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PORCELAIN MANUFACTURE IN NEW YORK.

Resuming our description where we quitted it last week, we have to direct the reader's attention to the next process, which is

CONVERTING THE WARE INTO BISCUIT,

as it is termed after the first baking. The kilns in which this operation is performed are huge cylindrical structures (see Fig. 7), fifteen and a half feet in diameter, and having two stories, the lower one eleven and a half, and the upper one nine, feet in hight. The walls, which are of brick, faced inside with fire brick, are nearly four feet in thickness. Directly beneath the lower story is a grate, covering the entire area and accessible by several doors. When fired, a kiln uses about ten tuns of coal to a baking, and combustion is continued for twenty-eight hours. It takes three days for the interior to cool. The raw ware for the first baking is placed in the upper story, which is subjected to a less degree of temperature than the compartment below, the exhaust heat being used. The seggars now come into use, each one being filled with as many articles as can be placed in it without touching each other, small pieces of fire clay serving as supports. The filled seggars are then ranged in piles from floor to ceiling, of the kiln, the bottom of one seggar serving as the cover to the other, and the surfaces being separated by rings of soft clay, which form a tight joint. As many as 30,000 pieces of ware may be included in one baking. The fires are now urged for the proper time; and after the kiln has cooled, the ware is removed, a hard, brittle, porous body. This is the biscuit, so called from its resemblance to ship bread.

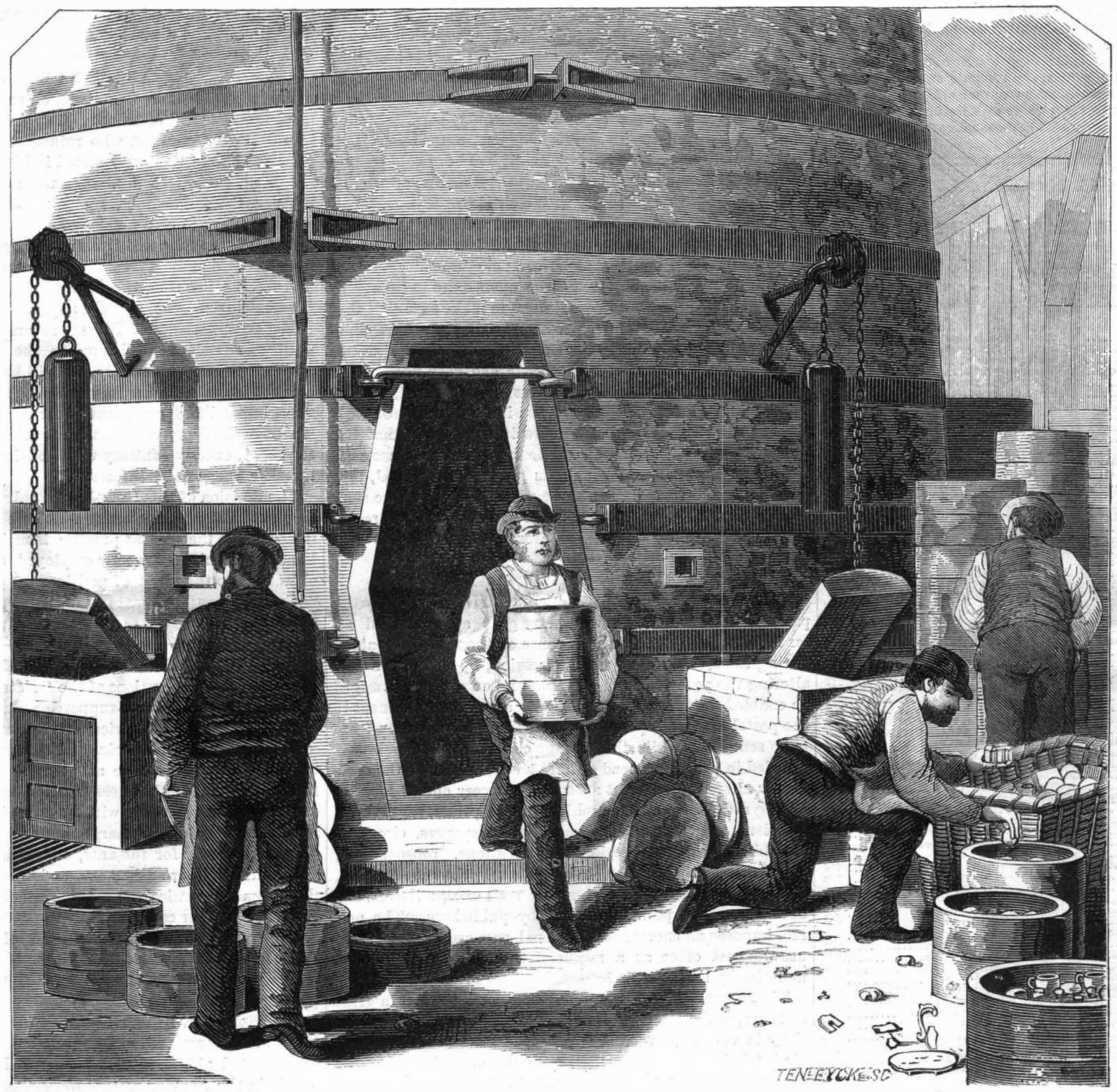

Fig 1.—THE EARTHENWARE KILNS.

The next operation is

GLAZING.

The glazing compound is made of precisely the same ingredients as the ware, only they are differently combined. There is more felspar added, so that the result is a complete

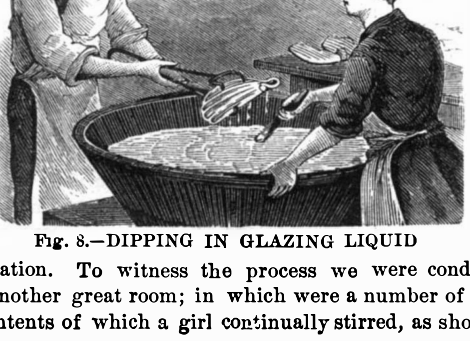

Fig. 8.—DIPPING IN GLAZING LIQUID

vitrification. To witness the process we were conducted into another great room; in which were a number of tubs, the contents of which a girl continually stirred, as shown in Fig. 8. The liquid was the glazing powder mixed into a thin cream with water. Into this the article to be prepared is quickly dipped. Being dry and porous, it speedily absorbs the moisture in the material deposited upon it, leaving the powder in an almost dry state, adhering to the surface. Thick pieces, such as knobs, have to be dipped in water first,

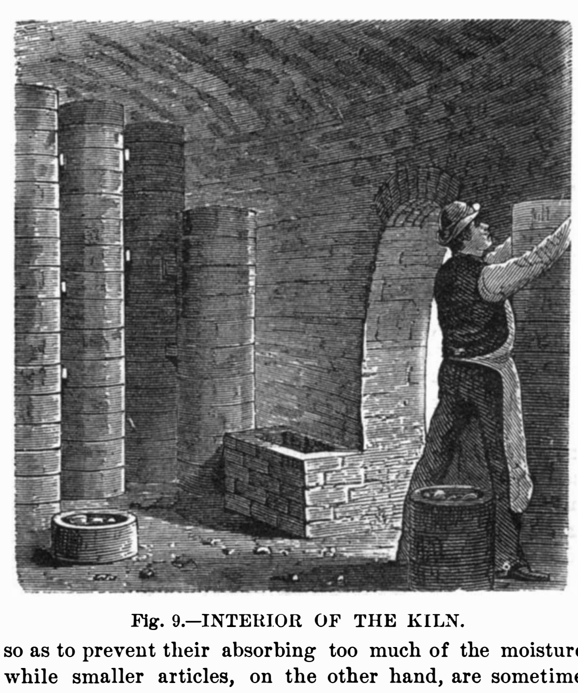

Fig. 9.—INTERIOR OF THE KILN.

so as to prevent their absorbing too much of the moisture, while smaller articles, on the other hand, are sometimes heated in order to force them to take up moisture enough.

We next found the articles being packed in seggars a second time, in order to undergo the intense heat of the gloss oven or

SECOND BAKING.

For this purpose the lower story of the kiln is employed, and the heat generated is far more than sufficient to melt iron. The seggars and their contents glow with an intense white radiance, and this continues until vitrification ensues. It is at this point that great skill is required in managing the fires, for, as our guide explained, "the art is to get up vitrification and yet have the ware stand up in the kiln." In other words, the fires must be checked at a point a little beyond that at which the glaze vitrifies, and just before the articles themselves run and melt.

Our artist has chosen the operation of removing the finished ware from the gloss oven as the subject of the large illustration, and in a smaller engraving (Fig. 9) he shows the interior of the kiln, with the seggars arranged in piles. The open shoots (on each side of the kiln in the large engraving), with the heavy covers, are furnace doors; and just beside the entrance to the kiln will be seen the glass-stoppered holes through which the process of baking is watched.

The porcelain is now finished, and nothing remains but to sort it over for imperfect pieces, which are consigned to the grinding mill to be pulverized and made over. In case the ware is to be ornamented with colors and gilding, still another manipulation is necessary. The

DECORATION

is done by hand. The colors used are formed by the combination of certain metallic oxides and salts, with certain fluxes, which enables them to fuse into colored glasses. The oxides are usually those of chromium, iron, uranium, manganese, zinc, cobalt, antimony, etc. The salts and other bodies are ground up with fatty turpentine, and painted on in the ordinary manner. It is not until the heat of the furnace has driven off the oil and chemically combined the ingredients of the colors that the effect can be judged of, for the hues at first are dingy and unpleasant, and

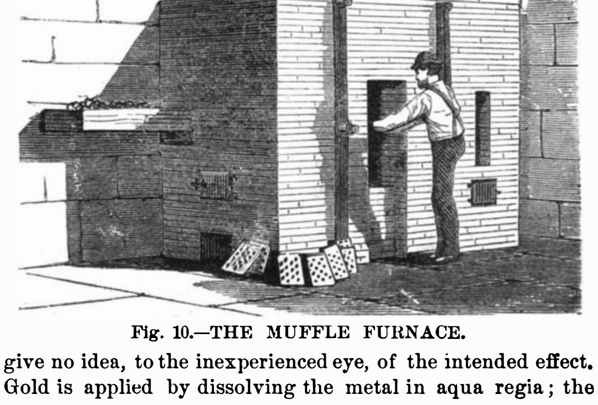

Fig. 10.—THE MUFFLE FURNACE.

give no idea, to the inexperienced eye, of the intended effect. Gold is applied by dissolving the metal in aqua regia; the acid is driven off by heat, when the gold remains in a state of minute division. After the ware is ornamented, it is inclosed in a muffle furnace, shown in Fig. 10. This consists of an inner box of fire brick, which is so arranged as to be completely surrounded by the products of combustion. After the colors are developed the articles are removed, and hand-burnishing of the metallic portions completes the manufacture.

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VOLUME XXXII., No 13. [NEW SERIES.] *Thirtieth Year.*

NEW YORK, SATURDAY, MARCH 27, 1875.

Contents.

(Illustrated articles are marked with an asterisk.)

FROZEN PIPES AND HYDRANTS.

This year the winter has been really one of the kind that are only equaled in the memory of the oldest inhabitants. In some places not far from New York, we hear of the water in mains being frozen, where it was supposed that the pipes were deeper in the ground than the frost ever penetrates. As for house connections and hydrants, they gave out soon after the commencement of the cold snap. As we explained recently, the house connections were in many cases unduly exposed by the carelessness of the plumbers who did the work. But there were numerous instances in which the water froze in connections that were laid on the level of the main. It did not need an occurrence of this kind to prove that there are a great many plumbers who have no consciences, for we see in the daily papers numerous remarks in regard to their outrageous charges, at all seasons of the year. But the manner in which they ordinarily proceeded to thaw out a frozen pipe seems to cap the climax, in regard to making repairs in the most expensive manner possible. As a general rule, when the water in a house connection was frozen, the plumber would lay a portion of the pipe bare, and light a fire around it, consuming from one to three cords of wood, and keeping several men employed for from twelve to thirty-six hours, or even longer. In this manner he would manage to run up nice little bills of thirty, fifty, one hundred dollars, and more, if we can credit the statement of victims, published in the daily papers. In some extended tours of observation throughout the city, we have seen but two or three boilers in use, furnishing steam to thaw out the pipes. It is such a simple means of clearing a pipe, and the boiler required can be constructed so cheaply, that we were surprised not to find them generally employed. As a result of a good deal of inquiry, however, we infer that the plumber reasons somewhat in this manner: "It will cost me thirty or forty dollars, or perhaps a little more, to make a steamer; and if I use it, I can clear a pipe in two or three hours. But if I keep on in the good old way, and build a wood fire around the pipe, I will incur no expense at starting, and will be a day or two about the job." We shall be greatly mistaken if some enterprising individuals do not draw a useful moral from these facts, or if, by another winter, the charges for this class of plumber's work at least will be properly regulated. While the house connections were becoming frozen, the street hydrants were following suit; and we see by the papers that in some cases they were frozen so hard that fires made great headway before they could be brought into service. We have been edified, in New York, by disputes between two departments, as to whose duty it was to thaw out the hydrants; but we have not seen much stress laid upon the fact that it is somebody's duty to prevent the hydrants from freezing up. In fact, we find a good many people who seem to think it is the correct thing for ice to form in a hydrant in cold weather, so that it cannot be used until the ice is melted. On the contrary, however, if a hydrant is properly constructed and cared for, no ice will ever form in it until the main with which it is connected becomes frozen. We could give a number of reasons in support of this assertion, but a practical proof will no doubt be more satisfactory to our readers. On the occasion of a recent visit to Poughkeepsie, in this State, we were very courteously shown around the water works by Mr. Davis, the superintendent. This gentleman informed us that, though it had been cold enough to form ice in one or two instances in the mains, all the hydrants had been serviceable, with a single exception. This single hydrant, which was frozen up, well illustrates the value of system. The hydrants are all inspected every day to see whether or not they are frozen; and immediately after a fire, the hydrants that have been opened are examined by an employee of the water department, to make sure that they are properly drained and closed. After one fire, the chief engineer of the fire department reported that three hydrants had been opened, while, in fact, four had been used. As a consequence, the fourth hydrant was not examined, and ice formed in it during the night; but it was discovered early the next day and thawed out. Now it seems to us that this demonstrates that hydrants can be kept ready for use even in very cold weather, although, as generally managed, they are very apt to freeze. It may be added that there are some forms of hydrants that should never be employed in a region where pipes are liable to become frozen up.

INCREASE OF POSTAL CHARGES.

The same Congress which rendered itself infamous by the passage of the well known salary grab again looked after its own interests, at the expense of those of the public, during the last hours of the late session, by enacting a law altering the postal rates in order that its own speeches might be enabled to cumber the mails. By a recent amendment to the postal law, the speeches of members and other stuff are to be sent free, while the postage charged to the public is doubled in price. Instead of half a cent an ounce, the scale is now altered to one cent an ounce on every one of the following articles: Books, pamphlets, maps, prints, engravings, transient magazines, periodicals and newspapers, circulars, handbills, posters, occasional publications, prospectuses, book manuscripts, proof sheets, blanks, patterns, samples, and, in fact, all articles sent by mail except letters, and newspapers and periodicals sent by publishers. The new rate imposes an enormous additional expense on those who use the post office as a means of transmission for articles more bulky than simple letters.

That this additional tax upon the people is due, in large measure, to the lobbying influence of the express companies there is very little room for doubt. Cheap postal rates are obviously in opposition to their interests, and it is well known that a strong and constant pressure has been brought to bear on Congress in their behalf during the past session. The express charge for the smallest package sent from New York to San Francisco is 75 cents; the post office carries one weighing a pound for sixteen cents, and before the recent amendment did the same service for eight cents. In some cases, for packages of certain weight forwarded short distances, under the old law the mail rates were much below the express charges; under the new, the former are considerably higher

There is a large number of persons whom the measure will directly affect in a business point of view. Publishers of books, of pamphlets, in fact of all works other than periodicals, many of which are of great value to the community as disseminators of useful information, will find it necessary to reduce the weight of their packages one half, in order to mail them at the same price as formerly. From this follows a diminution of labor and a decreased consumption of paper and material, and thus other classes of the public are in turn affected. Mercantile houses selling by samples sent by mail, shippers of seeds and of manufactured productions readily inclosed in small packages, and like forwarders will, in many instances, find the doubled postal charge by no means an inconsiderable inroad into their profits, and it will necessitate on their part a reduction in the weight of the articles sent. The consequence of the above, so far as the postal revenue is concerned, is that it will remain stationary, and will not experience that gradual increase which has always been attendant upon the cheapest tariffs.

The measure generally affects the reading public. Three cents postage must now be paid on the SCIENTIFIC AMERICAN and other large papers, and eight cents on each magazine that formerly went for four, and so on. Besides, a rather anomalous state of affairs is caused when a person is charged three cents to send this paper across the river from New York to Brooklyn, and but two cents to forward it over the ocean to London.

The country has very little cause for gratitude to Senator Hamlin, of Maine, for pushing through this ill-advised law. Its prompt and early repeal is a measure which the next Congress will doubtless find is demanded by the people.

MODELS BY MAIL.

We recently advised our readers that, by the provisions of the new postal law, they were at liberty to send models and other matters through the mail, in packets weighing not more than four pounds, at the rate of eight cents a pound; and we dilated a little upon the excellence and great public convenience of this arrangement. But scarcely were our types printed before the salary-grabbing Congress made a change in the law, doubling the above rates for the public, while ordering their own speeches to be sent *free*. Looked at in one aspect, this is an outrage on the public; but it cannot be helped until the meeting of the new Congress in December. Meantime the public must endure the payment of the doubled rates, and all who propose to send models should bear it in mind. Sixteen cents a pound must now be paid.

A TRADE MARK REJECTION.

The Commissioner of Patents, on an appeal taken to him in person, has had occasion to set aside a decision of the Trade Mark Examiner, who refused registration to the applicant, because the latter stated in his papers that he had not used, *but intended to use*, the mark. The Examiner rejected the application, requiring that, before he would grant it, the applicant must strike out the word "intended" and insert "commenced," thus making the applicant say in his papers that he *had already commenced to use the mark.* As this was not true, the applicant declined so to state, so the case was rejected and the appeal taken.

The Commissioner of Patents reversed this decision, and at the same time administered to the Examiner a rebuke which, if has any sensibility, he will be likely to remember.

"The language of the statute is made so plain that it would seem impossible for any one to err therein. Yet this plain language the Examiner assumes to criticise as loose, and interprets it exactly contrary to the obvious meaning by an altogether unnecessary inference."

The decision of this Examiner is only one of the many examples of Patent Office errors which are not likely to be eliminated while the present practice is maintained. About one hundred examiners are now employed, chiefly in hunting up objections to the grant of petitions for patents. If they did not make large numbers of incorrect rejections, their occupation would, to a great extent, be gone.

PARTNERSHIPS OF ANTS AND PLANTS.

The curious observations of the "Naturalist in Nicaragua," in connection with the ant-supporting plants and plant-protecting ants of tropical America, have been described in these columns. In certain *acacias* and *cecropias*, it will be remembered, Mr. Belt found the ants serving as volunteer armies for the defence of the trees against invasion by insect or other enemies, resenting with bites and stings the slightest interference with their charge, while the plant in return provided habitations for the ants, and either special secretions and fruits for their sustenance, or juices for the support of their domestic cattle: the relation between the two being so close that neither could thrive without the other.

It appears from the investigations of Mr. Britten, of the Botanical Department of the British Museum, that this remarkable sort of partnership is not so rare as has been supposed. His attention being called to the matter by Mr. Belt's observations, Mr. Britten has gone over the books and material at his command, and collected the scattered notices of ant-tenanted plants, a *resumé* of which he gives in a long article in the *Popular Science Review*, mentioning the following orders and genera as affording known examples, and specifying the parts of the plants which the ants inhabit

Leguminosæ: Acacia, various species: thorns.

Melastomaceæ: Tococa, calophysa, mycrophysa, myrmidone, and *maieta*, various species: petioles and leaf bases.

Rubiaceæ: Myrmecodia and *hydrophytum:* tubers. *Remijia*, petioles.

Gentianaceæ: Tashia Guianensis: stems.

Boraginaceæ: Cordia nodosa: base of petioles.

Verbenaceæ: Clerodendron: internodes.

Polygonaceæ: Triplaris, various species: trunks and branches

Artocarpaceæ: Cecropia peltata: trunks and branches.

Orchidaceæ: Schomburgkia tibicinis: pseudo bulbs.

One of the most striking instances of this sort is afforded by *myrmecodia tuberosa*, to the very existence of which it is essential that the tuber should be tenanted by ants. It was discovered by Rumpf, in Amboy, something over a hundred years ago; but he was uncertain whether the whole was a vegetable or whether the tuber was an ant's nest from which the plant sprung. It presents the form of a large, irregular tuber, from which spring a few thick, fleshy leaves crowded together at the summit. Dr. Beccari, who has lately collected the plant in Borneo, has watched the development of the tube throughout all its stages. The seed is surrounded by a viscid pulp, resembling that of the mistletoe, and readily attaches itself to the branches of trees on which it falls. It is probable that birds aid also in its distribution. The seed soon germinates under favorable conditions and unfolds its cotyledons; the stem develops slightly, then stops until a particular species of ant burrows a small lateral cavity at its base. The wound determines a great development of cellular tissue, as the sting of the cynips causes galls on the oak; and as the stem enlarges into a sort of tuber, the ants excavate galleries in all directions and establish therein their colony. The marvelous part of the matter is that, if the stem is not invaded by the ant, it fails to develop and the plant dies. The apparently abnormal tuber appears to be essential to the growth and maturity of the plant; and the ants—a small, red, and very fierce variety—aid in protecting the plant by making it unpleasant for anything which happens to disturb their dwelling.

The genus *myrmecodia* was formerly regarded as exclusively Malayan; but it is now known to be represented in Java and also in Australia. Five specimens of an Australian species are now growing at Kew Garden.

They have a slaty-gray color and greatly resemble wasps' nests. The galleries with which the tubers are intersected are lined by the ants with a thin papery material. Whether colonies of ants were imported with the plants, Mr. Britten does not say. The allied genus *hydrophytum* has a similar structure, and the best known species, *h. formicarium*, is tenanted by ants. There are three or four other species known, natives of Tropical Australia, the Fiji Islands, and the Indian Archipelago.

The next occurrence of the sort was observed by Aublet, and described in 1775, in his account of the plants of French Guiana. Aublet mentions two species of *triplaris* as inhabited by ants which acutely tormented him when he interfered with the trees in which they had taken up their residence. More recently Weddell, describing these trees, the trunk branches and even the smallest twigs of which are hollow and tenanted, says that, if one happens to touch the trunk of a *triplaris* accidentally, especially if it be shaken, the ants rush out by hundreds from the interior through the small canals by which the medullary canal communicates with the exterior; and if escape is not made quickly, the intruder is covered with dangerous guests, the bite of which is exceedingly painful. The Indians of Guiana call the *triplaris* the "ant tree," the tree being occupied by ants in every stage of its development. Weddell has found the tree, and suffered from the attacks of the ants, a clear brown variety, in many parts of Brazil, in Bolivia, and in Peru.

In the work already mentioned, Aublet describes also a shrub of the genus *tachia*, the stems of which, like those of the *cecropia* described by Belt, furnish bed and board for species of ants. The Galpis call it *tachia*, which in their language signifies "ant's nest."

