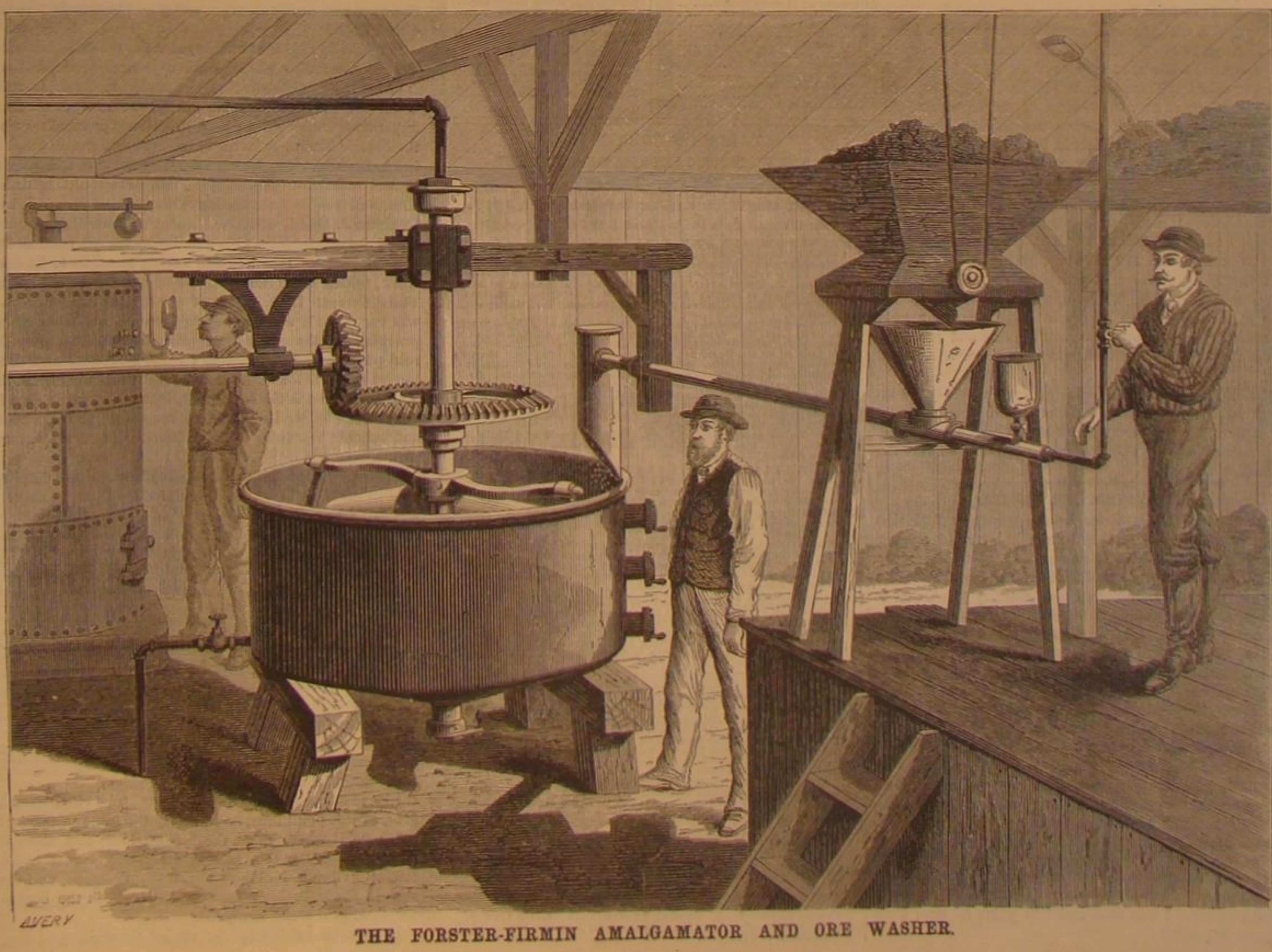
Fig. 2.



THE TUTTLE FAMILY KNITTER.

THE FORSTER-FIRMIN AMALGAMATOR AND ORE WASHER.

The magnitude of the mining interests in this country and the difficulties of treating ores containing the precious metals have resulted in many attempts to produce a machine or



THE FORSTER-FIRMIN AMALGAMATOR AND ORE WASHER.

system that will shorten the process of extracting the metals and reduce the cost, so as to enable poor ores, which are so abundant, to be worked at a profit. Millions of tons of the material are technically known as "tailings" (that is, ores from which has been taken all the gold and silver that, by present processes, can be profitably extracted, but which still contain an appreciable quantity of the precious metals) exist in all the auriferous districts. For the treatment of these ores various methods have been suggested. The principal difficulty that has been encountered is that of bringing mercury into contact with the gold where the latter exists in only small quantities, or from the flouring of the mercury when vapors of mercury are employed, entailing loss of amalgam and mercury in the subsequent treatment.

Messrs. Forster and Firmin, of Norristown, Pennsylvania, have recently devised a novel method of treating ores with mercury, for which letters patent have been granted them in the United States, Canada, Australia, and other countries. The pulverized ore containing free gold or silver is fed from the hopper, shown in the illustrations, with a horizontal tube, A, Fig. 2. While in the act of falling it is impinged

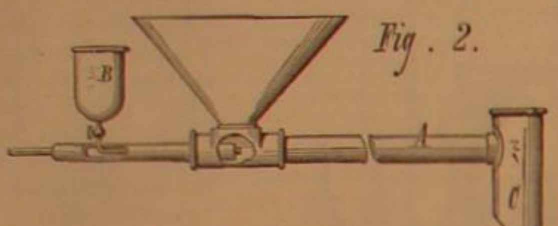
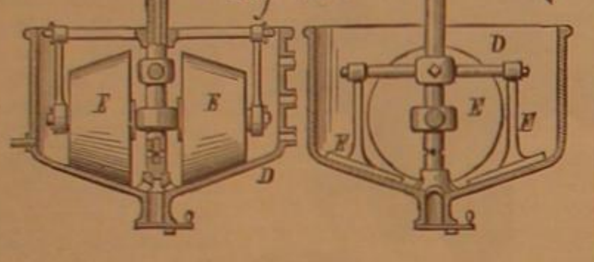


Fig. 2.

Fig. 3.



upon by a stream of mercury, which escapes from the receptacle, B, through the inner pipe shown. The flow is broken up and carried forward by steam or air pressure, after the manner of the well known principle of the sand blast. The horizontal tube connects with a vertical tube, C, upon which the ore and the atomized mercury are together forcibly projected, grain by grain, in a continuous stream, and fall, by their own gravity, into the washer or receiver, D. It is claimed that an almost unlimited quantity of ore may be treated by this process, as the attendants have only to feed the hoppers and remove the deposit. The inventors state that "with only a three inch tube from three to five tons of ore can be treated per hour."

In connection with this amalgamator an improved washer, shown in detail in Fig. 3, is used. This consists of a vessel, having a conical bottom, in which rollers, E, and also with scrapers or mullers, F, are placed. The feed water is injected through the shaft or near the bottom of the vessel, and the upward current carries off the waste ore, while the amalgam and surplus mercury collect in the dead water space in the conical bottom, whence they are drawn off through the discharge cock.

The advantages claimed for this invention are: 1st. The rapid continuous process of amalgamating, thus treating very large quantities of ore. 2d. The thorough impregnation of the metals with the mercury, giving larger results. 3d. The profitable working of poor ores or tailings, which are now valueless. 4th. The simplicity of the apparatus, having no parts to get out of repair. 5th. The cheapness and portability of the apparatus, and the ease and economy with which it can be operated wherever there is a steam boiler.

In the improved washer the amalgam and mercury are recovered rapidly with a comparatively small flow of water, without the danger of carrying off a portion of either the amalgam or mercury. For further information, address the inventors as above.

CONSTRUCTING ICE HOUSES.

People who do not own ice houses generally find that before the summer is over, they have paid a very high figure for their ice and that the sum so expended would have gone far toward the construction of a suitable storage building. Ice can be gathered near almost any country place, and it can easily be moulded into blocks even if obtained only in the form of a thin layer. The question is how to build a good ice house that will preserve it, and on this point there has been much discussion. Mr. R. G. Hatfield, one of the most prominent architects of this city, points out the best, cheapest and simplest way in SCIENTIFIC AMERICAN SUPPLEMENTS Nos. 55 and 59. There he gives working drawings of an admirable ice house which he has constructed and which has been found to answer its purpose in every particular. If the reader retained an architect to prepare a similar plan the cost would probably be at least fifty dollars; in the SUPPLEMENT, plans, specifications, and descriptions of all the details are given for but twenty cents.

AN OLD SUBSCRIBER.—An esteemed correspondent writes: "I have taken the SCIENTIFIC AMERICAN ever since its first number. I was then under 20 years of age; I am now over 50 years."

Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT
NO. 37 PARK ROW, NEW YORK.

O. D. MUNN. A. E. BEACH.

TERMS FOR THE SCIENTIFIC AMERICAN.

One copy, one year, postage included.................. $3 20
One copy, six months, postage included................. 1 60

Clubs.—One extra copy of THE SCIENTIFIC AMERICAN will be supplied gratis for every club of five subscribers at $3.20 each; additional copies at same proportionate rate. Postage prepaid.

The Scientific American Supplement

is a distinct paper from the SCIENTIFIC AMERICAN. THE SUPPLEMENT is issued weekly; every number contains 16 octavo pages, with handsome cover, uniform in size with SCIENTIFIC AMERICAN. Terms of subscription for SUPPLEMENT, $5.00 a year, postage paid, to subscribers. Single copies 10 cents. Sold by all news dealers throughout the country.

Combined Rates.—The SCIENTIFIC AMERICAN and SUPPLEMENT will be sent for one year, postage free, on receipt of *seven dollars*. Both papers to one address or different addresses, as desired.

The safest way to remit is by draft, postal order, or registered letter.

Address MUNN & CO., 37 Park Row, N. Y.

☞ Subscriptions received and single copies of either paper sold by all the news agents.

Publishers' Notice to Mail Subscribers.

Mail subscribers will observe on the printed address of each paper the time for which they have prepaid. Before the time indicated expires, to insure a continuity of numbers, subscribers should remit for another year. For the convenience of the mail clerks, they will please also state when their subscriptions expire.

New subscriptions will be entered from the time the order is received; but the back numbers of either the SCIENTIFIC AMERICAN or the SCIENTIFIC AMERICAN SUPPLEMENT will be sent from January when desired. In this case, the subscription will date from the commencement of the volume, and the latter will be complete for preservation or binding.

VOL. XXXVII., No. 25. [NEW SERIES.] *Thirty-second Year.*

NEW YORK, SATURDAY, DECEMBER 22, 1877.

Contents.

(Illustrated articles are marked with an asterisk.)

TABLE OF CONTENTS OF
THE SCIENTIFIC AMERICAN SUPPLEMENT
No. 103,
For the Week ending December 22, 1877.

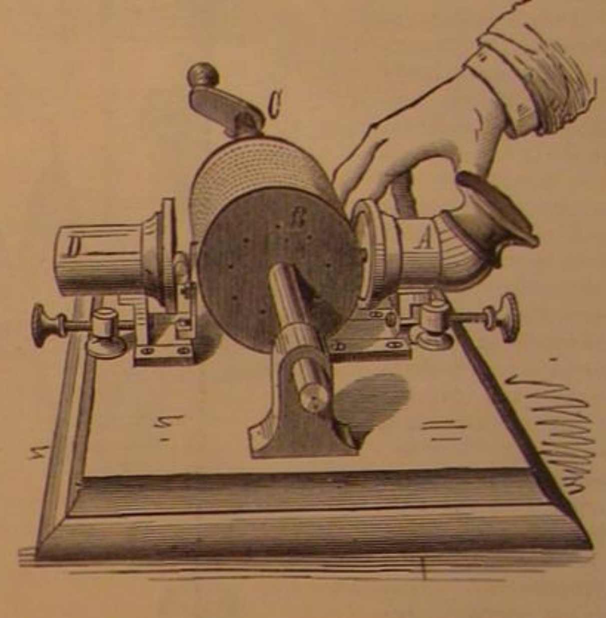
Price 10 cents. To be had at this office and of all newsdealers.

THE TALKING PHONOGRAPH.

Mr. Thomas A. Edison recently came into this office, placed a little machine on our desk, turned a crank, and the machine inquired as to our health, asked how we liked the phonograph, informed us that *it* was very well, and bid us a cordial good night. These remarks were not only perfectly audible to ourselves, but to a dozen or more persons gathered around, and they were produced by the aid of no other mechanism than the simple little contrivance explained and illustrated below.

The principle on which the machine operates we recently explained quite fully in announcing the discovery. There is, first, a mouth piece, A, Fig. 1, across the inner orifice of which is a metal diaphragm, and to the center of this diaphragm is attached a point, also of metal. B is a brass cylinder supported on a shaft which is screw-threaded and turns in a nut for a bearing, so that when the cylinder is caused to revolve by the crank, C, it also has a horizontal travel in front of the mouthpiece, A. It will be clear that the point

Fig. 1.

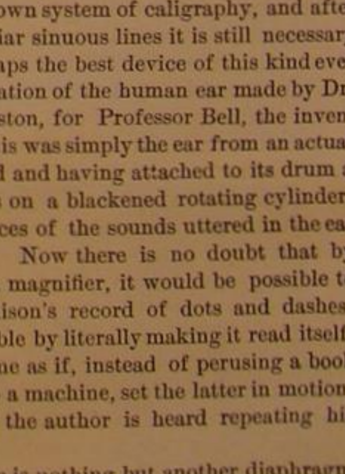


on the metal diaphragm must, therefore, describe a spiral trace over the surface of the cylinder. On the latter is cut a spiral groove of like pitch to that on the shaft, and around the cylinder is attached a strip of tinfoil. When sounds are uttered in the mouthpiece, A, the diaphragm is caused to vibrate and the point thereon is caused to make contacts with the tinfoil at the portion where the latter crosses the spiral groove. Hence, the foil, not being there backed by the solid metal of the cylinder, becomes indented, and these indentations are necessarily an exact record of the sounds which produced them.

It might be said that at this point the machine has already become a complete phonograph or sound writer, but it yet remains to translate the remarks made. It should be remembered that the Marey and Rosapelly, the Scott, or the Barlow apparatus, which we recently described, proceed no further than this. Each has its own system of caligraphy, and after it has inscribed its peculiar sinuous lines it is still necessary to decipher them. Perhaps the best device of this kind ever contrived was the preparation of the human ear made by Dr. Clarence J. Blake, of Boston, for Professor Bell, the inventor of the telephone. This was simply the ear from an actual subject, suitably mounted and having attached to its drum a straw, which made traces on a blackened rotating cylinder. The difference in the traces of the sounds uttered in the ear was very clearly shown. Now there is no doubt that by practice, and the aid of a magnifier, it would be possible to read phonetically Mr. Edison's record of dots and dashes, but he saves us that trouble by literally making it read itself. The distinction is the same as if, instead of perusing a book ourselves, we drop it into a machine, set the latter in motion, and behold! the voice of the author is heard repeating his own composition.

The reading mechanism is nothing but another diaphragm held in the tube, D, on the opposite side of the machine, and a point of metal which is held against the tinfoil on the cylinder by a delicate spring. It makes no difference as to the vibrations produced, whether a nail moves over a file or a file moves over a nail, and in the present instance it is the file or indented foil strip which moves, and the metal point is caused to vibrate as it is affected by the passage of the indentations. The vibrations, however, of this point must be precisely the same as those of the other point which made the indentations, and these vibrations, transmitted to a second membrane, must cause the latter to vibrate similar to the first membrane, and the result is a synthesis of the sounds which, in the beginning, we saw, as it were, analyzed.

Fig. 2



In order to exhibit to the reader the writing of the ma chine which is thus automatically read, we have had a cast of a portion of the indented foil made, and from this the dots and lines in Fig. 2 are printed in of course absolute fac-simile, excepting that they are level instead of being raised above or sunk beneath the surface. This is a part of the sentences, "How do you do?" and "How do you like the phonograph?" It is a little curious that the machine pronounces its own name with especial clearness. The crank handle shown in our perspective illustration of the device does not rightly belong to it, and was attached by Mr. Edison in order to facilitate its exhibition to us.

In order that the machine may be able exactly to reproduce given sounds, it is necessary, first, that these sounds should be analyzed into vibrations, and these registered accurately in the manner described; and second, that their reproduction should be accomplished in the same period of time in which they were made, for evidently this element of time is an important factor in the quality and nature of the tones. A sound which is composed of a certain number of vibrations per second is an octave above a sound which registers only half that number of vibrations in the same period. Consequently if the cylinder be rotated at a given speed while registering certain tones, it is necessary that it should be turned at precisely that same speed while reproducing them, else the tones will be expressed in entirely different notes of the scale, higher or lower than the normal note as the cylinder is turned faster or slower. To attain this result there must be a way of driving the cylinder, while delivering the sound or speaking, at exactly the same rate as it ran while the sounds were being recorded, and this is perhaps best done by well regulated clockwork. It should be understood that the machine illustrated is but an experimental form, and combines in itself two separate devices—the phonograph or recording apparatus, which produces the indented slip, and the receiving or talking contrivance which reads it. Thus in use the first machine would produce a slip, and this would for example be sent by mail elsewhere, together in all cases with information of the velocity of rotation of the cylinder. The recipient would then set the cylinder of his reading apparatus to rotate at precisely the same speed, and in this way he would hear the tones as they were uttered. Differences in velocity of rotation within moderate limits would by no means render the machine's talking indistinguishable, but it would have the curious effect of possibly converting the high voice of a child into the deep bass of a man, or *vice versa*.

No matter how familiar a person may be with modern machinery and its wonderful performances, or how clear in his mind the principle underlying this strange device may be, it is impossible to listen to the mechanical speech without his experiencing the idea that his senses are deceiving him. We have heard other talking machines. The Faber apparatus for example is a large affair as big as a parlor organ. It has a key board, rubber larynx and lips, and an immense amount of ingenious mechanism which combines to produce something like articulation in a single monotonous organ note. But here is a little affair of a few pieces of metal, set up roughly on an iron stand about a foot square, that talks in such a way, that, even if in its present imperfect form many words are not clearly distinguishable, there can be no doubt but that the inflections are those of nothing else than the human voice.

We have already pointed out the startling possibility of the voices of the dead being reheard through this device, and there is no doubt but that its capabilities are fully equal to other results just as astonishing. When it becomes possible as it doubtless will, to magnify the sound, the voices of such singers as Parepa and Titiens will not die with them, but will remain as long as the metal in which they may be embodied will last. The witness in court will find his own testimony repeated by machine confronting him on cross-examination—the testator will repeat his last will and testament into the machine so that it will be reproduced in a way that will leave no question as to his devising capacity or sanity. It is already possible by ingenious optical contrivances to throw stereoscopic photographs of people on screens in full view of an audience. Add the talking phonograph to counterfeit their voices, and it would be difficult to carry the illusion of real presence much further.

THE END OF VOLUME XXXVII.

With our next issue the thirty-seventh volume of the SCIENTIFIC AMERICAN closes. At the same time several thousand subscriptions terminate; and as it is our invariable rule never to send the paper after the period subscribed for has elapsed, those of our readers who desire no break in the regular reception of their numbers will favor us by a prompt renewal of their subscriptions. The volumes of the SCIENTIFIC AMERICAN for the coming year will, we believe, excel any of their predecessors. No pains will be spared to render their contents the most complete exhibit of everything that transpires in the world of science, mechanics, or arts, and it will be our endeavor to place this information before our readers at so early a date, and so simplified and digested, as to render it a constant fund of suggestion for those who are ready to exercise their inventive powers to devise new and useful modifications, improvements, or original conceptions. In order to invent it is necessary to know, first, what has been done, second, what is in progress, and third, the general drift of present advancement. The SCIENTIFIC AMERICAN presents the first through carefully prepared articles on prominent industries and lucid illustrated descriptions of the most recent and improved mechanical devices; the second through its correspondence from various parts of the world, its selections from the immense range of current foreign technical periodicals, and from the immediate contact of its managers with the best inventive minds of the country; and lastly, the third is pointed out in elaborate editorial reviews and comments on new ideas as the same are brought out. It may be safely said that more people have obtained from the SCIENTIFIC AMERICAN valuable suggestions which have returned them direct profit than through any other medium extant.

Besides pointing out the road to invention, the SCIENTIFIC AMERICAN during the coming year will give particular attention to the presentation of papers of practical instruction to mechanics of every class. Thoroughly competent mechanical experts will explain the best methods of workshop manipulation, and, both in answer to the questions of correspondents and elsewhere, an immense number of reliable trade recipes, besides valuable advice in special cases which may be submitted to us, will be given. In the department of natural history much that is rare and curious in the animal and vegetable worlds will be illustrated and described, and no engineering structure of importance will be undertaken but that it will be fully elucidated in our pages. The Great French Exposition of 1878 will also be completely described, and whatever is there exhibited of novelty or interest will be found illustrated in these columns.

All this valuable and varied information appears in no other journal, for none other enjoys the facilities for obtaining the same, now possessed by the SCIENTIFIC AMERICAN. The subscription price will remain, as heretofore, $3.20 per year, postage paid.

WINTER SHOP WORK.—BUILDING BOATS.

Many of our readers, especially those who are mechanical amateurs, are just now considering what work they shall undertake in their spare hours during the coming winter. We know several members of professions and other callings who make it a rule to work in their nicely fitted-up shops a few hours daily, and thus they gain health, strength, and relief from brain work, while the result of their labor often proves of value and profit. There are also many regular mechanics who are anxious to find some good paying job to labor at, over hours, so that they can lay up a little extra fund above their wages. Among the suggestions we make to these workmen, amateur and regular, is to build boats. Boats are very expensive to buy. The smallest kind of a 10 foot yawl costs about 50 dollars when purchased from a regular builder, and for a good sail boat from 200 to 600 dollars is charged. Boats can be built indoors. They require nice work, and the amateur mechanic can lavish on them just as much fine manipulation as he chooses as all such shows and enhances the beauty and value of the craft. A boat besides is always useful and frequently necessary to any one who lives near the water.

Most people, whose boat building has not extended beyond the construction of a flat bottomed scow, think that to build a yawl or a yacht is a difficult and expensive undertaking, while it is just the reverse. Any one who can put up a workmanlike chicken house can build an excellent sail boat. All he has to do is to follow instructions, and those he will find in the SCIENTIFIC AMERICAN SUPPLEMENT. In that journal we have published, with elaborate working drawings and directions, full particulars how to construct a scow for three dollars (SUPPLEMENT No. 25), a rowing skiff for five dollars (SUPPLEMENT No. 26), a fine sailing skiff for fourteen dollars (SUPPLEMENT No. 29), a neat ribbed row boat for twelve dollars (SUPPLEMENTS 30 and 32), a large row boat for sixteen dollars (SUPPLEMENT No. 36), a Whitehall boat of fine model, such as is used in New York harbor, for fifteen dollars (SUPPLEMENT No. 37). A sailing and rowing canoe of the type of the famous Rob Roy for fifteen dollars (SUPPLEMENT No. 39), a fast sailing yacht for thirty dollars (SUPPLEMENT No. 42), and finally a large fast and serviceable yacht for three hundred dollars (SUPPLEMENT No. 67). These estimates cover the materials, not the labor, of the amateur builder. The entire series, which embraces about 100 illustrations, mainly accurate drawings to scale, besides full details as to how to rig and manage the vessels, may be obtained for one dollar.

Last summer a great deal of attention was given to catamarans or double boats. Not even professional boat builders as a rule understand the construction of these exceedingly fast craft. In SUPPLEMENTS Nos. 105 and 106 will be found full directions of how to build three different sizes of these remarkable vessels at costs ranging from $50 to $500. Not only can the vessels above referred to be constructed for pleasure purposes, but we have no doubt any mechanic could find in their construction and sale a very profitable source of revenue.