The bases and petioles of the upper leaves of certain South American species of the genus *cordia* are similarly tenanted, so likewise are the leaves of a number of closely allied genera of *melastomaceæ*, all natives of South America. In these it is usually the petiole which has developed a form adapting it as a residence for ants. The following description, which Aublet gives of the mode of growth in the *tococa Guianiensis* will apply with slight modifications to all the other genera: The leaves are attached to the stems by a small hairy petiole, hollowed out into a groove on its upper surface and convex below. The two sides of the petiole swell out so as to form a double heart shaped bladder, corresponding with which are two holes on the under side of the base of the leaf, between the two intermediate nerves. Through these holes the ants have access to the divisions of the heart-shaped bladder. The stems, which are hollow, are entered by different openings. Mr. Belt describes a similar arrangement which he observed in an allied plant in Northern Brazil. A Mr. Trail, who is at present investigating this subject in Central America, writes to Dr. Hooker from Santarem, that at least three species of ants inhabit a melastomaceous plant of that region: he believes it to be *myrmodona formicaria*.

The manner in which the *acacia* known as the bull's horn thorn is tenanted and defended by ants in Nicaragua, as observed by Mr. Belt, was described in the SCIENTIFIC AMERICAN last summer.

In Honduras an orchid affords an equally satisfactory residence for ants. The hollow pseudobulbs have a small hole at their base through which the ants enter; and so thoroughly do they take possession that Mr. Skinner, who discovered the plant, was almost prevented from collecting specimens by the stings of the swarms which rushed out upon him when he touched the plant. The orchidaceous plant referred to by Mr. Bates, "The Naturalist on the Amazons," in describing the formicarium of the Brazilian *crematogaster limatus*, was probably a relative of the one described by Mr. Skinner.

Now that attention has been called to the matter, it is quite likely that other partnerships of the sort will be discovered. Indeed Mr. Britten mentions several plants, specimens of which give evidence of such occupation. They are all South American species: a rubesaceous plant no referred to *Remijia*; and two species of *hyptis*—*h. Salzmanni* and *h. calophylla*—which almost invariably present hollow swellings suitable for formicaria

MOLECULAR CHANGES IN METALS.

BY PROFESSOR R. H. THURSTON.

In a series of articles contributed to the SCIENTIFIC AMERICAN during the past year, the writer gave an outline of the various phenomena affecting the strength of metals used in construction, and described some that were peculiar in character and but recently discovered, illustrating these facts by graphic representions of the changes of resistance with change of form, such as were obtained by the automatic action of the autographic testing machine of the Mechanical Laboratory of the Stevens Institute of Technology. There are some phenomena which cannot be conveniently exhibited by strain diagrams; such are the molecular changes which occupy long periods of time. These phenomena, which consist in alterations of chemical constitution and molecular changes of structure, are not less important to the mechanic and the engineer than those already described. Requiring, usually, a considerable period of time for their production, they rarely attract attention, and it is only when the metal is finally inspected, after accidental or intentionally produced fracture, that these effects become observable.

The first change to be referred to is that gradual and imperceptible one which, occupying months and years, and under the ordinary influence of the weather, going on slowly but surely, results finally in important modification of the proportions of the chemical elements present, and in a consequent equally considerable change of the mechanical properties of the metal. The process of oxidation, or corrosion, is such a process, and is the most familiar one. Cast and wrought iron are both subject to it, the latter to, by far, the most serious extent. Cast iron is comparatively little affected by oxidation, even where exposed in wet situations or to alternate moisture and dryness. Wrought iron, under ordinary conditions of exposure, is said to become rusted to the depth of a sixteenth of an inch in a quarter of a century. In exceptionally trying situations, it corrodes far more rapidly. Steam boilers are sometimes rusted through, about the water legs, at the rate of a sixteenth of an inch a year, and instances have been known of even more rapid work that this. Exposure, however, while producing oxidation, has another important effect: It sometimes produces an actual improvement in the character of the metal.

Every mechanic knows that old tools, which have been laid aside or lost for a long time, seem to have acquired exceptional excellence of quality. Razors which have lost their keenness and their temper recover, like mankind, when given time and opportunity to recuperate. A spring regains its tension when allowed to rest. Farmers leave their scythes exposed to the weather, sometimes, from one season to another, and find their quality improved by it. Boiler makers frequently search old boilers carefully, when reopened for repairs after a long period of service, to find any tools that may have been left in them when last repaired; and if any are found, they are almost invariably of unusually fine quality. The writer, when a boy in the shop, frequently, if denied the use of their tools by the workmen, looked about the scrap heaps and under the windows for tools purposely or carelessly dropped by the men; and whenever one was found badly rusted by long exposure, it proved to be the best of steel. One of the most striking illustrations of this improvements of the quality of wrought iron with time has recently come to the knowledge of the writer. The first wrought iron T rails ever made were designed by Robert L. Stevens about the year 1830, and were soon afterward laid down on the Camden and Amboy Railroad. These were Welsh rails, and, when put down, were considered, and actually were, brittle and poor iron. Many years later, these were replaced by new rails, but until quite recently some still remained on sidings. When a lot of unusually good iron was wanted, some of these rails were taken up and re-rolled into bar iron. The long period of exposure had so greatly changed the character of the metal that the effect was unmistakable. These facts are stated by gentlemen upon whom perfect reliance may be placed.

"But," it will be asked at once, "how can such changes occur without apparent cause, however long the time?" There are probably two methods of improvement, each due to an independent molecular action. In the case of the razor and the spring, which regain their tempers when permitted to rest, it seems probable that a molecular rearrangement of particles, disturbed by change of temperature in one case and by alternate flexing and relaxing in the other, goes on, much as the elevation of the elastic limit and the increase of resisting power, discovered by the writer and shown on the strain diagram, takes place under strain and set. The other cases may probably be due to a combination of this physical change with another purely chemical action, which is illustrated best in the manufacture of steel by the cementation process. In this process, iron, imbedded in charcoal and kept at red heat, gradually absorbes carbon and becomes steel. Here the element carbon enters the solid masses of iron, and diffuses itself with greater or less uniformity throughout their volume. There seems to exist a tendency to uniform distribution which is also seen in a thousand other chemical changes. Many chemical processes are accelerated, checked, and even reversed by simple changes of relative proportions of elements, which compel acceleration or reversal as the only means of securing this uniformity of distribution.

When, therefore, wrought iron, containing injurious elements capable of oxidation, is exposed to the weather, the surface may be relieved by the combination of these elements with oxygen, and the surcharged interior, by this tendency to uniform diffusion, is relieved by the flow of a portion to the surface, there to be oxidized and removed. This process of flow goes on until the metal, after lapse of years perhaps, becomes comparatively pure. Meantime the occurrence of jarring and tremor, such as rails are subjected to, may accelerate both this and the previously described change.

The effect of strains frequently applied, during long intervals of time, is quite different, however, where they are so great as to exceed the elastic range of the material. The effect of stresses which strain the metal beyond the elastic limit has already been referred to in the SCIENTIFIC AMERICAN. The case of the porter bar (of which a sketch was given, showing how, after a long period of severe usage, it finally broke suddenly, exhibiting the peculiar fracture characteristic of such a method of rupture) will probably be remembered by many readers. A still more marked case has recently come to the notice of the writer

The great testing machine at the Washington Navy Yard has a capacity of about 300 tuns, and has been in use 35 years. Quite recently, Commander Beardslee, whose valuable work has been alluded to in this paper, subjected it to a stress of 288,000 lbs., but it subsequently broke down under about 100 tuns. The connecting bar which gave away had a diameter of five inches, and should have originally had a strength of about 1,000,000 lbs. Examining it after rupture, the fractured section was found to exhibit strata of varying thickness, each having a characteristic form of break. Some were quite granular in appearance, but the larger proportion were distinctly crystalline. Some of these crystals are large and well defined. The laminæ, or strata, preserve their characteristic peculiarities, whether of granulation or of crystallization, lying parallel to their axis and extending from the point of original fracture to a section about a foot distant, where the bar was broken a second time (and purposely) under a steam hammer. It thus differs from the granular structure which distiguishes the surfaces of a fracture suddenly produced by a single shock, and which is so generally confounded with real crystallization. This remarkable specimen has been contributed by the Navy Department to the cabinets of the Stevens Institute of Technology.

The somewhat similar instance of the dropping-off of the end of an immense shaft at the Morgan Iron Works, sometime since, while the opposite end was under the steam hammer, has been described in the SCIENTIFIC AMERICAN.

Were more conclusive evidence required of the occurrence of crystallization of iron, it has recently been given by an interesting incident at the Stevens Institute of Technology. A pupil, while annealing a number of steel hammer heads,

Fig. 1.

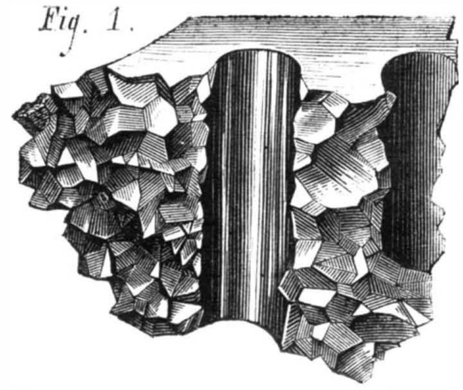
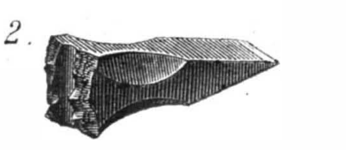


Fig. 2.



left them exposed all night to the high temperature of the air furnace in the brass foundery; when finishing one of them, a careless blow broke it, and the fractured surface was found to possess a distinctly crystalline character. In this example, however, the faces were all pentagonal, and were usually very perfectly formed. These illustrations are conclusive of the question whether iron may crystallize under the action of long continued and severe shocks, or of high temperature. When imperfect crystals are developed, it is easy to mistake them, but the formation of pentagonal dodecahedra, in large numbers and in perfectly accurate forms, may be considered unmistakable evidence of the fact that iron may crystallize in the cubic, or a modified, system. This may apparently take place either by very long-continued jarring of the particles beyond their elastic limits, or under the action of high temperature, by either mechanical or physical tremor. But no evidence is given here that a single suddenly applied force, producing fracture, may cause such a systematic and complete rearrangement of molecules. The granular fracture produced by sudden breaking, and the crystalline structure produced as above during long periods of time, are, apparently, as distinct in nature as they are in their causes. The broken hammer head is so beautiful and perfect an illustration, and such instances are so rare, that it has been drawn and engraved by the accomplished gentlemen attached to the SCIENTIFIC AMERICAN, and appears in this article as the first illustration of the kind which has appeared in the literature of engineering.

STEVENS INSTITUTE OF TECHNOLOGY, HOBOKEN, N. J.

Bacteria and Putrefaction.

Dr. Arnold Hiller, of Berlin, has made a series of elaborate experiments with the view of determining the relations of bacteria to putrefactive changes, and has come to the conclusion that the whole subject needs to be re-examined from the beginning. He has demonstrated that active putrefaction may take place in the absence of bacteria, and that bacteria may be present in abundance without giving rise to putrefaction. In short it seems quite possible that effect may have been mistaken for cause.

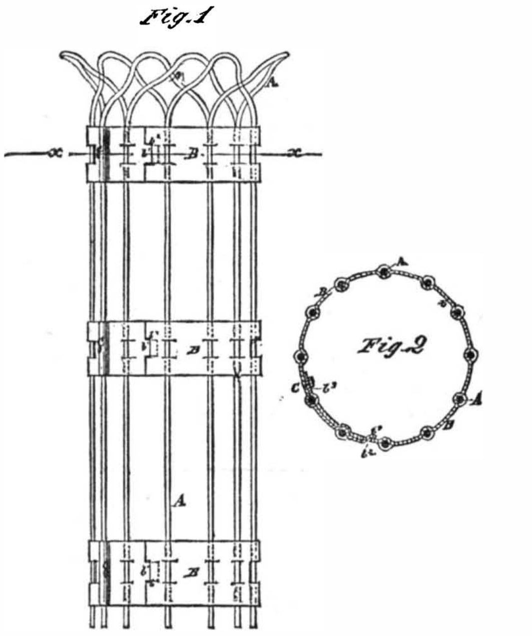
THE managers of the International Centennial Exhibition will promote the interests of the enterprise by establishing an agency in New York, and announcing the fact through the newspapers. A number of persons call at the office of this paper every day for information which we are unable to give.

A ONE track prismoidal railway is to be in operation by July 5, 1875, from Sonoma, Cal., to deep water in Sonoma creek, thus making communication by rail and water with San Francisco.

IMPROVED TREE PROTECTOR.

We publish an engraving of a tree protector which is intended by its inventor to furnish an efficient guard to the trunks of trees, and which is also easily placed, removed, and packed for storage and transportation. It is constructed of U-shaped wires, A, and straps of light sheet metal, B; the number of each depends on the required hight of the protector. In the straps, B, at a suitable distance apart, are cut pairs of short parallel slits. The metal between the slits is bent outward to form a half round transverse groove, and inward to form a half round transverse groove. In this way are formed sockets to receive the wires, A. The arms of the loops or bends of the wires, A, overlap or interweave with each other. Upon the end of each strap, B, is formed a small tongue, b^1, which fits into a short transverse slot, b^2,

Fig. 1

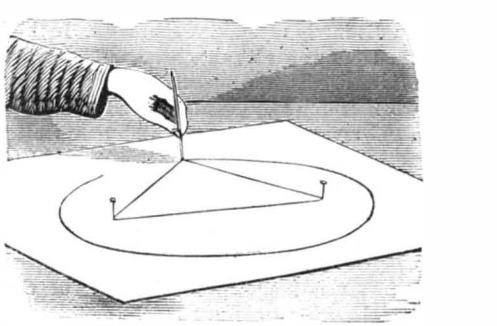


formed in said straps, B, near their other ends, as shown in Figs. 1 and 2. In the straps, B, at their square ends, and at a little distance from their tongued ends, are formed holes, b^3, Fig. 2, in such positions as to coincide with each other when the ends are overlapped, to receive a short bolt, C, which is secured in place by a nut screwed upon it. The outer arm of the last wire loop at each end of the straps, B, overlaps the last arm of the loop at the other ends of the straps.

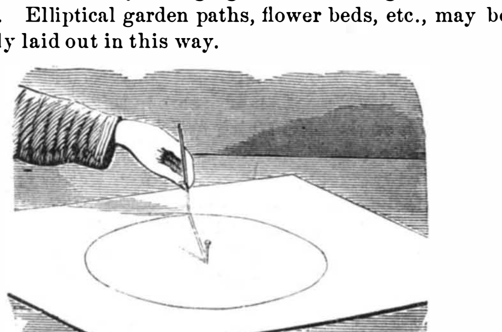
Patented April 7, 1874, through the Scientific American Patent Agency. For further particulars address Mr. Dwight Hitchcock, 34 Greene street, New York city.

TO MAKE OVALS AND CIRCLES OF ANY SIZE.

The following methods will be found convenient, in the absence of dividers or other instruments:



To make an oval, tie together the ends of a thread or string. Two pins arranged within the loop, as shown, govern the size of the oval, which is marked upon the paper by means of a pencil, carried against one side of the loop as indicated. The dimensions of the oval may be made larger or smaller, as desired, by enlarging or diminishing the size of the loop. Elliptical garden paths, flower beds, etc., may be accurately laid out in this way.



To describe a circle, attach one end of the cord to the center pin, and place the pencil in a loop at the other end. Then sweep the pencil around.

These methods are useful for cutting out picture ovals, patterns, and other purposes.

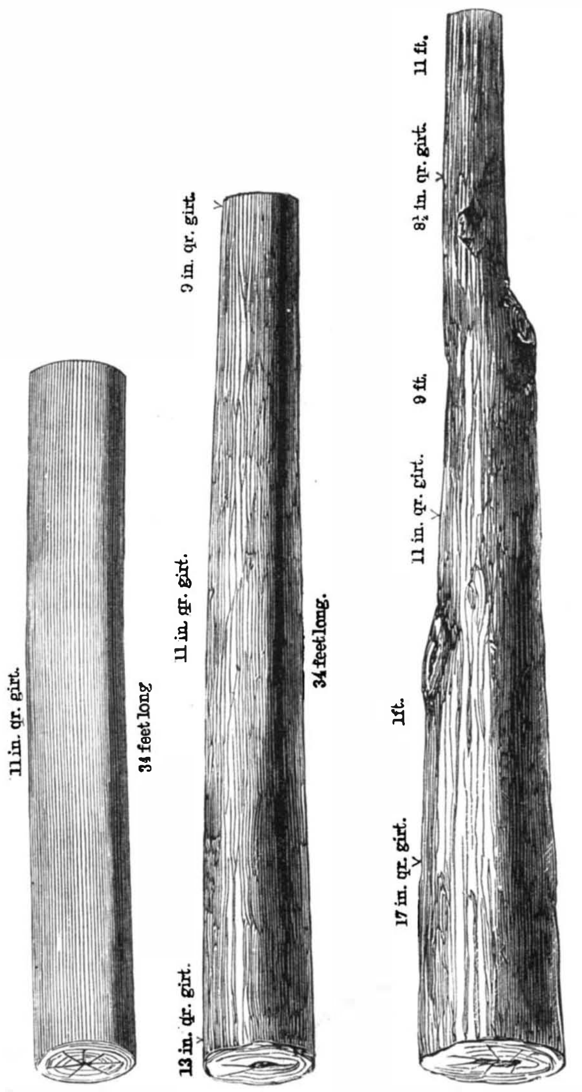
England and the United States, according to the latest statistics, are the largest sugar-consuming countries in the world. In 1874 England consumed 830,000 tuns, or about 57·2 lbs. per head of population. The United States in the same period used 770,000 tuns, or 44 lbs. per individual.

To prevent hard soap, prepared with soda, from crumbling he bars may be dipped in a mixture of resin soap, beef tallow, and wax

MEASURING BUILDING MATERIALS.

Mr. Richard Horton publishes, in a recent work entitled "The Complete Measurer," the following practical application of his method of ascertaining the solid contents of a tree or similar body:

"Measure its length in feet by a rod, tape, or carpenter's rule, and then take its circumference in the middle with a piece of common whipcord, doubling the cord into four equal parts, and so apply it to the carpenter's rule, to learn the quarter girt in inches, with any fractional quarter or



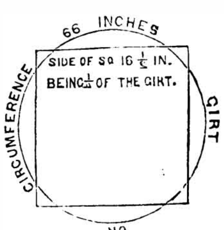
No 1 No 2 No 3

quarters of an inch that there may be. Or the circumference of the tree may be taken with a narrow, non-elastic painted tape, having spaces of four inches marked upon it, each space being numbered in successive rotation as girting inches, and every such space subdivided into four equal parts by a partial mark on the tape, to answer as quarters of inches. A purchaser will prefer using the whipcord, unless at the commencement of the tape three quarters of an inch is given in the measurement as an equivalent to him for the accustomed advantage obtained by the doubling of the whipcord to apply to the carpenter's rule to find the quarter girt of the tree. The tape, when passed round the tree, shows its quarter girt forthwith. These directions for taking the dimensions of a tree or pillar are under the consideration of its size being the same throughout, as instanced by the diagram No. 1; or of the tree or column tapering regularly from one end to the other, after the manner of the diagram No. 2. But when the size of a tree is not regular its whole length, in consequence of sudden variations in its circumference, each part or length of it so varying in girt must be measured separately, in conformity with the subjoined diagram, No. 3, and then the contents of the different parts added together. Having obtained the length and the quarter girt as directed, we refer to the top of the table for such quarter girt; and beneath it, opposite to the length of the tree found in the outward columns of the page, is shown the solid contents of the tree, or portion of the tree, as it may be.

Length. Feet.	Quarter girt. Inches.	Solidity. Feet.
14	17	35½
9	11	9½
11	8½	7
		52

Any part of a timber tree not girting 24 inches (that is 6 inches in quarter girt) is not usually considered timber, and is excluded from the measurement, unless by agreement to the contrary.

The annexed diagram of the transverse section of a tree, with its demonstration, is intended to exemplify the principle upon which the round timber table is compiled, and to represent how to acquire the true quantity of any round body,



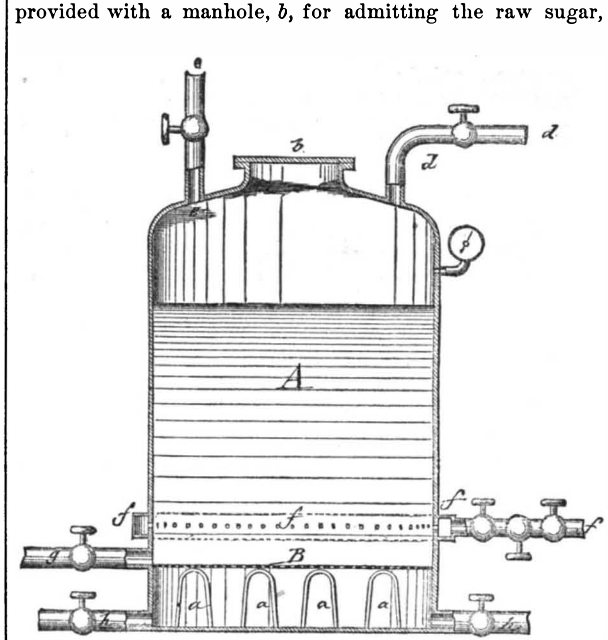
be its size what it may, as also to clearly show the construction of the square-sided timber table which Hoppus erroneously adopts for round timber."

Every stone for grinding tools should be provided with a rest, and apprentices should be taught how to use it.

IMPROVED SUGAR-REFINING TANK.

We illustrate herewith a new process for refining sugar, in which the raw product is, when suitably moistened, subjected to the action of air at a high pressure, so that the air is forced into and percolates through the granules, effecting the bleaching and purifying the sugar before it is dissolved. A subsequent part of the process consists in admitting steam and water into the vessel or tank, to complete the purification.

In the engraving, A is the tank, constructed (together with its false bottom or horizontal partition) of such strength and material that a pressure of about 65 lbs. to the square inch may be exerted thereon. The false bottom, B, is perforated and provided with sieves, being placed at suitable hight above the bottom of the tank, A, and stiffened by additional braces, *a*. The top part or side of tank, A, or both, may be provided with a manhole, *b*, for admitting the raw sugar,



the top of the tank being connected with the air-forcing pump by a pipe, *d*, at one side. A water pipe, *e*, of the top furnishes the water required in the treatment of the sugar. The tank is provided with a steam pipe, *f*, which surrounds the tank and admits the steam. An exit pipe and stopcock, *g*, below the steam pipe, *f*, admit the drawing-off of the solution of sugar, while pipes, *h*, serve as outlet pipes for the molasses or sirup. The degree of pressure is indicated on a manometer placed at a suitable point of the tank.

The raw sugar is filled into the tank and moistened, and a better quality of raw sugar, suitably moistened, placed on the top. The manhole and pipes are then closed, with the exception of one at the bottom below the sieves, and that connected with the force pump. The air-forcing pump is now set in operation, and the sugar exposed gradually to pressure.

The same tank is then made use of for the purpose of dissolving the sugar by admitting water and steam at the same time through the water pipe, *e*, and steam pipe, *f*.

When the purging of the sugar is complete, the air-forcing pump is continued in operation and dry cold or heated air forced through between the granules of the sugar, drying the same rapidly and carrying the evaporated moisture in similar manner as the sirup, through the lowermost outlet pipes.

Patented June 23, 1874, through the Scientific American Patent Agency. For further particulars, address the inventor, A. H. W. Schrader, Hoboken, N. J.

Agricultural Work for March.

The proper preparation of the ground, care of hotbeds, and sowing of hardy seeds will now occupy the gardener. Seeds of asparagus may be sown as soon as the ground can be worked, in drills a foot apart, and plants from seed sown last year may be set out. Put in rich soil in rows three to four feet wide, and a foot apart in the rows. Old beds ought to have a good dressing of rich manure. Sow beets, carrots, parsnips, and salsify early, in drills of fifteen or sixteen inches, and thin out as soon as they can be handled. Cabbage and cauliflowers from hotbeds, or wintered over, may be set out as soon as the ground is fit. Give them a good location, and keep them thoroughly worked. Sow celery as early as possible, and keep clean of weeds. Lettuce may be set out and seed sown for succession. As soon as the ground is tillable, onion sets may be planted and seeds sown thickly for sets for next spring's planting. They need a rich soil. Sow parsley seed in drills a foot apart, and keep clean. If the seed are soaked in warm water they germinate sooner. As soon as the ground can be worked, peas should be sown: make the drills pretty deep, cover with earth, and on top of this put fine manure. Put brush to them early. Potatoes for early use should be put in as soon as possible. Spinach may be sown now, and that sown last fall ought to be cultivated. Turnips may be sown as soon as the frost is out.

Hotbeds should be in order for sowing egg plants, tomatoes, and peppers to be set out in May. Melons, squashes, and cucumbers may also be started in them, a good way being to reverse pieces of sod and plant the seeds on them, as they are then easily moved, and, adds the *American Farmer*, have your seeds and tools all ready for the work now at hand.

A little camphene dropped between the neck and stopper of a glass bottle will render the latter easily removed if jammed fast.

GATHERING AND STORING ICE.

Our engravings illustrate the most recent improvements in the methods and tools employed for gathering and storing ice. They are selected from the *Science Record* for 1875.

Fig. 1 is a general view from a winterscene on the Hudson river, one hundred miles above the city of New York. At various convenient points along the banks of the river are located immense storehouses, within which the ice is deposited, and kept for summer use. Fifty thousand or a hundred thousand tuns are frequently deposited in a single storehouse.

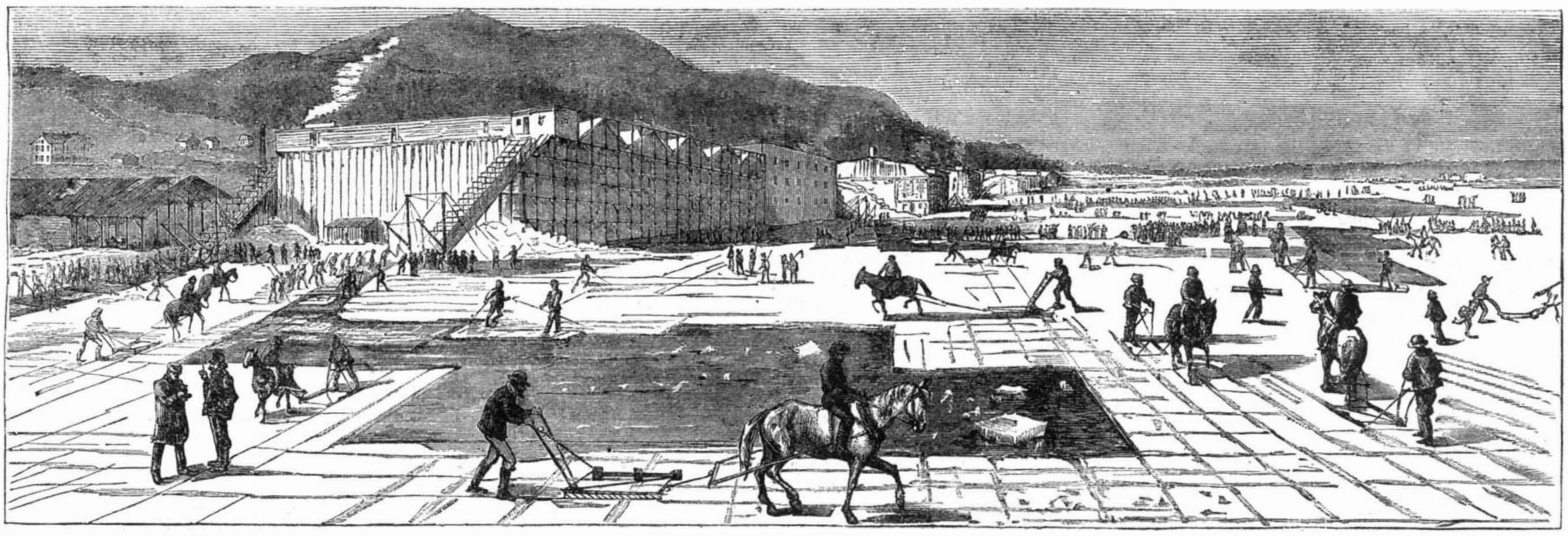


Fig. 1.—ICE GATHERING ON THE HUDSON RIVER, NEAR NEW YORK.

The storehouse buildings are composed of wood, with double walls, and are very rough-looking. In summer the ice is loaded into barges, towed down stream to New York, delivered therefrom directly into ice carts at the dock, and thence distributed to customers at the doors of their dwellings. Ice is thus ordinarily supplied in New York at a cost to the user of about one quarter of one cent up to one cent per pound, depending on the quantity taken and the relative abundance of the supply. An open winter yields a poor crop of ice, and the price during the ensuing summer is fixed at a higher figure.

In gathering ice, the work commences as soon as the ice reaches a thickness of nine inches. The plots of good ice (for the thickness and quality of the ice vary greatly at different points on the river) within convenient distance of the ice houses are staked out and marked with hemlock brush. Then, with ice plows, the men mark out the ice in suitable squares (36 by 22 inches), cutting the groove about an inch in depth (see Fig. 1). Following the markers, plowmen with plows of deeper blade sink the groove to a depth of three inches, and continue this operation until a sufficient depth is attained. Just enough ice is left to hold the blocks firmly together. The next operation is to separate a raft of the blocks (generally 112 in number) by taps of the heavy ice chisel. These rafts are towed by horses into a canal cut from the pond to the ice house, where the raft is secured by pikemen, and thrust toward the slope of the ice house. Before this is reached, men with tridents have broken the raft into single cakes, which, as they reach the slope, are guided to the cleats attached to endless chains, which, moved by steam power, carry a steady stream of ice to any desired gallery of the storehouse (see Fig. 2). From this point, the blocks glide swiftly down an incline until they reach the doorways, where bar men dexterously switch cake after cake into the slide which leads into the house. The work of stowing is quickly done, and the blocks are so arranged that a space of two or three inches between the cakes gives circulation of air and means of escape for the water from the melting ice. When the house is filled, loose hay is thrown over the top, and the house is closed.

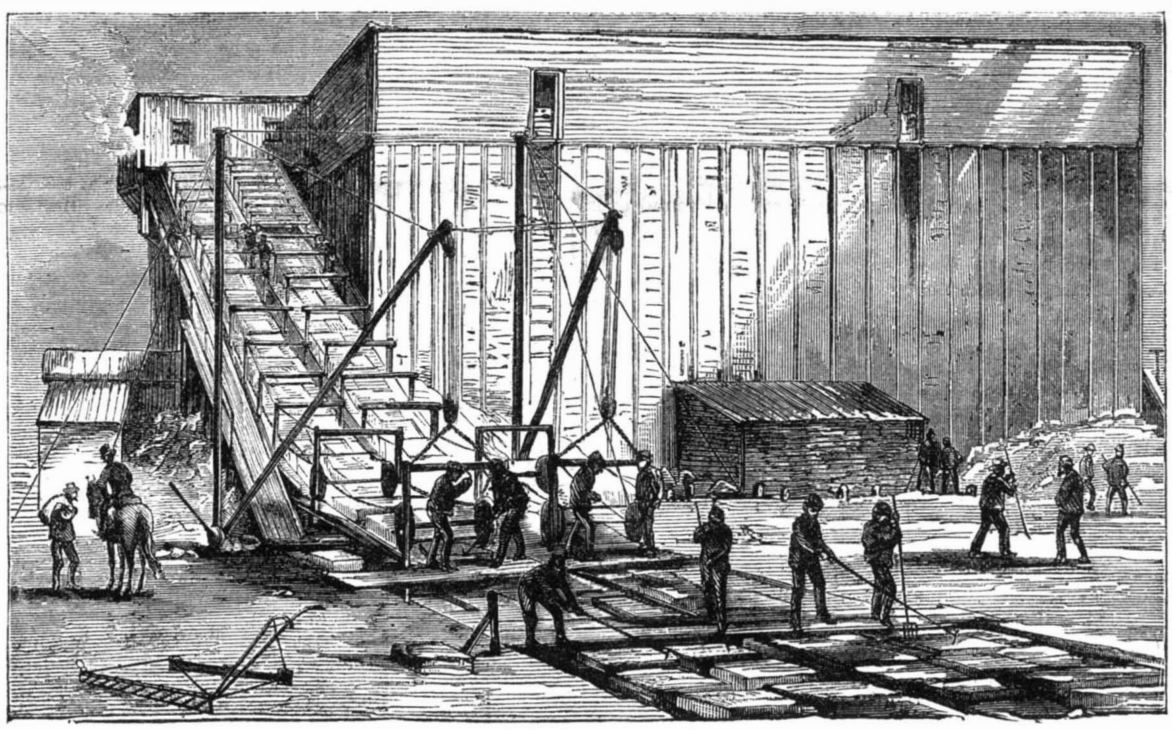


Fig. 2.—THE STEAM ICE ELEVATOR.

The form of the ice plows is shown in Figs. 1 and 2. One of the runners, which is smooth, rests on the ice and serves as a bearer; the other runner is provided with a series of teeth or shares, which cut a groove in the ice.

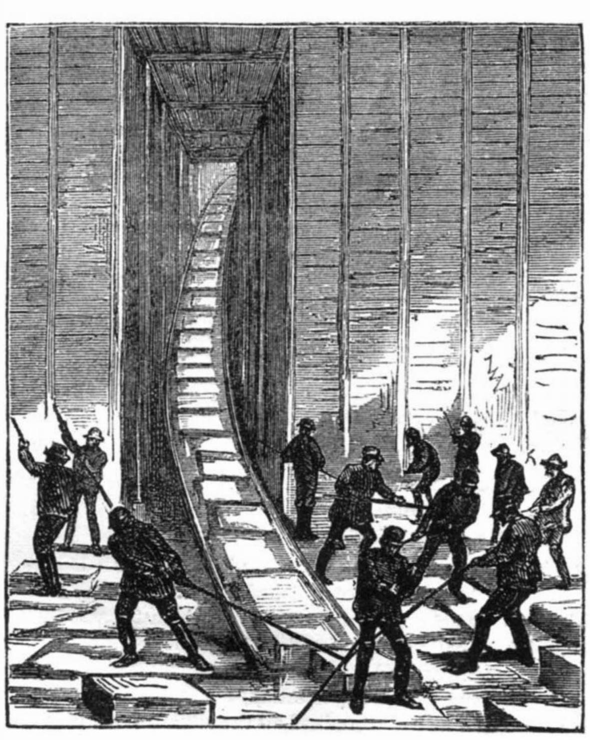


Fig. 3.—SMALL ICE ELEVATOR.

The New York Canals.

The State Engineer and Surveyor, in his annual report on the canals of New York, says that the navigable canals and feeders aggregate a length of about 907 miles, and, with the lakes and rivers artificially connected with them, make 1,393 miles of navigation. The total cost of these canals, including their equipment and extraordinary repairs, is given at $100,717,995.

It appears from the report that the improvement of the chief of these works—the Erie Canal—is not yet completed, either in width or depth, in accordance with the original plan. It is estimated that, for the expenditure of $379,000, a uniform depth of seven feet can be secured. The State Engineer expresses great confidence that the progress made in the use of steam, for towing purposes on the Erie Canal, will soon cause steam to supersede all other kinds of motive power.

Speed of Trains and Weight of Rolling Stock.

The current report of the Railroad Commissioners of Maine contains suggestions in regard to reducing the speed of trains and the weight of rolling stock on railways, to the end of diminishing the wear and tear of the latter and of the track. In a communication from Superintendent Sawyer, of the St. Croix and Penobscot Railroad, that officer writes: "With two engines in equally good repair, we ran one at a speed of 26 miles an hour, 42 miles daily, with a mail train, and at a speed of 14 miles an hour daily with a freight train: total, 84 miles daily until it had run 14,000 miles, when it became necessary to take it off for general repairs. The other ran 84 miles daily at a speed of 14 miles an hour, with a freight train, until it had run 21,000 miles before requiring general repairs, and was even then found in better condition than the one running at the higher rate of speed. Wood and oil were consumed nearly in the same proportion. It is fair to suppose, also, that the rails, sleepers, bridges, etc., suffered the same additional wear. It is my opinion that an increase of speed of 12 miles an hour, beyond 14 or 15 miles, will increase the cost of repairs at least 75 per cent.

"In relation to wheels, I think that, at a lower rate of speed, a 350 lbs. twenty-eight inch wheel is more than equal to a 500 lbs. 32 inch wheel at a high speed. A heavy axle will jar off at high speed before a light one will become unsafe with the same number of miles run at low speed. A 25 tun engine is of sufficient weight for general use. If additional power is required with a snow plow on heavy freights, rather increase the number of engines than the weight of them; there is less risk in moving snow with power and force than with momentum. As

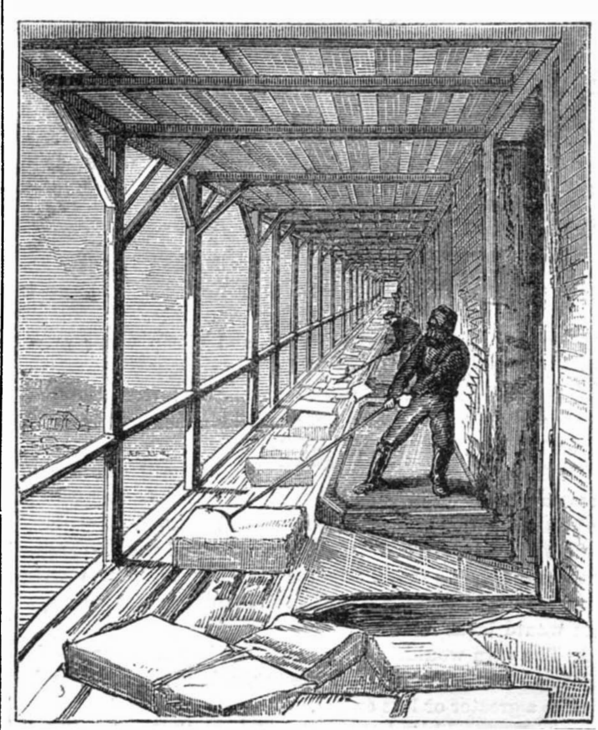


Fig. 4.—TRANSFERRING ICE FROM THE GALLERY TO THE STOREHOUSE.

to passenger cars, a fifty seat passenger car can, in my opinion, be run more economically than the ordinary car. The first cost is $1,000 less, the weight and wear on the rails are less, the cost of repairs is less, and it requires less power to move six fifty seat cars, there being a difference of 18 tuns in favor of the six light cars."

Correspondence.

A Fever Case.

To the Editor of the Scientific American:

In the coal regions of Pennsylvania is a town of five or six thousand inhabitants, situated in a valley so narrow that, for a considerable distance, only one street is possible. Down the valley runs a stream or creek which has a fall of about 200 feet to the mile. Sometimes the stream has a depth of 3 or 4 feet, at others only as many inches; it runs under the front and back yards and houses, and is used as a very convenient sewer to carry off filth of every description, to bless the inhabitants along the river where the current is not so rapid. This creek is generally covered with heavy hemlock plank, while in every yard is a door through which garbage may be emptied.

During last October, a citizen sent his teamster to dig some earth from the cellars of two of his stores; the earth was thrown into the street and then hauled some half or three quarters of a mile up town, and spread over a vacant lot adjoining some dwelling houses. The earth taken from the cellars had a pungent odor, and a peculiar watery, iridescent appearance. On the night following its removal from the cellar, the proprietor of the place, who had superintended and assisted at the digging, was taken with violent cramps, which lasted several hours, and then gave place to a dull, languid feeling, with pains like rheumatism and a discoloration of the skin, the hands and arms swelling and becoming quite purple. The next day the teamster was taken ill, and the doctor pronounced the symptoms to be those of typhoid fever. The day following a young man, working in one of the stores from the cellar of which the dirt was taken, was also taken violently ill, and the doctor pronounced the case to be similar to that of the teamster. Upon the same day a girl about 14 years old, living in the dwelling adjoining the lot where the dirt was thrown, was taken with the same symptoms, which developed into violent typhoid fever and culminated in death a few days later. There were soon more than a dozen cases of the fever, as it began to be called, and in two weeks the number reached upwards of 60. The symptoms generally were violent headache, pain in the back of the neck, and high fever, with loss of appetite and general languor. When the fever subsided, the tongue became coated with a thick coat of dark green matter, which remained until the patient was convalescent. The fever averaged, probably, in each case from 12 to 15 days, but was followed by extreme weakness, loss of memory, dimness of sight, etc., lasting from 3 to 6 weeks additional.

The majority of cases did not result in a radically typhoid condition, as I understand it, the bowels being seldom attacked. In every case where a patient took a relapse from exposing himself too soon, the result was fatal, and in very few other cases did it prove so. The evidence hardly seems indisputable that the fever was contagious, as sometimes only one person, and sometimes several, in a large family took it. In one case a person who came more than a hundred miles from home, to nurse a patient, left him upon his convalescence, and was home only a few hours when she was taken with the same complaint, and went through a regular six weeks' course, although hers was the only case in the city of 25,000 inhabitants where she resided.

The question has arisen whether the half dozen wagon loads of putrescent mud, the atmospheric conditions, or the possibly foul emanations arising from the natural sewer, in which the water had been rather low for some time, caused the fever. If any of your readers can throw light upon this subject, we would be happy to hear from them, as six weeks' experience with this fever has sadly broken into twenty-eight years of otherwise uninterrupted health. H.

East Mauch Chunk, Pa.

Cotton Manufacturing in the South.

To the Editor of the Scientific American:

It is a well known fact that cotton factories at the South have been making money while many of those at the North have been compelled to suspend operations in whole or in part. Some of the reasons for this state of things are as follows:

1. Labor is cheaper at the South than at the North.

2. In consequence of a milder climate, the necessary expense of living is less there than in New England, as is also that of heating factory buildings, etc.

3. Coal is abundant in the South, and cheap water privileges can be obtained in every direction.

4. The purchase of the raw material direct from the producer saves the profits of numerous middlemen, the cost of several buildings, and long transportation.

To these advantages I am satisfied that still another of great importance can be added. The Southern factory should buy the cotton in the seed, gin, and then spin it, without packing into bales; and it is to urge some of your inventive readers to arrange machinery for this purpose that I write this communication. Some of the advantages of such a system would be as follows:

1. The yarn would be stronger. Baled cotton cannot be prepared for carding without beating, and thus weakening the fiber to a greater or less extent.

2. There would be less waste. Frequently much cotton is discolored and otherwise injured by foreign substances that have been packed with it. I understand that at the North and in Europe it takes from 108 to 115 lbs. of cotton to make 100 lbs. of yarn; and although the waste is not so great at the South, it is nevertheless considerable.

3. The cotton seed would be pressed at the same establishment, and the oil and oilcake sold for many millions each year.

4. The interest on gins and gin houses, which are now idle the greater part of the year, would be saved to planters.

5. The raising of cottons on small farms would be encouraged. The plantation system is not adapted to free labor, and is steadily breaking up; but until cotton can be readily sold in the seed, few small farms will be opened in the cotton section, for the reason that a man cannot afford to buy and operate a gin if he only plants a few acres of cotton. Better cottons and more per acre will be obtained on small farms than on large ones. The reason of this is that a hand can plant and cultivate two or three times as much cotton as he can pick. During the picking season, the entire field should be gone over at least once a day. Even under the slave system, planters who put in an acre of corn for each acre of cotton, and sent the smallest pickanniny into the field to pick cotton, were often unable to pick fast enough; and now that they have so little control over their workmen, the result is sometimes disastrous. But the small farmer if he is unable to get extra hands when he needs them, can generally rely on wife and children to help.

I am confident that, under the system proposed, the South can manufacture cotton cheaper than New England, or Old England either; and that if the proper effort is made, it need not be long before her income from cotton will be double what is now.

Manhatton, Kansas. ALBERT GRIFFIN.

Telegraph Alphabets.

To the Editor of the Scientific American:

In your issue for March 13, you published a communication from John Millis, of Addison, Mich., in regard to telegraph alphabets, which is calculated to mislead your many readers, inasmuch as it gives an utterly erroneous and empirical view of the subject. Mr. Millis states that the Morse "alphabet is defective, as the sound of a dash is very much like the sound of a dot with a succeeding space." Judging from this, I should say that Mr. Millis is as yet but a beginner in the art, for when most persons begin to learn to telegraph they fancy they perceive the same thing. The fact is, to any one at all practised in reading by sound, the defect is by no means as stated in the communication under review. No operator could possibly mistake a dash sounded for a dot with a succeeding space; and I do not know an instance, even among very ordinary sound operators, in which a mistake has occurred for the reason given by Mr. Millis.

The defect is in the spaced dot letters, C, O, R, Y, and Z. This was long ago recognized. Bain avoided it; but his alphabet was longer than the Morse. In the European code, also, the defect is avoided; and were it not for the difficulties involved in achange, the Western Union Telegraph Company would have adopted it some time ago. It was seriously proposed at one time, as I clearly remember. This being the acknowledged and long felt-defect in the Morse alphabet, to which innumerable errors can be traced and by reason of which they are occurring every day, how does Mr. Millis' proposition meet the case? In the Morse system, there are five such letters, Mr. Millis proposes to increase them to seventeen. In other words, his alphabet, besides being cumbrous and inadequate to speed, increases the chances of errors more than three times.

It may not be inappropriate to suggest that the composition of telegraph alphabets be left in the hands of the great body of experienced telegraphers, not only in this country but in Europe, who may well be presumed to know the difficulties and wants of existing systems.

Washington, D. C. WM. E. SAWYER.

The Sun's Orbit and Rate of Motion.

To the Editor of the Scientific American:

As you have been kind enough to publish several of my articles, relative to the retrograde motion of the sun in space, you will still confer a favor by publishing the following, relative to the size of the orbit of the sun and the rate of his motion.

The sun annually retrogrades sufficiently to keep the earth rotating 20 minutes and 23 seconds before she comes to her sidereal place in the heavens. Those 20 minutes and 23 seconds are the 70⅝ portion of a day, and, strange as it may appear, I am going to measure the sun's orbit by them.

As astronomers have not given, so far as I am aware, the computed distance of the earth from the sun since observing the transit of Venus, I will assume a distance; and when the distance is announced, the correction, if any, can be made.