BUILDING ICE BOATS.

In a few weeks the rivers and streams of the Northern States will be frozen over, and therefore the present is the time for those who propose to pursue the exhilarating and health-giving sport of ice yachting to get their vessels in readiness. There is no known mode of locomotion which outrivals the ice yacht in speed. It travels at a mile a minute with ease, outstrips fast railway trains, and, when contrasted with the ordinary sailing vessel, is handled with ease and safety.

Ice yachting has been practiced on the Hudson river for a number of years past. The owners of the boats have exercised great skill and ingenuity in devising improved models, until at present by far the most elegant and swift ice vessel are to be found during the winter on the above stream. The ice yacht Whiff, which, it will be remembered, was exhibited at the Centennial Exposition, proved a revelation to thousands who had practiced ice yachting in comparatively slow and clumsy contrivances. Especially was this true of the people of Northern Europe, whose ice boats were little more than heavy sledges with sails. The result has been a demand for knowledge regarding the best form of ice yachts, a demand not confined to this country, but which comes from every quarter of the world where rivers and lakes freeze over, and where ice yachts can be used either for pleasure or as a source of profit.

Any mechanic of average ability, or any young man of fair mechanical acquirements, who knows how to handle carpenter's tools, can construct an ice boat from the minute directions, accompanied with elaborate working drawings, made to scale, which are to be found in the SCIENTIFIC AMERICAN SUPPLEMENT No. 63. If these are followed, a duplicate vessel in every particular to the famous Whiff is produced. Such information has never before been published and is not attainable elsewhere, and it is now being sent in response to calls to all parts of the world. In SUPPLEMENT No. 1 is given other engravings, showing how to construct ice vessels of different builds, besides full particulars as to management, organization of clubs, etc. For twenty cents, therefore, the mechanic can obtain information whereby he can construct the best class of ice yachts, which he can sell at large profit; or the amateur the directions which will enable him to produce a fine fast vessel at minimum expense and at little labor.

RECEIVING YOUR PAPER.

We shall consider it a favor if subscribers, editors of exchanges, and all others who are entitled to receive the SCIENTIFIC AMERICAN or SUPPLEMENT regularly, and whose numbers fail to reach them in proper season, or who miss numbers, or whose addresses are not printed exactly right on the slip pasted on the wrapper, will notify us promptly of the fact. A line in pencil to this effect is easily written on a postal card, and it may save considerable annoyance during the year. The internal affairs of this establishment, and especially those of the mailing department, are carefully systematized: our subscribers addresses are printed and affixed to the wrappers by machinery; and it is obvious that if anything goes wrong, there is error or neglect somewhere, which is easily traced and remedied. Our readers need have no fear with regard to giving us any trouble in this matter. We ask the information for the mutual advantage of both our readers and ourselves.

BUILD A STEAMBOAT.

Not a big one, but a small craft large enough to run around the river on the pond near your place. To construct the hull will be an excellent winter's work, and the engine can be obtained at a moderate price. There is no better practice for a boy of mechanical tastes than for him to learn to run a small steam vessel. It would be a good idea to buy the engine first, set it up in the shop and make it drive the saw and other tools which can be used in constructing the hull. This will familiarize you with the machine, which may afterwards be put in its place in the boat.

In building a craft of this description, there is every chance for fine work and for some really valuable invention. Shipbuilders everywhere are seeking to discover the best lines for small vessels, through which the highest speed may be obtained, for it is well known that the model of a boat has a great deal to do with her speed. On such a vessel the builder could easily try ideas in this direction of his own, and thus perhaps reach some valuable results. A steam launch is besides a much greater source of pleasure to her owner than any sailing yacht, as she is independent of wind and tide and admirably suited for long trips or even a summer's cruising.

To learn how to build the fastest kind of steam yacht send for SUPPLEMENTS No. 14, 69, 75 and 81, price ten cents each. These explain (with working drawings) how to construct a 15 foot launch like the Black Hawk, a very celebrated boat in this vicinity; how to build a fine 30 foot launch with machinery and everything complete for only $380. How to build a 40 foot steam launch with a three cylinder engine, and finally how to construct a 21 foot launch that will steam 10 knots per hour. An ingenious builder will take all these plans, pick out the best features of each, and produce a boat which probably will excel all.

Wire for the East River Bridge.

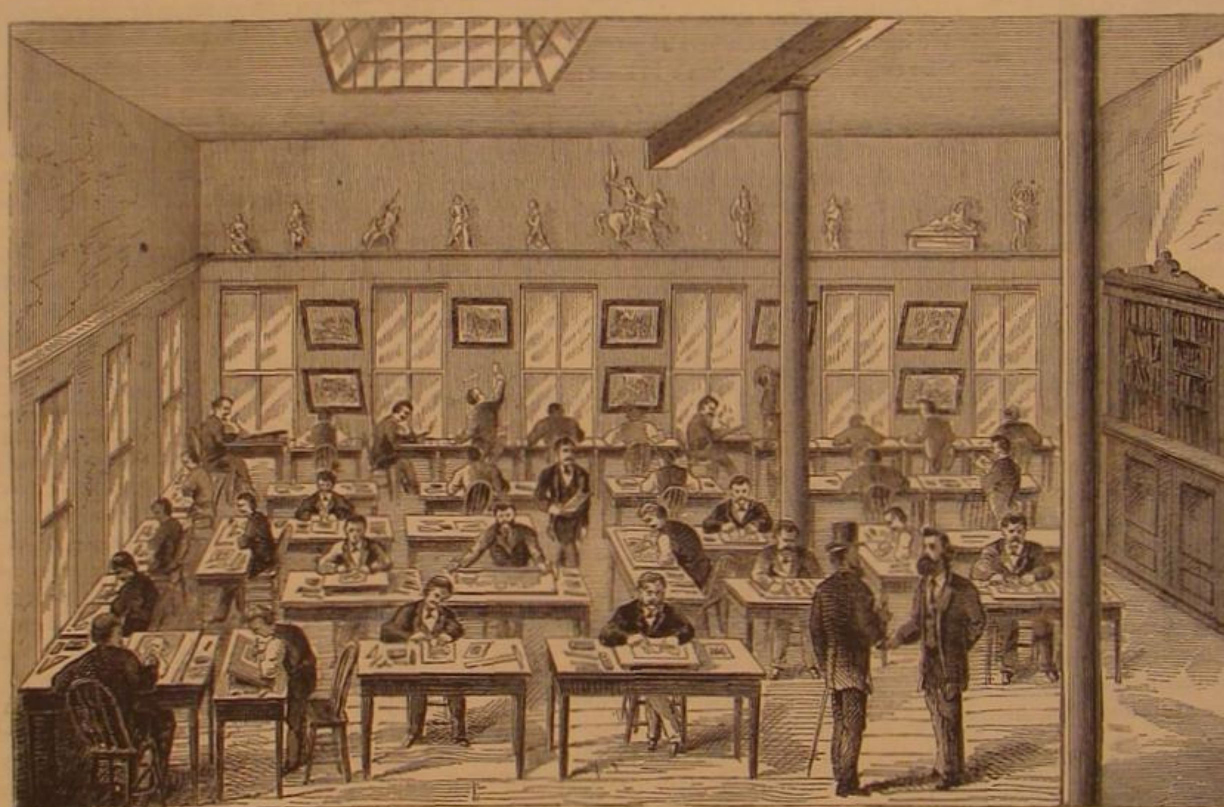
Proposals were recently called for the supply of the steel wire for the suspending ropes of the East River Bridge. The specifications require 325,000 pounds of wire rope, making, 70,000 lineal feet in all. There are two sizes required, one measuring $1\frac{5}{8}$ inches in diameter, weighing $4\frac{1}{4}$ pounds to the lineal foot, and having a breaking strength of not less than 180,000 pounds; the other measuring $1\frac{3}{4}$ inches in diameter, weighing 5 pounds to the lineal foot, and having a breaking strength of 200,000 pounds. The attention of the members of the board was called to a gnarled, broken, and twisted suspender rope. This specimen was made at the factory of Roebling's Sons & Co., by the direction of Chief Engineer Roebling. It was $1\frac{5}{8}$ inches in diameter, and had been tested by the Keystone Bridge Company, of Pittsburg. It was broken under a strain of 197,500 pounds, the required strength being 180,000 pounds. It was resolved award the contract to J. A. Roebling's Sons & Co., at seven cents a pound, for Bessemer steel wire.

THE PHOTO-ENGRAVING COMPANY OF NEW YORK.

The earliest attempts to produce engraved plates by the aid of light appear to have been made in France about the year 1813, by Nicéphore Niépce. He was prosecuting experiments in lithography, then in its infancy, when he conceived the idea of transferring his drawings on to the lithographic stone by the aid of light. While thus engaged it occurred to him that he might produce engraved plates by the same means, and even render permanent the image shown in the camera obscura. After continuing his experiments for more than fifteen years, he associated himself with Mons. Daguerre, who had also spent several years in similar investigations. In 1833 Niépce died, and a year or two later Daguerre invented his method of developing the latent image impressed by light on an iodized silver plate, by means of the vapor of quicksilver.

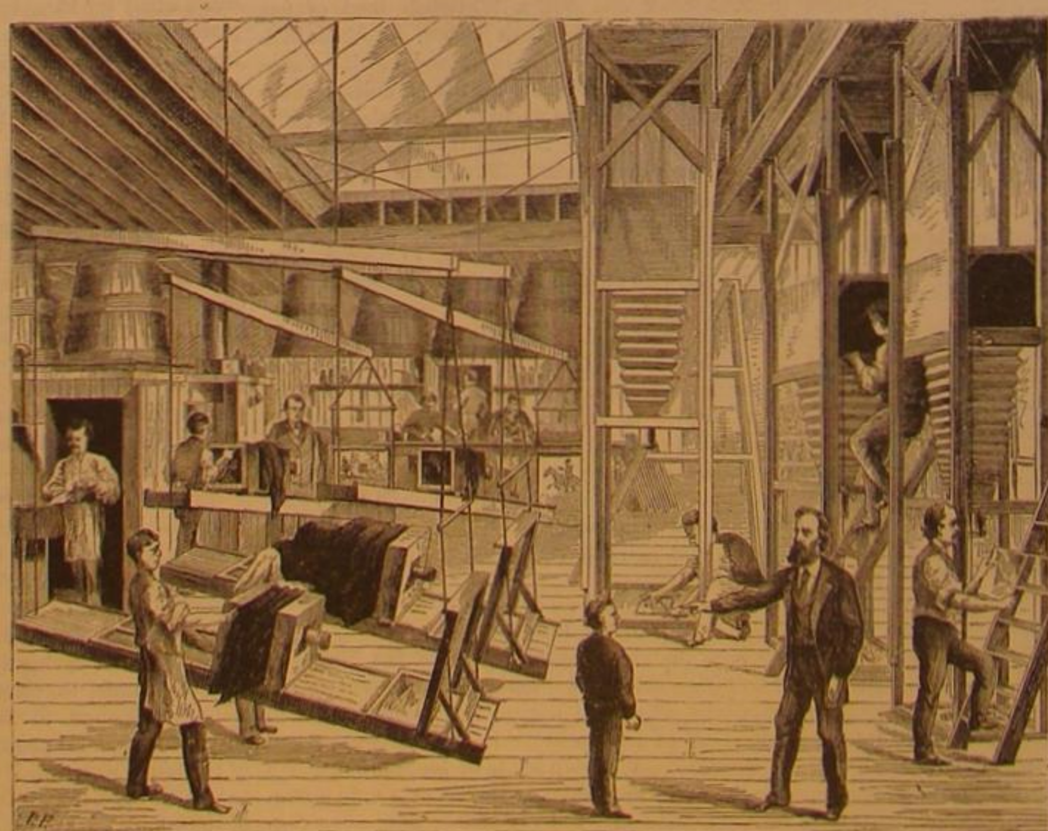
OFFICE OF THE PHOTO-ENGRAVING COMPANY, NEW YORK.—Fig. 1.

Niépce's method of heliography, as he called it, consisted in coating a metallic plate with a film of asphaltum dissolved in oil of lavender. Over this plate he laid a print or drawing, which had been rendered transparent by the application of oil, and then exposed it to the sun. The dark lines of the drawing protected portions of the asphaltum from the light, while the unprotected parts were acted upon and became insoluble. The plate was then washed with turpentine, which removed the asphaltum where the light had not acted, but left the remainder undisturbed. The bare metal, thus exposed, was then etched with an acid, and an engraving produced. But the results thus obtained were very imperfect and practically useless.



ARTISTS' STUDIO OF THE PHOTO-ENGRAVING COMPANY.—Fig. 2.

There are quite a number of different processes which may be classed under the general heading of photo mechanical printing, which it is not deemed necessary to review in detail here, as the degree of success attained has been frequently small, especially when the particular system was subjected to the rapid and comparatively careless manipulation incident to the use of the fast newspaper press. It may be stated, however, that nearly all of these processes depend upon the use of bichromate of potash with which is associated gelatin or similar organic matter. Mungo Ponton, in 1839, first discovered the sensitiveness to light of a sheet of paper treated with bichromate; in the following year Becquerel found that the sizing of the paper played an important part in the change, and in 1853 Mr. Fox Talbot discovered and utilized the insolubility of gelatin exposed to light in the presence of bichromate. In 1854 Paul Pretsch discovered and utilized the quality which such exposed gelatin possesses of not swelling in water. On Pretsch's discovery are based the gelatin processes that have attained most notoriety, and that have excited among experimenters the largest expectations of success, as follows: A glass or metallic plate is coated with a mixture of gelatin and bichromate of potash, which is allowed to dry and afterwards is exposed to the sun through a photographic negative. It is then immersed in cold water, when the parts protected from the light by the negative rapidly swell, while the parts not so protected are hardened and do not swell to the same extent. This gelatin surface then becomes the matrix from which, through intermediate steps, the final plate for printing is formed. The main difficulty encountered is that the surface of the matrix is made up of unequally swelled lines, and these, as reproduced, come out without sharpness—uneven and clumsy. Hence when placed upon the press, the plates are found incapable of yielding a clean and bright impression. The other process differs from the foregoing in that instead of swelling the soft parts they are wholly washed out. The difficulty here is that the water affects the insoluble portions, so that the lines are rendered rounded. Broad lines are also likely to become concave and to require subsequent pumicing to level them, a proceeding which is fatal to their delicacy and fineness of definition.



PHOTOGRAPHIC DEPARTMENT OF THE PHOTO-ENGRAVING COMPANY.—Fig. 3.

These processes, as already stated, constitute the foundation, but the results they yield are materially affected by the different minor modifications which individual experimenters have introduced and which, as a rule, are kept secret and not patented. The Moss process arose from an effort to avoid the difficulties above referred to. It is a combination of certain elements of other processes, for the purpose of securing completeness and delicacy of detail, in connection with all desirable depth and smoothness of lines. Of the two prominent photo-engravng concerns in this city, one prepares its plates of zinc, and turns them out ready for the press without the further necessity of any hand routing or other tool work; the other produces fine plates in type metal, and finishes by hand. In both cases, however, hand work is involved, as in that first mentioned the necessary sharpening of the lines is done on the negative.

The annexed illustrations, representing the various steps in the photo-engraving process, were prepared by the Photo-Engraving Company, of this city, and are excellent examples of the fineness and delicacy of the work done by means of the Moss process. These plates are made of type metal by stereotyping, and are hand finished. The first operation is to prepare the drawing which is to be reproduced. To do this successfully it is necessary that the picture should be formed of clean, sharp, and very black lines. Flat tints and washes, or blurred shadows, cannot be photo-engraved unless they are first translated into lines. Where an engraving is to represent a piece of machinery, for example, a photograph of the object is taken, but is not fixed in the gold bath. From this print the artist obtains his outline in black ink, and this done he obliterates the photograph by corrosive sublimate. He has then an accurate outline, which he proceeds to fill in with a shading, etc., of pen lines. It is usual to make the drawing somewhat larger than the engraving is to be, in order that by the reduction the lines of the latter may be rendered finer.

The interior of the artists' room of the Photo-Engraving Company is shown in Fig. 2. Next ensues the photographing, and the apartment in which this is conducted is represented in Fig. 3. Here a negative of the drawing is prepared, from which, by several intermediate steps, a mold is made. The picture during this process is reduced or enlarged as desired, the reduction being only limited by the capability of the resulting block to yield a clear impression under the conditions of printing to which it is to be subjected. Thus a finely reduced engraving would soon fill with ink and produce a disagreeable and blurred impression on a rapid press, while, on a slow book press and on fine smooth paper, the same engraving would give excellent prints.

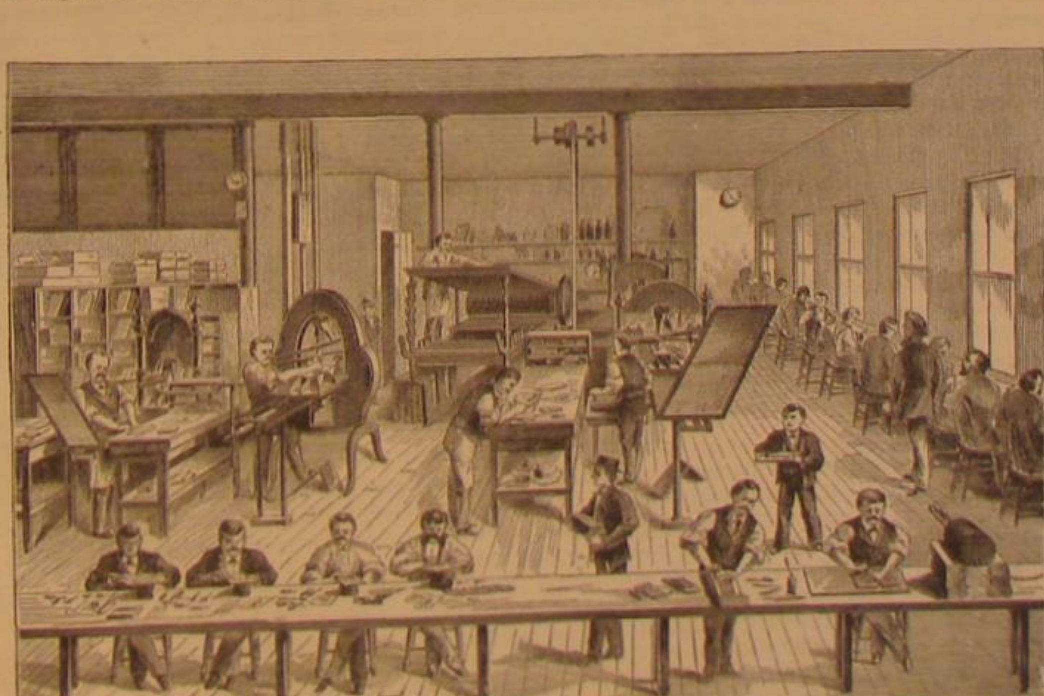
The reader will notice from this illustration that the cameras used are exceedingly large, thus giving clear and very well defined pictures, while the entire apparatus of both camera and retaining device for the picture to be photographed is suspended from the ceiling of the room by a single rope. The advantage of this last arrangement is that it prevents independent accidental movements of camera and object. Should one or the other move even the merest fraction of an inch—and this might easily be caused by the jarring of the building through the passage of heavy vehicles in the street—it is evident that the accuracy of the photograph would be impaired, but, so long as both camera and object must move together if at all, their relative positions always remain unaltered. It is by such nice relative refinements as this that the clear sharp work, of which the annexed engravings are excellent specimens, is produced by the Photo-Engraving Company.

After the photo-plate is finished, and this is a work requiring skill and scrupulous care, it is copied in metal, and this copy forms the engraving or block that is used on the printing press. The room in which these metallic plates are made is shown in Fig. 4, and here appear the various devices for melting the metal, running it upon the molds, etc. The next process is the trimming of the plates, and this is done by skilled engravers, who, with the burin, render the lines sharp and clear, and cut away metal in the high lights to intensify the same. This work is of course entirely auxiliary to the photo-engraving process, but it has the advantage of rendering the engravings produced by the Photo-Engraving Company from drawings or other engravings almost as perfect as the originals. Very often it is found necessary to reproduce a picture which is poor, but the only one attainable giving the desired representation. In such case the photo-engraving is an accurate reproduction, faults and all, but the latter are speedily modified by the skill of the finishing engraver.

The plate of metal is now mounted on a block, type high, and no further treatment is necessary to adapt it for the printing press. Sometimes where a large number of impressions are to be taken, the surface is coated with a thin film of copper by electro-metallurgy, or an electrotype is taken from the plate the same as from a wood cut.

STEREOTYPING DEPARTMENT OF THE PHOTO-ENGRAVING COMPANY.—Fig. 4.

Fig. 1 represents the interior of the office of the Photo-Engraving Company, at Nos. 67 and 69 Park Place, this city. Here may be seen a large collection of engravings reproduced by the process we have described. Fine line steel engravings are duplicated with wonderful accuracy, so that instead of paying ten or fifteen dollars for a choice picture, the lover of art may now obtain the same at a tenth the price. The capabilities of the photo-engraving art were never better illustrated than by the splendid portrait of Professor John W. Draper, which occupied our initial page last week. For color, delicacy of line, and general artistic effect, this work of art is universally admitted to equal the best efforts of the wood engraver. The process used by the Photo-Engraving Company is due to the ingenuity of Mr. John C. Moss, who has labored constantly in inventing and improving the same for nearly twenty years. The exact means whereby the excellent results we have noted are obtained are kept secret, but this is of no importance to the public, so long as such high grade work can be uniformly produced at a cost less than that of wood engraving. Several thousand illustrations prepared by the Photo-Engraving Company have appeared in the SCIENTIFIC AMERICAN and SUPPLEMENT during the last few years, side by side with the best productions of hand wood engraving; and in this fact will perhaps be recognized one of the best recommendations as to their excellence, which photo-engraved illustrative plates have received.



PROVING AND FINISHING DEPARTMENT OF THE PHOTO-ENGRAVING COMPANY.—Fig. 5.

Electric Fire Balls.

M. Planté seeks in the foregoing experiments of his an explanation of the *foudre globulaire* or "fire ball." They show that with a sufficient quantity and tension of electricity we can obtain the electric light in a globular form. He therefore thinks that this manifestation of the lightning discharge is due to an abundant flow of electricity in the dynamic state in which great quantity and potential are united. Those particular cases wherein the fire ball is seen to move and to stop are explained by the motion or rest of a column of humid air, strongly electrified and invisible, which serves for an electrode. In order to imitate this effect it suffices to oscillate the platinum electrode in the above experiments, pendulum fashion, over the water, or a metallic surface, when a little fire ball is seen to move over the surface opposed. This explanation of the fire ball has been advanced before by Mr. Cromwell F. Varley.

Prismatic House Signs.

A new contrivance for rendering the numbers of houses visible by night is becoming general in Paris. It consists of a hollow triangular prism about nine inches long, two of whose sides are formed of panes of blue glass,,on which the number of the house is picked out in white. This prism-shaped lamp-glass rests against the front of the house, so that the two sides with the numbers on them can be plainly seen by the passers-by. In the interior of the prism is a gas jet, fed by a pipe from the house. Householders on the Avenue de l'Opera have been obliged to supply this mode of numbering at their own expense on the houses they are building; and the municipal authorities have introduced it on some 450 of the municipal establishments, schools, police offices, fire brigade offices, etc.

Proposed Diversions of the Nile.

It is well known that the main stream of the Nile is supplied by the great equatorial lakes of Africa, and that the annual inundations are caused by the inrush of torrent water laden with soil from the fertile slopes of the Abyssinian plateau in July, August, and September. This silt is now for the most part being deposited in the bed of the Mediterranean, where it is gradually forming a new delta similar to the delta already formed at the river's mouth. Sir Samuel Baker has written to the *Times* suggesting a plan by which not only the water of the Nile but the mud, which it now deposits wastefully in the sea, may be turned to good account as a fertilizer of the deserts of Nubia, Libya, and the Soudan. He proposes by suitable engineering works to divert a portion of the Nile flood water into these deserts, where it can deposit its rich sediment on the sands, and also irrigate them so as to transform them from a desert into "cotton fields that would render England independent of America." This could be effected by having suitable dams and sluices at different points of the Nile, say at the Cataracts. These dams and sluices, by enabling craft to pass the Cataracts, would also render the Nile navigable from the Mediterranean to Gondokoro, a space of 29° of latitude.