Assuming that the distance of the earth from the sun is 92,000,000 of miles, the circumference of the terrestrial orbit will be 552,000,000 of miles. Now, in a sense, the earth sweeps around the whole in twenty-four hours. How many miles, then, are in the arc which the earth rotates past in twenty minutes and twenty-three seconds? Answer: 7,811,320 miles. That is the number of miles the sun travels in a year. Multiply the 7,811,320 miles by the number of years in precession, to wit, 25,800, and you have for the circumference of the solar orbit, 201,532,056,000 miles, and for its diameter, 67,177,352,000 miles: which shows that the diameter of the sun's orbit is nearly twelve times as great as is that of the orbit of Neptune; and when the two orbits are compared, the latter is like the eye or hole in the center of a large circular saw, compared to the saw itself.

Gloucester, N. J. JOHN HEPBURN.

Aerial Flight.

To the Editor of the Scientific American:

Will your various correspondents on this subject pardon my saying, after a careful study, that they are all on the wrong track? The first thing to be done is to comprehend the rationale of bird flight. This, I apprehend, is grossly misunderstood. It is supposed to be due solely to the mechanical movements of the wings, guided by instinct. Now, how could this be? Mere muscular effort will not reasonably account for the ascent in the air, still less for the propulsion forward. I would ask naturalists to consider, more particularly than they yet have done, the weight of the larger birds, the loads they sometimes carry with them, the great altitude to which they ascend, and the length of time they continue on the wing. Think of birds of passage flying for consecutive days without a single break on the journey, and that often against a strong head wind, the wings moving, in many cases, over 500 times in a minute. What a labor to be accounted for! It is manifestly above bird strength. If, again, they do rest upon the wing, all the greater is the mystery, for they would now have to be both kept from falling and glided onward by a power we know not of, otherwise one of these two catastrophes would ensue: Either they would fall to the ground, or they would fail in their journey; they would go in any direction but the right one. Upon the muscular effort theory, they would have before them a labor quite exceptional, so herculean that nothing in Nature is to be compared with it. Before they had gone many miles, they would fall to the earth exhausted, and die. Despite appearances, it must surely be that birds in their flight are not entirely dependent upon muscular energy; there must be no labor in the question at all. A beneficent Creator has given them the power of flight as their natural mode of transit; hence to fly, to them, is as instinctive, as natural, as it is for the heart to beat or the lungs to be incessantly inhaling and expelling large volumes of air. The animal flame internally performs unremitting labor, but without effort expended; toil there is none, but on the contrary, relief. To the winged tribes, it is a labor to walk, hence they are doomed to fly, and that is manifestly one of the crowning pleasures of bird existence.

The winged insect tribes afford more striking proof, I think, that flight is not entirely the effect of mechanical effort. The common bluebottle flies but little; he darts from place to place as if his wings seemed to do no more than balance him.

I do not think it possible to explain the phenomena in question without calling in the aid of some force hitherto unsuspected, which, for want of a better term, might be looked for under the name of "will power." If something could be laid hold of by investigation in this new channel, and applied to the balloon, aeronauts might, with greater cheer, prosecute their labors, and save some money and some necks, by making the discovery known. Huxley may be approaching the line of thought. MOUNT NEBO.

Dunedin, New Zealand.

Early Steam Navigation.

To the Editor of the Scientific American:

In reply to the question: "What was the name of the first steamship that crossed the Atlantic?" you answer: "The Savannah," built by Crocker and Fickitt in New York, in 1819.

My father, Dr. C. P. Van Houten, of Amite City, La., who will be 82 on April 15, 1875, writes me as follows: In 1816 he engaged with Allaire and Stoutinger, steam engine makers in Fulton's old works in Jersey City, he having previously served his time at the business. He afterward engaged with Daniel Dodd, engine maker, of Elizabethtown (now Elizabeth), N. J. Dodd soon placed him in charge of his works; and during his time, in 1818, the steamship Savannah received her engines and boilers from Dodd's shop, was fitted out and made a voyage to Russia, calling at Liverpool. She was the first steamship that crossed the Atlantic.

Matteawan, N. Y. P. L. VAN HOUTEN.

Frozen Water Mains.

To the Editor of the Scientific American:

The present severe winter, with its continued low temperature and severe frosts, has been a cause of much loss and damage to the systems of water supply. Steam fire engines have been rendered helpless, and burning towns left to the mercies of the elements. A remedy might be found in laying an additional pipe under all mains and service pipes, through which steam could be injected and the mains thus kept from freezing. The steam pipe should be immediately under the water pipe, and it could be arranged with a branch terminating at each fire plug. The steam pipe should also be supplied with means of relieving the pipe from the water of condensation.

The steam fire engines could be arranged to force steam into the pipe to thaw out the mains and fire plugs, and the action of frost might be very much resisted by forcing steam through the pipes occasionally in seasons of extremely cold weather. C. F. H.

Hazleton, Pa.

Small Steam Engines.

To the Editor of the Scientific American:

I have been much interested in reading the various statements as to the results accomplished by small steam engines, but why does not some one manufacture them for sale? The demand for small motors, for driving lathes, coffee mills, washing machines, and many other uses, is very great and rapidly increasing. Only yesterday, I was inquired of by a man who said he had examined all the advertisements in the SCIENTIFIC AMERICAN and other papers he could find, but nowhere could he find a steam engine of from one half to one horse power, nor could he find any one who could inform him where such an engine could be had.

If some person would make such an engine and boiler,that could be sold at a reasonable price, I am confident large numbers could be sold. As they would be used by amateurs in or about residences, they should be as simple as possible. No money should be expended on them merely for show, such as planing or polishing parts which can be painted; but they should be strongly built, and special care should be taken to furnish ample boiler capacity, with strength sufficient to prevent accidents.

Thinking persons are now convinced that much of our domestic labor can and should be done by power. It is a disgrace to our civilization that a woman should be compelled to break her back over a wash tub and board. Very few men would be willing to do the same work all day; and there is no reason, why this operation, which is a combined chemical and mechanical process,should not be done by machinery, and so of many other domestic labors.

Some fifteen years ago I had great difficulty to find a small foot lathe, as no manufacturer appeared to make one for sale; and after writing far and wide, I only succeeded in getting one from a man who built it for his own use. Today they are regular articles of trade, made by several concerns, all of whom find ready sale for them. The same would undoubtedly prove true of small engines. Who will do it?

Washington, D. C. W. C. DODGE.

An Appeal to Inventors.---A New Invention Greatly Needed.

To the Editor of the Scientific American:

This part of the country is infested with fleas and sand flies, and so far I have been unable to find anything that will either drive them away or kill them. We have tried rock camphor, carbolic soap, and kerosene oil, and have so far failed. The fleas infest our houses and barns,and almost every animal that walks. Some people say that the sand breeds them, some attribute them to the hogs, but there have been no hogs running round here since the war. Some people say that the fleas are not as bad as they were just after the war, but both pests are terrible. We keep our bedrooms dark, and undress outside; and keeping camphor in the beds, we have better nights, but in the morning they go for us, as hungry as ever and by the score.

The sand flies go for both man and beast,especially on still, moist mornings and evenings, and all day when it is still. Some people smoke to drive them away from the face, and the negroes substitute a stick in the mouth with a bunch of burning rags on the end; but the little persistent pests will bite the ears, hands, and neck,in spite of everything. Kerosene oil will keep them off for 5 or 10 minutes; but it evaporates, and they bite as badly as ever. If there is anything known to the scientific world, that will either kill or drive them off, you will confer a great boon on a large suffering community by letting us know of it.

Borel Plantation, St. Mary's, Ga. WILLIAM STEELE.

PRACTICAL MECHANISM.

NUMBER XX.

BY JOSHUA ROSE.

PUMPS.

Pumps are commonly divided into three classes,the suction pumps, the force pumps, and the suction and force pumps.

SUCTION PUMPS.

A suction pump causes water to raise itself, by relieving its surface of the pressure of the column of air resting upon it. The principle upon which it acts may be explained as follows:

The surface of all water exposed to the air has the pressure of the air or atmosphere resting upon it; if, therefore, one end of a pipe or tube be lowered into water, and the other end be closed by means of a valve or other device, and the air contained in the pipe be drawn out, it is evident that the surface of the water within the pipe will be relieved of the pressure of the atmosphere; and there will be no resistance offered to the water to prevent its ascending the pipe. The water outside of the pipe, still having the pressure of the atmosphere upon its surface, therefore forces water up into the pipe,supplying the place of the excluded air. The water inside the pipe will rise above the level of that outside of the same in exact proportion to the amount to which it is relieved of the pressure of the air, so that, if the first stroke of a pump reduce the pressure of the air contained in the pipe from 15 lbs. on the square inch (which is its normal pressure) to 14 lbs. per inch, the water will be forced up the pipe to the distance of about 2¼ feet, because a column of water an inch square and 2¼ feet high is equal to about 1 lb. in weight.

It is evident that, upon the reduction of the pressure of the air contained in the pipe from 15 to 14 lbs. per square inch, there would be (unless the water ascended the pipe) an unequal pressure upon its surface inside as compared to that outside of the pipe; but in consequence of the water rising 2¼ feet in the pipe, the pressure on the surface of the water, both inside and outside, is evenly balanced (taking the level of the outside water to be the natural level of the water inside), for the pressure upon the water exposed to the full atmosphere will be 15 lbs. upon each square inch of its surface; while that upon the same plane, but within the pipe, will sustain a column of water 2¼ feet high (weighing 1 lb.) and 14 lbs. pressure of air, making a total of 15 lbs., which is, therefore, an equilibrium of pressure over the whole surface of the water at its natural level.

If, in consequence of a second stroke of the pump, the air pressure in the pipe is reduced to 13 lbs. per inch, the water will rise up it another 2¼ feet, and so on until such time as the rise of the column of water within the pipe is sufficient to be equal in weight to the pressure of the air upon the surface of the water without; hence we have only to determine the hight of a column of water necessary to weigh 15 lbs. per square inch of area at the base of the column to ascertain how far a suction pump will cause water to rise, and this is found by calculation or measurement to be a column nearly 34 feet high. It becomes apparent then that, however high the pipe may reach above the water level, the water cannot rise more than 34 feet up the pipe, even though all the air be excluded within the pipe, because the propelling force, that is,the atmospheric pressure, can only raise a column of water equal in weight to itself. It is found, however, in practice, to be an excellent suction pump which will raise water thirty feet.

From this it will be perceived that the terms "drawing water" and "suction pump" do not accurately represent the principles upon which this pump performs its duty; and it would be much more proper to call it a "displacement pump," since its action is simply to enable the water to rise by displacing the air from its surface.

The duty of this pump is, therefore, in the first place, to extract the air from the suction pipe, and, in the second place,to discharge the water from its barrel through the medium of valves in such a manner that the column of water in the suction pipe is at all times entirely excluded from the pressure of the atmosphere.

FORCE PUMPS.

A force pump is one by means of which the water is expelled from the pump barrel and through the delivery pipe by means of the mechanical force applied to the pump piston or plunger; the amount of power required to drive such a pump will, therefore, depend at all times upon the hight to which the water is required to be forced. When a pump is arranged to draw the water, and force it after it has left the pump barrel, it is termed a suction and force pump; but if the water merely flows into it in consequence of the level of the water supply being equal to or above that of the top of the pump barrel, it is termed simply a force pump. Hence a suction pump performs its duty in causing the water to rise to the pump, a force pump is one which performs its duty in expelling water from its barrel, and a suction and force pump is one which performs both duties alternately.

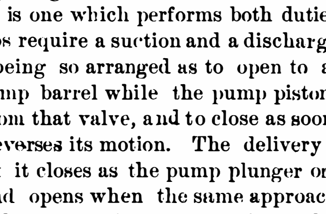
All pumps require a suction and a discharge valve,the suction valve being so arranged as to open to admit the water into the pump barrel while the pump piston or plunger is receding from that valve, and to close as soon as the plunger stops or reverses its motion. The delivery valve is so arranged that it closes as the pump plunger or piston recedes from it, and opens when the same approaches it. When, therefore, the pump piston recedes from the suction valve, the latter opens and admits the water; and when the piston reverses its motion, the suction valve closes, and the descent of the pump piston forces the water through the delivery valve, that being its only possible mode of egress from the barrel of the pump.

The arrangement of the valves may be the same for a force as for a suction pump (although it is advisable,in some cases, to place an additional valve to a force pump to prevent the pump piston from receiving the force of the water in the delivery pipe), the only difference being that the water is permitted to flow freely away from a suction pump,whereas it is confined to the delivery chamber or pipe in a force pump, so as to force it to the required hight or pressure, as the case may be.

PISTON PUMPS

A piston pump is one in which the water is drawn or forced by means of the piston fitting the barrel of the pump airtight, which is most commonly done by providing the piston with two cupped leathers, formed by being pressed in a die made for the purpose. The leather is soaked in water before being placed in the die, and is allowed to remain in the die until it is dry, when it will be sufficiently hard to admit of being turned in the lathe. Fig. 57 represents such a piston in section, A A being the leather, B the piston, C C

Fig. 57.



a piece of metal, placed between the leathers to fit their rounded corners, so that the sides of the leathers shall not move when the piston reverses its motion, and D the follower, which clamps the whole together by means of the pressure received from the nut behind it.

The capacity of a piston pump is its area multiplied by the length of its stroke; but it must be remembered that all pumps throw less water than their capacity, the deficiency ranging from 20 to 40 per cent according to the quality of the pump. This loss arises from the lift and fall of the valves, from inaccuracy of fit or leakage, and in many cases from there being too much space between the valves and piston or plunger.

A plunger pump is one in which a plunger is used in place of a piston, the gland through which the plunger moves serving as its guide and also keeping it air and water tight. The plunger is made smaller in diameter than the bore of the pump barrel, so that the capacity of such a pump is the area of the end face of its plunger multiplied by the length of its stroke, because the pump acts by reason of the displacement caused by the plunger entering the barrel. Pump plungers should always be draw-filed lengthways to prevent them from wearing away the packing so rapidly. It is always advisable in this kind of pump to allow as small an amount of space between the plunger and barrel as possible, for the following reason: When the plunger becomes worn, it is necessary to turn it up again in the lathe, thus reducing its diameter. The result is that there is so much air in the pump, between its barrel and the plunger, that it expands as the plunger leaves the barrel and is merely compressed by the plunger returning, so that the pump becomes very ineffective, and finally ceases to pump at all. If the pump, in such a case, be primed with water each time it is started, it may draw water, but not to its full capacity,as the air will remain in the pump barrel until such time as it may become absorbed by the water.

Suction valves for all pumps should be made as large in area as it is possible to get in, so that they will not require to lift much to admit the water to the pump: since it is evident that, when the piston or plunger commences to descend and the suction valve to close, the water passes back through the suction valve until it is closed, thus diminishing the effectiveness of the pump, and, further,causing the valve to close with a blow which proves very destructive to the valves, especially of fast running pumps.

The area of the opening of a suction valve must be at least equal to the area of the suction pipe, whose area is determined by the following principles: Water will not flow through a suction pipe in a solid stream at a greater speed than that of 300 feet per minute. It follows, then,that, the quantity of water the pump is required to throw being determined, the suction pipe must be of such a size that 300 feet of it will hold such quantity.

If the suction pipe be any smaller than that size, the pump will not be fully supplied with water; and the piston or plunger traveling faster than the supply of water follows it, there is, when it arrives at the end of its suction stroke, a partial vacuum in the pump barrel, which keeps the suction valve open. When the piston or plunger has descended until it strikes the water again (the suction valve not having yet closed), the water, descending with the piston, strikes the suction valve with a blow, which, as before stated, gives a backward impetus to the water in the suction pipe,and closes the valve with a blow very destructive to it; especially is this the case in a force pump or a fast running steam pump, in which latter case the steam piston accelerates in speed (when the pump piston has the partial vacuum, referred to, in it) because not only is the steam piston relieved from performing any duty, but it is assisted by the vacuum; so that it accelerates its speed greatly until the piston strikes the water in the pump barrel, which it will do with such force as to very probably break some weak part of the engine or pump, or cause the crossheads or piston to become loose. If the working parts of any pump are accurately fitted, it will deliver more nearly its full capacity of water when running slowly.

An air chamber placed in the suction side of any pump causes a better supply of water to the pump by holding a body of water near to it, and by making the supply of water, up the suction pipe, more uniform and continuous. Air chambers should be made as long in the neck as possible or convenient, so that the water, in passing from the pump barrel to the delivery pipe, shall not be forced up into the chamber at each stroke of the pump; for the air in the chamber becomes gradually absorbed by the water. If fresh water is continually passing into and out of the chamber, the air in it will soon become absorbed, and water will supply its place; but if the air chamber has a long neck, the water at its highest level in the chamber will remain there unchanged by the action of the pump, and will become impregnated with air, thus diminishing its propensity to absorb any more; and although the air will finally become all absorbed out of the air chamber, the process is a very much slower one, the air chamber being so much the more effective, and its elasticity, imparting a steady flow of water from the delivery pipe, being unimpaired.

Pumps whose pistons revolve are subject to the same defects from inequality of wear as are rotative engines,but the results are not so keenly experienced, because water will not leak through so rapidly nor to so serious an extent as steam, and, further, because the leakiness of the pump may be compensated for by an increase of the rotative speed of the piston.

Water will not, however, as before stated, flow through the suction pipe at a greater velocity than 300 feet per minute; so that, if the pump performs more revolutions that are requisite (according to its capacity) to carry off more than the quantity of water contained in 300 feet of its suction pipe, the power used in running those extra revolutions is lost,inasmuch as they are superfluous except for the purpose of compensating for the defects in the construction or leakiness of the pump, in which case the excess of speed becomes a necessary evil.

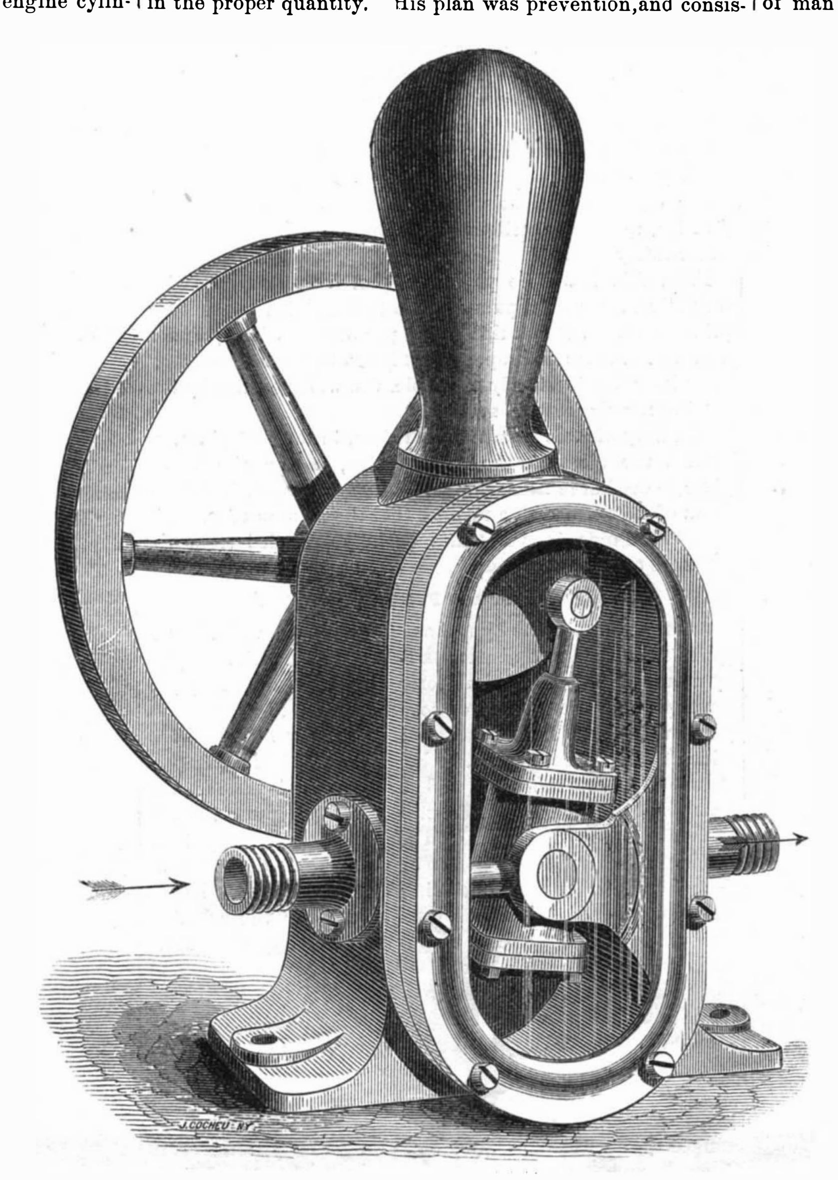
HAIR can be turned blonde, or, in other words, killed, by washing in a very weak solution of soda twice a day. We happen to know that two of the leading belles of New York society owe their much-admired golden tresses to this simple recipe. A piece of soda about as big as a small hickory nut to a quart or so of water is the right proportion. Less soda gives the hair a reddish tone. We do not advocate, however, any such interference with Nature.

IMPROVED HYDRAULIC MOTOR.

The hydraulic motor represented in our illustration is intended to run one or more sewing machines, or other light machinery, and may be used in any house provided with a regular water supply. The apparatus consists of an oscillating engine placed within a perfectly watertight outer casing, into which the water enters at one side and leaves at the other, as indicated by arrows. The oscillating engine cylinder, driven by the water, swings in bearings, as shown, suitable entrance and exit ports of the bearing permitting alternately the entrance and discharge of water from the cylinder. The piston rod of the cylinder is pivoted to a crank disk of the driving shaft. The power is transmitted to the machinery by a friction cone and belting, and can be arranged to run the same at different speeds. A brake device could be applied to produce the instant stoppage of the motor.

The regulating air chamber, shown at the top of the inclosing casing, secures uniformity of motion under varying pressures. A glass front shows the working of the interior parts of the apparatus. The casing is to be attached by fastening screws to any suitable point at or near the sewing machine, and the water can be conveyed thereto by rubber pipes. No oiling is necessary, as the apparatus works entirely in water, which forms a sufficient lubricant. The motor is capable of making from 120 to 500 revolutions per minute, with an average water consumption of forty gallons.

The inventor of this ingenious little apparatus is Mr. A. Schmid, of Zurich, Switzerland.



SCHMID'S HYDRAULIC MOTOR.

Application of Armatures to Magnets.

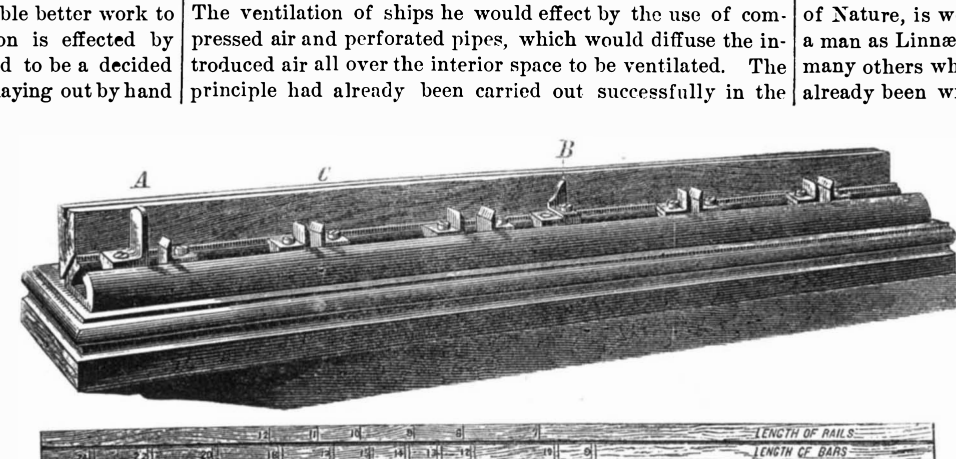
M. J. Jamin states that, if a single armature is placed at the northern end of a magnet, it in no wise modifies the magnetic condition of the southern end, which remains bare. If the effect produced on the south side by the application of an armature is considered, it will be found that it takes magnetism which the steel loses, but that this new distribution is no wise modified by putting an armature on the opposite side, or by removing one. Hence, as regards armatures, there is an absolute independence between the two halves of the magnet. This independence proves a capital fact: that the application of an armature to one of the ends of the magnet occasions a new distribution there, but neither decreases nor augments the sum total of the magnetism there present; the steel loses what the armature gains. This points out a method of determining the magnetism of steel as compared with that of soft iron.

IMPROVED DEVICE FOR LAYING OUT SASHES.

The invention illustrated herewith is a device for laying out sashes of all sizes, from two-lighted windows having casements four feet square to windows of sixteen lights. It is claimed to mark in such a way as to enable better work to be produced than when the like operation is effected by gages fixed in the mortising machine, and to be a decided improvement over the ordinary method of laying out by hand or from separate standards for each size. Stiles, rails, and bars may, in using the apparatus, be molded before marking, thus saving the time used in marking them with a pencil in pairs.

The device consists of iron guides in which the markers are easily adjustable. Upon the upper knife edges of the markers the stiles are laid, the stop, A, receiving the end mortised out for the meeting rail. A light tap of the hammer causes the cutting blades to enter the wood, thus marking any number of pieces exactly alike. For rails and bars the stop, B, is used, which allows the tenon to extend and receive the shoulders.

The bar, C, serves as an index to the implement, and gives the exact length between the shoulders of rails and up and down bars for twelve-lighted sash from 7x9 to 12x24 inches. It is so arranged that the stiles and bars will always be in proper relative proportion. The length of the apparatus is four and a half feet, and its weight 40 lbs. Its construction is strong and durable, and, judging from the numerous references forwarded us by the inventor, its use has given excellent satisfaction. A sash square, to regulate the depth of molding, and full directions for operation are supplied with each device. For further particulars address the inventor, Mr. Andrew Cook, Box 66, Medina, Orleans county, N. Y.



COOK'S IMPROVED DEVICE FOR LAYING OUT SASHES.

Protection from Fire.

At a recent sitting of the Society of Arts, in London, Mr. Coleman, an American civil engineer, read a paper descriptive of an apparatus for the protection of buildings and ships from fire, and for the ventilation of ships, starting with the statement that the annual loss to England and America from fire cost the two countries $250,000,000. Mr. Coleman proceeded to express his undoubted opinion that neither country was possessed, as yet, of the proper apparatus for quenching a fire, either in a building or on shipboard. The cases of Chicago and Boston had shown that no building was absolutely fireproof; and also that, from the moment a great fire obtained a certain head, no amount of water could quench it. What was wanted was an apparatus calculated to send the water into a fire in the proper place, at the proper time, and in the proper quantity. His plan was prevention, and consisted of iron standpipes, one going to the roof, and others to the separate stories of a building, the cocks of the whole to be secured in a box in the side wall. These pipes he would work with a steam engine, placed within the building or close to it. For ships he would have a somewhat similar apparatus. A ship of 1,200 tuns could be fitted with his apparatus for $1,500, and by it all danger of fire at sea would be avoided. The ventilation of ships he would effect by the use of compressed air and perforated pipes, which would diffuse the introduced air all over the interior space to be ventilated. The principle had already been carried out successfully in the Mont Cenis Tunnel. The use of steam as a means of extinguishing fires he had ascertained, by experience, to be an expedient of doubtful efficacy. In the brief discussion that followed, the lecturer was complimented on the ingenuity of his plans, but some doubts were expressed as to their being so applicable to European as they were to American buildings, also as to whether their expense would not be an obstacle to their introduction.

To the above we may add that not only are better means needed to apply water to fires, but inventions are wanted to prevent the freezing of the hydrants in winter. In this city great trouble was experienced during the recent cold weather. Hundreds of hydrants were rendered useless by freezing, and the city was exposed to fearful risks of great conflagrations.

NEGOTIATIONS are in progress for the construction of a narrow gage railroad on the island of Nantucket, to extend from the village of Nantucket, through Town Pasture, the Plains, and head of the plains to the South Shore, a distance of five miles.

Natural History in our Public Schools.

Professor Tenney, of Williams College, publishes an interesting article, in the New England *Journal of Education*, on the importance of teaching natural history in public schools. From it we extract the following:

Every physical necessity and want of man is supplied, and every physical comfort and every physical enjoyment of man comes, directly or indirectly, from the material world; and therefore no subject, of mere human study and learning, can be of greater practical importance than that which embraces the consideration of those things upon which his very existence depends. Nay, the food which we eat, the hat on our head, the shoes on our feet, the coat on our back, every substance which enters into the structure of our dwellings, all come from the objects which natural history considers, and with which this science makes her votaries acquainted. And there are scores and hundreds of objects—minerals, plants, and animals—in the material world today, in addition to those we now use, which are waiting to serve us and bless us, when they have been fully studied and all their properties pointed out.

No, language can hardly exaggerate the importance of natural history studies, and the importance of teaching the elements of these studies early, even to children in the primary schools, as well as to those in the schools of higher grades.

And I have not alluded, by name, to the fact that all the great problems relative to supplying the world with glass and all grades of earthenware—with coal and iron—with lead and tin and copper—with gold and silver and precious stones—with grain for bread—with food fish from the streams and the lakes, and even from the ocean itself—with the flesh of fowl and of cattle—are connected today, most intimately, with natural history studies, and will be more so with every increasing year, with every added million to the population of the earth, and with every real or imaginary physical want.

Nor have I alluded to the fact that in every country, our own as well as others, millions upon millions of dollars worth of grain are destroyed by insects every year, both in the fields and in the granary, and that, if this annual destruction ever ceases, as it probably will cease, or at least be much abated, it will be mainly through remedies or preventives which will come from a more extensive knowledge of the insect tribes; and the boy who is catching and studying butterflies and other insects today may become the man who through his knowledge of natural history shall save to the farmers of this great nation, millions of bushels of grain in a single year—and perhaps a nation from want, and even from famine itself.

What one man can do who has been trained in the elements of natural history, and thus led to the careful study of Nature, is well illustrated by what has been done by such a man as Linnæus, or such a man as Pasteur, or such as many others who might be named, and whose history has already been written, and with whose valuable labors we are already familiar.

Many will perhaps remember that it is recorded that when the King of Sweden saw the ship timber in the royal dockyard going to decay and destruction, he consulted Linnæus, hoping through him to learn the cause of the destruction, and also a remedy or preventive; and he was not disappointed as to what he would know. Linnæus traced the destruction of the timbers to insects, learned their instincts and habits; and by directing the King to have the timbers sunk beneath the water at a certain season of the year, when these insects are abroad in the winged state and when they lay their eggs, he enabled him to prevent further waste. And who can tell the millions of dollars that have been saved to maritime nations by this simple direction which Linnæus gave to the King of Sweden! And it was Linnæus, who had studied the nature and habits of plants, who first taught the nations how to resist the encroachments of the sea by merely sowing a certain species of beach grass (*arundo arenaria*) which served to cover the sands and bind them in their places; and to this day Holland and other nations of the earth have profited by his teaching.

A few years ago, when the silk culture of France was crippled and apparently in danger of being wholly annihilated, by the disease of the silk worm known as *pébrine*, when France had lost by this malady more than two hundred millions of dollars, the French government invoked the aid of Pasteur, a student of Nature, hoping thereby to learn both the true nature of the disease and a remedy or a preventive; and the aid was not invoked in vain. He saved, directly and indirectly, millions of dollars which we can hardly estimate. And all this done, and all this saved, I say, by one man, a careful student of Nature, and just such a one as should be growing up in every school room in our country.

AN EAST INDIAN ORNAMENTAL SHRUB.

Our engraving represents a specimen of a beautiful genus of the sub-order *vacciniaceæ*, or whortleberry family. The familiar huckleberries (three kinds) are of this tribe, and the cranberry, blueberry, and bilberry are nearly allied to it. Many species are exceedingly ornamental as greenhouse shrubs, our present subject (*epigynium leucobotrys*) being, according to the English *Garden*, the best adapted for this purpose. The foliage is very handsome, the leaves being of a bright glossy green; and the berries, which the plant produces in great profusion, are of an opalescent white color, dotted with black spots. The root of the shrub is very peculiar, being very similar in appearance to a tuber, such as a yam or a Chinese potato.

The *epigynium leucobotrys* has flourished well in the open air in the south of Ireland, standing the winter, which is very mild in that region, exceedingly well. The blossoms, regarded individually, are not especially attractive, but they are produced in abundance; and springing from the centers of the clusters of leaves at the ends of the last year's growth of wood, the intervening stems being quite bare, they give the shrub a singular and effective appearance. The blooms are short-lived, and set their fruit immediately, the berries coming to their full development early in September, and usually remaining on the shrub during that month.

Great Exhibition of Machinery in Manchester, England.

The preparations for the exhibition of machinery, fixed and in motion, at the Royal Pomona Palace, Manchester, in May next, are progressing in the most satisfactory manner; and no doubt, after the great success which attended the show of machinery in connection with the cattle show at the same place a few months ago, most of the principal manufacturers and exhibitors in the country will send entries. The amount of prizes offered exceeds $5,000; and as it is intended to keep the exhibition open for a lengthened period, ample opportunity will be afforded for exhibitors to exhibit their productions and to attract buyers from all parts of the country. The immense demand which is daily made for improved machinery of all kinds in the manufactories of Lancashire makes Manchester essentially a headquarter where an exhibition of this nature cannot fail to attract attention, especially as the Lancashire manufacturers themselves are so keenly alive to competition from without. Already many entries have been sent in, principally from Lancashire, London, and Newcastle on Tyne, including machines for converting fiberous materials, such as cotton, wool, silk, hair, etc., into yarns, threads, or fabrics, andfor printing and otherwise imparting designs to them, also machine tools and apparatus used in molding, casting, pressing, forging, engraving, and cutting metals or timber. The general machinery will embrace steam, hydraulic, and other engines, boilers, and apparatus for generating and transmitting motive power, tramway, engines, and carriages; letter press printing apparatus; machinery for melting, puddling, working, and rolling iron and steel; machinery for bleaching, finishing, dyeing, etc. The promoters of the exhibition, further, with the view to give the exhibition a thoroughly universal and practical character, have applied to the Board of Trade to grant provisional protection to any unpatented and novel invention, and their request has been acceded to. Unpatented and novel inventions may thus be provisionally protected, and persons of limited means may have the opportunity of being assisted in making their designs practicable through their being submitted to the test of thoroughly competent judges. The exhibition will be held in a brick building with a glass roof, covering an area of 40,000 square feet, and Mr. Reilly, the proprietor and one of the promoters of the exhibition, has undertaken to provide, at his own cost, steam boilers, main steam piping, and covering for the floor. The classification of machinery will, as far as practicable, be the same as was adopted at the Great Exhibitions of 1851 and 1862.—*Iron*.

Finding the Meridian.

Mr. George W. Blunt, of this city, who knows as much about nautical matters as any gentleman we know, gives the following simple mode for running a meridian line:

Take a piece of board, or any similar material, and describe on it a number of concentric circles. Place this in the sun; over the center hang a plummet. Observe the shortest shadow from the plummet; the sun will then be on the meridian; draw a line to the center of the circle, and that will be the true meridian line. This will do to mark the apparent time or to correct the compass for variation.

The Tock-Tay, or Large House Lizard.

A correspondent from Eastern Bengal, India, describes (in *Nature*) the lizard of that country.

"This noisy but harmless animal generally finds a lodgement in the bamboo and mat houses of the district that are anywhere near the jungle. It is also fond of living in hollow trees, which give great resonance to its loud and staccatoed cry of tock-tay. It is of a green tint, mottled over with red spots; and suckered feet, like its smaller congener, the tickticKee, enable it to run under beams and bamboos. Its cry is, however, very different from the gentle tick-tick of the small lizard, being sufficient at night to awaken the soundest sleeper. He begins with a loud rattle as if to call attention; this is followed by another and more imperative rattle; and when every body may be supposed to be listening, he strikes in deliberately with tock-tay—a moan—tock-tay—another moan—tock-tay—a last and final moan, with which he winds up, not to be heard again for an interval.

In the way of edibles he is fond of a good crust, and the common dung beetle frequently furnishes him with a *pièce de résistance* That insensate insect becomes an easy prey, owing to his heedless rattledum-clash ways; he is the great extinguisher of lights at night in native houses, and Europeans are also familiar with his strong sustained drone, varied by intervals of silence when he has dashed against some rafter or projection, or given himself a heavy fall; but he is not to be discouraged, and is soon droning about as dismally as ever.

THE EPIGYNIUM LEUCOBOTRYS.

The drone, however, is sometimes suddenly quenched without the consequent thump on the floor, and when this is followed by a cruching sound overhead one may safely infer that it is tock-tay who has been lying in wait for him and has snapped up his prey.

These lizards may easily be caught during the day by slipping a noose over their necks while they are asleep in an exposed position; and when so caught they snarl, growl, and snap at their captor in a very ferocious way. I have not heard, however, that they are venomous."

THE CUT-LEAVED BEGONIA.

This pretty little species, *begonia Richardsiana*, is a native of Natal, and was introduced to England in 1871. In general habit and mode of flowering it bears considerable resemblance to the well known *b. Dregei*, from which, however, it differs, in having laciniated foliage. It forms an elegant decorative plant and grows freely in a moderately cool greenhouse, forming bushy little specimens covered with multitudes of snow-white crystalline flowers. Like all the tuberous-rooted species of the genus, it is readily propagated by division; and if grown near the light, these divisions soon form flowering plants. A compost of turfy loam, leaf mold, and coarse sand suits it admirably, and, like most other members of the genus, it requires an abundant supply of root moisture when growing. Plants of this desirable little species have already found their way into European markets, and it well deserves cultivation as one of the prettiest plants in the whole group.

New Process for Preserving Wood from Fire and Decay.

The following process is by S. W. Moore and Weatherby, of England:

The wood to be prepared is first kiln-dried, which process deprives it of all moisture and much of its volatile turpentine and other inflammable matter; it is then put into suitable cylinders, in which lime and water, with sulphurous acid gas, are forced into the pores of the wood under considerable pressure, the sulphurous acid being a by-product from the wasting of pyrites.

The wood is removed and dried, and is then ready for use.

When sulphurous acid is passed into lime under pressure, a sulphate of lime is formed which is soluble in water, capable of crystallizing as a bisulphite, which is readily oxidizable and convertible into sulphate of lime or gypsum.

As this is an exceedingly insoluble salt, it is not easily removed, therefore, from the pores of the wood, and not only protects the wood by its presence as a non-conductor of heat, but deoxidizes all matters which are likely to prove objectionable as ferments.

The advantages presented by this wood are that its weight is less after treatment than of the same wood before kiln-drying; a series of pieces gave a mean specific gravity of 0·3501. The process for working is very much cheaper than that of any other yet devised; it is an admirable means for preventing dry rot and decay from the action of water, as the pores are coated with an insoluble salt; it thus wears longer and vibrates less than ordinary pine; it resists the attacks of insects, and, from the removal of the volatile inflammable matter, as well as from the introduction of a non-conducting material, it is well able to withstand fire, the interior parts not giving up gaseous matter, which always so readily inflames.

The wood, although answering these ends, contains but little matter foreign to itself. Wood fiber, 87·2; moisture at 239° Fah., 8·5; ash, 4·3. Total 100.

The idea here presented is much the same as that noticed accidentally in the late Franco-Prussian war; many houses there were found to have been protected from fire when they were largely built with plaster; lath and plaster walls were absolutely uninjured by the fire when surrounding parts were destroyed.

Portland Cement.

Portland cement, says Mr. H. Faija, of London, consists of carbonate of lime mixed with silica, iron, and alumina, and is made by mixing chalk with mud obtained from the banks of the Thames and Medway, in the proportion of about four of chalk to one of mud; in some cases gault clay is used instead of mud. The materials are mixed in wash mills, and the result, called slurry, is run into large reservoirs or backs, and allowed to settle; it is then dried and calcined at a high temperature, and afterwards ground between millstones to the requisite fineness. The wash mill is a large, shallow, circular pan built of brick, into which the barrow loads of chalk and mud or clay are tipped; and a supply of water being added, the whole is stirred and thoroughly mixed by a a set of revolving arms carried upon a central vertical shaft.

The liquid material flowing from the wash mill is raised by an elevator or pump, and delivered into a reservoir, in which it is allowed to settle; the water is then drawn off by a sluice, and the reservoir refilled from the wash mill. This process is repeated until the reservoir is full of the deposit or slurry, which is then dug out and laid on a drying floor of fireclay tiles or iron plates, heated by flues underneath, and covered with a light roof. The dried slurry is taken to the kilns to be burned, being charged into them with alternate layers of coke; when sufficiently burned, the clinker is allowed to cool, and is then drawn out at the bottom of the kiln, and taken to the crushing rollers, by which it is broken up into small pieces preparatory to being ground by the millstones. Having passed through the millstones, the cement is laid out on the warehouse floor and allowed to cool, being occasionally turned over; this mixes the different days' work, and gives uniformity to the cement produced, and also allows any particles of lime still unslaked to slake by exposure to the air. In color, Portland cement should be of a dull bluish gray, and should have a clear, sharp, almost floury feel in the hand; it should weigh from 112 to 118 lbs. per struck bushel, and, when molded into a briquette or small testing block, and soaked in water for seven days, should be capable of resisting a tensile strain of from 300 to 400 lbs. per square inch. The cement should, during the process of setting, show neither expansion nor contraction.

Diamond Glass Cutting.

In a recent patent trial concerning the revolving wheel glass cutter, Judge Shipman described the form and action of the diamond in cutting glass as follows:

While almost any diamond will scratch or tear the surface of glass, it is a fact that the value and efficiency of a diamond to be used for the cutting or severing of glass depends not merely on the hardness, but upon the form, of the cutting surface. Other gems than the diamond will successfully cut glass, provided they can be shaped into forms similar to those of the diamonds used for this purpose. Dr. Wollaston, in the "Philosophical Transactions" for 1816, thus explains the peculiarities required for the glazier's diamond: "In the natural diamond there is this peculiarity, in those modifications of the crystals that are chosen for this purpose, that the surfaces are, in general, all curved, and, consequently, the meeting of any two of them presents a curvilinear edge. If the diamond is so placed that the line of the intended cut is a tangent to this edge, near to its extremity, and if the two surfaces of the diamond laterally adjacent be equally inclined to the surface of the glass, then the conditions necessary for effecting a cut are complied with. The curvature is not considerable, and, consequently, the limits of inclination are very confined. If the handle be too much or too little elevated, the one extremity of the curve will be made to bear irregularly upon the glass, and will plow a ragged groove, by pressure of point. But, on the contrary, when the contact is duly formed, a simple fissure is effected, as if by lateral pressure of the adjacent surfaces of the diamond, diverted equally to each side. The effects of inequality in the lateral inclination of the faces of the diamond to the surface of the glass are different according to the degree of inequality.. If the difference be very small, the cut may still be clean, but, as the fissure is then not at right angles to the surface, the subsequent fracture is found inclined accordingly. When an attempt is made to cut with an inclination that deviates still more from the perpendicular, the glass is found superficially flawed out on that side to which the greater pressure was diverted, and the cut completely fails."

The Electrical Condition of Air in the Arctic Regions.

M. Vikjander, during one of the recent Swedish expeditions to the arctic regions, made extended investigations into the electrical condition of the air there existing. All of his observations agree in showing that the atmosphere conducts electricity at temperatures relatively high, a circumstance to which may be attributed the absence of thunder and the presence of the aurora borealis. It has been suggested that this is due to the great humidity of the air in such regions; but it is evident that the phenomenon must be ascribed to other causes, since the same temperature and the same degree of humidity do not produce a like effect in lower latitudes. At less temperatures, —4° and —13° Fah., and below, the air isolates better.

Generally the arctic atmosphere appears to be positively electrified, and the earth negatively. In several instances, the air was effectively electric of itself, and this not due to terrestrial induction. During certain periods of the spring, at a time when the air isolated relatively well, both ground and air were charged with negative electricity. This change of electrical state of the atmosphere was not a constant consequence of greater cold; but when the temperature had been lowered for some time, the air had an evident tendency toward a negative condition.

There seems to be a natural connection between these facts and the aurora. During the months of January and February, the latter phenomenon appeared daily, and was especially noticeable on the 19th and 26th days of the latter month. It then disappeared, to reappear, however, on the 2d of March.

At the same time, changes in the electricity of the air were observed, suggesting the theory that the negative electricity, deprived of the possibility of discharging itself into the aurora, was obliged to accumulate in the lower atmospheric strata, which isolated relatively well. From the 2d to the 11th of March, the aurora returned; and during this period the air was in a good conducting condition, or else, when effecting isolation, was positively charged. Subsequent to the latter date, the auroras ceased entirely, and an interval supervened, of low temperature with negatively electrified air, which lasted until the increasing light of the season of the year precluded further auroral observations.

The Royal Albert Bridge.

The Provincial Parliament some time since passed an act for the construction of a bridge over the St. Lawrence river at Montreal. Up to the present time the surveys have been completed, and the future plan is in process of elaboration. The length of the bridge proper over the river will be 7,300 feet, and of the viaducts in the city 5,000 feet, making the total length of the structure 12,300 feet. The main span, of 600 feet in length and 160 feet above water, will extend over the navigable channel. On each side of this principal span there will be one of about 350 feet, and the remaining spans will average some 300 feet, or such other dimensions as may be established when the cost of stone piers with iron superstructure is fully considered. The piers will be very heavy, and those in the water will be built after the manner of the similar portions of the Victoria Bridge.

The style of iron superstructure will be open lattice work. The rail level will be on the lower chords. Twenty feet above, a floor will support the ordinary carriage traffic; a second floor, twelve feet above the first, will give facilities for city car traffic, several lines of rails being placed and the train drawn by dummy engines; the top of the bridge (to be floored over, and with strong ornamental iron railings for safety) will furnish all the required facilities for pedestrians. For the convenience of the latter, hydraulic or steam elevators are to be arranged at different streets where the bridge extends over the city, so as to enable passengers readily to reach the footway.

Generally speaking, it is thought the bridge will cost very considerably less than the Victoria, and be built in one half the time, the surveys having revealed much more favorable engineering conditions of line than had been anticipated.

Wood Ashes as a Fertilizer.

How can I best utilize that big heap of ashes out by the wood pile? This is a question which we have no doubt that hundreds of the some odd thousands of farmers who read this paper have suggested to themselves, now that the milder weather renders drafts on the wood pile less frequent. In nine cases out of ten, we wager that the speaker's excellent spouse immediately remarks that she is about to sell them to the soap maker; and the money? well, that is her perquisite, and it would be very ungallant on our part to venture a suspicion as to its outlay. Still, we dislike to see these ashes go to the soap boiler, and perhaps a word as to their value to our farmer friend may cause him to think as we do; so with a word of apology to both madame and the soap man for our unwarrantable interference with their little traffic, we venture to suggest that those ashes are very much more valuable as fertilizer than for lye.