New Oil Wells—Pennsylvania.

A correspondent of the *Petroleum Reporter* says the Clarion oil region is just now experiencing livelier times in the way of operations and new developments than it has ever done heretofore. The number of wells going down is simply enormous, and the statistics total for November will far exceed that of any previous month. The principal field of production, and that wherein lies the most excitement at present, is the Eastern belt, or what is known by that title in the district. A large number of "wildcats," or test wells, have gone down off the eastern edge of the defined line, but with very few exceptions they have proved dusters. The venturesome operators have succeeded in widening the belt but little, although a great deal of money has been spent for that purpose the present summer. The most prolific territory appears to be in the vicinity of Slam Bang City, a new town on the Twenty-two degree line, and situated between the Stone Church and Shippenville. The Davis well, struck at this place, about three months ago, started off at 400 barrels a day, and has averaged about 125 barrels ever since the "head" was pumped off. Several other wells have been struck in the same vicinity, the largest being that of Cram & Co., on the Wood farm. This one made 750 barrels the first twenty-four hours, and is yet doing over 100 barrels a day.

A good deal of operating has also been done on what is known as the Middle belt, but the territory is all old and developed, and no big strikes have been effected. The Western belt came into existence in May last. Three wells which had been sunk previous to that time proved dusters, and the first oil was found in that month. The next well down on this belt was the great Howe gusher, which did 400 barrels the first day. After that strike operators went crazy, and scores of holes have been put down since. About one half of them are dry, while the others are gradually and fast decreasing in production. The sand is very tight and thin, and the pumping wells decrease after the style of the Bullion gushers.

Some New Lecture Experiments.

H. Kämmerer proposes to show the combustibility of nitrogen, in other words, that nitrogen will unite with oxygen at a sufficiently high temperature to form nitric tetra-oxide, NO_2, a reddish colored gas. He takes a half gallon glass cylinder full of air, and burns in it some 12 or 15 inches of magnesium ribbon. The heat produced is sufficient to produce some of the red gas, which can be easily recognized by its color and intense odor. To prove its presence to an audience, he puts in the jar an acetic acid solution of iodide of potassium and a little starch solution, which is blued by the iodine which has been liberated by the nitric tetra oxide.

Gramp exhibits the green flame of burning zinc, and the cloud of white oxide (philosophers' wool) formed, by making a little brush of zinc turnings 1½ inches long and ¼ inch thick, and fastening it to the end of an iron rod, which he holds in the flame obliquely over an iron plate. To show the combustion of cadmium and the cloud of brown oxide he heats the metal in a small porcelain crucible over the blast lamp. Cadmium can be obtained in beautiful brilliant crystals by distillation in hydrogen gas current.—*B. d. D. Ch. Ges.*

MAGNETIC PROPERTIES OF NICKEL AND COBALT.—M. Hankel finds that with feeble currents the magnetic power of nickel is equal to that of soft iron, but with strong currents it is comparatively feeble. The magnetic power of cobalt with both strong and feeble currents is much less than that of nickel and soft iron.

AQUA FORTIS, applied to steel, produces a black spot,

Communications.

Our Washington Correspondence.

To the Editor of the Scientific American :

Besides the bills for amending the patent laws, referred to in my previous letters, many others are being introduced into Congress for the

EXTENSION OF PATENTS,

and for the reviving of old rejected cases. Among these, I notice that the application of Aikin and Felthousen, for an extension of their patent on sewing machines, has again made its appearance, as it has done every session for many years past. This patent, if extended, would lay the whole sewing machine interest under tribute, as no sewing machine can be made that people would now buy without infringing it. There does not, however, seem any probability of the success of this case, as neither Senators or Representatives are willing to grant any more extensions of sewing machine patents.

Rollin White is also on hand again with an application for an extension of his patent on repeating fire-arms, dated April 3, 1855, which, if granted, would give him the monopoly of the manufacture of all revolvers using metallic cartridges. A bill for its extension was once passed by Congress, but it was vetoed by President Grant, acting, it is said, under the advice of General Dyer.

Roxana Rice, as the widow of B. T. Rice, makes application for an act to authorize the Commissioner of Patents to extend the patent of said B. T. Rice for a paper bag machine, dated April 28, 1857, already once extended by the Patent Office.

Another bill authorizes the Commissioner to extend, for the benefit of Olivia C. Reed, also the widow of an inventor, the patent granted to her late husband for handcuffs, dated June 14, 1862.

The heirs of C. H. Davidson, the inventor of an enema syringe, have had a bill brought in authorizing the extension of his patent of March 31, 1857, which was once extended by the Commissioner of Patents.

C. Shunk has also applied for an extension of his patent on manufacturing iron and steel, which, I believe, covers the Bessemer process.

The heirs of the late W. A. Graham, who filed an application in 1837—*only* forty years ago—for a patent on a fire extinguisher, are again before Congress with a bill authorizing the Commissioner to grant a patent for his apparatus. This, if allowed, would cover every chemical fire extinguisher manufactured.

Another bill, similar to this, authorizes the granting of patents to W. W. Hubbell, for a "self-loading and self-firing gun," "a gun to load with great rapidity and effect," and "ammunition for the same," for which Mr. Hubbell alleges that he filed applications in 1853 and 1865.

A third similar bill has been introduced in favor of Stephen V. Benet, authorizing the issue of a patent to him for an improvement in cartridges, for which he made application April 14, 1866.

Another bill introduced into the House continues in force, for the full term of seventeen years, the patent of T. A. Weston, granted in 1867, for the well known differential pulley, as otherwise it expires with his English patent granted several years earlier.

THE AGRICULTURAL DEPARTMENT.

General Le Duc some time since opened a correspondence with many of the leading agriculturists in all parts of the land, and their ideas thus obtained are now being classified and digested, and the results will from time to time be published for the benefit of farmers generally. The Commissioner believes, from what he has seen in several trips made to different parts of the South, that the people of that region are fairly started on the road to prosperity, that public opinion is adapting itself to the new order of things, and that hands formerly soft and delicate showed, by their hardened condition, a familiarity with the handles of the plow and other similar implements that gave good evidence that the old ideas as to labor had undergone a great change.

The Commissioner has also devoted considerable attention to what he thinks may be a new industry in this country—the cultivation of the tea plant. He has been collecting data respecting it from various sources and finds that, so far as climatic conditions are concerned, a strip of country lying in the latitude of the northern part of South Carolina, and running from the Atlantic coast to the Mississippi, seems very favorable for the purpose, and the results of some few attempts in the cultivation of the tea plant that have been made in that neighborhood have been so encouraging, he thinks, as to remove all doubt as to the success of future efforts to produce it here. The Commissioner will, however, most probably find that the successful cultivation of the plant is not all that is necessary to the production of tea, but that the picking, curing, and preparing of the leaves for market is one of the essential points. I am under the impression that one of the most promising attempts to introduce the cultivation of tea, made some years since in California, failed from this reason. But it is possible, and indeed very probable, that our inventors may be able to overcome this difficulty by devising machines for picking, rolling, and curing the leaves, thus removing one of the main difficulties in the way to the practical cultivation of tea in this country; but if we have to perform these operations by hand, it is useless for us to try to compete with the cheap labor of China, even if we import Chinese laborers used to the business.

The commission sent by this Department to Southern New Jersey, to examine into the possibilities of beet culture in that section for the manufacture of sugar, have returned, and report that, while the experiments made last year were not pecuniarily successful, yet it is decided that the climate is favorable, and that the soil can be made so. At present, a large amount of the sugar used in this country is imported in the crude state, and therefore considerable interest should be taken in this matter, so as to avoid the loss of the large amounts of money annually sent out of the country to pay for the imported article. Under the efforts of the first Napoleon the manufacture of beet sugar became thoroughly established in France, and there seems no reason why it should not be as successful in this country.

THE GEOLOGICAL AND GEOGRAPHICAL SURVEY.

Dr. Hayden, the director of the above important work, has prepared his annual report to the Secretary of the Interior, of his operations during the past year. The most important of those in the field have been referred to from time to time in my previous letters. Of the office work, not so much has been said, although equally important, as but for it the world at large would remain ignorant of the results of the investigations carried on in the field. The publications of the survey during the past year have been quite numerous, consisting of more than 10,000 pages quarto, profusely illustrated. The reports, which are in an advanced stage of preparation, are two quarto volumes on the vertebrate fossils of the West, one on the fossil insects, and another on the rhizopods. The atlas of Colorado will be completed about February, 1878. The tenth and eleventh annual reports of the survey are well advanced, and will be printed and ready for distribution before the close of the regular session of Congress. The work of publication has been much delayed by the cutting off for the last two years of the amount heretofore appropriated for engraving.

THE SIGNAL SERVICE.

From General Myer's report, it appears that 159 stations have been maintained during the year to fill the system of stations of observation from which reports are deemed necessary to enable proper warning to be given of the approach and force of storms, and other meteoric changes, for the benefit of the agricultural and commercial interests. From the data thus obtained, 1,095 tri-daily reports, known as the "Synopsis and Indication," have been furnished for publication. These are based on the observations telegraphed in cypher from the different stations to the headquarters, where they are spread upon seven charts for study, from the result of which the "Synopsis and Indications" are sent out. The average time, elapsing between the moment at which the instruments are read at the outlying stations to that at which the reports are telegraphed to the press, has been one hour and forty minutes. Notwithstanding the little time thus consumed, but a small portion of which is given to considering the reports and making ready the "Indications," their truth has been verified to be on an average at the rate of 86·19 per cent, and it is hoped to bring the average as high as 90 per cent. Cautionary signals are now displayed at 47 different ports and cities, and of these, 78·91 per cent have been reported as justified. In addition to these reports and cautionary signals, by an arrangement with the Post Office Department 6,264 "Farmers' Bulletins" are distributed and displayed daily in as many different post offices, for the benefit of our agricultural population. The service has now in its care, and operated by its force, no less than 3,200 miles of telegraph lines.

From these figures some idea of the amount of work that has to be done by the signal service may be had. The importance and usefulness of it is now well known by every one, and it is hoped that our rulers, with their economical notions, will not decrease the facilities now possessed by it, but rather increase them, as General Myer requests. The late fearful calamity of the loss of the Huron might have been avoided had proper attention been given to the cautionary signals; and there is no knowing how many lives nor how much money has been saved by those who have heeded their warnings, nor what losses may be caused by limiting the operations and usefulness of the service.

THE LIFE-SAVING STATION.

The disadvantages of too close economy may also be seen in this service. From a desire to save money, the stations on the coast where the Huron was wrecked are not manned until the 1st of December, and the stations are not about half the number actually required. It is believed by the head of this service that if the stations had been manned, although it is probable no boat could have reached the vessel, that by the aid of the shot line, which would reach double the distance the vessel lies from the shore, many, if not all, of the lives of the crew could have been saved. If the stations had been manned, as they would have been but for the false economic ideas now prevailing, the discovery of the wreck would have been made shortly after the vessel struck, as a constant patrol is kept up along the beach every night, and immediate attempts to help the crew could have been made. Instead of this immediate discovery and relief, seven and a half hours elapsed between the striking of the vessel and the discovery of the wreck, during which time there is no doubt but that a resolute crew trained to the service could have rendered such efficient help as would probably have saved a majority, if not all, the lives lost on the ill-fated vessel.

MORTALITY OF THE NEGRO.

A recent report of the Board of Health of this city calls attention to the alarming death rate of the negro population. From the statistics, which are kept with great care, it appears that, while the death rate of the white population is only 18·27 per cent, that of the colored is as high as 44·50. Of 119 still birth investigations by the sanitary inspector, 107 were colored, while, reckoning according to population, the still births would be as 23·77 of the black to 31·04 of the white. This heavy death rate is not confined to this city, but is equally well known in other parts of the country to those who take an interest in the wellfare of the colored people. Mr. Redfield, the well known correspondent of the Cincinnati *Commercial*, contends that the race is doomed to extinction, and, to sustain his view, states that from 1850 to 1860 the rate of increase of our colored population was 25 per cent, but that in the succeeding ten years the rate fell to 10 per cent; and as many reports concur in showing that there are more deaths than births among these people, it seems probable that our next census will show an actual decrease in this class of our population. This excessive mortality among them in this city is, no doubt, owing mainly to their great ignorance of sanitary laws; the overcrowding of their houses, ten or a dozen frequently occupying one small room; their living, as a majority of them do, in filthy back alleys, and in huts utterly unfit for human habitation; their irregular mode of living, half starving frequently, and then, as soon as a little money is procured, as the result of some chance job, spending every cent in a feast for the day, without a thought of the morrow; and, lastly, to their radically weak constitution, which causes them, as soon as any serious sickness touches them, to give right up and die off like rotten sheep. Outside of the cities they do not probably suffer so much from overcrowding as they do in them, but other causes step in and overbalance the point.

Washington, D. C. OCCASIONAL.

Locomotive Economy.

To the Editor of the Scientific American :

The query is often made as to what can be done to render the locomotive more efficient. Letters are frequently received asking for an opinion upon some detail pertaining to the improvement of this machine.

As to its general arrangement, with its horizontal cylinders and outside connections, the modern locomotive cannot be much improved probably. But while it requires some 120 lbs. pressure to the square inch in the boiler to realize an average maximum of 70 or 80 lbs. to the square inch against the pistons, it is quite clear that there is a chance for some improvement in its supply apparatus between the steam chamber of the boiler and the pistons. It is of course well known that the nearer the initial or maximum pressure in the cylinders can be made to approach the boiler pressure the greater the economy and efficiency of an engine. As the supply apparatus is now proportioned and arranged, there is a steam pipe some ten feet long and five inches in diameter (more or less according to the size of the engine) between the throttle valve and the cylinders, which must be filled with steam every time the throttle valve is opened before the steam can act upon the pistons; all of this steam (some two or more cubic feet) must of course be discharged at the exhaust nozzle with that in the cylinders as often as the throttle valve is closed.

The amount of steam directly lost here, in addition to the loss from low effective pressure, must depend upon the frequency of starts and stops and upon the degree of expansion the steam has attained when discharged; but the chief loss is in the low percentage of the boiler pressure utilized. If an auxiliary throttle valve for common use were placed near the cylinders, and the steam pipe enlarged and kept fully open to the steam chamber of the boiler during working hours, as high as 90 per cent of the boiler pressure could doubtless be made effective, instead of 60 per cent as now. In other words, from 20 to 30 per cent less boiler pressure would suffice for doing the work of the engine. The saving of fuel would, of course, be in like proportion.

F. G. WOODWARD.

The Keely Motor Deception.

To the Editor of the Scientific American:

I notice in some of my exchanges that "even the SCIENTIFIC AMERICAN was deceived by the Keely Motor." Now as I have never seen where you have even ventured a suggestion of the possibility of the success of a machine so wholly at variance with the known laws of natural philosophy, I would be pleased to see your position from first to last clearly proclaimed. S. H. H.

Our correspondent cannot be a very attentive reader of the SCIENTIFIC AMERICAN if he supposes that we have endorsed or supported so gross and palpable a deception as the Keely Motor. He will find our views sufficiently expressed if he glances over some of our back numbers.

Effect of Glycerin upon Fermentation.

Munk has observed that if cheese be added to a solution of milk sugar, and enough carbonate of soda added to give a distinctly alkaline reaction, and then mixed with an equal volume of pure glycerin, neither lactic nor butyric fermentation results for three weeks, even at a temperature of 104° C., whereas without the glycerin the formation of lactic acid can be recognized in 11 or 12 hours. Small quantities of glycerin merely postpone fermentation.

The spontaneous fermentation of milk is very energetically checked by glycerin. The addition of $\frac{1}{8}$ glycerin at a temperature of 60° to 68° prevented the milk from souring for 8 or 10 days; even 2 to $2\frac{1}{2}$ per cent retarded it essentially at 60° to 70°. A larger addition of glycerin, $\frac{1}{4}$ or $\frac{1}{3}$, had retarded it 6 or 7 weeks. The higher the temperature the more glycerin is required for the same effects.

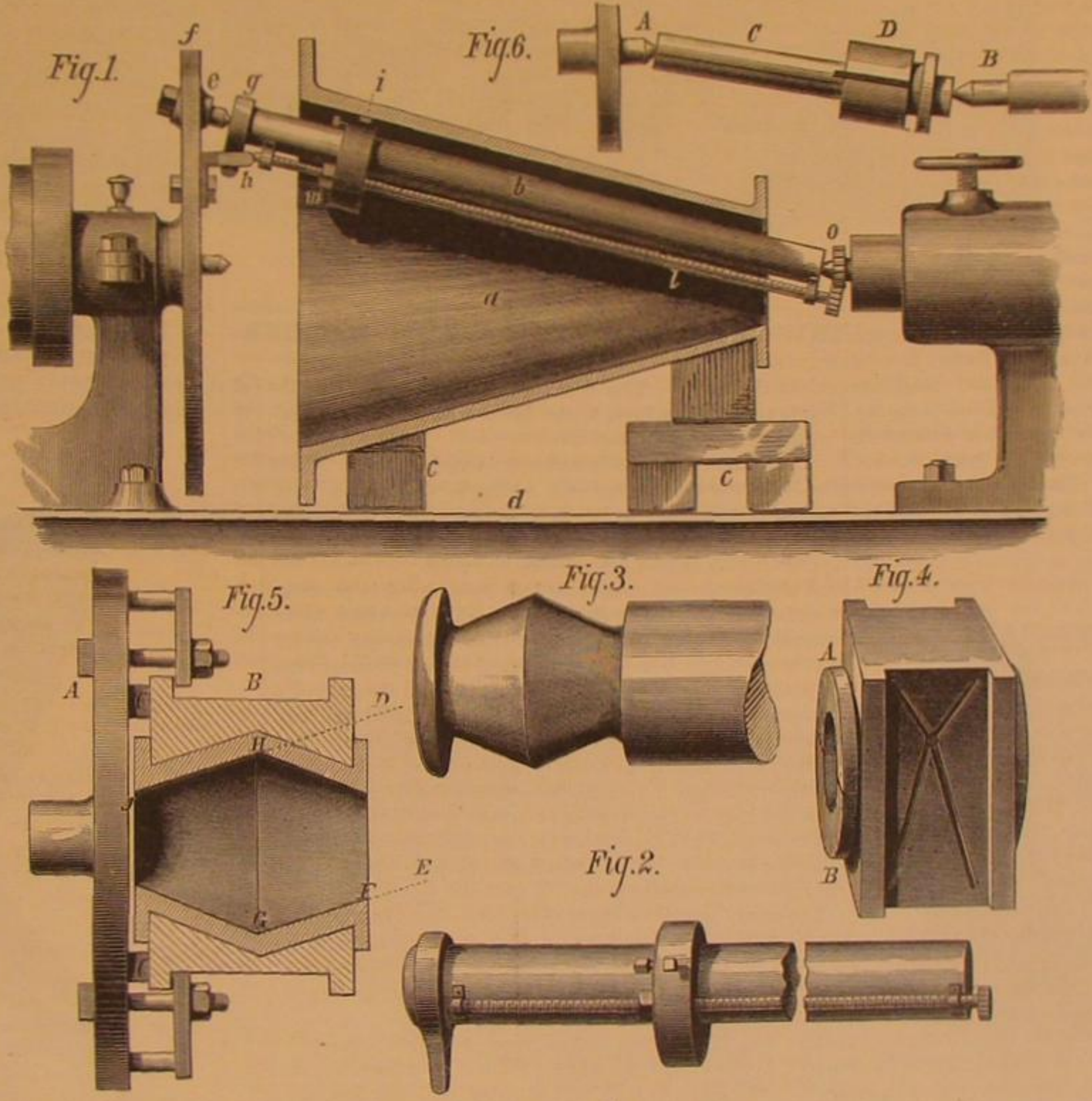
The alcoholic fermentation of the carbo-hydrate is also retarded by glycerin. A sugar solution containing fresh beer yeast and an equal quantity of glycerin had not given off any carbonic acid at the end of 48 hours.

Munk has also studied the effect of glycerin upon the decomposition of amygdalin by emulsion. This action being much more energetic requires more glycerin to stop it. By adding 2 volumes of glycerin to a mixture of emulsion and amygdalin, in which prussic acid would otherwise form in a few minutes, its formation was delayed 7 hours, and was slower afterwards than otherwise.

Finally, it was established that the diastatic action of pancreatic juice upon starch paste was retorted by glycerin.—*Industrie Blätter.*

SOME CURIOUS METHODS OF BORING TAPERS.

With the old-time method of setting a lathe to bore a taper by setting the upper slide of the slide rest out of parallel with the bed of the lathe, every machinist is of course familiar. That method has been superseded in lathes where many tapers require to be bored or turned by fixing the head and tail stocks upon a bed, which in turn swings by means of a vertical pin pivoted in a closely fitting hole provided in the lathe bed proper, so that from that center the bed or plate upon which the head and tail stock stand will swing out of parallel with the lower bed upon which the carriage slides. The advantage of this device, which is coming largely into use in the Eastern States, is that the center line of the lathe centers stands parallel with the work instead of at an angle to the same, as is the case when the upper part of the tail stock sets over, as is so common in ordinary lathes. The advantage of the new plan is that the centers do not wear large or get out of true, and therefore the truth of the taper with the parallel parts of a piece of work may be depended upon, no matter which part of the work was finished first or last. It sometimes happens, however, that a job will present itself which is not provided for in the construction of any ordinary lathe or machine; and here it is that the inventiveness of the workman is called upon to devise some means of doing the job without an undue expenditure for machines, tools, or appliances; and two noteworthy instances of such examples are presented in our engravings.



That shown in Fig. 1 is a case in which it was required to bore a taper casting for a cylinder for grinding pulp. It was about 8 feet long, the bore being 40 inches diameter at one end and 12 inches at the other. The small end necessitated the use of comparatively a very small boring bar and head, while the length demanded a strong stiff bar so as to bore the cone true and smooth throughout. The workman took a 6 inch iron shaft, see *b*, Fig. 1, its length being 9 feet 6 inches, turned it true and parallel, and cut in it a keyway from end to end for the feather preventing the head from revolving upon the bar from the pressure of the cut and relieving the feed screw of pressure. For a boring bar head an old eccentric was employed, a gib key being used so that it could not slide out from the eccentric while sliding freely in the keyway of the bar. The feed screw was made of a piece of $1\frac{1}{8}$ round iron, the thread being cut by a common die of a bolt machine, and the screw was straightened after being cut. A common square nut was attached to the side of eccentric head (see Figs. 1 and 2) by a small machine screw, the nut being placed so as to push and not pull the eccentric when at work. A hole about $1\frac{1}{4}$ inch diameter was drilled through the eccentric for the feed screw to pass freely through, so that the irregularities of the feed screw were not felt on the bar, the nut being left able to slide a little freely in any direction to also accommodate defects in the feed screw, the machine screw before mentioned merely serving to prevent the nut from turning around upon the eccentric head, or the head from moving forward in case the tool lost the cut in any part of the bore of the cone; and in this way was a suitable boring bar improvised. The conical cylinder, *a*, in Fig. 1, to be bored throughout its whole length, was then laid upon the suitable wooden blocks *c*, *c*, and secured with bolts and nuts to the lathe bed, *d*, the center of its bore being set parallel with the lathe bed by placing a piece of iron in the lathe centers and setting the bore of the casting true with it by means of a piece of iron wire used as a gauge. Then a lathe center, *e*, was fastened in one of the radial slots of the lathe face plate, the center line of this lathe center being made to stand parallel with the surface line of the bore of the casting or cylinder The bar, *b*, was secured, the center was screwed by a nut on its end firmly to the lathe face plate, and the boring bar was secured firmly by a lathe dog, G, to the driver in the latter, also being bolted firm to the lathe face plate so as to prevent the bar, *b*, from turning upon its own centers. A feed motion or gearing was provided to the bar as follows: The feed screw, *l*, was provided with bearings affixed to the boring bar at each end, and on the dead center end which protruded through its bearing a small gear wheel was keyed. Another and suitably sized gear wheel was fastened on the dead center of the lathe so that the revolutions of the bar caused the feed screw to revolve in the usual manner, thus feeding the tool as the lathe revolved. The result was that a cone of unusual proportions was bored true and smooth at a slight expense, and throughout the whole operation no special care was needed, except to have the lathe center fastened to the face plate of the lathe pointing dead true to the center in the lathe tail stock, because any deviation from the center of motion in the dead center, O, would cause the boring bar to be too tight in one and too loose (between the lathe centers) in another portion of each revolution.