We suppose that every agriculturist now-a-days has some general idea of the principle of restitution; that is to say, the elements necessary to the growth of vegetables must be replaced; and if they are not, the crop either fails utterly, or at best is deficient in health and growth. The amount of these elements, phosphorus, lime, potash, and several others, to be replaced varies according to the vegetables cultivated. Thus a potato crop from seven and a half acres of land takes away the seed constituents of four wheat crops, besides about 600 pounds of potash. The average turnip produce of the same area removes the seed constituents of four wheat crops and about 1,000 pounds of potash. Similarly also grapes, clover, peas, beans, lucerne, and nearly all leguminous vegetables remove potash in immense quantities. It is evident that in such cases potash is the material which the land most requires to produce a new crop. To buy potash and add it to the soil would be expensive; true, it may be procured in combination with other substances in various fertilizers, but there is a much simpler source for it, and that source is the ash heap, which otherwise the soap man purchases.

Professor Storer, whose recent paper on the fertilizing properties of wood ashes we find in the *Bulletin* of the Bussey Institution, gives the latest information on the value of this most useful material. He says that the analysis of thirteen samples of house ashes shows a range of from 6 to 10·8 per cent of potash, and from 0·4 to 4·6 per cent of phosphoric acid. The lowest percentages of potash, 6 to 6·5, were from ashes of a mixture of maple, oak, and white pine wood, collected by a soap boiler in a country village. The highest percentages, 10 to 10·8, were in ashes of mixed beech, birch, and maple in one case, and in those of pitch pine in the other. Eight of the samples ranged, as to potash, from 7·4 to 9·5, the average of them, as well as that of all the thirteen samples, being about $8\frac{1}{2}$ per cent. This, it must be borne in mind, is the proportion of the chemist's potash or oxide of potassium, and corresponds to about $10\frac{1}{4}$ per cent of the potash of commerce, which is an impure carbonate and hydrate of potassium. The average of phosphoric acid in dry commercial wood ashes, whether unleached or leached, is about two per cent, a much less quantity than would be inferred from the composition of the "pure ash" of many woods.

This phosphoric acid is also a valuable fertilizing material in the majority of soils. The balance of the elements contained in the ash, namely, silica, alumina, iron and manganese oxide, lime, soda, etc., are of no or little account, so that, on what the potash, first, and the phosphoric acid, second, contained, mainly depends the value of wood ashes as a fertilizer. The material is besides a useful dressing for the ground about orchard trees, as it not only improves the soil, but prevents in considerable degree the inroads of insects in the roots and bark.

It only remains for us to show that there is not merely a loss to the land effected, but that a direct expenditure of money is the result of using ashes in a manner otherwise than we have pointed out. In order to thrive, the farmer must keep his land in producing condition, and, as we have already remarked, to soils which require potash, potash must be returned. Potash is worth about six cents a pound, and phosphoric acid is sold in the New York markets for about $12\frac{1}{2}$ cents for the same quantity. A barrel of wood ashes is bought by the soap maker for say twenty-two cents, and it weighs 125 pounds. These ashes contain on an average, as we have already shown, 8 per cent, or 10 pounds, of potash, and besides include two per cent, or two and a half pounds, of phosphoric acid. According to the above prices, the total value of these substances is 91 cents, and therefore a barrel of ashes is intrinsically worth as a fertilizer nearly five times the amount for which it can be sold to the soap manufacturer.

"Ashes," says the *Rural New Yorker*, "contain essential components of all crops. They should not be mixed with compost (there is no gain in so mixing them) but applied broadcast directly to the soil, whether it is grass or arable land. We never knew a farmer who could get more ashes than it was profitable to apply to his land. One hundred bushels per acre is not too much to apply to old cultivated lands. Especially are ashes excellent for orchards. They should not be heaped right about the bodies of the trees, but spread over the roots, which extend as far from the bodies of the trees as the branches do. Ashes are especially valuable as top dressing on old grass lands, or on lands cropped with grain. For root crops they are equally important; indeed, as we say above, there is no crop grown and no land cultivated that is not benefited in a greater or less degree by the application of leached or unleached ashes, the latter being the more valuable."

Most farmers still sell wood in the cities and villages; and rather than go home empty, they should carry back ashes and other fertilizers to replace the potash, lime, and phosphoric acid that have been carried off in the crops and animals sold. Ashes show immediate effect from their application, and at the same time last long in the soil.

DECISIONS OF THE COURTS.

United States Circuit Court.--District of Massachusetts.

PATENT BRUSH—THOMAS E. MURPHY *et al. vs.* LAURENT KISSLING *et al.*

[*In Equity.—Before* SHEPLEY, J.—*October*, 1874.]

This was a suit under letters patent for an improved brush, granted to Francis McLaughlin, January 11, 1870, being the same patent that was involved in the suit of *Murphy et al. vs. Eastham et al.* The object of the McLaughlin invention was to obviate the danger of breaking glass and injuring the surface of wood or other substances to be washed or dusted by contact with the brush head. To this end the patentee proposed to form a groove in the brush head or stock near the bristles, and in this groove to insert a rubber band, one edge or angle of which should project outward and prevent injurious contact between the brush head and the surface to be cleaned. The novelty of the invention and the scope of the patent were fully discussed in the case above referred to.*

Decree for injunction and account as prayed for in the bill.

[*J. L. Newton*, for complainants.

J. T. Wilson, for defendants.

NEW BOOKS AND PUBLICATIONS.

WOODEN AND BRICK BUILDINGS, WITH DETAILS, containing One Hundred and Sixty Plates of Plans, Elevations, etc., with Descriptive Letter Press. Two Volumes, Large Quarto. Price $18. New York city: A. J. Bicknell & Co.

We know of no recent publication which will prove of so much utility to architects and builders as that the title of which is above written. The first volume, just issued and now before us, contains fifty-four designs, carefully drawn and evidently reproduced in *facsimile* from the handiwork of some of the foremost architects in the country. These are accompanied with forms of specifications, descriptions of details, and other explanatory matter calculated to be of direct practical use to the profession. To architects residing in country and suburban towns, we can especially commend the work, as it abounds in designs for rural dwellings, all of which are handsome, and some artistically elegant. Mr. A. J. Bicknell, publisher of the *American Builder*, under whose supervision the book has been compiled, deserves great praise for the admirable and painstaking care exhibited in its pages. Both to him and to the publishing house of which he is the head, the public has long been indebted for the production of architectural works, the effect of which must be gradually to substitute, for the normally uncouth edifices of American towns, structures which combine the principles of scientific building with exteriors denoting taste and artistic skill.

THE PRIVATE LIFE OF A KING. Compiled by John Banvard, Artist. 670 pages. Price $2.25. New York city: The Literary and Art Publishing Company, 806 Broadway.

This book is alleged to contain a truthful memoir of the Prince of Wales afterwards George IV., of England.

NEW YORK STATE RAILROAD REPORT.

We are indebted to Hiram Calkins, Esq., Clerk of Assembly, for a copy of the State Engineer's Report for 1873. We also acknowledge the receipt, from same source, of a copy of the "Clerk's Manual" for 1875.

Recent American and Foreign Patents.

Improved Trellis.

Timothy L. Buell, Marietta, Ohio.—This is a trellis made of wire bands or rings and stakes and posts, the rings being attached to the stakes and posts, so that the trellis may be folded up when not in use.

Improved Water Closet Valve.

Edwin O. Brinckerhoff, New York city.—The weight of the person using this water closet forces down rods and valves, compressing springs and bringing the openings of the valves opposite the open ends of the pipe, so that the water may flow freely, and may continue to flow as long as the weight of the person rests upon the seat. As the weight of the person is removed, the elasticity of the springs raises the rod and the valve, stopping the flow of the water.

Improved Saw-Burring Tool.

Franklin J. Martin, Williamsport, Pa.—Two angle plates, about the length of four or five saw teeth, are bolted together adjustably, so that a channel is obtained between the plates for the reception of the edge of the saw between them. The channel being widened or narrowed, according to the gage of the saw to be burred, by shifting one of the plates on the other, this tool is placed on the edge of the saw, with the bottom wall of the channel against the points of the teeth, after the saw has been filed. The operator then gently taps it with a hammer, and thereby burrs the points of the teeth a little, flattening them slightly on the points, and making them of uniform width and length. By this burring of the teeth the saw is prevented from dodging out of its course, and it makes the lumber much smoother than the teeth are capable of as ordinarily dressed.

Improved Safe.

George Damen, Brooklyn, N. Y.—This invention consists of safe having a series of pigeon holes or recesses arranged equidistant from a center spindle, which carries a revolving face plate with apertures fitting the pigeon holes, so as to open one of them at the time while closing the others, and locking them all by means of suitable spring bolts entering rear holes of the face disk in moving the disk forward.

Improved Car Axle Box.

Benjamin K. Verbryck and Thomas Newberry, Chicago, Ill.—The object of this invention is to improve the axle boxes of railway cars in such a manner that the covers or lids are locked or fastened in an absolutely secure manner without the use of set screws, springs, or other devices. The lid is hinged to one side of the axle box, and provided at the other side with a groove and cam, into which a pivoted latch piece with eccentric cam is swung, thus locking rigidly the cover.

Improved Attachment for Injector.

David Lees, of Birmingham, assignor to himself and S. C. Stewart, of Tyrone Forges, Pa.—Between the valve and nozzle of the injector is a lateral tube, in which is placed a valve, held inwardly and away from its seat by a spring, until the pressure of steam is sufficient to close it. Until this occurs, the water of condensation is afforded an outlet, and thereby the starting of the injector greatly facilitated.

Improved Washing Machine.

Simon W. Shanks, Benton Harbor, Mich.—An endless chain of slats passes around two wheels attached to a shaft, the journals of which work in bearing in standards. By this construction, a longer rubbing surface is formed for the clothes, and the spaces between said slats allow the water squeezed from the clothes to flow off freely. Four coiled springs hold an upper rubber down upon the clothes, and at the same time allow said rubber to yield to adapt itself to the varying thickness of the clothes being operated upon. In using the machine, the clothes are inserted between the lower and upper rubbers, and are carried back and forth between said rubbers by turning the crank, first in one and then in the other direction.

Improved Paper Bag Machine.

Charles H. Kellogg, East Leverett, Mass.—The paper passes over guide rolls and between feed rolls, which draw it from the paper roll and present it to the folding table over longitudinal body folders, the margin being at the same time drawn under a pasting roll. The paper rests on a carrier, which reciprocates between the feed rolls and the head, and conveys the paper forward to the cutters, its complete reciprocations corresponding in number with the strokes of the cutters. The carrier turns the feed rolls by the belts, and a coiled spring is applied to pull the carrier back after carrying the paper forward. The belts go back without turning the feed rolls back, and engage the rolls by ratchets and pawls, to turn them forward when the belts are pulled forward by the carrier. A cross head carries a forming plate, over which the tubular portion of the bag is to be folded, which is moved down upon the sheet of paper at the same time that the cutter goes down, and it is held while the folders are performing their work. After this forming plate comes down on the paper, the longitudinal folders are thrown over, folding the paper and sticking the edges together by the pasted margin. After these folders are turned over, they are held while the bottom is folded and till the bag is ready to be discharged. They are then thrown back by springs. Before the folders go back, the bottom of the bag is folded and pasted, the first operation being by the horizontal spreaders, which fold in the side parts against the ends of the folders and the table. As soon as the sides of the ends of the tubes are folded in by the action of the spreaders, the paster rises and pastes the upper and lower corners of the folded bottom, above and below the spreader. The object of this pasting operation is to unite one of the said corners to the middle of the bottom or end portion of the bag, and the other corner to the first corner, which will result when the corners have been folded. The lower vertical folder has a pressure roll connected with it, to press the ends together after they are folded, and stick the paste. There is also a little projecting stud on the upper corner of each folder, to throw it off a little when it comes in contact with the paper, so as not to tear or cut it. A little coiled spring regulates the pressure of the folder on the paper. The discharger, being under the lower part of the bag and pushing against the folded bottom below the center to draw it off from the folder, thrusts the lower edge of the bottom forward and presents it to rolls, so that, in drawing it between them, they fold the bottom down on the upper side, ready for folding up for packing in bales or boxes.

Improved Tea Kettle.

Harriet Gray, Marquette, Mich.—The subject of this patent is an improved tea kettle, by which the spilling and boiling over of the water is prevented, and also the heat issuing at the top part is utilized for the purpose of keeping articles warm or cooking therewith. The kettle is provided with a funnel-shaped top rim and outer cover, and also with an interior perforated cover, having an adjustable slide plate, for opening or closing the steam-issuing perforations.

Improved Dash Board.

Christian C. Schwaner, Winterset, Iowa.—The frame for this dash for buggies and other vehicles is so formed that it may be contracted or expanded should the leather cover be made too tight or too loose, and also so that all the stitching may be done before the said cover is applied to the said frame.

Improved Window Shade Fixture.

Charles De Quillfeldt, New York city.—The main objection to the shade fixtures with spring rollers has been the sudden escape of the shade from the hands of the person trying to adjust the same by the action of the spring, so that the shade is wound up with great rapidity around the roller, and exposed to injury. This invention is designed to produce the absolute and positive stopping of the shade at any desired point, by means of a notched hub of the spring roller, having sliding disks, in connection with a covering roller cap, provided with a break piece for stopping the roller and disks when turned in one direction by the spring, but admitting the passage of the disks in opposite direction for the unwinding of the shade.

Improved Saw Gummer.

George Washington Griswold, Pottersville, N. Y.—The clamps for holding the saw are on the ends of screws, one of which passes through the end of the handle, and the other through the end of a bow. The other end of the bow is confined on the outside of the handle. The bow rises up from the screws to give room for the saw. A cutting cylinder is made with a shank, which passes through the sleeve, and has one or more slots through its surface. Cutters, passed through the slots, are inserted from the end, and are beveled at the inner ends, so that they correspond with the surface of the cylinder. The cutters cross each other, and their edges project sufficiently to take a thin chip from the saw as the cylinder revolves.

Improved Ticket Printing Machine.

James Anderson, New York city.—The paper is drawn between a pair of printing rolls from a spool, printed and caused to issue from the case and passing between cutters which cut off a ticket at each half revolution of the printing rolls, one cutter being forced down by a spring, which is restrained by a cam while the paper is moving, and released by it at the proper time for the cutter to strike. As it may not in some cases be desirable to use a cam independent of the printing rolls, and geared to them in this manner, the cutter may be lifted by a push pin and lever, to be worked by hand before turning the rolls, one of which may have cams to hold the cutter up as soon as the roll is turned far enough, so that the push pin may be released by the thumb to leave the cutter free to be thrown back by the spring. There is a little frame to prevent the printing roll from turning backward or forward while the cutter is down. It is tripped to release the roll when the cutter rises by arms. This instrument is designed essentially for making tickets to be given by the conductors to passengers when they pay their fares, so that they can be detected in case they do not give them; but it is equally adapted for other purposes.

Improved Binder for Roll Couplings.

James Gillespie, Cleveland, Ohio, assignor to himself and William Garrett, of same place.—The object of this invention is to provide, in place of the leather belts used for binding together the spindle and stretchers in rolling mills, an improved spring binder, that may be quickly applied and taken off, so as to secure the stretchers tightly during the motion of the rolls, and to prevent completely the slipping off of spindle and roll-connecting boxes. It consists of a wire binder, with spiral spring part and hook and eye at the ends, for being tightly fastened around the roll-connecting spindle and stretchers.

Improved Cooking Stove.

Edwin O. Brinckerhoff, New York city.—This cooking stove is provided with an arrangement of flues and spaces, so that when the stove is used for baking purposes it may be heated quickly, thoroughly, and uniformly, and with a comparatively small amount of fuel, and that when used for boiling purposes the entire stove need not be heated.

Improved Horse Power Attachment.

John George Merchen, Lowden, Iowa.—In the upright bars of a drum are formed holes to receive the ends of cords which pass through guide eyes formed in pulleys pivoted to the upper ends of short studs attached to sweeps near the edge of the platform. From the studs the cords pass around guide pulleys pivoted to the upper ends of other studs, which are made higher than the studs first mentioned, and the lower ends of which are attached to the outer ends of the sweeps. To the outer ends of the cords are attached loops to which the horse reins are designed to be attached. The studs support the cords and the reins at such a hight as to be out of the way of the doubletrees and whiffletrees, and so as to prevent the horses from getting their feet over said cord or reins. The driver, by turning the central drum, draws all the reins taut at the same time, and is thus able to readily control all the horses.

Improved Hitch Hook for Street Cars.

David Demarest, New York city.—This consist in a bill or head formed upon the point of the hitch hook of street cars, and of such a size that the coupling link of the pole shoe can be readily raised over it when the horses are in line with the car, but which, when the horses are in any other position, will force the side of the link of the pole shoe beneath the shoulder of the said bill, and thus prevent the detachment of the horses. This invention will prevent the running away of frightened horses that have become accidentally detached fr m their car.

Improved Sole and Heel Shave for Boots and Shoes.

Fanny M. Foster, Leicester, Mass., executrix of George P. Foster, deceased.—The body of the knife is slightly curved, and its side edges are dovetailed into the stock. A screw passes through the stock, with its end bearing on the long end of the lever, and exerts a lever purchase to force the short end against the beveled or dovetailed side of the knife. By means of this lever the knife is forced down into the dovetail, kept firm, and prevented from chattering when in use. The lever also prevents the knife from getting loose or starting out. By lowering the screw, the knife may be slipped from the dovetails and taken out for sharpening and other purposes.

Improved Sand-Papering Machine.

Valentine Hepp, Chicago, Ill.—The frame which carries the heads around has a hollow shaft, with a shaft running down through it, and carrying a large spur wheel, which gears with the pad carrier, so as to divide the motion between the carrying frame and the driving shaft, in such a manner as to obtain the requisite rapid motion of the pad carriers without having to run either the frame or the driving shaft at a high speed.

Improved Child's Carriage.

J. Manvill Lewis, North Springfield, Vt.—The two axles are connected by a reach of two malleable iron rods, with a spring near about the middle for supporting the front portion of the body. Ordinary C springs on the rear axle support the rear end of the box, by which it is designed to simplify and cheapen the construction considerably, while at the same time the carriage is equally as strong and more elastic than those in which the body sills curve down and connect with the front axle to form the reach.

Improved Washing Machine.

Francis M. Myers, Windsor, Mo.—This invention is a roller to which clothes are attached, and a semi-cylindrical oscillating rubber, provided with a slot through which the clothes pass, and resting upon a roller bed, or equivalent surface. When one side of the part of the clothes being operated upon has been sufficiently rubbed, the rubber is turned once around in such a direction as to reverse the position of the clothes between the rubber and the roller, and the rubber is again oscillated. When this part of the clothes has been sufficiently rubbed, the roller is turned to roll the washed part of the clothes upon it, and another part is operated upon. When the article has been wholly washed, it is detached and another is applied.

Improved Magazine Fire Arm.

Edwin A. Prescott, Hatfield, Mass., assignor to Prescott Pistol Company, of same place.—The invention consists of certain peculiar devices and arrangements thereof for throwing out the case of the exploded cartridge, feeding the cartridge to be fired into the barrel, and retaining the cartridges in the supplementary barrel or magazine while the discharging barrel is being loaded. Two springs in the magazine are used for holding the cartridges from falling out when the barrel is turned down, instead of one spring and a notch in the barrel, as heretofore. A spring catch is combined with the stock and the groove into which the head of the cartridge is received from the magazine, to catch the flange and hold it against being thrown or knocked out before the flange rises up. The slide is connected with the arm by a connecting rod, for working it by said arm, instead of a toothed segment on the arm and a toothed bar on the slide, which is a simpler and cheaper arrangement, and works more accurately. A little cam on the end of the rod connected to the slide is thrown up above the top of the slide to raise the cartridge above the top of the slide while being moved up to its position behind the barrel. This avoids the loose joint, which is objectionable for its rattling noise and uncertain action. The spring catch for fastening the barrel and the breech together swings vertically on a horizontal pivot, and is provided with a thumb bit directly in advance over the top of the barrel, so that the thumb of the hand in which the arm is held may be used for unlocking the barrel to swing it down for loading, by merely pushing down on the thumb bit, and also so that the pressure exerted for unlocking them also tends to force the barrel down.

Improved Feathering Paddle Wheel.

Bernhard Vater, New York city.—This is an improved construction of paddle wheels for steamboats, by which the paddles pass vertically into and through the water, so as to utilize the full amount of power with less agitation of the water and vibration of the vessel. The invention consists of a paddle wheel with vertically arranged paddles, that retain their position during their passage through the water by the rotation of the supporting frame in connection with the action of intermediate gearing, and a central stationary cog wheel on the gear wheels of the paddles.

Improved Spring Equalizer.

Thomas L. Guest, Pottstown, Pa.—The forward and backward throw of the body of a carriage, as the wheels descend and rise from a level in passing through a hollow and over an obstruction, are limited to the amount of play given to a stay rod, and the movement of the said body within said limits is made easy by the play of pivoted cross bars in their bearings.

Improved Holder for Ornaments, etc.

Walter J. Garvey, St. Louis, Mo.—The object of this invention is to provide means for holding up the ornaments which are placed upon ceilings until they can be fastened thereto; and it consists in a spring holder made adjustable as to length, capped with rubber or other soft material, and with a spring at the other end, to hold it in place.

Improved Drag.

Wilson Gardner, Wheelersburg, O., assignor to himself and L. Salladay, of same place.—The pulverizers and furrowers are connected with the same carriers, so that ground may be laid off in rows for planting as fast as it is brought into fine tilth, and by the same operation.

Improved Blind Stop.

Charles E. Steller, Milwaukee, Wis.—A series of slats pivoted in a frame is connected with an opening and closing bar. A slight pressure of a cam against the side of the bar serves to hold it and the blinds in any desired position, while a tighter pressure makes the blind slats stand so firm that no wind or storm can cause them to rattle.

Improved Chair.

William T. Doremus, New York city.—In this device, when the cover is put under pressure a roller will be turned in such a direction as to tend to coil up springs, so as to give elasticity to the back of the chair.

Improved Printing Press.

William E. Gump, New York city, assignor to Mrs. Maria L. Gump, Garden City, N. Y.—By operating a lever, the platens will be brought up against the form. Upon the rear of the upper parts of the end frames are formed cams, which take up all the play of the joints of the rods, arms, and levers, and bring the platens against the form fully and squarely, and thus insure a full, clear, and clean impression.

Improved Washing Machine.

Thomas Stumm, Ada, O.—This invention has for its object to improve the construction of the washing machine for which letters patent were granted to same inventor May 5, 1874. By moving the free end of a lever in one or the other direction, the uprights and a rod or shaft and its attachments may be raised and lowered to raise the clothes out of or lower them into the water. To the uprights are attached the ends of a dasher board, against which the clothes are pressed, and which has numerous holes formed through it to allow the suds to readily escape.

Improved Velocipede.

Edwin Crother and Michel Bergeron, Hackensack, N. J.—In this velocipede the rider can use either his hands or his feet, or both together, to control the direction and uncouple one of the wheels for turning curves in the road. When the strain upon the spring ceases, the reaction throws the coupling into gear with the wheel, and both wheels become propelling wheels.

Improved Car Coupling.

Benjamin J. Sirmans, Blackshear, Ga.—When two cars are run together, the link of one car will enter the hole of the bumper head on the other, strike against a plate, and push the inner end of a lever to the rearward, which movement of the said lever withdraws a catch arm from another lever, and allows the pin to drop thr ugh the bumper head and link, coupling the cars.

Improved Bob Sled.

John Waupach, Shakopee, Minn.—Pivots and holes in the tongue roller are contrived to allow the pins to play up and down freely as the roller is raised or lowered at one end above or below the other by the rising or falling of one of the runners independently. The hounds extend forward of the hind beam each side of the reach, and cross bars connect them at the front, above and below the reach, to hold the hind beam so as not to rock with the runners.

Improved Corn Planter.

Abram Staley, Martin, Mich., assignor to himself and Joseph L Staley, of same place.—The slides are so arranged relatively to each other that the opening through one registers with the passage through the pocket when the other does not, thus enabling one to close and the other to open by one and the same movement of the two slides. The construction of these jaws and slides is such that the jaws open and make a good opening in the ground before the seed drops, which allows the seed to scatter as when planted by hand, and they open so that the seed can be seen after dropping, and before the jaws are lifted out of the ground, so as to be certain of the perfect action in every case. The machine also opens the ground, so as to insure the covering of the soil perfectly.

Improved Organ Reed Board.

John R. Lomas, New Haven, Conn., assignor to Bernard Shoninger, of same place.—A partial set of reeds is inserted below the sounding board, which come within the length of the bass reed valve. By this means there are added to the treble as many reeds as can be supplied with air by this valve, thereby making no difference in the required touch of the keys.

Improved Composition for Filling Teeth.

Erwin Erlenmeyer, Houston, Tex.—This is a composition for filling hollow and decayed teeth, which is pulverized when used, and which is compounded of phosphoric acid, lime, magnesia, fluoride of calcium, potash, silica, and oxide of zinc.

Improved Harvester.

Charles K. Myers, Pekin, Ill.—The driver, while standing upon the platform attached to the rear part of the tongue, by operating a lever can easily guide the machine in any desired direction, and by means of another lever can raise and lower the cutter bar to cut the grain farther from or closer to the ground.

Improved Machine for Making Metal Shoe Shanks.

John Hyslop, Jr., Abington, Mass., assignor to Hiram H. Jenkins and George O. Jenkins, of same place.—The shanks are cut off from a sheet fed on a stationary block, and fall down the stationary incline in front of the stationary former, where they are held by suitable means until the movable former comes forward and presses them to produce the requisite shape. A couple of pushers move forward aft r each one falls, and push it, together with the previously fallen ones, forward along the table side by side, so that they may be taken off in batches in such order.

Improved Carriage Curtain Fastener.

Carl Kurz, New York city.—This invention consists of a metal button with a T head, which is fastened to the inside of the apron or curtain, and a little slotted plate fastened on the bow, with its slot at right angles to the head of the T, so contrived that the slotted plate, which only swells out a little around the slot, does not project like the studs now in use, nor does it show on the outside, as the studs do. The button-hole plate to be used for the top of the curtain has the upper portion of the slot widened, so that the buttons can drop into it when the button plate is held up horizontally; and a portion of the button-hole plate above the slot is so contrived that, after the button has been dropped down with the curtain as it hangs, it locks the button, so that it cannot be detached while so hanging.

Combined Land Roller and Seeding Machine.

James H. Holland, Aurora, Mo.—The roller is made in two parts, and to its outer ends are detachably bolted two wheels, one or both of which are rigidly connected with the shaft, so as to carry said shaft with them in their revolution.

Improved Lamp Extinguisher.

Augustus Umholtz, Tremont, Pa.—The invention consists in attaching an extinguisher to the stem or rod by which the wick is raised and lowered, so that both may be operated together, and in constructing the extinguisher plate with slots in the flanged top portion, contiguous to the top of the wick tube, for admitting the passage of air upward to the flame of light downward.

Chief Engineer's Office, U. S. Navy Yard,
WASHINGTON, November 18, 1874.

Commodore Thos. H. Patterson, U. S. N., Commandant:

SIR:—In obedience to your order of October 5th, 1874, to carefully test the EMPIRE PORTABLE FORGE, manufactured at Troy, N. Y., I have the honor to submit the following report:

* * * * * This is a very excellent and convenient forge. It works easy and with but little noise, and the power being applied with a lever, it can be worked without interfering with the manipulation of the fire.

I can recommend it as a very useful tool for work on ship board or shop use.

Very respectfully, your obedient servant,
[Signed] EDWIN FITHIAN,
Chief Engineer, U.S.N.

Business and Personal.

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

Notes & Queries

J. S. & Co. will find directions for utilizing mica scraps on p. 42, vol. 25.—J. D. F. will find directions for manufacturing ice on p. 54, vol. 31.—L. F. L. will find instructions for preventing the percolation of water through a brick wall on p. 75, vol. 32.—R. H. D. will find a recipe for Worcestershire sauce on. p. 281, vol. 26.—A. C. A. will find some particulars as to the manufacture of aluminum on p. 91, vol. 31.—J. H. will find directions for preparing buffalo hides on p. 266, vol. 26.—J. M. C will find a formula for ascertaining the contents of a cylinder on p. 281, vol. 25, and for the proportions of a safety valve on p. 107, vol. 31.—E. S. T. will find a recipe for indelible ink on p. 112, vol. 27.—H. R. W. will find a recipe for wood filling on p. 347, vol. 31.—L. F. S. will find directions for making rubber hand stamps on p. 156, vol. 31.—B. A. S. will find directions for making and using a pantagraph on pp. 99, 179, vol. 28.—F. G. T. should consult, as to his diet, a physician who is acquainted with his case.—C. S. R. will find a recipe for a dip for brass goods on p. 282, vol. 29.—W. F. R. and others can solve the problem of the length of the hypothenuse by the method illustrated on p. 187, vol. 32.—W. B. will find directions for calculating the proportions of gear wheels on p. 187, vol. 29.—F. B. will find directions for removing clinkers from stoves on p. 187, vol. 32.—A. B. will find the dimensions of the Great Eastern on p. 346, vol. 31.—J. R., Liège, Belgium, and others will find a description of a wood-splitting machine on p. 79, vol. 28.

(1) H. M. asks: Please explain the antiseptic action of common salt, and also of sugar. A. In the case of salt, the albumenoid and other putrifiable matter goes into solution in the brine; sugar or sirup acts by preventing the access of atmospheric oxygen to the substances immersed in it.

(2) H. D. D. and others.—One process for utilizing tin scrap consists in first cutting it in a suitable machine into comparatively fine chips, and then placing it in a revolving cylinder so arranged as to constantly shower the chips with mercury, with which the tin unites; and the two may afterward be separated by distillation, or by the oxidation of the tin.

(3) W. C. asks: Can heat enough be obtained in a small furnace to melt brass without the aid of a pair of bellows? A. Yes.

What will dissolve chemical paint out of a brush? A. This depends wholly upon the composition of the paint. Most of the common pigments find solvents in either water, turpentine, alcohol, ether, or oil.

(4) J. H. asks: In pressing quicksilver through buckskin to extract the impurities or gold, is it injurious to have the hands in contact with it? A. We do not know of any trouble originating in this way: but as mercury is slightly volatile at common temperatures, extreme care should be taken not to inhale the vapors, as it is liable, otherwise, to produce salivation.

(5) J. McM. asks: Why is an inverted image seen when one looks upon the concave side of a burnished spoon, and an erect image when the convex side is turned towards the face? A. In the case of a concave mirror, the reflected rays of light approach and cross each other before reaching the eye, thus producing an inverted image. In the case of convex mirrors, the convex surface simply causes the rays to diverge.

(6) D. H. S. Jr. asks: 1 Has ozone ever been used as a bleaching agent? Yes. 2. Can it be produced by the discharges (into atmospheric air or pure oxygen) of the electricity generated by the glass plate or cylinder electrical machine? A. It can, but in exceedingly minute quantities in comparison with the bulk of the gas operated upon. 3. Is there any work extant which treats minutely upon the production, properties, and uses of ozone? A. Read the work by Cornelius B. Fox, entitled "Ozone and Antozone," published by J. A. Churchill, London, England.

(7) L. N. P. says: 1. I am thinking of putting electric bells into a house. Is there any likelihood of the batteries or any connections ever setting fire to easily inflammable things? A. No. 2. Is there any chance of batteries in a closet forming gas liable to catch fire? A. No.

(8) F. G. N. ask: 1. Suppose that I take a permanent magnet, and surround its armature with a helix, would not a feeble current be generated every time the magnet and armature were united and separated? A. Yes. 2. If the ends of the helix are connected with a Rhumkorff coil, would not the feeble current of electricity generated induce a stronger one in the other wire of the coil, so that, by connecting several wires successively, we might finally obtain a current indefinitely stronger than the one we started with? And if we connected the last coil with a helix surrounding a soft iron horseshoe, would not the current of induced electricity transfer it into a much stronger temporary magnet than the permanent one we began with? A. If properly constructed, it would. 3. Would the induced current differ from the generating current otherwise than in being stronger? A. That would depend upon the construction of the machine. 4. If this is true, does it not overthrow the idea that one force cannot produce a greater one without a corresponding loss in time or distance? A. Not at all. If the results you suggest were to follow your premises, they would not tend to overthrow the idea mentioned. In this case it would be simply a transfer of mechanical force (the moving of the armature) into electrical energy, and the amount of the energy would be proportioned, other things being the same, to the rapidity of the movement of the armature.

(9) D. H. L. H. says: In your answer to W. E. D., you give directions for making a Callaud battery; can I nickel plate steel with such a battery? A. Yes.

(10) P. R. H. asks: Is there any battery that will produce electricity continuously, without being touched or renewed after once being completed and put to work? A. No.

(11) I. H. asks: How can I plate with nickel without a battery? A. Use a magneto-electric machine.

(12) M. P. asks: What is the best method of removing gold that has been deposited on brass by galvanic battery, so as not to destroy the brass in the operation? A. Place the articles in strong nitric acid, and add some common salt in crystals. After coming out of the acid, the articles must be polished.

(13) E. M. asks: Will you please suggest the simplest way that I can produce rotary motion by electricity? I have a small battery and electro-magnetic telegraph. But I want to show to my pupils how a wheel may be turned. Being poor, I cannot buy an electric engine. Any cheap and simple way by which I can make rotary motion by the battery, at home, that is what I want. A. Suppose you attach four soft iron keepers to the circumference of a wooden wheel, so that in turn they approach the poles of an electro-magnet. Let the circuit of the electro-magnet be closed as each keeper approaches the poles and opened as soon as it comes opposite. The method of making a circuit closer will occur to any ingenious mind.

(14) W. D. H. asks: 1. How can I electroplate in bronze? In what solution shall I immerse the articles to be bronzed? A. Make a solution composed of 50 parts carbonate of potash, 2 parts chloride of copper, 4 parts sulphate of zinc, 25 parts nitrate of ammonia, and use a bronze plate as the positive electrode. 2. Which is the best battery for the purpose, Smee's or Leclanché's? A. The Smee.

(15) L. K. asks: 1. How many feet of air does one grown person require to keep him in good health for six hours? A. The average amount of air inspired and exhaled at each respiration is 30 cubic inches, and the average number of respirations 20 per minute, so that 500 cubic feet of air pass through the lungs in 24 hours. The amount of carbonic acid exhaled is variable, and is interesting as an index of the rate of internal change. The more energetic the circulation, the larger the quantity of carbonic acid; it is less during sleep than while awake, and less during fasting than after a full meal. 2. Is it best to have a constant change of air from the outside into a room in which we are sleeping? A. A sleeping apartment should always have adequate ventilation while in use.

(16) O. D. asks: I have heretofore worked the burglar alarm apparatus in my house by the Leclanché battery, of which I use 6 cells. But this winter they stopped working. I then put in 6 new cells of the same; still they did not work. I then substituted the ordinary sulphate of copper battery, and have had no trouble since. Now can you tell me what probably was the matter with the Leclanché? Did the cold weather produce any mischief? A. No. The Leclanché battery will stand as much cold as the sulphate of copper. Did you test your Leclanché cells separately on short circuit to see if the connections were good?

(17) H. M. asks: What chemicals are used to render paper sensitive so that you can photograph directly on it? A. Chloride of ammonium 40 grains, gelatin 20 grains, water 20 ozs. Dissolve by the aid of heat and filter when cold. Take 10 or 12 sheets of thin clear paper, and, having marked the right side, immerse them bodily in the liquid one by one, taking care to remove air bubbles; then turn the batch over, and remove them singly, beginning with the sheet immersed first. Render the paper sensitive by a solution of ammonio-nitrate of silver, 60 grains to the oz. of distilled water.

Is there any chemical that I can insert in the bark or sapwood of trees, that will kill them? A. Try a strong solution of chloride of zinc.

(18) J. W. L. asks: Can I light gas by electricity? A. Put on a pair of dry slippers, and walk briskly over a carpet. You will thus charge yourself with electricity, and may light the gas with your finger in dry cold weather.

(19) P. J. N. asks: 1. To what pressure per square inch can air be subjected by means of the air pump? A. A maximum of condensation has not been reached. It depends altogether upon the strength of the pump, its valves, and the power and velocity with which it is driven. 2. What work is the best on pneumatics? A. Ganot's "Physics."

(20) E. L. F. asks: Why does a distant light scintillate like a star? A. Because of the interposed changing layers of air of different densities. The diverging rays are caused partly by the irregular figure of the crystalline lens of the eye, and are partly owing to the pull of the six muscles which move it.

(21) W. B. H. asks: 1. How many Grove cells are required to operate a line half a mile in length, using No. 14 common iron wire, with a relay at one end of 100 ohms, and at the other a relay of 120 ohms? A. Two cells. 2. How can I charge a main line Grove battery of 10 cells? A. Cover the zincs with quicksilver. Put 16 parts water to 1 part sulphuric acid for the outer solution, and use pure nitric acid of commerce for the porous cup. 3. How often should it be replenished? A. Replenish the nitric acid every day and the solution once a week. Brush the zincs every day.

(22) C. W. asks: Which is the heavier, a cubic foot of water or of ice, and what is the difference? A. The water is the heavier. If one cubic foot of distilled water at 39° Fah. weigh about 62¾ lbs., one cubic foot of pure ice will weigh about 58⅓ lbs.

(23) A. C. asks: What acid is used to mix with urine to detect Bright's disease of the kidneys? A. Nitric acid. Urine when mixed with nitric acid and boiled should coagulate if the person is suffering from Bright's disease.

(24) J. D. W. asks: 1. Is the Leclanché battery inodorous and constant? A. Yes. 2. Do the contents of the porous cups ever have to be removed and renewed? A. Yes. 3. What are the proportions of sal ammoniac and water to a quart cell? A. Two thirds full. 4. What is the reaction? A. Ammonia is set free at the negative pole, while the nascent hydrogen from the ammonium reduces the peroxide of manganese to sesquioxide. The zinc unites with chlorine, forming chloride of zinc.

(25) W. H. B. asks: Is there a solution which, mixed with pure white quicklime, will harden it into stone in 24 hours? A. Soluble glass, or silicate of potash or soda, is used for this. You will find it advertised in our columns.

(26) R. M. C. asks: What is the latest and and best work on electro-metallurgy? A. "Manual of Electro-Metallurgy," by James Napier.

(27) D. X. asks: What are the powers and focal lengths of the two largest equatorial refractors? A. That at Washington is 26 inches clear aperture, weighs 180 lbs., and was nine months correcting. The new McCormick telescope is a trifle over 26 inches aperture, was eight months correcting, and weighs 170 lbs. Both are of about 33 feet focus, and their highest power is 2,000 diameters. The objectives alone are worth $25,000 each. The government equatorial cost $46,000 currency, the McCormick $38,000 gold.

(28) H. H. asks: 1. What battery, and how many cells, would be the best for electroplating and making an electric light? A. For electroplating, 2 cells of Smee's battery. For electric light, 50 cells of Bunsen's. 2. What solutions should I use for gold, silver, nickel, and copper plating? A. Gold solution, 1 grain of gold and 10 grains of cyanide of potassium in 200 grains of water. For silver, 2 grains of cyanide of silver and 2 parts of cyanide of potassium in 300 grains of water. For copper, a saturated solution of sulphate of copper. For nickel, See p. 346, vol. 31.

(29) C. J. W. says: 1. I have made a Morse sounder, key, and battery for telegraphing. I made my horseshoe magnet by winding the covered wire round in the usual way, only I wound both poles to the right and then joined the wires. I made another by screwing two cores into a flat base, and wound one pole to the right and the other to the left. This has a neater appearance. Which is the best in your opinion? A. They must be so wound that the current shall flow in the same direction in both. 2. Does it make any difference to a magnet if the wires from the battery are first applied in one way, and then (by mistake) reversed? A. No. 3. How is the electric bell made? A. The armature lever closes an electric circuit when the spring draws it back, and opens it when the magnetism draws it forward. 4. What is meant by positive and negative poles of a bat

tery? A. The copper pole is positive and the zinc negative. 5. What are the right proportions of sulphuric acid and water for the Bunsen battery? A.One acid to 19 water. 6.What are the proportions of bichromate of potash and sulphuric acid for the porous cup? A. Two ounces of bichromate of potash to 20 water and 10 sulphuric acid. 7. Is the Bunsen a good battery for telegraphic purposes? A. Yes. 8. How many cells should I have for 100 feet of very thin copper wire? A. One cell.

(30) C. B. L. asks: What cement will do for cementing emery together to form wheels? A. Try oxychloride of zinc.

(31) S. & S. ask: Does distilled water contain any vegetable, mucilaginous, or albuminous substances? A. It should not when distilled in proper vessels, and dust excluded.

What substance is best to use to test oils for mucilaginous or albuminous matters? A. Strong oil of vitriol should produce a stain by carbonizing mucilaginous matter, etc.

(32) B. & S. ask: Is there any preparation for coating the seams of large wrought iron tanks so as to prevent the leakage of alcohol? The tanks are for storing it; they are perfectly watertight, but the spirit, being of a much less specific gravity than water, oozes out. A. Try cotton cloth soaked in glue, and cold rivet with this between the plates. Let us know if this succeeds, and also the results of other expedients tried by you; and we may be better able to inform you of a mode of procedure.

(33) P. W. asks: How could I make my cider foam like ale, and at the same time be clear and bright as wine? A. Try adding a little sugar to the bottled cider.

(34) G. F. C. asks: What is the reason that coal oil freezes at 3° below zero? It is almost white after being frozen. A. Coal oil is composed of numerous compounds, whose volatility and melting points vary greatly. Your oil is probably rich in some of these denser bodies, such as paraffin, which congeal before attaining a very low degree of temperature.

Can rosin from the bow be removed without injury to a varnished violin? It may be removed by a little ether; expeditiously applied.

(35) C. G. says: I am a distiller of virgin turpentine in a copper still of about 800 gallons. By what process can I so clarify the turpentine as to make window glass rosin? I think that the dregs or particles of bark, wood, etc., prevent the rosin from being transparent after distillation. A. Common rosin or colophony essentially consists of pinic acid mixed with a little sylvic acid. Its dark color is traced to pinic acid. White rosin is obtained from Bordeaux turpentine by digesting the powdered rosin, six parts of cold alcohol, and one part of ether, and the residue is treated with boiling alcohol. This solution is next evaporated down, and the rosin melted and allowed to cool, yielding a colorless glass as clear as crystal.

(36) C. R. W. asks: How can four messages pass over one wire at the same time? A. There are various methods of doing it, but the method employed by the Western Union Telegraph Company is probably the best. This is simply a modification of Stearns' duplex, by the addition of a current reversing key and a polarized relay to his bridge plan. The polarized relays are worked by a change of polarity in the battery, and the Morse relays by an increase of potential. Some knowledge of the more advanced methods of telegraphy is required to understand the details of the arrangement, but the above outline will convey a correct and intelligible idea of the general principle upon which the apparatus depends for its successful operation.

(37) M. A. B. asks: If we have two cisterns each 20 feet deep, one filled with hot water at 200° Fah., and the other with cold water, will there be any difference in pumping the water with pumps of equal size? A. The power required will be that which is necessary to lift the water. The weight of a cubic foot of water at 60° Fah. is 62½ lbs., while at 200° it is $60\frac{8}{10}$ lbs.; the cold water, therefore, will be the hardest to pump. If the piston of the hot water pump is above the surface of the water, it will not pump water but steam; for as soon as the pressure of the atmosphere is removed from the water in the pump, steam will form and fill the vacuum, and so balance the atmospheric pressure upon the surface outside the pump. At 15 lbs. to the square inch pressure, water will boil when it contains 212° of heat, at $11\frac{6}{10}$ lbs. pressure it will boil at 200°, and at $\frac{9}{10}$ of a pound pressure it will boil when heated to only 100°. Thus it is seen that steam is easily formed in the pump, in proportion as the pressure is reduced; and steam will be pumped instead of water in the case of the hot tank.

(38) A. E. S. asks: 1. Can there be a mixture of lard and kerosene made, that would be safe to burn at 212° Fah.? A. No. The inflammability of the mixture will depend upon the burning point of the kerosene, which will not be rendered higher by mixture with the lard oil. 2. Please give me a recipe for making signal oil. A. Use a lard oil.

(39) J. McK. asks: I contend that no steel can be made without carbon. My friend claims that chrome steel, by the introduction of chrome ore into the crucible with ordinary iron, secures the different grades in proportion to the amount of chrome used. I claim further that the result of such a process is not steel, but an alloy or chromate of iron. Which is right? A. It may be steel, because the iron itself contains carbon, the presence of which is, as you say, essential to the formation of steel. The chromium enters, like manganese and other metals, as an alloy, and modifies the properties of the steel.

(40) J. B. G. asks: What is the difference between a high pressure and a low pressure engine? A. In one the steam is condensed, in the other it is exhausted into the atmosphere.

What is the average temperature at Peru and at Rio de Janeiro? A. About 75° Fah. in each case.

How many miles of railroad are there in Brazil? A. Between 400 and 500.

(41) A. P. A. asks: Can compressed air give the same amount of power as steam, used in a common engine, the compressed air and steam having similar pressure? A. Yes, if worked under the same conditions.

(42) D. K. J. Jr. asks: How can I ascertain the heaviest blow which a steam hammer of given dimensions is capable of giving? A. It could only be ascertained by experiment.

(43) F. E. H. says: I have made a large wooden trough to hold a silver solution for electroplating. With what shall I cover the inside, so that the solution would have no effect on it? A. Marine glue.

Would an engine of 2 inches bore x 4 inches stroke furnish power enough to run a polishing lathe? A. Yes.

(44) A. J. B. asks: What is meant by 6 to 1, or 3 to 1, or 1½ to 1, which we see on architects' details? A. It means that, of the two things compared, one has 6, 3, or 1½ times the measurement of the other. Thus, if the lengths are as 6 to 1, the length of the first is 6 times that of the second. The expression is used similarly of area, volume, hardness, strength, velocity, etc.

(45) C. L. G. asks: At what place in the United States was the first steam railway built? A. The Baltimore and Ohio Railroad; it was commenced in 1828. Fifteen miles were opened in 1830, horses being used until 1831, when a locomotive was brought into use.