The second instance referred to was as follows: In cases where it is of great importance to prevent the end play of journals in bearings, it is not unusual to have the journals either ball-shaped or else V-crowned. In the instance under consideration the journal was of this latter form, as shown in Fig. 3, and the journal box was of the form shown in Fig. 4, in which it will be noted that the brasses, A and B, have flanges fitting outside the bore as shown. Now the ordinary method of doing such a job would be to chuck the box on the face plate of the lathe, setting it true by the circle (marked for the purpose of setting) upon the face of the brasses and by placing a scribing point tool in the lathe tool post and, revolving the box, making the circle run true to the point which would set the box one way, and then setting the flanges of the box parallel with the face plate of the lathe to set the box true the other way: to then bore the box half way through from one side and then turn it round upon the face plate, reset it and bore the other half; thus the taper of the slide rest would not require altering. This plan however is a tedious and troublesome one because, as the flanges protrude, parallel pieces have to be placed between them and the lathe face plate to keep them from touching; and as the surfaces of the casting parallel with the face plate were not trued up, packing pieces of paper or tin as the case might require had to be placed between the box and the parallel strips in the necessary places; and under these circumstances, ordinary ones as they are, to set the box and to unset it after boring one side and reset it quite true to bore the other side becomes a tedious and difficult job. While several of the men were studying how to obviate the difficulty, one of the workmen offered to take the job contract for a price that was thought ridiculously low; but when he had the front end of the first box bored, the secret was found to be that he had discovered a way to avoid the second chucking, which was as shown in Fig. 5, in which A represents the lathe chuck and B is a sectional view of the bearing chucked thereon, *c*, *c* being the parallel pieces. Now it will be observed that the plane of the cone on the front end and on one side stands parallel with the plane of the cone on the back end at an exactly opposite diameter, as shown by the dotted lines, D and E. If then the top slide of the lathe rest be set parallel with those lines, we may bore the front end by feeding the tool from the front of the bore to the middle as marked from F to G, and then, by turning the turning tool upside down, we may traverse or feed it along the line from H to *g*, and bore out the back half of the double cone without either shifting the set of the lathe rest or chucking the box after it was once set; and this was the workman's secret and very successful it proved to be. Another workman in a different shop adopted for a similar job the plan of boring the front end as usual, and then, crossing the lathe belt, he ran the lathe backwards, used a tool with the face up as usual, to bore the back half of the box. This plan had the advantage that he could see the tool cut and perhaps work to a little better advantage in that respect; but this was more than counterbalanced by the trouble entailed in lacing and unlacing the belt to cross it (for the lathe had no reverse motion), and the liability of the chuck to unscrew, unless indeed it be provisionally fastened.

In lathes not having a compound slide rest, the device shown in Fig. 6 is almost invaluable for boring small conical holes or indeed for parallel ones if no reamer or standard bit is at hand. A is the running lathe center, and B the dead center. C is a mandrel placed between the two centers and having a keyway running along it as shown, the end at A is made square to prevent it from revolving with the lathe head and to hold it against the pressure of the cut by applying a wrench there. D is a sleeve, a neat working fit upon the mandrel, *c*, and is provided with a feather, a good sliding fit in the keyway of *c*, the duty of the feather being to prevent the sleeve, D, from revolving from the pressure due to the cut. Along D is cut upon its circumference a slot to receive a boring tool; to feed the sleeve, D, a piece of steel is fastened in the tool post and the end of it projects in the annular groove shown at one end of D. The amount of taper is of course regulated by the set over of the lathe tail stock. This device is so much stiffer than a boring tool that it produces a much better job and will take a heavier cut, nor is it so liable to spring away from the cut.

Population of the World.

According to recent careful computations, the population of the world is 1,423,917,000, or 28 persons for every square mile. The following table shows the populations of the great divisions of the earth:

Europe	309,178,300	Australia	4,748,600
Asia	824,548,500	America	85,519,800
Africa	199,921,600		

The combined populations of 1876 exceed those of 1875 about 27,000,000. The inhabitants of different States of Europe are divided as follows:

Germany	42,723,000	France	36,102,921
Austro-Hungary	37,700,000	Great Britain	35,450,000
Switzerland	2,699,147	Spain	16,551,647
Holland	3,809,527	Portugal	4,298,881
Belgium	5,336,634	Italy	27,482,174
Luxemburg	205,153	Turkey in Europe	8,500,000
Russia	71,730,980	Roumania	5,073,000
Sweden	4,383,291	Servia	1,377,078
Norway	1,802,882	Montenegro	190,000
Denmark	1,903,000	Greece	1,457,894

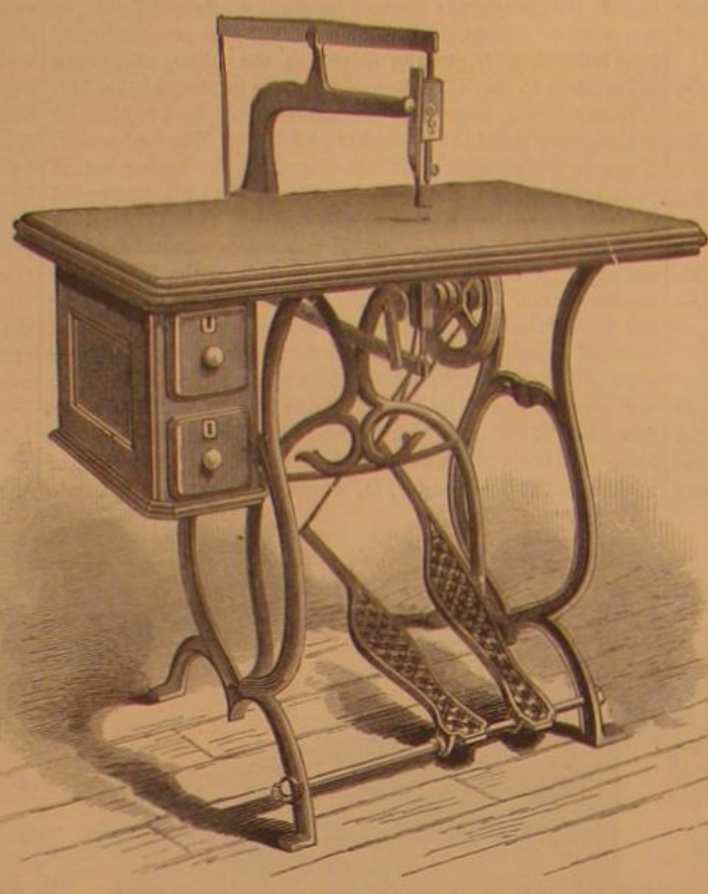
The population of Turkey in Europe, Asia, and Africa reaches 47,600,000 souls, of whom 20,500,000 are divided between Egypt, Tripoli, and Tunis, Asia having 13,000. The population of the Russian Empire is estimated at 85,586,000, or 900,000 over the population of 1875. The population of the British Indies numbers 289,000,000, that of China 405,000,000, and that of Japan 33,299,015. London has 3,489,428 souls, Paris 1,851,792, New York and Brooklyn 1,535,622, and Berlin 1,045,000.

IMPROVED SCROLL SAWING MACHINE.

The annexed engraving represents an accurate and durable scroll sawing machine, highly finished in all its parts. The table is black walnut, 2½ feet long, 1½ feet wide, and 1 inch thick. It is ornamented with a heavy moulding, and a case is provided holding two drawers with locks and key.

The machine will saw material up to two inches thick; it saws under the arm seventeen inches. The legs, treadles, and arm are cast iron, and the spindles and shaft are of steel. The spindles are bored so that long saws can be used without bushing them off. The machine operates with a fast, steady, even stroke, and straight up and down. The saw blades are strained equally at all parts of the stroke. The machine occupies no more room than a sewing machine, and is very light running. It is well adapted for the uses of carpenters, joiners, cabinet and pattern makers, and amateurs.

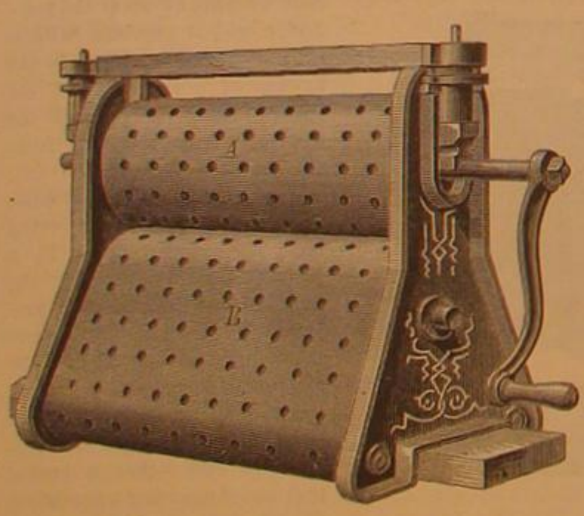
For further particulars address W. E. Lewis, Cleveland, Ohio.



LEWIS' IMPROVED SCROLL SAWING MACHINE.

THE DENNEY WASHING MACHINE.

The accompanying engraving illustrates a washing machine which is claimed to be well suited for use upon the finest articles of wearing apparel, or other domestic goods. The two washing rollers are about four inches in diameter, and are corrugated; the rounded ridges formed upon the top roll fit into corresponding grooves in the under roll; a sleeve, A, of pure vulcanized India rubber fits tight upon the top roller. To prevent its getting loose by stretching under the severe pressure, there is applied to the top roll a narrow strip of cloth which is inserted in the rubber near to each end of the sleeve; lines of perforations extend lengthwise of the sleeve, directly over the groove formed between the rounded surfaces. An endless band, B, rests upon the upper surface of the under roll, and passes down at quite an angle around small carrying rollers at the lower corners of the frame, and crosses underneath the machine; this band is made, like the roll cover, with narrow strips of cloth near the edges, and is perforated also. The roll cover and band are made of pure rubber. The pressure is applied to the top roller by a rubber spring, which is encased in a chamber, and acts upon a suitable bearing protruding from the same which rests upon the roller shaft. The amount of pressure applied to these machines ranges from 60 to 75 lbs; and yet



from the peculiar adaptability of the rubber, it is stated that the machine operates easily, runs smoothly,, and makes little or no noise in running.

The clothing passes between the two elastic surfaces, and the action of the rolls is such that the water and air which enters the channels in the under roller is forced in jets through the body of the goods. The articles can be passed entirely through, past the rolls, and are carried back by the band, thus washing each piece out to the end without continually dropping down into the tub.

For further information address the manufacturer, Mr. S. L. Denney, Gap, Lancaster county, Pa.

IMPROVED OSCILLATING GRATE BAR.

The new grate bar illustrated herewith is claimed to be adapted for burning any kind of fuel with but little loss, to be durable, easily managed, and easily cleaned. Each bar consists of an axis, A, Fig. 1, from which wings or lugs radiate. In the wings are slots or holes, as shown in the illustration, which are so arranged that the apertures do not come opposite each other, so that the fuel that falls from the wings of one bar is caught by the wings of the adjoining bar, without stopping up the passages.

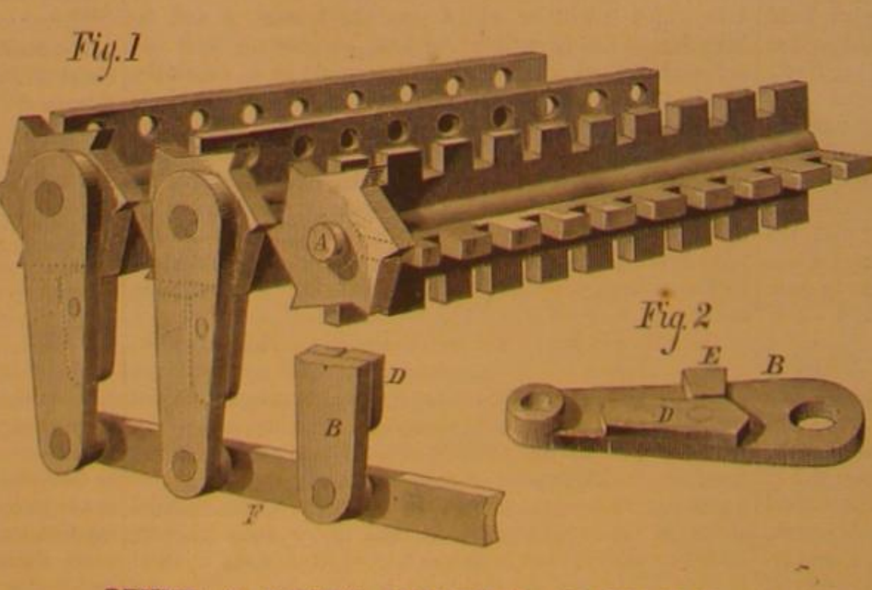
The shafts of the bars project, and upon said shafts the bars work freely. The levers, B, Fig. 2, fit over the ends of the shafts; and attached to the bars, and just inside the levers, are ratchet wheels, C, having six teeth. A pawl, D, on each lever, engages with these teeth and gives the bar an intermittent rotary motion when the lever is oscillated back and forth. The lug, E, on the lever acts as a support to the pawl and receives the thrust. The connecting bar, F, unites all the levers and extends back to the boiler room where it is attached to an upright hand lever.

These bars are placed in furnaces in various ways. When the furnace is constructed with a view to their use, a long, narrow opening may be left in front underneath the furnace doors, and at the back end of the furnace a support is placed, provided with holes a proper distance apart to receive one end of each bar. After the bars have been placed in position, a similar support can be slipped on over the front ends of the bars, thus securing them firmly in their places, and closing up the opening. The bars thus placed cannot be moved out of position, and can be readily inspected. In the case of a locomotive or portable engine furnace, the supports may rest on projections on the inside of the firebox, or be bolted on the lower edge of the same. When used on locomotives a lever extending up into the cab enables the fireman to operate the bars to clear the fire of refuse or to dump the entire contents of the furnace. This bar is also specially adapted to use in stoves, as it enables fuel to be used which would drop through ordinary grates.

The rotary motion of the bars is claimed to break up and discharge all clinkers and dross by crushing them between the lugs or wings. By continuing the rotary motion the grate becomes, in effect, a dumping grate, and the whole contents of the furnace can be discharged.

The bars being set so that the wings or lugs overlap to a greater or less extent, as may be desired, they form a continuous fuel table, so that finely divided coal, sawdust, tanbark, etc., can be burnt, as it is almost impossible for it to pass through without being caught by the lugs or wings on the adjoining bars.

For further information, address Messrs. Denny & Ruth, patentees, Circleville, O.



DENNY & RUTH'S IMPROVED GRATE BAR.

A GOOD bell metal consists of copper 100, tin 20 parts.

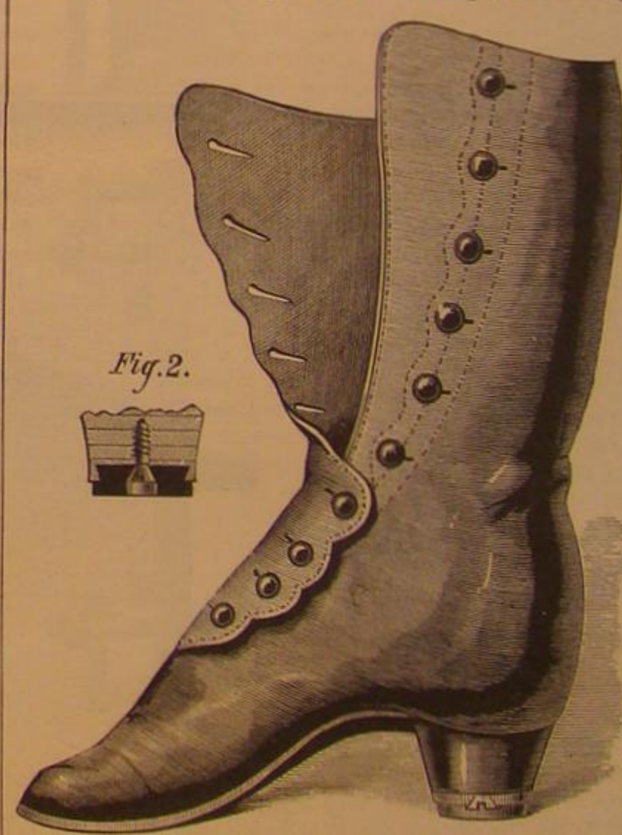
Origin of the Carbon in Plants.

It has long been known that the green parts of plants are able in sunlight to decompose carbonic acid and absorb the carbon. To decide the question whether plants can take up carbon in any other way than through their leaves, J. W. Moll undertook a series of experiment, which led to he following results: Leaves and parts of leaves kept continually in a place free from carbonic acid never form any perceptible quantity of starch, even if in immediate contact, by over or underground parts of the plant, with an atmosphere much richer in carbonic acid than the air. Hence the excess of carbonic acid that is at the disposal of any portion you choose of a plant, never causes the production of a perceptible quantity of starch in a leaf or part of leaf united to it, if the leaf is kept in a space free from carbonic acid. The formation of starch in a leaf in open air is not perceptibly hastened when any other part of the same plant is in a place containing more carbonic acid than the atmospheric air. The carbonic acid at the disposal of the roots of a plant, in the soil, neither causes the formation of starch in a leaf excluded from carbonic acid nor perceptibly hastens it in those in the open air.

REVOLVING BOOT AND SHOE HEEL PROTECTOR.

The annexed illustration represents an ingenious device which serves the double purpose of protecting the heel of the boot or shoe, so that it cannot be worn away unequally, and also of preventing the wearer slipping upon ice. It also, by affording an elastic cushion to the foot, renders walking easier and less fatiguing.

It consists of a circular metal or rubber plate having a dovetail flange. Inside the latter a rubber disk is inserted, and through the center of the disk is an aperture with a metal conical lining. Through this opening the fastening screw which enters the heel of the boot passes. The screw is forced in just tight enough to enable the plate to be revolved by hand, so that when the wearer walks it will be caused to rotate of itself, and in this way the wear on the India rubber pad will be equalized. When the head of the screw is forced into the conical aperture, the effect is to expand the rubber pad under the flange, thus causing



the former to be tightly secured in place. When the rubber is worn out another disk may be inserted at small expense, and without renewing either plate or screw.

Among the advantages specially claimed for the device not mentioned above are that it tends to support the ankle and to keep the foot erect; it will not mark or soil floors, oilcloths, or carpets; it gives a neat finish to the shoe, and is furnished at less expense than that ordinarily involved in re-heeling the shoe. Twelve sizes of the protector are manufactured, and it is sold with the necessary implements for applying it. Patented through the Scientific American Patent Agency. For further particulars, see our advertising columns and address the Massey Revolving Shoe Heel Co., 824 Broadway, New York.

THE new pipe line between Great Belt and Pittsburg was lately finished. It is thirty-six miles long, and will supply twenty-eight refineries in Pittsburg, all owned by the Standard Oil Company.

THE "hygroscopic flowers," as indicators of damp or dry weather, do not appear to be very modern. They were used as early as 1792.

THE BANDED CHERSYDRUS.

The achrocorde or banded chersydrus is a curious aquatic serpent found in the bottoms of marine creeks and mouths of rivers on the borders of the sea, in the vicinity of Malacca, the bay of Manilla, Coromandel, Java, Sumatra, New Guinea, and generally along the coast of southern Asia. The fishermen frequently catch them on their lines, not willingly, as the fangs of the reptile are provided with a deadly poison. It is distinguished from other serpents by being almost entirely free of scales. The body is covered with grain-like particles inserted in the thin and wrinkled skin. Those on the back project slightly in the center, and those on the stomach are pointed. The median line is marked out by two or three ranges of scales placed at angles. The nostrils can be closed with a membraneous fold. The tail is flat and compressed, resembling an oar blade. The body is generally banded with black and white oval rings, the tail is spotted with white, and the small head is brownish. Some specimens have yellow or brown bands. They are classed by some among the sea serpents, aud by other among boas.

THE BANDED CHERSYDRUS.

Preservation of the Dead.

The corpse of the great Italian republican, Mazzini, was petrified by the method invented by Señor Gorini, of Lodi. Recent travelers say that it proves entirely successful, the features of the eminent agitator presenting no visible alteration, and the expression well preserved, as he reposes in his tomb, which is open to the inspection of visitors. Señor Gorini has not revealed the secret of his method, but has taken measures to give it to the public at his death.

STORKS EATING YOUNG RABBITS.

Our engraving represents a hungry stork making his breakfast off of an unfortunate young rabbit. It is not often that the bird captures such large prey, but probably, while searching the thick grass with its bill partly open, as is its curious habit, it encountered the rabbit and pounced upon without stopping to consider the difference between young rabbits and field mice. The latter, together with snakes, toads, frogs, and large insects, constitute the stork's ordinary food. The unhappy victim is not gorged instantly, but is carried off to the margin of some pond where its captor shakes it and beats it with its bill until it is reduced to a proper condition for easy swallowing. Then the meal is dispatched in a gulp or two, and the bird, which possesses an enormous appetite, resumes its hunting. The stork's favorite food is eels, which it captures with great dexterity. No spear in common use for taking that fish can more effectually secure it between its barbs than can the stork's mandibles. A small eel, desdespite its lightning movements, has no chance of escaping when once aroused from its lurking place by a stork.

STORKS EATING YOUNG RABBITS.

In Europe the stork attaches itself to man and his habitations, building huge nests on tops of houses, and tamely walking round the streets. It especially parades about fish markets, where it finds no lack of subsistence in the offal.

EDUCATION, as defined by Aristotle, means an agency for the implanting of sound and virtuous habits. Nothing else would satisfy him for a moment.

Testing Lubricating Oils for Acids.

That a small quantity of fatty acid in oil renders it unfit for lubricating purposes is too well known to need repeating, but how to ascertain its presence before irreparable injury has been done is a more difficult problem. Dr. Wiederhold proposes the following simple method of testing for acids, namely, its action upon sub-oxide of copper, or red oxide. If the red oxide is not at hand, the copper scale or ash of the coppersmith may be employed, as it contains this sub-oxide. Either of these substances is placed in a white glass vessel, and covered with the oil to be treated. If the latter contains a trace of acid, or any resinous acid from rosin oil, with which it may have been adulterated, the oil soon turns green, and that too nearest the copper scales. A gentle heat hastens the reaction, which, in the cold, requires from 15 to 30 minutes. The test is extremely delicate, and cannot result in any doubt or error to those who use it for the first time. The author states that it is superior in accuracy, reliability, and simplicity, to any method previously known, so that an oil which is not turned green by the copper scale can unhesitatingly be pronounced absolutely free from acid. If there be but little acid present the green color is fainter, by more acid, intenser, and if rosin has been added it is bluish. The chemical reaction is this: The free vegetable and fatty acids separated the sub-oxide into oxide and metallic copper; the former then combines with the acids to form greenish blue salts, that dissolve more or less in the oil and impart their color to it. The oxide of copper does not answer as well as the sub-oxide.

BRASS castings shrink $\frac{1}{8}$th inch to the foot, in cooling.

Peace and Prosperity in Holland.

The Department of State has received a report on the social and political condition of the Dutch from the Minister of the United States to the Hague. As an illustration of the carefulness and steadiness of the Dutch, the Minister says that there has not been a bank failure in Holland during the last forty years, and that the paper money of the banks during that time has been equal to gold. In regard to fire insurance companies, there is no such thing as a failure on record, and, while the rate of insurance does not average more than half of one per cent, the companies are in the most flourishing condition, realizing twelve to sixteen per cent per annum. First class railroad travel is only one cent per mile, and yet the roads pay good dividends. Pilfering officials are scarcely ever heard of, and when they shock the nation by turning up, they are severely punished and forever disgraced. No free passes are granted, and managers and directors have no power to pass anybody over the roads free. All must pay the public rates. Dishonesty of any kind, or failure in business, means public dishonor, and utterly bars the dishonest from any future public consideration. Four millions of people live within an area of 20,000 square miles, a fact unprecedented in any other country; and all appear to be happy, prosperous, and contented. The secret of this prosperity lies in the fact that all live within their income, and that industry and honesty are principles so firmly established that their violation is looked upon as an outrage on the national characteristics.

Cape of Good Hope International Exhibition.

It has been officially announced from the Cape that a second International Exhibition is to be opened in Cape Town in April, 1878. It appears that the success of the first exhibition was sufficient to cause a demand for a repetition on a larger scale, especially as regards machinery, implements, and other matters employed in agriculture. This subject was, therefore, laid before the Assembly, a committee was appointed to examine the petition and statements presented, and in reporting thereon it recommended the Government to subscribe a sum not exceeding a thousand pounds, in aid of the coming exhibition: "It being of opinion that the enterprise and energy which has accomplished so much for the colony should be encouraged and assisted," ending with the recommendation above quoted as "in return for the advantages already derived."

During the last few years there has been a marked increase in the commerce of the Cape, for it appears that the imports of the colony increased in value from less than two millions sterling in 1866, and little more than two and a half millions in 1871, to £5,731,319 in 1875, while the exports had grown in the same time from two and a half to nearly four and a quarter millions; and as there are no manufactures of any importance carried on in the colony, the exports consisting of raw material, horses, cattle, and sheep, copper, ore, tallow and skins, and from Natal, sugar, arrowroot, pineapples, indigo, coffee, etc., there seems no probability of this rapid growth of the trade with our South African colonies being arrested.

The figures referring to reports given above do not include diamonds, which are principally sent in letters or parcels, and of which there are no custom house returns; the amount to the present time is estimated at about twelve millions.

The exhibition of the coming year is introduced under the special patronage of Sir Bartle Frere, Governor of the colony. Its programme includes almost every article of export: Class 1. Preserved meats, fruits, vegetables, etc., condiments, preserves, wines, beer and spirits, corn, flour, etc. Class 2. Chemicals, perfumery, medicines, surgical appliances; oils, soaps and candles, paints, colors, inks, varnishes, glue, starch, blue, black lead, etc.; surgical and dental instruments and appliances; tanning matters, disinfectants, insect destroyers, etc. Class 3. Furniture and upholstery of all kinds; glass, porcelain, earthenware, household utensils, and small wares of all kinds; sewing, washing, and other domestic machines; toys and games; writing-desks, work-boxes, etc.; shop fittings, show cases, etc. Class 4 includes all kinds of clothing and fabrics, watches, plate, and jewelry. Class 5. Vehicles, tents, and anything connected with traveling, emigration, and camp life. Class 6. Tools, cutlery, and needle goods. Class 7. All the machinery and materials of construction. Class 8. Agricultural implements and materials of all kinds. Class 9 is devoted to science and education, and includes books, maps, printing machinery, etc., instruments, apparatus, and materials. Class 10 embraces tobacco, cigars, etc.; aërated water apparatus, beer engines, etc.; ropes, cordage, boats, etc.; fire extinguishers, and papier maché ornaments.

The Wreck of the U. S. Steamer Huron.

The United States steamer Huron, an iron gunboat of 1,020 tons measurement, recently, during a heavy storm, ran ashore at Kitty Hawk, on the coast of North Carolina, some 35 miles south of Norfolk, and was totally wrecked. Out of 138 persons on board, but 34 are known to have been saved. The disaster occurred during the night, and only about twelve hours after the ship had sailed from Norfolk. The cause seems to have been the entanglement of the vessel in a shorewise setting current which carried her nearer land than her navigator supposed her to be. The heavy sea prevented accurate sounding, and the dense fog rendered the shore invisible, so that the first intelligence received of the ship's peril was her contact with the bottom, which was followed soon after by her bilging.

The large proportion of lives lost will give rise to the question of what means of safety the vessel was provided with, and why the same were not of more avail. It seems that there were a few cork jacket life-preservers—articles of great rarity on board of a man-of-war—but beyond these there were a small balsa life-raft, which proved of little utility, and the boats, which were of none, as they were unable to live in the surf. Although the wreck was quickly known to people on shore, and a large crowd gathered on the beach, no method of communicating with the wreck was at hand; while the crew of the stranded vessel, although abundant time seems to have been afforded, were unable to get a line ashore. Although numerous devices have been suggested for sending ropes to land from wrecks, notably by kites, it would seem that still simple means of communication are necessary. A new adaptation of men-of-war's cutters as unsinkable and uncapsizable life-boats would be of utility. The arrangement must be such that the space in the boat necessary for transportation of men, provisions, etc., is not cumbered with large air cylinders or similar devices, nor must the arrangement be such as will interfere with the ordinary every-day use of the boat. A life-preserving jacket, which might also serve as a waterproof dress in bad weather, might also be a useful device, and if such were invented, of sightly appearance and capable of easy storage, the Navy Department could be asked to consider the propriety of its being made a part of the regulation uniform outfit of naval seamen.

AN EASY METHOD OF PRODUCING BAS RELIEFS.

The production of patterns from which to cast ornamental articles is confined to a class of artizans who, by long experience in carving and modeling, have attained great excellence in workmanship. An amateur, while he may not hope to attain to such excellence, and cannot expect to produce, by the usual processes and with limited practice, such exquisite articles as may be seen in many of the city shop-windows, may, if he possesses even a modicum of artistic taste and skill, do something in that direction for both pleasure and profit, by observing the following directions:

The articles required to carry out the process are some thin sheets of semi-transparent wax,* a knife having a narrow, dull blade, and the printed or drawn design of the form to be produced. The backing, or surface on which the relief is made, may be of any of the materials of which patterns are commonly made.

Having given the backing the required form and located thereon the position of the relief, a sheet of wax is laid over the design and the extreme outline of the figure is traced on the surface of the wax with a dull point. The wax is now laid upon a smooth board and cut upon the line just made with the knife, the blade being slightly warm. The wax thus cut is now placed on the foundation or backing, and fastened by heating the knife blade quite hot and touching the wax at several points, so as to cause it to melt and adhere to the backing. Supposing this piece of wax to have the thickness required in the thinnest portion of the relief, another sheet is laid upon the design and traced within, and a small distance from, the outline of the design. It is cut and laid upon the first piece and made to adhere by pressing it down slightly.

* For complete directions for making sheet wax, see SCIENTIFIC AMERICAN SUPPLEMENT, No. 17, "Casting, etc."

Fig. 1.

Fig. 2.

Another sheet of wax is traced within the outline of the second, and cut and placed upon the two already secured to the backing, and so on until the design is produced in what might be termed the *rough*. This stage is illustrated in Figs. 1 and 2, which are respectively front and edge views, which give the idea of the arrangement of the several sheets.

Fig. 3.

After the sheets are placed upon one another in the manner first observed, the edges may be burnished down by the rounded back of the knife, or by any smooth rounded implement, which must be slightly warmed.

Superfluous wax may be removed by scraping when cold, and indentations and interstices may be filled by adding a little wax. A scroll design is shown in Fig. 3.

When the model is to be reproduced in metal cast in sand moulds, the wax should be slightly varnished with pattern varnish; but when the design is to be produced in plaster, a mould of plaster may be taken from the model after it has been oiled.

Fig. 4.

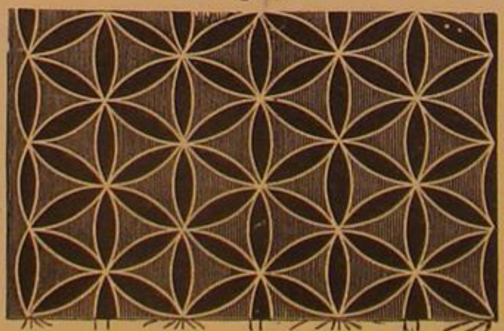


Fig. 5.

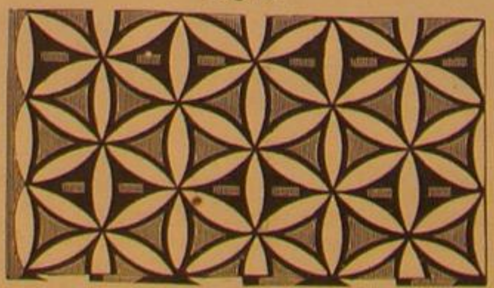
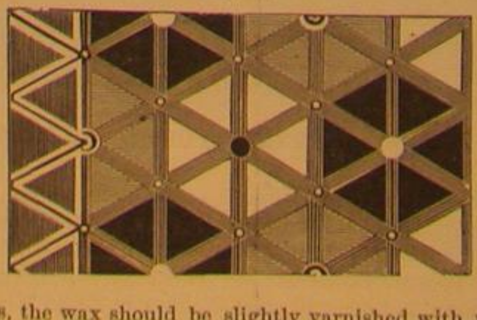


Fig. 6.



A bas relief may be made in this way from a profile photograph or from an engraving.

The process may be employed to advantage in ornamenting patterns for the coarser and heavier kinds of work.

Figs. 4, 5, and 6 represent surfaces ornamented in this manner.

The process is applicable to bas relief ornamentation only, but it is capable of considerable development. G.M.H.

The Sense of Beauty.

There is nothing which more distinctively marks true progress in education than the increasing breadth of view which is taken of the whole subject. Gradually we are discovering that man needs not merely the knowledge contained in text books, and laid down in the various courses of study, but much that must be gleaned from other sources; that he has not only one set of faculties to be developed, but many; and that true culture includes the careful nurture of every part.

Among the hitherto neglected powers of our nature is the sense or perception of beauty. We all have this in its germ, but few of us ever think it worth our while to cherish and improve it. Yet there is scarcely one of our faculties that is so amply provided for in the external world as this. Beauty pervades the entire universe. Mountains and valleys, forests and meadows, skies and oceans are full of it. The more we explore Nature the more do we discover of her loveliness. Science is every day revealing new beauty by her discoveries, and every accession of knowledge opens up charms of which we had never dreamed. Only a small portion of creation can minister to the necessities of the body, and that portion can only be made available by toilsome labor; but the sense of beauty has but to awaken to its own need to find the whole universe waiting to pour upon it the richest supplies. In most cases our desires far outrun their possible fulfilment, but in this it is just the reverse. Here it is the inner sense that needs developing to respond to the wealth of beauty that awaits its recognition. It is as if, in an exquisite palace, filled with choicest pictures and statuary, and adorned with everything that taste could suggest to make it attractive, the inhabitants were partially blind, and could barely distinguish one article from another, much less comprehend the loveliness by which they were surrounded. The world is full of beauty that we barely see, or seeing yet fail to understand or to enjoy.

It may, however, be questioned whether, after all, it is so important that this sense should be quickened and sharpened into keen appreciation. It does not help a man to earn his living, or to grow rich; it does not give him standing in society or political power; it does not add to his stock of knowledge, or enable him to fight the battles of life with any more success. It is true that it does not directly promote these results, though through its culture some of them may be indirectly aided. Yet these are not the only things in life worth pursuing, though in our materialistic age we are apt to think so. The joy that beauty confers is of itself no mean or trifling thing. Pure and innocent pleasures are the best safeguards against unwholesome excitements. He who early learns and retains the habit of enjoying external beauty, and letting its influence sink deeply into his nature, will not be greatly exposed to temptations of a gross or sensual nature. Beauty is eminently refining, purifying, ennobling. As the eye which perceives it is the most delicate and sensitive of all the bodily organs, so the inner sense which responds to it is the most tender and refined of all the faculties. To cultivate and develop this sense is then to exalt the pleasures, to purify the desires, to refine the feelings, to ennoble the aims. No one can expand and intensify his sense of beauty without being a better man, and breathing out a sweeter influence than before. It may be, as Socrates declares, that outward beauty is but the emblem of expression of what is lovely, grand, or noble in the unseen or spiritual world. Certain it is that they are closely akin, and they act and react upon each other with the most perfect harmony.

Whoever is imbued with the sense of beauty will involuntarily create it around him. It will give a grace to his demeanor, a fitness to his words, a harmonious proportion to his conduct. Good taste and consistency will shine in his domestic arrangements and in his business affairs. Unconsciously, by his intercourse, he will develop the same power in others. Partaking of his pleasure and enthusiasm, they also will respond to the beauty around them with fresh joy and fervor. Let us, then, no longer neglect the culture of this important part of our nature. Let us open our eyes and our hearts to receive all the beauty that they are capable of taking in; let us welcome its pure delights, and hasten to shed them on others: let us give it a place in our daily life and thoughts, and let its presence ever dwell in our homes, to bless and purify them.—*Phila. Ledger.*

A Mammoth Barrel Factory.

The Standard Oil Company is constructing at Pittsburg a factory for the manufacture of barrels for its own use. The building will be 300 feet square, and supplied with the latest improved machinery for making barrels, with a capacity of turning out 5,000 to 7,000 barrels a day. The establishment, it is c lculated, will cost about $50,000. In connection with this immense cooperage there is being erected a huge agitator, to be used in completing the process of refining oil, and to which the oil will be conducted by means of pipe lines, and barrelled. These establishments will have the effect of making the locality an extensive shipping point.

Manufacture and Uses of Bird Lime in Japan.

The following extract, which is taken from the Hiogo *News*, is inserted by Consul Annesley, in his report upon the trade of Hiogo and Hsoka. Although bird lime may be obtained in small quantities in other countries, still Japan may perhaps be considered the only country in the world in which it is regularly manufactured on a large scale, and as an article of some commercial importance, the production of which gives employment to some thousands of people.

The Chinese characters used to express the word "mochi," sometimes called "tori-mochi," to distinguish it from "mochi" (rice cake), give an excellent idea of the nature of the article, and may be freely translated "bird-catching, sticky substance." It was first manufactured at a place called Yoshino, in the province of Yamato, and the manufacture has spread thence over the whole of Southern Japan, being limited in the locality by the habitat of the trees from which the article is made. The date of its discovery it is certainly difficult, and perhaps altogether impossible, to obtain, some placing it 500 years back, and some only 300. It is, however, certain that, within the last twenty years, the quantity that has been brought into the market has been perceptibly affected through the destruction of the trees, by denuding them of their bark for its manufacture. The Japanese have made some attempt to arrest this destruction by leaving, in a particular manner, a certain amount of the bark on the trees, with the hope that they might serve a second time; but it is found that the article made from this second bark is of very inferior quality.

Osaka is the great center of the mochi trade; large stocks of it may be found, anomalously enough, in the hands of the Kane-Cutsaya (dried fruit merchants), who have their headquarters in and about Tema. Its present value is about 13 yen to 16 yen per picul (133⅓ lbs). The best kinds, which are distinguished by being free from bark, of a dull whitish color, extremely viscid, and having a very gummy consistency, come from the provinces of Yamato, Kischin, Tosa, Aiva, and Igo, an inferior quality being made in Satsuma, Chosin, Bungo, Isé, and Mino, the two latter places being the northern limit of its manufacture. All found north of these provinces is imported from Osaka and places south of that port. The best kinds are said to keep good for any length of time. The principal tree from which this bird lime is made is a dark evergreen, having its habitat in the southern half of Japan; it grows high up the shady side of deep mountain glens, and is frequently used by the Japanese as an ornamental shrub; in fact, it may be seen in the ornamental grounds of the Osaka Railway Station. Its bark is of a grayish-brown color, and roughish texture; the leaves are opposite, smooth, dark green, rather more pulpy than the English holly leaf, ovate-acuminate in form, have an unbroken linear edge, a very short petiole, and almost imperceptible stipules. Its efflorescence is a panicle, centripetal in its development, having small, white, wax-like diandrous and monopetalous florets, which are also slightly cruciform.

The manufacture of bird lime extends over a period of several months, commencing about June, when the bark of the mochi trees is stripped off and macerated in water for about forty days, after which it is collected and beaten in a mortar, exactly in the same manner in which rice is cleaned. The pestle, however, is of a different make, being shod with iron, the flat under surface of which is armed with spikes projecting downwards. When the pulpy mass under the pestle becomes glutinous, it is taken out and washed in water. This is done to remove as much as possible of the rough outer bark, and the pulp is then again pounded and treated in a cauldron with hot water, on the surface of which it floats. During this treatment it undergoes continual manipulation at the hands of the workman, for the purpose of disengaging the remaining particles of bark, which sink to the bottom of the boiler. This is the most difficult part of process, as considerable skill and experience are required in the workman to keep the stuff from adhering to his hands. After this it is again washed in cold water, and the pounding, boiling, and washing are again repeated until the material becomes sufficiently clean and pure. During the above process about nine tenths of the weight of the raw material is lost, 250 catties of the latter not turning out more than 25 of good bird lime.

The uses to which this article is put by the Japanese are more extensive and diverse than one would suspect, its prinpal one being, of course, for the snaring of birds and animals. By its means animals as large as monkeys are caught. When they once get the stuff upon their paws they soon cover themselves with it, and so exhaust themselves in trying to get rid of it that they fall an easy prey. Birds also as large as ducks are taken, and by a very ingenious process. The young shoots of the fugi (*Wisteria*), which attain considerable length, and are strong, light, and flexible, are gathered, dried, and knotted together in one continuous length. This is smeared with bird lime, and floated out to sea, when very often in the morning, as the writer has witnessed on the eastern coast of Choshin, the hunter is rewarded with several birds. It is a very inexpensive method of bagging wild fowl, as the tackle will serve any number of times till the bird lime dries, when it is easily replaced. Small birds are caught in various ways, some by means of a decoy bird concealed near a patch of tempting feed, which is plentifully planted with little splinters of bamboo, like large needles, the upper half of which is covered with lime. Others are caught while on trees by means of a long, slender bamboo, the top of which is anointed with the lime, and then stealthily thrust against their feathers. Rats are easily caught by spreading a small quantity on a piece of board or paper, and placing it near their holes. It is spread upon a bamboo leaf, and universally used throughout Japan during summer, for catching flies or other insects. The writer has even seen a flea trap made of it, and used by the Japanese in bed. This trap looked more like an English toast-rack without a handle than anything else, simply a piece of board with the lime spread over its upper surface, while over this semicircles of bamboo were fixed at some distance apart, to prevent the bedding, etc., from getting smeared with lime. Should the vivacious insects happen to get on to this during their noctural frolics, their fate is as surely sealed as that of a little fish in the embrace of an octopod.

Another use of bird lime is for medicinal purposes. In certain diseases of the eye it is taken in small pills or dissolved in hot water. It is also used for those complaints of the pelvis which the Japanese call "senke;" it is considered one of the best cures for flesh wounds, cuts, etc., and is almost universally used in the manufacture of plasters. Both water and oil are used in its manipulation, to prevent it sticking to the fingers, but it is generally handled with a stick. It can be purchased at any greengrocer's ("yawoya") store throughout Japan. It might be as well to mention that a very inferior quality of bird lime is made out of wheat by most of the "fuga" (makers of wheaten food); it soon loses its properties and becomes useless.

THE LIMITS OF NATURAL KNOWLEDGE.

In an address delivered at the Munich meeting of the German Association, by Professor C. von Nägeli, on "The Limits of Natural Knowledge," the lecturer maintained that the solution of the question: In what way and how far may I know and understand Nature? is evidently determined by the answers to three questions: (1). The condition and capacity of the intellect; (2). The condition and accessibility of Nature; and (3). The demands which we make of knowledge. In regard to the capacity of the intellect, were it not for our five senses we would not know at all that there is anything besides, nor indeed that we are in bodily existence ourselves. With regard to the completeness of sensual perceptions there is another boundary which is not generally thought of. Scientific analysis shows that each particle of matter influences and is influenced by every other particle, according to distances. The theoretical possibility, therefore, exists that the human organism may obtain bodily perceptions of all phenomena in Nature. In reality among the beings known to us certain parts have developed themselves into organs of sensation, which are extremely sensitive for certain natural phenomena. As Darwin says, in organic Nature only such arrangements attained full development which were useful to the individual bearer. We are endowed, for instance, with great sensitiveness for temperature; it is necessary for our existence, otherwise we might perish through cold or heat without knowing it. We are very sensitive towards light; it acquaints us in the best and quickest manner with all objects which surround us and which may be useful or dangerous to us. On the other hand, we are not organized to perceive the electricity which surrounds us; and were it not for accidental experiences, which revealed it to us, we should have no idea of that force which undoubtedly plays the greatest part in organic and inorganic Nature. Our senses are indeed only organized for the requirements of our bodily existence, but not to satisfy our intellectual cravings. We cannot rely upon our sensual perceptions acquainting us with all the phenomena of Nature.

There are, therefore, two important limits to our perceptions of Nature. On the one hand we are probably deficient of the power of sensation for whole domains of natural life; and on the other, as far as we really have this power, it is confined in time and space to an insignificantly small part of the whole. By conclusions from facts which were recognized by the senses, we arrive at facts equally certain which can no longer be perceived by the senses. The hope of conquering the entire domain of Nature by the reason can, however, never be realized. As the effect of a natural force decreases with the distance, the possibility of knowledge also decreases as the distance of space and time increases. The confined capacity of the intellect, therefore, allows us only an extremely fragmentary knowledge of the universe.

In passing to the second question, we find that the difficulty which Nature opposes to human knowledge is her endlessness of time and space, and of everything which depends on this as a necessary consequence. We cannot conceive her as a whole, because a process of conceiving which has neither beginning nor end does not lead to conception. On all sides uninvestigable eternity bids the investigation categorically to stop. As soon as man wishes to overstep this domain, and wants to form some conception of the whole, he falls into absurdities. Whenever our finite reason wishes to raise itself to conceptions of the eternal in however logical a manner, its wings become paralyzed, and, like a second Icarus, before the sunny heights are reached it falls back into the depths of finite and obscure ideas.

The third question regards "the demands which we make of knowledge." As all conceptions which we form of Nature are exclusively the results of sensual perception, our knowledge cannot go further than to compare the phenomena we have observed, and judge them with reference to one another. We understand something perfectly if we create it ourselves because in this case we see its cause. The only thing in the domain of knowledge which, based upon our sensual perceptions, we can accomplish, is mathematics. We can also understand real things with certainty, as far as we find mathemathical ideas realized in them. Our knowledge of Nature is therefore always a mathematical one, and consists either in simple measurement, as in the morphological and descriptive natural sciences, or in casual measurement, as in the physical and physiological sciences. To understand a natural event means nothing else, as it were, than to repeat it in thought, to reproduce it in our mind.

We can thus only know what our senses acquaint us with, and this is limited in time and space to an infinitesmal domain. Of all that is endless or eternal, of all that is stable or constant, of all absolute difference, we have no conception. Of that with which we are acquainted at all we can only know what is relative and differs by degrees, because we can only apply mathematical ideas to natural things. Professor Von Nägeli sums up in the words: "We can only know the finite, but we can know all the finite which comes within reach of our sensual perception."

New Inventions.

An automatic fan and fly brush has been patented by J. B. Boone, of Galveston, Texas. It consists of a fly brush attached to a shaft with rotary-reciprocating motion communicated to it by a clockwork device. The spring has strips of paper attached to it and fans are affixed to the revolving shaft which works in a supporting plate attached to the ceiling.