(46) F. H. D. asks: 1. If a small quantity of nitro-glycerin were exploded in a vessel strong enough to withstand the shock, how long would the gas thus formed retain its pressure? A. Probably the pressure would commence to diminish at once, as the gases cooled down. 2. How much pressure would 1 oz., if exploded as above, exert if confined within a cylinder 12x24 inches? A. This is a matter that could only be settled by experiment. It is supposed that one volume of nitroglycerin produces about 10,000 volumes of gas after explosion; but if it were rigidly confined, complete explosion might not take place. 3. Would there be any shock or noise following the burning of nitro-glycerin in such a vessel? A. We presume not, if the vessel were perfectly rigid. We advise you to turn from idle speculation of this character to something of practical importance.

(47) E. A. P. asks: 1. What pressure per square inch will a column of water 90 feet high exert? A. This column will require a pressure of 40 lbs. by steam gage to sustain it. 2. Will a steam boiler pressure (by the gage) sustain the column? A. This will depend on the size of pipes, bends, etc. Under average conditions, you could expect to get a hight of 50 or 60 feet.

(48) G. W. H. asks: 1. What would be the loss, by friction and other causes, in the conveyance of compressed air at 60 lbs. per square inch to a distance of 1,600 feet? The pipe is to be about 1½ inch gas pipe. A. Two or three lbs. pressure per inch. 2. What would be the loss in pressure of steam under similar circumstances, the pipes being well protected? A. Double the above.

(49) A. M. says: My friend says that a stove with thin plates requires more fuel than a stove with thick plates. I say the contrary. Which is right? A. You are.

(50) N. P. B. says: 1. My small cast iron castings are too hard. How can I make them soft enough to drill and file nicely? A. It would be well to use a better quality of iron. 2. What can be used for the purpose of bedding one rough piece of casting to another, besides putty or plaster of Paris? The extent of the surface is 6x12 inches, and the openings range from ¼ inch to the least thickness. A. See a forthcoming article on "Glues and Cements."

What is the best way by which large grindstones are trued up when worn out of truth? A. The common method is to use an iron tool with a hooked point.

(51) J. J. W. says: I am a blacksmith by trade, and am bothered with my swage iron becoming bare and exposed to the fire. I have been using common yellow clay to bed it with. Is there anything which will stand the fire and not crumble away as the clay does? A. Try firebrick, set in fire clay.

(52) J. S. B. asks: How is music made on glass goblets, and how are they tuned? A. By moving the moistened finger around the rim, which puts the material of the goblet into vibration, after the manner of a bell. They can be tuned by having different quantities of liquid in them, or by grinding them until they produce the right note.

How are the magnets of a telegraphic sounder constructed? A. See p. 379, vol. 30.

(53) W. C. K. asks: Can a piece of steel be refined and made to stand as good a temper, by pressing it into shape by machinery, as a similar piece forged by hand, using the same style of die? A. In general the hammered steel will be the best.

(54) J. F. B. asks: What would be gained by applying a condenser to an engine of the following dimensions: Diameter of cylinder 22 inches, length of stroke 4 feet, with automatic cut-off balanced poppet valves, gridiron slide valves, and exhaust open full length of stroke, running 60 turns per minute under from 60 to 80 lbs. of steam? The engine is scarcely ever called on for more than half her power, about 60 or 70 horse. A. As a general rule, if an engine is in good order, a condenser makes a saving of at least 25 per cent. As you will see, however, by the article on the subject, p. 256, vol. 31, you do not send enough data.

(55) W. D. G. asks: Which of the following metals will best stand exposure to heat without warping, sheet steel, sheet iron, cast iron from $\frac{1}{16}$ to $\frac{1}{10}$ of an inch in thickness? A. All metals will be liable to warp, if exposed to high temperature in the form of large and thin sheets. Probably cast iron will answer as well as any other.

What are the largest sized sheets of mica that can be had for use in blowers for fire grates? A. About 8 by 10 inches.

(56) A. D. B. says: 1. In building a large brick cistern lined with cement, would it be of service to brush over the cement with water glass? A. The use of water glass solution is of doubtful policy. 2. Is Portland cement enough better than Rosendale for lining cisterns to pay for the difference in cost? A. Yes, if you get the best kind of Portland cement. It is not always uniform in quality.

(57) H. Y. N. says: I have an engine of 36 inches stroke, with plain slide valve, having 2¾ inches travel. It cuts off steam at $\frac{9}{11}$ of the stroke and exhausts at $\frac{10}{11}$. The exhaust port is open ¼ inch before it takes steam at the other end. Is not ¼ inch more clearance than is necessary? If I arrange to cut off at 20 inches, should I make the clearance less? A. It would not be well to decrease it.

(58) A. E. P. asks: 1. How many horse power can I get from an engine, the cylinder of which is 4¾ inches in diameter by 9 inches stroke, with 80 lbs. steam? A. From 4 to 5 horse power, under favorable conditions. 2. Is said engine powerful enough to run a circular saw, 18 inches in diameter, for sawing shingles? A. Yes.

(59) R. M. asks: Why is it that a greater number of drivers are used on locomotives designed for heavy draft, since the adhesive friction is not dependent upon the extent of surface contact? A. To avoid bringing excessive weight on any one driver.

(60) J. P. N. says: On a very cold day I had to keep the cold water faucet in the kitchen dripping constantly in order to prevent freezing. About sunset I noticed that our girl had shut the water off, and the sink (a cast iron one) had become dry. I opened the faucet full and suddenly, when, the instant the water touched the iron, an explosion occurred at that point, sounding very like a gun cap, only louder. Can you explain this? A. We have often noticed the expulsion of air under such circumstances, accompanied by a kind of explosion. We have never, however, witnessed precisely what you describe, and without further information must confess that we cannot explain it.

(61) A. C. asks: 1. Is it practicable to line a water reservoir (to hold 1,000,000 gallons) with plate iron from ⅛ to $\frac{3}{16}$ of an inch thick? A. Yes, perfectly. 2. Is there any material good for coating the iron with to prevent rust? A. Pitch would make a good material for coating the iron, or the plates might be galvanized.

(62) X. Y. Z. says: A. claims that the air is lighter when smoke does not rise. I say that it is heavier. Which is right? A. Sometimes the smoke does not rise because the barometer is low, that is, the pressure of the air is diminished. At other times, as in damp weather, the smoke is cooled down, and will not rise, even though the pressure of the atmosphere is the same as before. 2. A. also claims that the wind lowers the mercury in a thermometer. I say that the wind has nothing to do with it. Which is right? A. You are.

What is a good cement for joining the angles of an aquarium, built of glass and wood? A. Make a mixture of boiled linseed oil, litharge, and white and red lead.

Has a law permitting any person to make and sell any patented article, on payment of 10 per cent to the owner, been passed? A. Such a law was proposed, but has not been passed.

(63) J. A. B. asks: What size of engine would be the most economical for driving a two run flouring mill and attachments? A. The question is rather indefinite, but we imagine that an engine with cylinder 7x9 will answer your purpose very well. If you use shavings for fuel, a plain slide valve engine will give good satisfaction.

Which has the fastest motion, the top of a wagon wheel or the bottom? A. Considering the rate of motion with respect to a fixed point without the wagon, the top of the wheel runs the fastest.

(64) L. A. C. asks: What is the cause of ice forming on the bottom of the bay at Rockaway? It is sometimes from two to three inches in thickness. A. It is doubtless formed at low tide, and afterwards covered with water.

(65) M. asks: What is the philosophy of warm weather driving the frost into the ground still deeper? It seems to be a fact that water pipes laid four feet deep are more apt to freeze when warm days come than during the coldest weather. In other words, when it commences to thaw, the frost in the ground extends to a greater depth than before. A. We never observed that this was a fact, but it is easy to understand that the freezing process may go on underground when it is thawing above, since it takes time, as well as cold, to produce frost and ice.

(66) C. O. H. asks: Is it practicable to use a wire rope (instead of chain or hemp rope) over pulleys 3 inches in diameter, where there would be an unsteady strain of from 100 lbs. to 400 lbs.? A. It would not be easy to use a wire rope with such small pulleys, or, indeed, a hemp rope or chain, unless some special construction were adopted.

(67) H. M. F. asks: Can you give me a method for determining the pitch line of a cog-wheel, having the number of cogs and the pitch? A. We could not do the subject justice in our limited space. You will find it well treated in Rankine's "Machinery and Millwork," or in the "Machinist's Assistant."

Can you give a recipe for making a preparation for sticking drawing paper to a board? A. Good paste answers very well.

(68) F. McG. asks: If equal quantities of salt water and fresh water were put in a vessel, which would come to the top? A. They would mix, but not very readily; and the lighter of the two, the fresh water, would tend to go to the top.

(69) G. V. asks: What is the momentum of a body of a given weight moving at a given velocity? Take for an example the piston, rod, walking beam, and connecting rod of a steamer. How much power is required to arrest the motion of these parts, and to move them in a directly opposite course? A. To change the motion suddenly from one direction to the opposite direction, with the same velocity as before, the energy of the moving mass must be overcome, and an equal amount of energy impressed. The force required to overcome the energy of a moving mass is found by multiplying the weight of the body in pounds by the square of the velocity in feet per second, and dividing by 64·4.

(70) W. E. H. asks: We have been putting in two new turbine water wheels under 21 feet head, using 52½ cubic feet of water per second. We bring the water to the wheels in a round wooden trunk of 208 feet length and 6 feet inside diameter. The trunk is made of white pine, 3 inches thick and hooped with iron hoops, ½ inch thick by 2 inches wide. The hoops are placed 2 feet apart, from center to center. The lags are 44 in number to the circle of the trunk, each lag being driven 2 feet, there being no more than 7 joints under any hoop. At the upper end of trunk we put an air pipe 8 inches in diameter. When the wheels are running, the volume of water passes through the trunk at a speed of from 2 to 3 feet per second. What is the shortest time in which it will be safe to shut the gates without danger of bursting the trunk? We have a regulator connected with the wheels which will shut the gate in 40 seconds. A. We think it will be perfectly safe to close the gate in the time mentioned. It might be well to connect a pressure gage to the trunk, and see exactly what change of pressure occurs from shutting the gate quickly.

(71) W. F. S. asks: 1. Do you think it a good plan to force hot water through the tubes of a horizontal boiler 15 feet long, 3 feet in diameter, with 24 three inch tubes? The boiler is new, made of ⅜ inch iron doubly riveted. A. We understand you to refer to cleaning the tubes by forcing hot water through them. We do not recommend this. It is better to use a brush or scraper. In special cases, steam can be employed with advantage. 2. My engine is a horizontal; cylinder is of 9 inches diameter and 18 inches stroke. It drives about 8 horse power. I carry steam at 60 lbs. and exhaust into about 1,000 feet of three inch heating pipes, the lever to back pressure valve having considerable weight on it. I burn between 5 and 6 cwt. of Pittston nut coal per day, and very little smoke comes from the chimney. I would like to put an indicator on my engine, but I cannot get one here. Am I using too much coal? We cannot tell certainly whether you are running economically, but it seems to us that you are managing very well.

(72) J. N. T. says: I grouted the floor of my cellar some two years ago with a mixture of sand, gravel, lime, and cement. Since it became dry, it has continually ground off from the top into a fine lime dust, making it impossible to sweep without raising a great dust, besides wearing down into the larger gravel in some places where it is used most. Can you suggest through your columns a cheap wash or paint that will harden the surface and obviate the dust? A. Wet the surface and float it over with a thin, pasty coat of Portland cement of best quality. This may give you the surface you want.

(73) S. says: I have an icehouse whose dimensions are 89 feet 6 inches long, 22 feet 6 inches wide, and 14 feet 9 inches high. How many tuns of ice will it contain? A. Multiply the length by the breadth, and this product by the hight, all in feet, and the result will give you the number of cubic feet of contents in your icehouse. Then, as there are about 40 cubic feet in a tun of ice, divide the said number of cubic feet by 40, and the quotient will indicate the number of tuns of ice the house will contain if filled full in all parts solid (about 742 tuns in this case). But allowance must be made for vacant spaces in every case. Weight of a cubic foot of ice, 57½ lbs.

(74) D. W. S. asks: 1. Is a single Bunsen quart cell sufficient to magnetize a horseshoe bar within a helix? A. Yes. 2. Must a helix be made of copper wire, or will soft iron wire answer the same purpose? A. Copper is better.

(75) H. L. C. says: I have a battery of four Hill cells, and a key and sounder. I used No. 32 cotton insulated wire for my sounder. When I arrange my battery for quantity (all zincs on one wire and all coppers on the other), the sounder is so faint that it cannot be heard. What is the difficulty? A. The wire is too fine in your sounder.

(76) G. G. B. says, in reply to J. C. W., who asks how to tin small lead castings: Clean your castings well, rub them with powdered rosin, and dip them in a tin bath. Be sure to use plenty of rosin.

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

J. M. H.—It is iron pyrites.—R. L.—It is tin.—W. S. N.—It would be difficult to form an estimate from the pieces of ore sent, which are of ferruginous quartz rock. If you desire to have an assay, it would be necessary to send sufficient of what you regard as average rock, to yield about an ounce of the ore. The expense of the assay for silver would be $10, for silver and gold $20. If the surface indications are as you state, it would be well to locate the vein.—W. H. G.—It is tin.—R. L.—No. 1 is sulphide and carbonate of copper. No. 2 is the same as No. 1, with quartz. No. 3 is carbonate of copper with oxide of iron. No. 4 is oxide of manganese with quartz. No. 5 is yellow oxide of iron. No. 6 is oxide of manganese, containing carbonate of lime.—J. E. G.—It is actinolite, a silicate of magnesia and lime with a small percentage of the oxides of iron and manganese. It is not valuable as an ore.—J. C. B.—It is a compact slate, containing a considerable amount of iron pyrites; this has been converted by exposure to the weather to a white incrustation of sulphate of iron, which is soluble and gives the disagreeable taste. No. 2 is a fine sand rock containing some alumina.—B. S.—The specimen of granite sent has a fine color, is tough, and would come into use for the purposes to which red granite are applied.—H. L. A. C.—The red mineral is red ocher, or sesquioxide of iron; the crystals in the cavities are quartz, which have occupied the place of crystals of another species; the other mineral, glassy but softer than quartz, is sulphate of barytes or heavy spar.—J. C. B. T.—It is sulphide of lead, or galena.

E. J. B. asks: What will cure blindness in chickens? The disease, which is contagious, consists in a sort of yellow scum growing over the sight of the eye, and comes, I have been told, from overfeeding with corn.—D. G. asks: How can I prepare small blocks of wood so that they will not expand when exposed to the action of steam, nor contract when exposed to the atmosphere of 100° Fah.?—H. B. asks: Does the hair grow after death? If so, why ?—W. says: A cast iron ball 18 inches outside diameter, cored out to 12 inches, leaving a shell 3 inches thick, with one hole 1½ inches in diameter through the shell, lay in such a position that it filled with water. The water froze, and with a loud report the ball was torn in three pieces. How many tuns pressure did it take to tear asunder the ball, and why did it give a report in bursting?—W. J. B. asks: What is the best method of grinding leger blades for shearing woolen cloth?

COMMUNICATIONS RECEIVED.

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

On Propelling Yachts. By H. W. H.
On the Birth Rate. By F. Y. A.
On the FishJointed Rail. By F. A. B.
On an Ore-Roasting Furnace. By E. H.
On Talking Ants. By J. S.
On Rifle Projectiles. By J. M.
On Spiritualism. By F. H. R.
On an Invisible Gas Lighter. By E.
On Telegraph Alphabets. By J. W. C.
On the Sagacity of the Partridge. By J. K.
On Mathematical Problems. By A. E. O.
On Perpetual Motion. By J. W.
On Small Steam Engines. By E. W.
On Engine Valves. By L. F.
On Pneumatic Transmission. By S. P. D.
On Balloons. By W. A. W.
On the Drive Wheel of a Locomotive. By J.A.K.

Also enquiries and answers from the following:

F. A. R.—H.—G. G. C.—J. W. C.—J. N. N.—A. M. C.—J. C.—J. E. B.—W. J. D.—G. A. B.—J. V. M.—R. D. C.—M. F. R.—P. P. J.—T. F. & Co.—F. A. G. B. W. G.—C. T. E.

HINTS TO CORRESPONDENTS.

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

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

Hundreds of enquiries analogous to the following are sent: "Who sells dollar steam engines? Who makes pens for ruling machines? Who sells sextants and quadrants? Who makes endless chain? Who makes a machine for cutting dough into pieces of similar weight? Who sells hemispherical anemometers? Who makes blowers suitable for furnaces for melting iron? Who sells nitroglycerin? Who sells stereotyping appliances? Who sells materials for decalcomanie, vitrimanie, and diaphanie?" All such personal inquiries are printed, as will be observed, in the column of "Business and Personal," which is specially set apart for that purpose, subject to the charge mentioned at the head of that column. Almost any desired information can in this way be expeditiously obtained.

[OFFICIAL.]

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31,252.—IRON BALE TIE.—J. J. McComb.
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31,324.—LOOM.—Jno. Davis.
31,330.—CARRIAGE WORK COLLAR.—M. Seward.

DESIGNS PATENTED.

8,070, 8,071.—PAPER.—H. D. Cone, Stockbridge, Mass.
8,072.—CARPET.—J. H. Smith, Enfield, Conn.
8,073 to 8,106.—CARPETS.—O. Heinigke, New Utrecht, N. Y.
8,107 to 8,125.—CARPETS.—H. Horan, East Orange, N. J.
8,126 to 8,131.—CARPETS.—L. G. Malkin, New York city.
8,132 to 8,151.—CARPETS.—E. J. Ney, Dracut, Mass.
8,152 to 8,159.—CARPETS.—H. Nordmann, New York city.
8,160.—CARPETS.—G. W. Piggott, New York city.
8,161.—WORK STAND.—M. S. Dunn, Rochester, N. Y.
8,162.—CARPET.—H. F. Goetze, Boston, Mass.
8,163.—ROCKING CHAIR.—G. M. Harwood, Troy, N. Y., et al.
8,164, 8,165.—GLASS DISHES.—G. W. Lowry, East Cambridge, Mass.
8,166.—SPOON HANDLE.—C. Osborne, N. Attleboro', Mass.
8,167 to 8,171.—CARPET.—J. H. Smith, Enfield, Conn.
8,172.—CARPET.—F. W. Green, Orange, N. J.
8,173 to 8,176.—CARPET.—J. H. Smith, Enfield, Conn.
8,177 to 8,179.—CARPET.—W. H. Smith, Enfield, Conn.

TRADE MARKS REGISTERED.

2,247.—SILVER POLISH.—W. E. Dunham, Fall River, Mass.
2,248.—SHAFTS, ETC.—J. A. Leippe, Lancaster, Pa.
2,249.—CIGARS.—S. Lowenthal & Co., Cincinnati, Ohio.
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2,253.—TEAS.—Williams & Co., San Francisco, Cal.
2,254.—COSMETIC.—A. Deland, New York city.
2,255.—CIGARS.—A. W. Foote, Brooklyn, N. Y.
2,256.—TOOTH PASTE.—Forster et al., Philadelphia, Pa.
2,257.—CIGARS.—Goldsmith et al., Cincinnati, Ohio.
2,258.—POCKET STOVE.—G. P. Houston, Washington, D. C.
2,259.—STEAM ENGINE, ETC.—V. Mauger, New York city.
2,260.—COTTON PRESS.—Mrs T., C. Nisbet, Macon, Ga.
2,261.—PAINT OR CEMENT.—E. W. Tibbels, Chester, Pa.

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CANADIAN PATENTS.

LIST OF PATENTS GRANTED IN CANADA,

FEBRUARY 26 to 27, 1875

4,430.—E. H. Aydon, Wandsworth, England, et al. Improvements in smelting, etc. Feb. 26, 1875.
4,431.—Wm. Johnson et al., Montreal, P. Q. Plane iron adjustments. Feb. 26, 1875.
4,432.—H. M. Converse et al., Waterloo, P. Q. Blind and scene apparatus. Feb. 26, 1875.
4,433.—J. B. Tison, Montreal, P. Q. Window fastener. Feb. 26, 1875.
4,434.—P. Beaudry et al., Ottawa, Ont. Motor. Feb. 27, 1875.
4,435.—J. Dewe, Ottawa, Ont. Mail or despatch bag. Feb. 27, 1875.
4,436.—H. J. Young, Lansdowne, Ont. Hay loader Feb. 27, 1875.
4,437.—J. B. Brown, Stanstead, P. Q. Milk cooling apparatus. Feb. 27, 1875.
4,438.—S. T. Lamb, New Albany, Ind., U. S. Nut lock and washer. Feb. 27, 1875.
4,439.—S. L. Crocker, Taunton, Mass., U. S. Smelting and refining copper ores, etc. Feb. 27, 1875.
4,440.—L. Miers et al., Lynden, Ont. Horseshoe machine. Feb. 27, 1875.
4,441.—R. Eaton, Montreal, P. Q. Freight car. Feb 27, 1875.
4,442.—L. A. Frigon, Montreal, P. Q. Spring bed. Feb 27, 1875.
4,443.—D. R. Winnett, London, Ont. Oil still. Feb. 27 1875.

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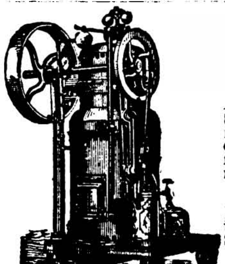

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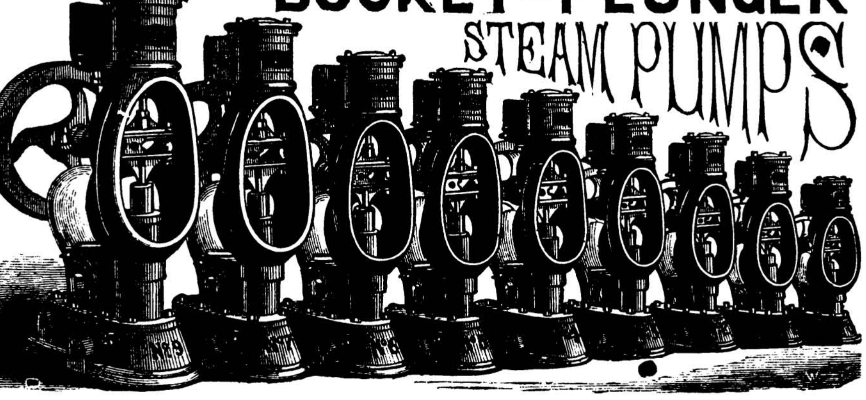

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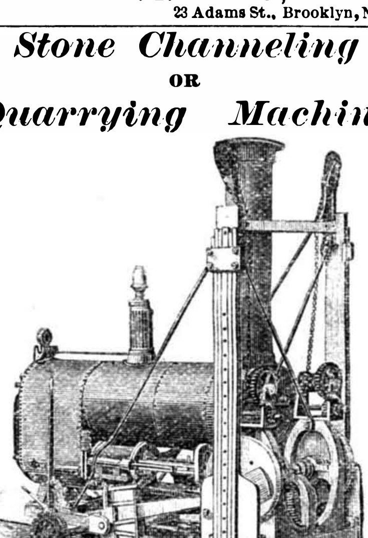

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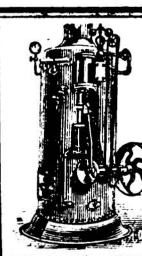

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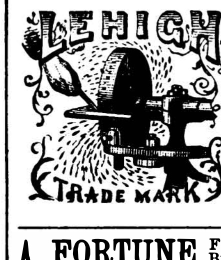

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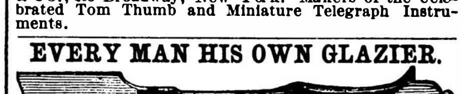

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