John W. Drake, of Toronto, Ill., has invented an improved lamp shade and reflector. The shade has a conical top section and a lower supporting section of inverted conical shape. The lower section has at one side a large opening for the exit of the light, which opening may be enlarged or diminished by ring-shaped sections. At the opposite side of the of the lower section is arranged an adjustable and detachable reflector, for throwing the light through the opening of the shade. A strong light can thus be thrown to any point.

An insole patented by J. K. Gittens, of Brooklyn, N. Y., consists of sheepskin with wool for the inner layer, heavy paper for the intermediate layer, and heavy japanned drilling for the outer layer, gummed together, and bound with a worsted or silk binding. It does not wrinkle.

Mr. Frederick Becker, of Hokah, Minn., has devised a new window shade in which thin strips of wood are connected together, tilted to shut out or admit more or less light and raised by cords passing over pulleys or rollers near the top of the window.

An instrument for cleaning telegraph wires, patented by Joseph Walsh, of New York city, consists of a long tube fitted with knives and springs. When it is placed around the wire and moved along, the device cuts away all obstacles such as kite strings, and clears the wire.

A Tap Attachment to Beer Barrels has been patented by J. H. Bruns and Henry von Dehsen of New York city. It consists in an externally threaded cup which screws into the barrel head. The cup has an apertured bottom, into which is screwed a faucet, which is threaded at its outer end, to receive the coupling by which it is connected with the counter beer faucet. The plug of the faucet is placed midway in the cup and is moved by a pin. The cup has a screw cover, which when removed and the plug turned permits the beer to pass.

Owen W. Taft, Brooklyn, N. Y., has patented a Bird Cage. It consists in a bird cage body made in detachable parts and arranged to be held in its complete integral form by a tension exerted either individually or collectively upon the several wires constituting the same. In practising the invention, numerous modifications of the same may be made all tending to the same result, but the preferred form is that in which each wire has formed in the same a spiral coil which gives an individual tension for each wire to hold the detachable cap piece, standards, and base ring together, to form a complete bird cage body.

Sylvester Root, of Kentland, Ind., has invented a Fire Escape, which consists in an apparatus so constructed that persons may be lowered from a building to the ground by means of a chain or rope, and the latter will then be automatically drawn up again to facilitate the descent of other persons. The means employed consist of the chain with waist belt attached, a drum for winding and unwinding the chain, and spring power and brake apparatus for regulating the action of the drum.

A Chair Seat and Back has been patented by Paul Rath, of Jersey City, N. J. It consists of a molded pasteboard seat or back, having a central hole, stuffing, and covering, in connection with a separate pasteboard section bolted thereto, and carrying auxiliary springs, to increase the elasticity of the stuffing. It furnishes a light and useful seat.

A Bougie invented by Stephen St. John, of Port Jervis, N. Y., consists in a compound of gelatin or isinglass and glycerin, thoroughly mixed together in proportions varied accordingly to the quantity of the ingredients and the requirements of the species and intensity of the disease. The compound thus made is then formed into cylinders, and medicated to suit different purposes.

A Dress Elevator has been patented by Emil C. Calm, of New York city, by which the dress may be supported at any elevation, and adjusted with great facility. It consists of the connection of the hook by which the dress elevator is attached to the belt, and of the chain to which the dress-holding clamp is applied, of a pulley or other guide device connected to hook, and of a suitable chain-retaining device.

Imitation of Wood Mosaics.

Hugo Riha describes the following neat method of imitating mosaics in wood: The smooth pine board is painted with three or four coats of dull white for a ground. When dry it is ground with *ossa sepiæ*, well dried with a piece of buckskin and left a day standing. A thin liquid paint is made by grinding the finest ivory black with turpentine on a glass plate, very fine, and mixing thoroughly with a mixture consisting of three parts of ordinary copal varnish and one part turpentine. This is applied evenly, with not too stiff a brush, upon the white tablet, and graded down very fine and delicately with a badger's hair grader. After two hours the paint dries so solid that work may be begun on it. The tablet is placed on an inclined position and the drawing of the design, the outlines of which have been pricked through the paper with a needle, is laid upon it, and reproduced on the black surface by striking it gently with a bag filled with finely ground chalk, and after removing the paper the outlines will be found in white upon the black background. The design is next painted over with a solution of calcined soda. In two or three minutes afterwards the painted part is washed with a piece of sponge dipped in water, with a circulatory motion of the hand and arm. With a little rubbing the black paint is removed from the portions where the soda was applied. The washing with clean water and sponge is repeated until the design appears in white. This, of course, is the white ground that was under the black. This surface is then dried with a piece of buckskin. By this process the white portion is depressed while the black portion which did not come in contact with the soda remains raised. The colors are now applied to the white portion to imitate the different kinds of wood; and where two kinds of wood are to be matched together, a strip of adhesive paper is pasted along the line where they are to meet, and one kind of paint applied up to the paper. When dry the paper is removed and placed over the painted part and the other color applied. When the design is completed it may be varnished and polished. As the paint applied does not form a thicker coat than the black which surrounds it, the work has the appearance of natural wood mosaic inlaid in a black groundwork, instead of being raised from it as in the usual method.

Making Wrought Iron and Steel.

In a paper on the direct process of making wrought iron and steel read before the Franklin Institute, Mr. Charles M. Dupuy recently gave many interesting facts, from which we make selections.

Forged iron is made by the "direct" and "indirect" methods. By the primitive direct method 400 or 500 lbs. of ore, mingled with charcoal, are subjected to the action of blast for 3 or 4 hours, when it becomes imperfectly matted together, and is transferred to the hammer, where its earthy impurities, being melted, are removed by pressure. This process secures a high grade of iron, at a cost of about 300 bushels of charcoal and great waste of ore to the ton of iron. The "indirect" method treats large masses of ore, carbon and fluxes in the blast furnace. The earthy impurities are mainly tapped off, but still the pig iron may be said to be a compound of iron, carbon, silica, and other substances which require a second melting, and laborious manipulation to purify the metal for forging or rolling.

The devices for improving and cheapening iron by the direct method have been numerous, for the superiority of the metal thus treated had been observed. In 1791 Samuel Lucas patented a process for reducing ores with carbon in airtight pots, and in 1794 Mushet forged iron which he had reduced in a crucible. The simplest method, by reduction of ores in crude clay pots, seems to have been known from the earliest times. A fresh pot for every operation was, of course, too expensive, and devices have been invented by which ore could be deoxidized and the vessel used over and over again.

In a long series of experiments on iron reduced in close pots, Mr. Du Puy found that ore and carbon are such perfect non-conductors that the highest heat penetrates from the outside very slowly through a thickness of about 3 inches of this substance, and that to add 2 or 3 inches thickness of crucible, or containing vessel, practically defeats complete reduction in a sufficiently speedy time to be successful. He also found that a white welding heat was necessary to thoroughly reduce the ore. Crucibles of any refractory material sufficient to withstand this heat are costly at first, and in frequent renewals; besides the material would soften, and incorporating with the metal, deteriorate it. To secure the advantages of the "close pot" it became evident that some substance should compose it that should withstand the high welding heat, and be homogeneous with the metal, and finally, when its work was done, and the ore changed to metal, would weld up with it.

As it is estimated that every pound of silica ordinarily carries with it about three pounds of iron, it occurred to Mr. Dupuy to create for the silica a greater affinity than it has for the metal, by mingling alkalies, and to so proportion them, that the glass thereby produced by not combining with it, should not only save the iron, but that it should be further utilized by forming particles of glazing or varnishing material, covering the little particles of metal as formed, and thus protect them from furnace reoxidization. This step proved effective. Now the alkalies in quantity, and kind, having been determined by an analysis of the ore, they are mingled with it along with the carbon, and are all pulverized together, by being thrown, in the proper proportion, into an ordinary Chilian mill, such as is used in Western rolling mills for grinding the "*fix*," and from thence shoveled at once into the canisters, and charged into the furnace.

It will be observed that a triple chemical operation begins to take place at once, from the moment the canisters are charged into the furnace.

First. The oxygen of the ore combines with the carbon, passing off as carbonic oxide.

Second. The silica and alumina combine with alkalies introduced, and form the glazing material which cover the particles of newly made metal, effectually sealing these particles from reoxidation from the furnace gases.

Third. The phosphorus melts into this glass, and passes off with it as a slag, not contaminating the iron.

If it is desired to make steel, the canisters, filled as described, are charged on end into the furnace on a layer of coke, a few inches in thickness, so as to allow the heat to penetrate from the bottom, as well as sides and top. They are usually placed 7 or 8 inches apart to secure a radiation of heat between them.

In the course of from five to seven hours, according to the strength of the heat, the ore will be reduced from its oxide and settle down into almost a solid metallic mass, so firm as to be separated and broken with great difficulty, even in its highly heated state in the furnace. In this solidified condition it is removed and hammered, or thrown into the squeezer and rolled to muck bar, at this one first heat. It is then cut up, reheated and piled, with the usual loss of 8 to 10 per cent of ordinary piled iron. This stock is then fitted for the steel pot, producing all grades of steel, up to the highest, without mixing with other stock, but by simply varying the carbon.

If iron is required, as soon as the metal has separated from its impurities, precipitated to the bottom, and covered with slag, the operator at once rolls it up in balls and subjects it to the hammer or squeezer. No excessive labor is required in stirring the metal, as is required to decarbonize pig iron, for this metal has been deoxidized without labor, simply by the chemical action of heat on the material; and there is no excess of carbon to eliminate. It has also separated itself, in the liquid state, by specific gravity, from its metalloids altogether, without the aid of physical labor. Finally, as it lies at the bottom of the furnace, it is incorporated with just sufficient carbon as is needed by the operator to produce the grade of metal required.

The ore, carbon, and fluxes, as has been proved by working, may all be ground together and charged into the canisters at an outside cost of 40 cents per ton of ore; when systematized, 30 cents per ton will be sufficient.

It will be found that muck-bar may be produced a few dollars per ton above the cost of pig iron; that it will rank with the highest grades of wrought iron for special purposes; and that the plant is so simple and inexpensive, as to make a large reduction in the interest account of all ironworks. Besides this, it will be found that the process is so greatly under the control of the operator, as to enable him to make such mixtures as to produce the exact quality of iron or steel desired, not being subject to the irregularity of the blast furnace. This direct process, in a word, reduces the exact results of the laboratory to a large and intelligent practical working basis for the manufacture of iron and steel.

Astronomical Notes.

BY BERLIN H. WRIGHT.

PENN YAN, N. Y., December 22, 1877.

The following calculations are adapted to the latitude of New York city, and are expressed in true or clock time, being for the date given in the caption when not otherwise stated.

PLANETS.

Mercury sets	5 56	evening
Venus "	8 18	"
Mars in meridian	6 18	"
" sets	0 30	morning
Jupiter "	5 21	evening
Saturn in meridian	5 1	"
" sets	10 33	"
Uranus rises	9 15	"
Neptune in meridian	8 6	"
" sets	2 50	morning

FIRST MAGNITUDE STARS.

Sirius rises	7 32	evening
Procyon "	7 7	"
Betelgeuse "	5 16	"
Regulus "	9 11	"
Aldebaran in meridian	10 22	"
Vega sets	9 21	"
Altair "	8 8	"
Fomalhaut sets	8 45	"
Capella in meridian	11 0	"
7 stars (cluster) "	9 33	"

REMARKS.

The sun entered the constellation *Sagittarius* and attained his greatest southern declination (23° 7′ 26″) December 21. Twilight begins in the morning at 5 h., 42 m., and ends in the evening at 6 h., 14 m., having lasted in both instances 1 h. 39m.

All the planets are advancing or moving eastward among the stars, except Uranus and Neptune, which are retrograding. Mercury is now brightest, and can be seen in the west in early evening. He sets 1h. 25m. after the sun, and almost at the same point in the horizon (¼° south). He is between Venus and Jupiter, having almost the same declination as the latter and setting 35 m. later. His color will serve to distinguish him from Jupiter and stars. Only 0·226 of Venus' illuminated disk is visible, yet on a clear moonless night she will now cast a well defined shadow.

White and Colored Troops.

The recent annual report of the Surgeon General gives somes figures in regard to the health of the army during the fiscal year ending June 30, 1877, which are interesting. The average mean strength of the army was 23,284 white men and 2,075 colored men. Among the white troops the total number of cases of all kinds reported as taken on the sick list was 40,171, or, taking the average, each man was sick less than twice a year. The average number constantly on sick report was 1,026, or about one twenty-second part were sick all the time. The total number of deaths was 260, making the proportion of deaths from all causes one in one hundred and fifty-five. Among the colored troops the total number of cases was 4,348, or each colored man was sick on the average more than twice a year. The average number constantly sick was 99, or about one twentieth. The number of deaths was 32, or one in one hundred and thirty-six. Comparing the ravages of disease among the two races, we find that 1,482 per 1,000 strength of white men suffered, against 1,821 per 1,000 strength of colored men, the proportion being about 20 per cent against the latter. In deaths, however, we find the proportion reversed, for only 7 per thousand of colored men died of disease, as against 8 per thousand of white men. In cases caused by wounds, accidents, or injuries 8 per thousand negroes died, against 3 per thousand of white men. It thus appears that the negroes become diseased more easily than white men, and also recover more easily; but when actual bodily injury occurs they die more than twice as fast as white men.

It is easy to follow out this line of thought in case of actual warfare. The negro troops would be more subject to sickness and when wounded would die quickly. The white troops would be less liable to succumb to disease, though when afflicted the percentage of recovery would be against them. But on the other hand they would recover more easily from their wounds, which are after all the most serious troubles to be met with in war. Disease can be guarded against, but wounds can not. The superiority of the white to the colored soldier would thus seem to be in measure a proved on the score of health alone.

Heat Waves.

Professor Piazzi Smyth, of the Royal Observatory, Scotland, says that the coming winter is to be exceedingly cold. From the observations of earth thermometers over a period of 39 years, he finds that between 1837 and 1876 three great heat waves from without struck Great Britain, namely: The first in 1846·5; the second in 1858—0, and the third in 1868·7. The next one will probably come in 1879—5, within limits of half a year each way. The periods of minimum temperature, or greatest cold, are not in the middle time between the crests of these three heat waves, but are comparatively close up to them, on each side, at a distance of about a year and a half. Hence the next cold wave is due at the end of the present year, and very frigid weather may be looked for.

NEW BOOKS AND PUBLICATIONS.

WHITWELL'S IRON SMELTER'S POCKET ANALYSES BOOK. By Thomas Whitwell. John Wiley & Sons, Publishers, New York. Price $2.

The want of a pocket analysis book, properly prepared for the various materials used in an iron or steel works, or by the metallurgical engineer will be fully supplied by this choice little work. It contains tables of specific gravities, proportion of weights, melting, boiling, circumference, English and French weights, and other tables of use to the furnace owner or engineer. It is designed for the pocket, and contains room for 450 analyses; its value will increase with the use made of it.

THE CHEMISTS AND DRUGGISTS DIARY. Publishers: 44 Cannon street, E. C., London, England.

This is a volume of great value to chemist and druggists. It contains a dictionary of chemical synonyms, a list of poisons and antidotes, mineral waters, books interesting to pharmacists, a directory of London hospitals, addresses of London doctors, and a dictionary of minerals. Also acts of parliament affecting druggists, botanical calendar and a large diary with ample space for every day in the year. A similar work for the profession in this country would undoubtedly be appreciated.

THE WATER SUPPLY OF SOUTH AFRICA. Compiled by John Croumbie Brown, LL.D. Oliver & Boyd, Publishers, Tweeddale Court, Edinburgh, Scotland.

Mr. Brown has already published valuable works with the philanthropic object of exhibiting the bad results arising from forest destruction and the positive advantages to be gained by tree culture. He has entered with much detail into the effects of forests upon rainfall, and in another work he has exhibited the benefits of the plan pursued in replanting the Alps and other mountains of Europe with trees and bushes, the object being to arrest and prevent the destructive consequences of torrents. In the present volume he has gathered a large amount of material showing the why and wherefore of the desiccation of South Africa, and pointing out the appropriate means for reclaiming the country. These means it is considered are irrigation, arboriculture and an improved forest economy, or the erection of dams to prevent the escape of a portion of the rainfall to the sea, besides other means of minor importance. A very large number of authorities are cited and the subject is treated with great minuteness.

THE LAW OF PATENTS, TRADE MARKS AND COPYRIGHTS. By Orlando L. Bump. Baker, Voorhis & Co., Publishers, 66 Nassau street, New York. Price $6.00.

This is a very complete compendium of the law as contained in the Revised Statutes of the United States. Notes are given under each section referring to decisions of the courts and the Commissioner of Patents. A valuable table is added, showing the time of the repeal of each act, and other information, so that a lawyer may readily ascertain whether a provision in a statute cited in a decision is still in force, or whether a statute has been so modified as to affect the application of a decision. The rules of practice of the Patent Office and a large collection of forms are appended. Nearly 2,500 cases are referred to and digested, and it is believed that, what with the information contained in the book itself, besides that attainable through its very copious references to original sources, the reader will be furnished with all likely to be required in the investigation of any subject under the laws.

A MANUAL OF VEGETABLE PLANTS. By Isaac J. Tillinghast. Tillinghast Brothers, Publishers, Factoryville, Pa.

This is a neat volume of 100 pages containing the experiences of the author in starting all those kinds of vegetables which are most difficult for a novice to produce from seeds, with the best methods for combating and repelling noxious insects and preventing the diseases to which garden vegetables are subject. It is a handbook of much value to gardeners and embraces a variety of useful information.

Business and Personal.

The Charge for Insertion under this head is One Dollar a line for each insertion.

Notes & Queries

(1) E. N. asks: 1. Can old work be re-kalsomined? A. Yes, unless too much smoked: in which case it will be necessary to wash the wall first. 2. How can a new patch of plastering in old work be kalsomined so the old and new wall will look uniform? A. Make the kalsomine somewhat thicker than usual, and if necessary apply several coats. Ceilings should be painted.

(2) J. W. G. writes: I want to make some photo-chromos. Will you tell me through your valuable columns what will make the paper transparent? A. Allow the photograph to remain in water until thoroughly soaked, then place it between blotting paper, and let it remain until just damp enough to be pliable. Then coat the face of the picture with good starch paste and lay, face down, on the glass. Commence in the center of the picture and rub outward toward the edges to dispel all air and excess of paste, care being observed not to get paste on the back of the print. While rubbing keep the paper damp with a sponge. When dry lay on a heavy coat of castor oil, and after a time rub off the excess of oil with a cloth. After standing a day or two it may be colored. Cover the back with a thin plate of glass, and bind the edges.

(3) F. H. B. asks: How can I make or obtain a clay or other suitable substance for modelling, which will not crack on drying? A. Try adding a little glycerin to the clay paste.

(4) C. N. asks for a recipe for destroying vermin on trees and plants? A. The solution obtained by agitating together a quantity of water and recently slaked lime, and permitting the mixture to stand for a few hours in a covered vessel, is said to be excellent for this purpose, and very cheap. It may be sprayed on and around the twigs, using a small syringe with a finely perforated rose nozzle. A decoction of the dried leaves of the sumac tree is also said to preserve vines and plants from the attacks of insects. The application must be repeated occasionally. Besides these, sulphur, alkaline sulphides, calcium sulpho-carbonate, etc., are used with satisfactory results.

(5) P. E. T. asks what the solution is which is used for crystalizing grasses, bouquets, etc.? A. Use strong solution of gum arabic, white sugar, and salt.

(6) E. T. H. writes: What can I do to keep my hair from turning red? A short time ago it was of a black color, but it is now fading into a reddish tinge. A. The red color may have been caused by free alkalies in the oil or pomatum used, or the excessive use of these in washing. Apply occasionally cologne water mixed with a little vinegar of cantharides, and keep the scalp clean by the use of a stiff brush.

(7) C. C. asks: How can a trace of sewage be detected in well water without going to a costly analysis? What is the nearest distance a cesspool should be to a well 50 feet deep? A. Add to a sample of the recently drawn water enough solution of potassium permanganate to impart to it a faint pinkish tinge. If the coloration disappears immediately, or within half an hour, the water may generally be considered unfit for drinking and cooking purposes. One grain of the permanganate will distinctly color 1½ gallons of pure water. Make a saturated solution (in cold water) add 1 fluid oz. of this to 6 fluid ozs. of the water to be tested, and set it aside for 24 hours; a turbidity or curdy precipitate indicates the presence in the water of organic impurities. See p. 296, vol. 36, SCIENTIFIC AMERICAN. Evaporate a quantity of the water to dryness and heat the residue slowly to redness, noting at the time the character of the residue and odors. It is not safe to trust the water from wells located within 200 feet of a cesspool.

(8) L. F. says: Parties here are selling an article for cleaning windows, etc., which resembles whiting. It is made into balls and colored. Can whiting be pressed into balls, and how is it done? A. We have not seen the preparation referred to. Whiting can be pressed into balls by moistening it with thin gum water.

(9) Onyx asks for a good flavor for cigars? A. Try cascarilla bark or vanilla bean.

(10) T. E. asks for a recipe for making a cheap sealing wax? A. Resin 4 lbs., shellac 2 lbs., Venice turpentine and red lead, each, 1½ lbs. Mix and melt.

(11) O. W. O. writes: The water we are using for domestic purposes comes from a river on which are several woodworking establishments, and our wood pulp mill is above the locality whence the water supply is taken. The water is drawn from a wooden tank containing three feet of coarse gravel, the supply coming in under the gravel, and the suction pipe of a common double plunger pump being inserted above the gravel or filter (capacity of pump 12½ gallons for each revolution or complete out and return stroke of both plungers). From this pump the water is distributed. This arrangement has been going over a year without the gravel in the filter ever having been changed. Recently the water was drawn off and the gravel washed, since which time the water has had a very milky appearance at times. What is the cause? A. The milky appearance of the water is most likely owing to the imperfect washing and cleaning of the gravel, and the disturbance of the salts or "brack" that after so long an exposure probably coated every grain of the sand. It would have been much better to have provided fresh gravel, well washed, from the bank; and if the water is used for culinary purposes, this had better be done now.

(12) H. L. C., who sent us a photograph of a curiously marked stone, is informed that the corrugations in the stone were doubtless the work of small rills of water on the yielding surface of a fine deposit of clayey soil, deposited behind some dam in a shallow muddy stream. On drying, cracks were formed, and these subsequently filled with crystalline carbonate of lime, or other substance.

(13) D. H. D. says: How can I set a 21 inch turbine water wheel in a quicksand bottom to a depth of say 2 feet into the quicksand? If I once get the box down and the wheel set, how can I hold it down? The fluid sand pushes it up just as water pushes up an empty barrel. A. You must weight the box sufficiently to keep it down.

(14) D. F. H. asks: How can I construct an electric apparatus for blasting purposes? A. Arrange two pieces of copper wire about 3 inches long, and rather stout, say No. 16 gauge, side by side, and parallel, but separated, and insulated by a strip of wood similar in size and shape to an ordinary lucifer match; bind them firmly by wrapping with cotton thread, and to the two upper ends solder a shred of platinum, or piece of fine platinum wire, so that it will be in circuit between the two copper wires; this constitutes the "fuse," and, when the insulated copper wires, called leading wires, are connected with its two lower ends, it is placed in the cartridge and surrounded with powder; all that is necessary to fire is simply to connect the two ends of the leading wires with a galvanic battery, composed of one or more cells of Grove's battery, when the platinum shred immediately becomes white hot, and ignites the powder.

(15) G. McN. asks for a recipe for making gelatin, such as is used in making moulds for casting plaster of Paris ornaments? A. They are made of good glue dissolved in hot water containing from five to fifteen per cent of glycerin. Glue thus made, on cooling, gelatinizes, but does not dry or harden.

(16) J. F. T. says: I have a 120 ton schooner. It is necessary for me to go into many small harbors, where I have great difficulty in getting out on account of light winds. Could I have a small steam engine put in, which would not take up much room, that would drive my vessel about 4 or 5 miles per hour? A. You could have auxiliary steam power, with a screw that could either be hoisted or disconnected from the engine. By inserting a notice in our "Business and Personal" column, you will doubtless obtain estimates from reliable builders—or you can entrust the matter to an expert.

(17) C. D. W. writes: I want to make a compound magnet of five on six, and I have some bars of very good spring steel. Will it do, or must I use cast steel? A. Spring steel, after it has been hardened in water, will magnetize very well.

(18) J. W. R. asks: 1. Which is the better positive pole for a single acid battery, a carbon plate or a platinized silver plate? A. A platinized silver plate. 2. Which gives the better results, a bichromate of potash solution or sulphuric acid solution? A. That will depend on the style of battery in which the solution is used: bichromate of potash, or chromic acid, in a weak solution of sulphuric acid, is best for the Grenet battery, whereas a weak solution of sulphuric acid is better for the Smee battery. 3. How can I platinize copper? A. Have it silver plated, then roughen with platinum black.

(19) J. D. S. asks how to determine the slip of side wheels in steamers? A. If you know the distance the vessel runs for a certain number of revolutions of the engine, the difference between the distance passed over by the center of pressure of the wheel and the above is the slip.

(20) J. W. and M. H. ask for opinions on the following assertions: 1. It is not actually necessary in long stroke expansive engines to open the exhaust valve before the stroke is completed. A. It is usually desirable. 2. It is more necessary to close the exhaust valve a trifle before the stroke is completed in order to cushion the piston. A. A certain amount of cushion is generally desirable. 3. It is customary in Corliss engines to open the exhaust valves late in order to make them close early. A. You are wrong.

(21) H. H. C. asks: What is the proper solution for a battery composed of carbon and zinc without the use of the porous cup usually used therewith? A. In a battery composed of a plate of zinc, faced by one or more plates of carbon, a solution of the sulphate of mercury in the proportion of ten grains of the sulphate to the ounce of water may be used; or a weak solution of bichromate of potash or chromic acid in water, to which is added one twentieth of its weight of sulphuric acid.

(22) C. R. P. says: I have a steamboat 53 feet long, 10 feet beam, draught 17 inches. It has side wheels each 6 feet 6 inches diameter; paddles 3 feet long. How wide should the paddles be, and how deep in the water should they run to get the best speed? There are two engines 6 x 18 inches geared to run two and one third revolutions to the wheel's one. A. Make the paddles from 6 to 8 inches wide, and immerse them from 12 to 14 inches.

(23) J. A. K. asks how to remove ink stains from clothing? A. Wash first with pure water, then with soapy water, and lastly with lemon juice, but if old use oxalic acid and wash well afterwards.

(24) D. P. asks: Do you think that the use of petroleum as a preventive of scale is likely to cause foaming in the boiler? A. No.

(25) G. M. asks for a cheap way to build a furnace to melt cast iron; one large enough for 100 lbs. of metal? A. You will find a good description of a blast furnace in the SCIENTIFIC AMERICAN SUPPLEMENT for December 8, 1877.

(26) F. J. S. asks: Can I make my main driving belt run well by carrying from the main wheel (9 feet diameter) to a vertical shaft having a 4½ feet pulley? Distance from center to center of shafts or pulleys about 25 feet, main belt 14 inches wide and 70 feet long. My idea is to do away with gearing and use belting, so that I can ship and unship my mills without stopping. A. You can make this change without any difficulty if the belt is of sufficient size to transmit the power.

(27) E. A. writes: 1. Please describe the nature and workings of the electric pen? A. It is simply a tube used as a pen, having in it a very fine needle, whose point has a very rapid motion (of $\frac{1}{50}$ of an inch) in and out the tube or pen; the needle receives its motion from a little electric engine mounted on the upper end of the tube, and having attached to it two flexible conducting cords, that conduct the current of electricity from the battery that drives it. You simply write with it (as you would with pencil), on waterproof paper, having the needle point against the paper; and the writing consists of an immense number of perforations very close together, caused by the rapid motion of the needle piercing the paper; this motion is so rapid that it does not interfere with the movement of the point over the paper. Now all that is necessary is to moisten one side of this waterproof paper with some fluid color, and enough of the color will strike through the perforations to print one sheet after another of ordinary paper placed under it, and then pressed in a common letter press. 2. Was the enclosed specimen made by its means? A. No.

(28) H. R. & Co. write: Could you please inform us by what plan we could remove the lime from our water which we feed our steam boiler with, as there is considerable deposit of it each time we clean the boiler out? A. The best way to cure this evil is to use water that is free from lime: but as this cannot always be obtained, the only remedy left is to free the water from the lime: and one convenient way to do this is to run the water through two boilers; the first, in which the water is heated to boiling point, serves as a trap for the lime, and the water is pumped from this to the other boiler, which furnishes steam. Can you not collect sufficient rain water to feed your boiler?

(29) C. W. D. asks: In making a pony telegraph sounder or relay, the bobbins or arms of the magnet to be ⅞ inch long and ⅜ or ¾ inch diameter, what diameter should the iron arms be, and what number wire, and how many courses, must I use to give strong clicks? A. The iron arms of the magnet are called cores, and if the spools are ⅞ inch long and ¾ inch diameter, they should each be made of a piece of soft round iron, 1 inch long and ¼ inch diameter; and the spools should be formed of six or eight layers of No. 30 copper wire, either silk or cotton insulation, for a sounder, and of from twelve to fourteen layers of No. 36 copper wire (silk insulation), for a relay.

(30) J. A. C. writes: 1. Will you please inform me what number of copper wire I should use to form the outdoor line connecting two telephones, about 200 feet apart, the helix formed of No. 36 insulated wire wound on ($\frac{3}{8}$'' x 4'') round steel magnets? A. Use No. 16 Brown and Sharpe's gauge, of either iron or copper wire. 2. Also if the copper wire outdoor should be insulated or not? A. Naked wire, on glass insulators, will answer. 3. Also, should I use two wires or ground connections? A. Use ground connections, if they consist of either gas or water pipes; if not, use two main lines.

(31) J. W. N. asks (1) for a simple method of treating or tanning sheep skins intended for glove leather? A. The skins are first soaked in water and handled, and are then hung up in a close warm room to putrefy. The exudation is afterwards scraped off, and the skins are steeped in milk of lime for a month or six weeks, after which they are smoothed on the fleshy side by a sharp knife. They are now to be steeped in a bath of bran and water, where they undergo partial fermentation and become thinner in substance. Immersion and agitation follow in a bath composed of 3 lbs. alum and 4 lbs. salt, dissolved in water, per 130 skins. Another washing in another bran and water bath succeeds, and the skins are then trodden in a wooden tub with a solution of eggs in water, previously well beaten up to give them a gloss. The pelts are then drained, dried, and then smoothed with hand irons. 2. Also, how to color the same? A. Stretch the skins and brush them with any strong liquid dye of the proper color, used for cloth dyeing.

(32) W. W. asks for the particulars as to the process that is adopted in New York for bending the plumber's seamless lead traps, that are made from 2 inch and 4 inch lead soil pipe? A. A new apparatus has been devised for bending pipes, which is probably used in the instances you refer to. The pipe is filled with water under heavy pressure, and the tube is then bent without its trickling or becoming otherwise injured.

(33) D. F. asks how to make mercurial soap? A. Beat into a homogeneous mass in a mortar Castile soap, 1 lb.: protochloride of mercury, ½ oz., dissolved in 4 ozs. of alcohol.

(34) M. B. asks how to remove yellow iron stains from linen? A. Use hydrochloric acid or hot solution of oxalic acid, washing well in warm water afterwards.

(35) C. L. says: 1. Will you please tell me what is meant in note 4, p. 251, of SCIENTIFIC AMERICAN of October 20, 1877? In describing how to make an induction coil, it says, "use for secondary coil enough wire to bring outside of coil 2 inches from cover." What is meant by the outside of the coil, and what by cover? A. You should read core, not cover. 2. About what number of feet will it take, proportionally, to make an induction coil (for primary No. 16, secondary No. 32)? A. The proportion of primary to secondary wires depends upon the size of core used and the strength of battery employed. For small coils it may be as 1 foot of primary to 15 feet of secondary wire.

(36) E. H. L. asks: 1. What battery power, kind, and number of cells is necessary to run an ordinary sewing machine? A. Twenty cups of gravity battery. 2. How can the power be most conveniently applied? A. Through an electric engine. 3. Please state size and length of core and wire for the electro-magnets? A. That will depend on the style of engine.

(37) H. asks: What is the best length to have my rifle barrel, caliber $\frac{44}{100}$, to shoot accurately from 200 to 300 yards? What is the shortest barrel I can use, for that distance, to do good shooting? Which is the best ammunition, metallic cartridge or P. B. for muzzle loader? How short can I have a shot barrel breech loader, ½ to ¾ inch bore, to do good shooting

A. Barrel 26 to 32 inches for the rifle. The recent international match demonstrated the superiority of the metallic shell (for breech loaders) provided the loading is done by the individual. Factory cartridges are not reliable. For general use for a 12 gauge gun, 28 or 30 inches is the best length; but for a 10 or 8 bore duck gun, 32 inches is a good length for the barrel.

(38) C. A. T. asks how to stereotype ordinary sized letter heads; has tried plaster of Paris and paper, but the metal will not go down in the impression. A. Paper makes an excellent matrix if rightly applied. Oil the form and place on it first a sheet of tissue paper, then a sheet of soft printing paper, which must be pressed evenly on the tissue. Cover with a damp rag and beat the paper evenly in upon the type with a stiff brush. Then paste on a piece of blotting paper and repeat the beating, after which three more pieces of soft tenacious paper must be pasted on and used in a similar way. Finally back up with cartridge paper and dry under moderate heat.

(39) A. G. asks: What is mixed with the white of eggs for size in gilding edges of books? A. The edges of the leaves are gilded while in the hydraulic press. The composition applied is 4 parts Armenian bole and 1 of candied sugar ground together with water and laid on with the white of egg with a brush.

(40) C. H. D. asks how to lay out steam ports in trunnions of oscillating cylinders of two inch bore? A. The ports should be proportioned in a similar manner to those for other engines, that is, they should have such an area that the velocity of the steam shall not exceed 100 feet per second.

(41) T. R. & Co. ask (1) how fast a lathe should run to grind skates? A. It depends on the kind of emery wheel used, the speed varying between 3,000 and 5,000 circumferential feet per minute. 2. What is the size and grade of emery wheel best adapted to the purpose? A. The size of emery wheel depends upon the amount of concave you want; we should say about 4 inches for edge and about 15 inches for sides of blade. Grade number, 50 for roughing and 120 for finishing.

(42) W. B. writes: Will you tell me of a simple plan to construct a galvanic battery? A. Into an ordinary glass tumbler drop a few crystals of sulphate of copper until the bottom is just covered, and on this lay a disk of thin sheet copper, having metallic contact with an insulated copper wire, running up and over the edge of the tumbler and forming the positive terminal, or pole, of the battery. Sprinkle a few more crystals of the sulphate of copper on the disk, until its surface is covered; and about one inch above this, suspend a disk of ordinary stove zinc, similar in size and shape to the copper disk below it; and suspended by a strip of zinc running up and over the edge of the tumbler: this strip forms the negative pole of the battery; the zinc disk with its strip can be cut at once from a sheet, so as to save joining the strip to the disk. Now pour in clean cold water until the zinc disk is covered; it is in fact a miniature gravity battery, and will give give quite a good and steady current in about one or two hours.

(43) C. H. B. writes (1) for a list of the different conductors and non-conductors. A. We have not room to mention all, but as conductors, silver, copper, gold, all the metals, then the acid and salt solutions. As non-conductors or insulators, hard glass, silk, hard rubber, shellac, etc.; for a more complete list, see "Parker's Philosophy." 2. Also, is there any non-conductor that would do for the cylinder and other parts of a little electrical engine that I am making that have to be non-conductors? A. Hard rubber is the material most generally used as an insulator, in any form of electric engine.

(44) L. I. F. asks: How can I make a smal battery suitable for plating, out of a stone jar and earthen pot? A. Place within the jar a porous cup of earthenware containing a strip or roll of zinc; fill up the space between the cups with a strong solution of copper sulphate (blue vitriol) in water, and immerse in this a sheet of copper bent around the cup. Fill up the inner cup with water containing about 10 per cent of zinc sulphate in solution. The current will pass from the copper to the zinc through a wire and other conductors joining them.

(45) L. R. asks: What length should the wire in the coil of a Bell's telephone be? A. That will depend on the gauge of the wire? See previous answer in this column.

(46) W. writes: I wish to build an electro-medical machine of such power that, when a man of ordinary strength takes hold of the handle and the full force of the battery is turned on, it will knock him down. I wish to know: 1. What number of wire shall I use (22, 32, 44, etc.) and how many lbs. of that number shall I use? Will the machine exert more power if I wind my wire into a long thin coil, or *vice versa*? A. 15 lbs. of No. 44 silk-covered; wind in three short coils, whose aggregate length shall be 8 inches. 2. How much battery power shall I have to use, and what kind of battery is best for my purpose? A. Three cups of Grove.

(47) I. R. B. asks: Is eating thirty quail in thirty days, one bird each day, a difficult task to accomplish, and why? A. The eater becomes greatly nauseated, the flesh probably having some medicinal action. It has been accomplished, and accounts can be found in our back numbers.

(48) J. M. asks for a recipe for syrup for popcorn balls, that will stay sticky when cool? A. Use molasses, or boil the syrup but slightly.

(49) W. T. asks in regard to the telephone: 1. How much copper wire is needed for a pair? A. About 4 ozs. 2. Is it necessary the copper wire should come in direct contact with permanent magnet? A. No, it must not. 3. Is it necessary permanent magnet should move endways to be adjusted, as in a relay? A. No. 4. What are the collars made of that hold the copper wire in position? A. Either wood or hard rubber. 5. Is copper wire wound on haphazard or in layers? A. The same as a spool of cotton is wound. 6. How can I make the iron rod become a permanent magnet? A. You cannot; it is a rod of hardened steel, and can be magnetized by drawing it in one direction over one pole of a permanent horseshoe magnet; or by placing it in a helix and then connecting the helix with a battery and breaking the connection before removing the steel from the helix.

(50) W. S. H. asks how the bluish white color is given to gun locks and mounting? They have a grayish white frosted appearance. A. The colors appear from the casehardening process, which consists of heating the articles sealed in a box containing bone dust and charcoal to a red heat, maintained for two or three hours, and then dipping them in water.

(51) R. W. S. asks: 1. What kind of a stove or heater, and how should I arrange the pipe and heater, to warm a poultry house 100 feet long, 10 feet high, and 10 feet wide? A. Use a hot water apparatus, such as are provided for graperies and greenhouses. There are some that are very simple, consisting of a stove and large cast iron circulating pipe, that give a continuous but low degree of temperature. 2. Also, what can be used instead of blacking? A. An application of asphalt might answer the purpose. Pipe of galvanized iron does not rust so easily as the common pipe.

(52) L. E. asks how blue vitriol can be dissolved for electrical purposes? A. In either hot or cold water.

1. It is said that if kerosene oil be allowed to run through a hot tube it will turn into gas. Is it true? A. Yes. 2. If so, what is the name of it? A. It is one form of carburetted hydrogen. 3. Will it burn? A. Yes, in the presence of air or oxygen. 4. Is it explosive? A. Yes, when it is mixed with certain proportions of either air or oxygen.

(53) A. S. says that his plow castings were recently rusted by the flood in Richmond, Va., and asks how to clean them? A. Retumble them in broken glass.

(54) P. S. asks: 1. Is the hissing sound made by steam escaping from a boiler through say a 4 inch valve that is one turn open, a certainty that the steam is perfectly dry? Will not any steam, wet or dry, escaping through a small opening into so large a pipe and being constantly consumed before it has time to fill the said pipe, will it not make the same hissing sound? A. Either wet or dry steam, escaping through a small orifice, will produce sound; but the sound produced by dry steam will be of a higher tone than when it is produced by wet steam. 2. Are the Harrison boilers, which are made of cast iron and are put together in globe-shaped sections, a first class boiler as regards economy, safety from explosion, and for making the best, that is the dryest, steam for running machinery? A. They are a very good boiler, as far as safety is concerned, but we believe they will not furnish as dry steam as the ordinary tubular boiler.

(55) W. A. B. asks how to make a wire of a gradual taper? A. You might try passing the wire under tension through a bath of heated lead or through some gas or other flame, reducing the speed gradually to increase the taper.

(56) W. S. asks how to harden a piece of steel 9 inches long by ½ inch square, so that it will not warp in hardening? A. Heat it in red hot lead, dip it endwise and vertically, and hold it quite still in the water.

(57) C. M. F. H. asks: What would prevent a steel plate from corroding, and cause it to retain its high polish? A. A thin coat of Canada balsam varnish, or possibly warming the plate and applying a little paraffin, rubbing the wax well in, would answer.

Is it possible to make asbestos, mixed or saturated with silicate of soda, pliable, when pressed or roelld out, it being thoroughly dry? A. This can best be determined by experimenting.

(58) W. J. G. asks for the composition of the white lead mixture applied to bright metal work to keep it from rusting? A. Mix white lead, tallow, and linseed oil to a thick paint.

(59) Mack asks for the degrees of expansion and contraction by heat of the different metals? A. The length of a bar at 32° Fah. being 1, its length at 212° would be as follows: Bismuth, 1·00139; brass, 1·00190; cast iron, 1·00111; wrought iron, 1·00125; steel, 1·00118; platinum, 1·00095; silver, 1·00201; tin, 1·002; zinc, 1·00294; copper, 1·00174; gold, 1·00149; lead, 1·00284.

(60) Dr. T. D. offers the following suggestion for opinion: To so attach the water spouts to side walls as to insure always complete isolation by glass rings or other device of non-conductor, as in the manner of lightning rods proper. As now arranged our water spouts attract toward the interior of the houses the electricity, whereas they might act as protectors (by extending upper and lower ends) always quite as well and at less cutlay than by the rods. A. The interposition of glass or other non-conductor, to insulate lightning conductors, is not only useless, but undesirable—the discharge from a large induction coil easily pierces blocks of glass several inches in thickness, and the tension of atmospheric electricity during a thunderstorm is vastly greater than that from the coil. Metal leaders seldom have adequate connection with the earth, and are therefore not only incapable of properly diverting the charge, but are in many cases sources of danger in the absence of a good rod. If the the leader is used as a lightning conductor, it must terminate in moist earth, with an exposure of surface not less than 100 square feet, and must be joined, by means of stout copper wire, with the gas and water pipes, and other metal work of the building. This arrangement may afford protection, but it would be safer to provide the rod also.

(61) O. F. asks for rules for making a cone pulley (or pair of pulleys) so that a belt will be equally tight on the different sides of the cone? A. First assume the radii of one driving pulley and the corresponding driven pulley, measure the distance between their centers, and find the length of belt required. Then assume values for the radii of the successive pulleys on the driving cone, and calculate the values of the corresponding radii on the driven cone by the following rules: I. Having assumed the value of one radius, it is first necessary to ascertain whether the one to be calculated is greater or smaller: (1) Multiply the assumed radius by 3·1416 and increase the product by the distance between the centers of the pulleys. (2). If the quantity obtained by (1) is greater than half the length of the belt, the assumed radius is greater than the one to be determined. (3). If the quantity obtained by (1) is less than half the length of the belt, the assumed radius is less than the one determined. II. *When the assumed radius is greater of the two, to find the other one.* The distance between the centers, and the length of the belt are supposed to be given. (1). Multiply the assumed radius by 6·2832; subtract this product from the length of the belt, and divide the remainder by the distance between centers. (2). Add the quantity obtained by (1) to the number 0·4674 and extract the square root of the sum. (3). Subtract the quantity obtained by (2) from the number 1·5708, and multiply the difference by the distance between centers. (4). Subtract the quantity obtained by (3) from the assumed radius and the remainder will be the required radius. III. *When the assumed radius is the smaller of the two, to find the other one.* (1). Same as (1) of preceding rule. (2). Same as (2) of preceding rule. (3). Subtract the number 1·5708 from the quantity obtained by (2) and multiply the difference by the distance between centers. (4). Add the quantity obtained by (3) to the assumed radius; the sum will be the required radius. These rules apply to an open belt passing over any two stepped cones.

(62) S. S. B. asks: What is the so-called "madstone," supposed to be a cure for hydrophobia, and what are its virtues? A. The madstone of the Southern States is an aluminous mineral, and its charm lies in its power of absorption. The Ceylon madstone or "pombo kaloo" is a black highly polished substance which, when applied to an open wound, rapidly imbibes the blood, and with it the poison. Faraday analyzed it and found it to be a bit of charred bone. The Mexican madstone is charred deer horn. The efficacy of the remedy resides simply in the stone being porous and withdrawing the blood. Sucking the wound would accomplish the same result.

(63) C. H. M. says: In your "Notes and Queries" you frequently refer to back numbers or to the SUPPLEMENT. Can you furnish these, and at what price? A. In most cases we can. By referring to our advertising columns you will see that an unusual opportunity now exists for purchasing a large number of bound back volumes of the SCIENTIFIC AMERICAN at about the cost of the binding. We can supply all the back numbers of the SUPPLEMENT, bound or unbound.

What is the chemical called "colgate"? A. We know of no such substance. Send us a specimen for examination.

(64) A. W. asks if there is any way of making autograph letters other than by lithography? A. The electric pen furnishes a simple means of obtaining any number of copies. The letter is written with the pen which forms the characters by minute perforations, so that the sheet serves as a stencil plate over which an inked roller is passed, the ink marking through the holes upon a sheet of paper placed beneath.

(65) A. G. C. asks how to cut stencil plates otherwise than by chisels. I have coated my brass with wax, scratched through to the metal, covered the letters with sulphuric, nitric, and muriatic acid, but neither of the acids named will cut through the plate. A. There must be something wrong with your acid. Generally nitric acid diluted with ¼ water is used. The best plan is to etch the plate as much as possible with the acid, and then clear the cutting with the graver. To obtain clean cuts the back of the plate should be smeared with oil.

(66) H. L. C. writes: 1. I am making a new electric engine in which I have three pairs of electro-magnets wound with 1¼ lb. of No. 16 cotton insulated copper wire to each pair; it will be necessary to have all three pairs in the same circuit at one time. Now if they are all set in a brass plate that makes connection with the cores of all the magnets—but not with the wire direct—will such connection carry the current across from one to the other of the outside magnets, so as to affect the strength of the middle magnet? A. No. 2. Would iron be better than brass? Wood is not strong enough. A. Brass is the best metal to use in this case.

(67) W. T. K. asks if there is a locality on the globe where the sun jumps a day; where at high twelve Sunday, noon ceases, and instantly Monday meridian begins, or where Sunday comes into a man's house on the eastern side, and becomes Monday by the time it passes his western door? A. The sun does not jump a day anywhere. Navigators in sailing around the world, provided they use the time of any given locality, gain or lose a day in their reckoning, and by common custom it is usual when not already done to adjust time pieces for this error on passing the meridian of Manilla. But as a rule clocks are adjusted aboard ship daily, the local time being determined by observation.

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

T. A. A.—It is lignite in a gangue of ferric sulphide—marcasite—and sandstone. The mineral is of no practical value, but if obtainable in larger samples might be of some interest to the mineralogist.—B. B.—They are fine specimens of what are known as claystones—concretions formed by the tendency of matter to collect about a center. They are usually flattened, and at the center there is most commonly some foreign object, a fossil, shell, twig, or the like, which was the nucleus of the crystallization.—E. A. J.—It is a banded agate. It is composed of silicic acid. The colors are caused by traces of organic matter, oxides of iron and manganese, and by the difference of density of the siliceous rings. As regards your other question, there must exist some outlet for surplus water, if the measurements were properly made.—A. W.—It is not brown coal, but a slaty shale.—The color is due to oxide of iron.—W. P. McC.—The silicious clay does not contain coloring matter other than a little oxide and silicate of iron—it is not valuable.—We have received an unlabeled sample of ore rich in zinc and lead—probably from Connecticut.—Will M. S. send other samples of his ore?

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 Theory of Universal Gravitation. By J. McC.
On Algebraic Equations. By J. T.

HINTS TO CORRESPONDENTS.

We renew our request that correspondents, in referring to former answers or articles, will be kind enough to name the date of the paper and the page, or the number of the question.

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

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

WANTS AND BUSINESS INQUIRIES.

Almost any desired information, and that of a business nature especially, can be expeditiously obtained by advertising in the column of "Business and Personal," which is set apart for that purpose subject to the charge mentioned at its head.

We have received this week the following inquiries, particulars, etc., regarding which can probably be elicited from the writers by the insertion of a small advertisement in the column specified, by parties able to supply the wants:

Who manufactures soap-making machinery, and where can the plan of a soap factory be obtained?

MACHINISTS' SUPPLIES.

The Best and Cheapest in the Market. Everything in the line that a Machinist or Mechanic wants. Chucks, Twist Drills, Oil Cups, Lubricators, Steam and Gas Fittings, also MACHINISTS' TOOLS in variety, Taps and Dies. H. A. ROGERS, 19 John Street, N. Y.

FOR STEAM ENGINES WITH CORLISS VALVE, all sizes, apply to WATTS, CAMPBELL & CO., Newark, N. J.

25 NEW YEAR CARDS, with name, 20c. 25 Extra Mixed, 10c. Geo. I. Reed & Co., Nassau, N.Y.

PATENTS SOLD.

For terms, address EUROPEAN and UNITED STATES PATENT EXCHANGE, 200 Broadway, N. Y. Box 2801.

LIPSEY ADJUSTABLE STEEL WRENCH.

"RELIABLE"

STRONGEST AND BEST MANF'D AT 91 WASHINGTON ST. N.Y.

THE PHENOMENA OF HUMAN LIFE. A recent address by Professor John Tyndall. A most able and interesting paper, in which the Laws of Energy and the Continuity of Motion as they are found in the material universe are pointed out and their existence traced in the Animal Economy and the Human System. The operation of the Will and the Relations between the Mind and the Body are described in the clearest manner from the standpoint of the man of science. Contained in SUPPLEMENT No. 97. Price, 10 cents.

DON'T FAIL TO USE

Massey's Revolving Shoe Heel Protector.

Warranted to wear the heel evenly on all sides, maintaining an upright tread to the Foot, and avoiding uneven wear of the Sole and Upper. It doubles the durability of Shoes and Boots, saves expense of reheeling, is Noiseless, does not Tire the Foot, and does not Slip. No nails to wear the carpet. Can be attached by any one. Twelve Sizes made suitable for all Shoes and Boots. Samples, with Tool and Directions for applying, sent postpaid, on receipt of 50 cents. Liberal discounts to the Trade. N. B.—In ordering, send width of heel for proper size. Address MASSEY REVOLVING SHOE HEEL CO., 824 Broadway, New York.

FOR SALE CHEAP. The Machinery of a first-class Planing Mill and Sash and Blind Factory. Also Moulding Machine and Turning Lathe. Can all be seen running. Address P. B. RATHBONE, Syracuse, N. Y.

PATENT FOR SALE. A Right to manufacture Neasham's Tool Post for Lathes. Address ROBERT NEASHAM, Mount Washington, Pittsburgh, Pa.

To Inventors and Owners of Patents.

Patents at Public Sale

Regularly on the last Thursday of each month. [By H. P. Wolbert, Auctioneer, at his Salesrooms, 202 Market St., Philadelphia. Established 1847]. For most liberal terms, address THE PHILADELPHIA MUTUAL PATENT BAZAAR, 202 Market St., Philadelphia.

THE SALT MANUFACTURE OF MICHIGAN. By S. S. GARRIGUES, Ph.D. One engraving. A Complete and Instructive Description of Salt Making. The Well-boring Machinery. Pumping and Evaporating Brine. Kettle and Pan Blocks. Solar and Steam Evaporation. Grades, Qualities, and Analyses of Salt. Tabular Statement of Companies, Capital, Amount of Salt produced, number of Kettles, etc. Cost, Profit, Labor, and Details. Contained in SCIENTIFIC AMERICAN SUPPLEMENT No. 102. Price 10 cents. To be had at this office and of all newsdealers.

JENNINGS' WATER CLOSETS. PRICES REDUCED. SEND FOR CIRCULAR. 94 BEEKMAN STREET NEW YORK

$100 PER MONTH and EXPENSES or Commission to a few good men to sell our TEAS to DEALERS. NO PEDDLING. C. A. LONG & CO., Nos. 4 & 5 Fuller Block, Dearborn Street, Chicago, Ill. YEARLY Contract

Old Books Wanted at American Book Exchange, 55 Beekman St., N. Y., for New Books or Cash. Books loaned to all parts of the United States. Local Agents wanted. Say where you saw this.

WIRE-DRAWING MACHINERY complete, from rods to No. 40 wire, is manufactured by S. HEALD & SONS, Barre, Mass. Send for prices, etc.

Brainerd MILLING MACHINES, all styles and sizes.

Universal, Index, Gear Cutting, and Plain. Screw Machines and Vises. Address, for illustrated circular and prices, B. M. M. CO., 131 Milk St., Boston, Mass.

WROUGHT IRON BEAMS & GIRDERS

THE UNION IRON MILLS, Pittsburgh, Pa., Manufacturers of improved wrought iron Beams and Girders (patented).

The great fall which has taken place in the prices of Iron, and especially in Beams used in the construction of FIRE PROOF BUILDINGS, induces us to call the special attention of Engineers, Architects, and Builders to the undoubted advantages of now erecting Fire Proof structures; and by reference to pages 52 & 54 of our Book of Sections—which will be sent on application to those contemplating the erection of fire proof buildings—THE COST CAN BE ACCURATELY CALCULATED, the cost of Insurance avoided, and the serious losses and interruption to business caused by fire; these and like considerations fully justify any additional first cost. It is believed, that were owners fully aware of the small difference which now exists between the use of Wood and Iron, that in many cases the latter would be adopted. We shall be pleased to furnish estimates for all the Beams complete, for any specific structure, so that the difference in cost may at once be ascertained. Address CARNEGIE, BROS. & CO., Pittsburgh, Pa.

SPARE THE CROTON AND SAVE THE COST.

Driven or Tube Wells

furnished to large consumers of Croton and Ridgewood Water. WM. D. ANDREWS & BRO., 414 Water St., N. Y., who control the patent for Green's American Driven Well.

Wright's Automatic Cut-off Engine.

Superior in economy, simplicity and durability to all other engines in market. Engines, Boilers and Machinery, new and second-hand. Send for circular. GEO. M. CLAPP, 205 Broadway, N. Y.

PATENT MINERAL WOOL.

Incombustible. The best non-conductor. Cheap enough for lining frame houses. Send for circular. A. D. ELBERS, 26½ Broadway, N. Y. P. O. Box 4461.

Lathes, Planers, Shapers

Drills, Bolt and Gear Cutters, Milling Machines. Special Machinery. E. GOULD & EBERHARDT, Newark, N. J.

BLAKE'S STONE AND ORE BREAKER AND CRUSHER.

For breaking hard and brittle substances to any size. Endorsed by the leading Mining, Manufacturing, and Railroad corporations in the United States and Foreign Countries. First Premium wherever exhibited, and hundreds of testimonials of the highest character. A NEW SIZE FOR PROSPECTING AND LABORATORY USE. ☞ ALL STONE CRUSHERS not made or licensed by us, containing vibratory convergent jaws actuated by a revolving shaft and fly-wheel, are infringements on our patent, and makers and users of such will be held accountable. Address BLAKE CRUSHER CO., New Haven, Conn.

AT NEW STOCK EXCHANGE. John Hickling, 62 Broadway and 21 New St. You can deal in 5, 10, 20, 25, 50, or 100 shares of Stock on 1 per cent. margin and no further liability.

1-16 commissions 1-16 on 25, 50, or 100 shares.

Visitor to Wall St. can deal with a responsible house by calling on JOHN HICKLING, 21 New St., New York.

LADIES can make $5 a day in their own city or town. Address ELLIS MAN'F'G CO., Waltham, Mass.

50 LARGE MIXED CARDS, with name, 13c. 40 in case 13c. 25 styles Acquaintance Cards 10c. Ag'ts outfit 10c. DOWD & CO., Bristol, Conn.

$3 GOLD PLATED WATCHES. Cheapest in the known world. Sample Watch Free to Agents. Address, A. COULTER & Co., Chicago.

MADE TO ORDER.

Milling Cutters, Special Machinery, and Tools. A. A. Pool & Co., 55 R. R. Ave., Market St. Sta., Newark, N. J.

50 Elegant Mixed Cards, with name, 13c. Agent's outfit 10c. Seavy Bros., Northford, Ct.

WORK FOR ALL

In their own localities, canvassing for the Fireside Visitor, (enlarged) Weekly and Monthly. Largest Paper in the World, with Mammoth Chromos Free. Big Commissions to Agents. Terms and Outfit Free. Address P. O. VICKERY, Augusta, Maine.

65 MIXED CARDS, with name, 10c. and stamp. Agent's Outfit, 10c. L. C. COE & CO., Bristol, Ct.

The HOADLEY PORTABLE STEAM ENGINE. WITH AUTOMATICAL CUT-OFF REGULATOR AND BALANCED VALVE. THE BEST & MOST ECONOMICAL ENGINE MADE. SEND FOR CIRCULAR. The J.C. HOADLEY CO. LAWRENCE, MASS. STATE WHERE YOU SAW THIS.

Second-Hand Microscopes.

Beck's, Crouch's, Ross', Nachet's Hartnack's, Zentmayer's and other makers, from 25 to 50 per cent. below the catalogue prices.

Glass slips and thin glass covers for mounting objects, at reduced price. Send for the list. JAMES W. QUEEN & CO., OPTICIANS, 924 Chestnut St., Philadelphia.

AGENTS WANTED. For particulars address WILSON SEWING MACHINE CO., 829 Broadway, New York city, New Orleans, La., Chicago, Ill. Or San Francisco, Cal.

Pond's Tools,

Engine Lathes, Planers, Drills, &c. Send for Catalogue. DAVID W. POND, Successor to LUCIUS W. POND, Worcester, Mass.

Wood-Working Machinery,

Such as Woodworth Planing, Tongueing, and Grooving Machines, Daniel's Planers, Richardson's Patent Improved Tenon Machines, Mortising, Moulding, and Re-Saw Machines, and Wood-Working Machinery generally. Manufactured by WITHERBY, RUGG & RICHARDSON, 26 Salisbury Street, Worcester, Mass. (Shop formerly occupied by R. BALL & CO.)

A Golden opportunity. Every Agent in the country should subscribe at once for the Agents' Journal. A handsomely bound 24 page Journal devoted to their interest. A knowledge of what it contains will render it indispensable to you; it is brim full of Spicy and Interesting reading, and is Just What Agents Need. Sample Copy with terms sent free. Address AGENTS' JOURNAL, N.Y.

SALES MEN WANTED ON A YEARLY SALARY $125 A MONTH and all expenses, to sell to DEALERS. Samples FREE. Send 3c. stamp to insure answer. S. FOSTER & CO., Cincinnati, O. CIGARS

PATENTS AT

AUCTION.

Regular Monthly Sales the first week of each month, by George W. Keeler, Auctioneer, at his salesrooms, 53 Liberty Street, N.Y. For terms, etc., address The New York Patent Exchange, Room 11, 55 Liberty Street.

THE DRIVEN WELL.

Town and County privileges for making Driven Wells and selling Licenses under the established American Driven Well Patent, leased by the year to responsible parties, by WM. D. ANDREWS & BRO., NEW YORK.

The George Place Machinery Agency

Machinery of Every Description. 121 Chambers and 103 Reade Streets, New York.

MACHINISTS' PATTERN LETTERS in great variety. VANDERBURGH, WELLS & CO., Printers' Warehouse, 18 Dutch Street, New York, corner Fulton. (Up-stairs.)

DANBURY DRILL CHUCKS. Perfected and Price reduced. Manuf'd by the HULL & BELDEN CO., Danbury, Ct.

BRADFORD MILL CO. Successors to Jas. Bradford & Co. MANUFACTURERS OF French Buhr Millstones, Portable Corn & Flour Mills, Smut Machines, etc. Also, dealers in Bolting Cloths and General Mill Furnishing. Office & Factory, 158 W. 2d St. CINCINNATI, O. J.R. Stewart, Pres. W.R. Dunlap, Sec. PRICE-LISTS SENT ON APPLICATION.

$1200 Salary. Salesmen wanted to sell our Staple Goods to dealers. No peddling. Expenses paid. Permanent employment. address S. A. GRANT & CO., 2, 4, 6 & 8 Home St., Cincinnati, O.

ADVERTISERS SELDOM FAIL TO MAKE MONEY

When their advertising is properly placed. For list of best mediums, address EDWIN ALDEN'S ADVERTISING AGENCY, 174 ELM STREET, CINCINNATI, O. ☞ Best rates on the best papers. Send for catalogue. Estimates and information free.

WE ENAMEL in FINE JET BLACK every variety of turned wood work parts of machinery, castings, tin-ware and other metal work. ENAMELED JET GOODS, in wood or metal, made to order. AMERICAN ENAMEL CO. 17 WARREN ST. PROVIDENCE, R. I.

$2500 a year. Agents wanted everywhere. Business strictly legitimate. Particulars free. Address J. WORTH & Co., St. Louis, Mo.

BIG PAY To Agents selling my 10 new articles. Chromos, Watches, Jewelry, etc. Send for catalogue. R. Morris, Chicago, Ill.

Locomotives on Street Tramways. The undersigned, being largely interested as engineer to tramway companies in Europe, would be glad to correspond with makers of engines suitable for passenger tramways. JOSEPH KINCAID, Civil Engineer, 11 Great George St., Westminster, London.

GOLD WATCH and CHAIN ONLY $20. Cheapest in the World! Sample WATCH and CHAIN FREE to Agents. C. M. LININGTON, 47 Jackson St., Chicago.

BARNES' FOOT POWER MACHINERY. 13 Different machines with which Builders, Cabinet Makers, Wagon Makers, and Jobbers in miscellaneous work can compete as to QUALITY AND PRICE with steam power manufacturing; also Amateurs' supplies. MACHINES SENT ON TRIAL. Say where you read this, and send for catalogue and prices. W. F. & JOHN BARNES, Rockford, Winnebago Co., Ill.

Lightest, Strongest, and Best

BELT PULLEY

made. Secured to the Shaft without Keys, Set Screws, Bolts or Pins; also, Adjustable Dead Pulleys and Taper-Sleeve Couplings. Send for catalogue. Address Taper-Sleeve Pulley Works, Erie, Pa.

EAGLE FOOT LATHES,

Improvement in style. Reduction in prices April 20th. Small Engine Lathes, Slide Rests, Tools, etc. Also Scroll and Circular Saw Attachments, Hand Planers, etc. Send for Catalogue of outfits for Amateurs or Artisans. WM. L. CHASE & CO., 95 & 97 Liberty St., New York.

IMPORTANT FOR ALL CORPORATIONS AND MANF'G CONCERNS.—Buerk's Watchman's Time Detector, capable of accurately controlling the motion of a watchman or patrolman at the different stations of his beat. Send for circular. J. E. BUERK, P.O. Box 979, Boston, Mass. N. B.—The suit against Imhaeuser & Co., of New York, was decided in my favor, June 10, 1874. A fine was assessed against them Nov. 11, 1876, for selling contrary to the order of the court. Persons buying or using clocks infringing on my patent will be dealt with according to law.

Boult's Patent Reverse Motion

Paneling, Variety Moulding & Dovetailing Machine. Cuts Panels of any design or style of mould in the solid wood with neatness and dispatch.

Is a first-class Shaper, Edge, & Scroll Moulder. Does general Dovetailing with thick or thin stuffs. Simple, Durable and Efficient. ☞ Send for Pamphlet and Sample of work. Improved Solid Steel Cutters for all kinds of Variety Moulders made to order, and warranted by the B. C. MACHINERY CO., Battle Creek, Mich.

OTIS' SAFETY HOISTING Machinery.

OTIS BROS. & CO., No. 348 Broadway, New York.

IT PAYS to sell our Rubber Hand Printing Stamps. Terms free. G. A. HARPER & BRO., Cleveland, O.

Small Tools of all kinds; also GEAR WHEELS, parts of MODELS, and materials of all kinds. Castings of Small Lathes, Engines, Slide Rests, etc. Catalogues free. GOODNOW & WIGHTMAN, 23 Cornhill, Boston, Mass.

A GOOD WELL can be made in one day with our 4-foot WELL AUGER. Send for our Auger Book. U. S. AUGER CO., St. Louis, Mo.

BIG PAY made by Agents selling our Rubber Printing Stamps. Taylor, Bros. & Co., Cleveland, O.

WATER SUPPLY ENGINEERING. By J. T. FANNING, C.E. Complete Practical Treatise: 620 pages; 125 Tables; 180 illustrations. Price $6.00. D. VAN NOSTRAND, Publisher, 23 Murray St., N. Y. *** Copies sent free by mail on receipt of price.

Laundry Machinery and the Nonpareil Washing Machine, manufactured by Oakley & Keating, 40 Cortlandt St., N.Y. Specifications, Plans and Estimates for Laundries furnished. Correspondence invited.

DYKES' BEARD ELIXIR

Patent Atmospheric Gas Burner,

for softening paint with Gas. One man removing two square feet of paint in one minute. The ONLY BURNER that will burn with its mouth downward and not heat back. A. H. WATKINS, 294 Harrison Ave., Boston, Mass. *** Send for Circular with Testimonials.

Mrs. Stowe's New Novel, "OUR FOLKS AT POGANUC,"

BEGAN NOV. 28TH, IN THE

CHRISTIAN UNION.

Special Features for 1877-8.

LEONARD BACON, D.D., "Political Problems."
J. H. VINCENT, D. D., "Sunday-School Papers."
EDWARD EGGLESTON, D.D., "How to Hold our Young People."
JOS. P. THOMPSON, D.D., R. W. DALE, M.A., } Foreign Correspondence.
A MEMBER OF THE N. Y. BAR, "A Layman's Thoughts on Preaching."
"LAICUS," "Letters from my Library."
HENRY WARD BEECHER, Sermons from Plymouth Pulpit.
JOSEPH COOK, Boston Lectures (condensed).
LYMAN ABBOTT, Sunday-School Lessons.

Sent for balance of 1877 to Jan. 1, 1879, for $3. To Clergymen, $2.50.

The first two Numbers containing chapters of Mrs. Stowe's Novel sent free on receipt of postal card.

HORATIO C. KING, Publisher, 27 Park Place, New York.

BIG 84-page Picture Book, free. My plan beats all to make money. Is easy, honest, and pays you $10 a day. DAVID C. COOK, Chicago, Ill.

AIR COMPRESSORS

FOR ALL PURPOSES. A SPECIALTY of HEAVY PRESSURES. THE NORWALK IRON WORKS CO., SOUTH NORWALK, CONN.

"OLD RELIABLE." TO KNOW ALL about the Best Pump for Paper Makers, Tanners, Contractors, and for Irrigation, send for illustrated pamphlet, 78 pages. HEALD, SISCO & CO., Baldwinsville, N.Y.

WESTON DYNAMO-ELECTRIC MACHINE CO

Machines for Electro-plating, Electrotyping, Electric Light, etc., in addition to testimonials in our Catalogue of Jan. 1. We beg to refer to the following houses: MERIDEN BRITANNIA CO.; RUSSELL & ERWIN M'F'G CO.; REED & BARTON; HALL, ELTON & CO.; RICHARDSON, BOYNTON & CO.; WM. H. JACKSON & CO.; STANLEY WORKS; ROGERS CUTLERY CO.; CHAS. ROGERS BROS.; EDWARD MILLER CO.; MITCHELL, VANCE & CO.; NORWALK LOCK CO.; HAYDEN, GERE & CO.; DOMESTIC SEWING MACHINE CO.; EBERHARD FABER; JOS. DIXON CRUCIBLE CO.; MUMFORD & HANSON; FAGAN & SON, and over 200 others. Outfits for NICKEL, SILVER, BRONZE, Plating, etc. The two highest CENTENNIAL AWARDS, and the CENTENNIAL GOLD MEDAL of American Institute. Prices from $125 to $500.

CONDIT, HANSON & VAN WINKLE, Sole Agents, NEWARK, N.J.

THE SUN.

1878. NEW YORK. 1878.

As the time approaches for the renewal of subscription, THE SUN would remind its friends and well wishers everywhere, that it is again a candidate for their consideration and support. Upon its record for the past ten years it relies for a continuance of the hearty sympathy and generous co-operation which have hitherto been extended to it from every quarter of the Union.

The Daily Sun is a four-page sheet of 28 columns; price by mail, postpaid, 55 cents a month, or $6.50 per year.

The Sunday edition of THE SUN is an eight-page sheet of 56 columns. While giving the news of the day, it also contains a large amount of literary and miscellaneous matter specially prepared for it. THE SUNDAY SUN has met with great success. Postpaid $1.20 a year.

The Weekly Sun.

Who does not know THE WEEKLY SUN? It circulates throughout the United States, the Canadas, and beyond. Ninety thousand families greet its welcome pages weekly, and regard it in the light of guide, counsellor, and friend. Its news, editorial, agricultural, and literary departments make it essentially a journal for the family and the fireside. Terms: One Dollar a year, postpaid. This price, quality considered, makes it the cheapest newspaper published. For clubs of ten, with $10 cash, we will send an extra copy free. Address PUBLISHER OF THE SUN, New York city.

PATENT SCROLL AND BAND SAW MACHINES A speciality. CORDESMAN, EGAN & CO., Cincinnati, O.

Baker Rotary Pressure Blower.

(FORCED BLAST.)

Warranted superior to any other. WILBRAHAM BROS. 2318 Frankford Ave. PHILADELPHIA.

The National Petroleum Gas Co. Have the only process that will produce pure fixed Gas from petroleum. Uniform and reliable as the *best Coal* Gas, and much more brilliant, *at half cost*. Will furnish works for Cities, Towns, Manufacturing Corporations; also, Portable Works for Hotels and Private Dwellings, of any size required. Send for circular. GEO. M. CLAPP, General Agent for States of New York and New Jersey, 206 Broadway, New York.

H. R. WORTHINGTON,

239 BROADWAY, NEW YORK. Hydraulic Works, Van Brunt Street, Brooklyn. Manufactures Pumping Engines for Water Works. In daily use at 100 stations. Also Steam Pumps, Water Motors and Water Meters. See SCIENTIFIC AMERICAN SUPPLEMENT, January 27th, 1877. Prices largely reduced July 1st, 1877.

SHEPARD'S CELEBRATED $50 Screw Cutting Foot Lathe. Foot and Power Lathes, Drill Presses, Scroll, Circular and Band Saws, Saw Attachments, Chucks, Mandrills, Twist Drills, Dogs, Calipers, etc. Send for catalogue of outfits for amateurs or artisans. H. L. SHEPARD & CO., 88, 90 & 92 Elm St., Cincinnati, Ohio.

JOHAN KOOPMANS & CO., OF AMSTERDAM (Netherlands), beg to inform the public in general, and American manufacturers in particular, that they have established a wholesale business for American articles, both for their own account and as the representatives of several manufacturing concerns in the United States. Manufacturers desirous of making their products known in Holland and its colonies, will find it to their advantage to address them with catalogues and price current, giving them full information about their goods. Reference, J. Agostini, 30 Beaver St., N. Y.

FOUNDRY MOULDING MACHINE. Simple, strong, and practical. The best machine made, at reduced prices. T. F. HAMMER, Patentee and Manufacturer, Branford, Conn.

CODY' PAT. SHAFT OILERS, OIL FEEDER &c. Adr. CINCINNATI BRASS WORKS