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[NEW SERIES.]

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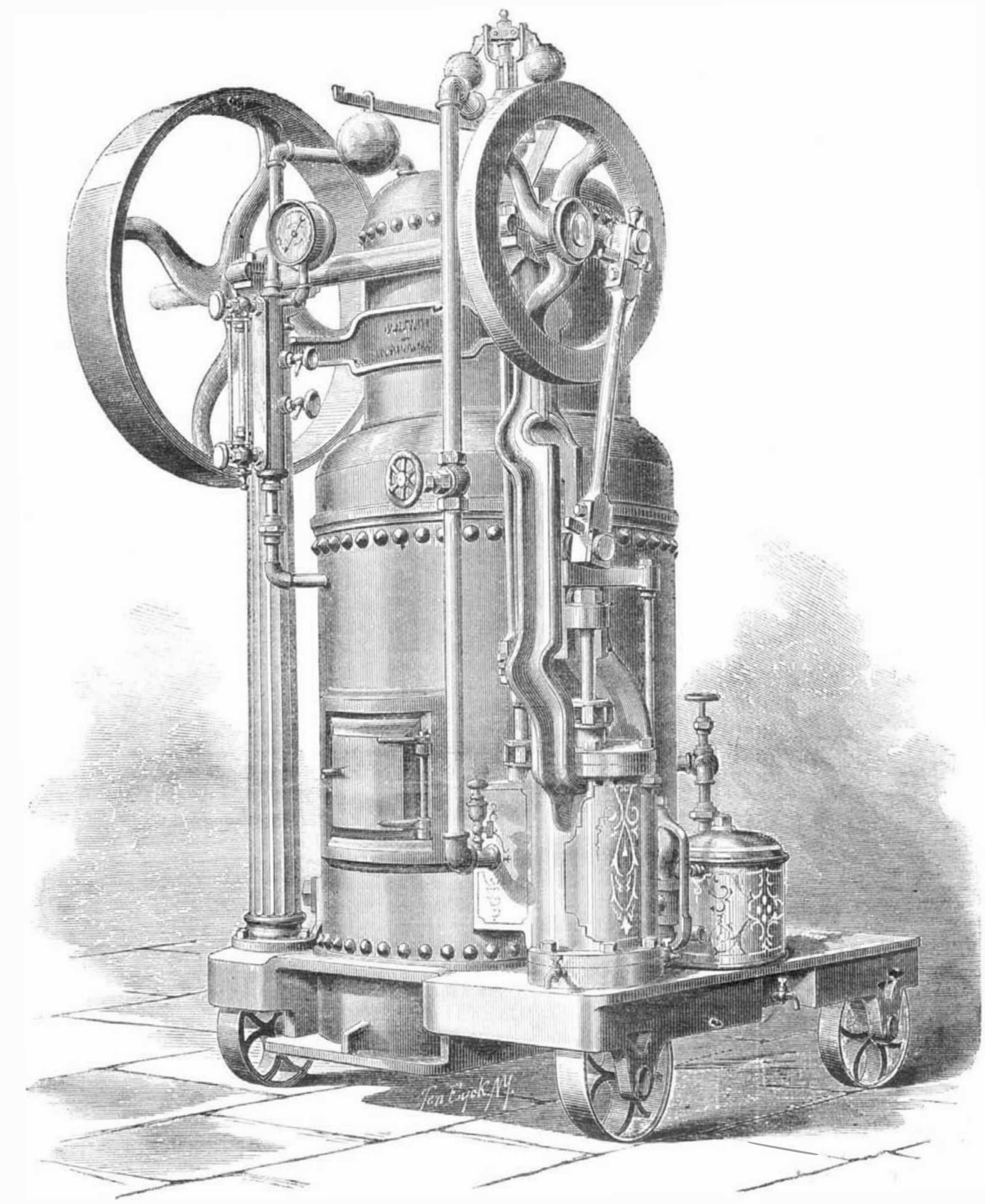
THE SHAPLEY ENGINE.

A new portable engine, which is claimed to possess the advantages of cheapness and economy, in addition to those of simplicity and compactness, is the subject of the annexed illustrations. The principal features of the invention, which render it an improvement of value, lie mainly in the construction of the boiler, since the engine proper is, as will be seen from the large perspective view, a single upright cylinder with the ordinary slide valve mechanism. There are some minor arrangements in connection with the engine, notably improved stuffing boxes and a neatly contrived feed water heater, which add to the general efficiency; but these, as well as the build of the machine as a whole—except, perhaps, to note that this last is substantial in all respects—may be passed over, in order to direct attention at once to the novelties in construction of the steam generator.

The idea is to build the boiler to generate the greatest amount of steam, and, at the same time, to have a sufficient reservoir for the same. From the sectional view, Fig. 2, it will be seen that the fire box is conical in shape. The heat thus concentrated in the upper portion passes through the horizontal cross tubes, A, thence, following the course of the arrows, down the vertical tubes, B, and finally into the hollow base, at the rear of which it escapes up the flue. This arrangement gives an unusually large amount of heating surface in comparatively small space, the result of which is an economy in consumption of fuel. From actual tests, we are informed that the fuel used does not exceed two and one half lbs. per horse power per hour, and in some cases less than two lbs. has sufficed.



THE SHAPLEY PORTABLE ENGINE.

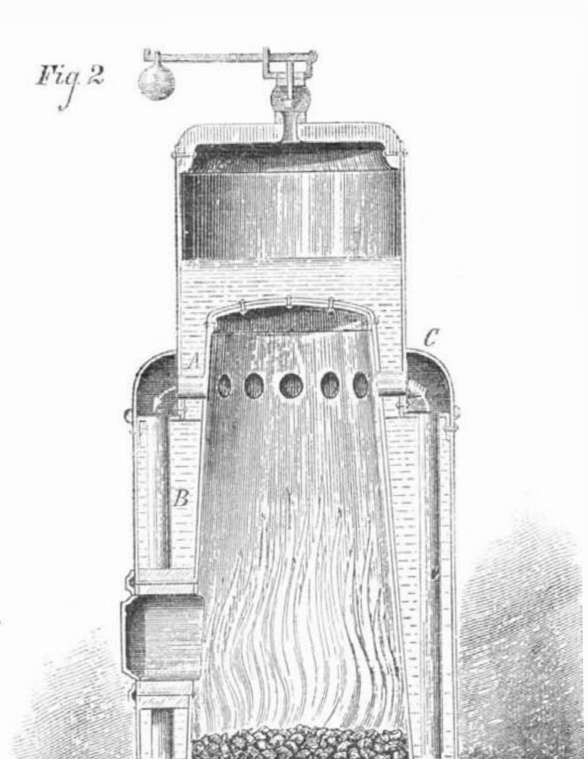
In order to provide for cleaning the tubes, a detachable jacket is placed between the two sections of the boiler, at C. This can be very easily removed by taking out the bolts, since it is made in two parts. The tubes are then cleaned with a short flue brush, the jacket replaced, and the joints filled with wet clay.

So far as material is concerned, we are informed that none but the best is used. The boiler is thoroughly stayed over the crown sheet of the fire box; and since all the heating surface is below the water line, there is very little chance of its burning out. Sixty pounds of steam is the calculated pressure, but one hundred pounds may be safely carried, since all the boilers are tested to a cold water pressure of one hundred and thirty pounds. They are inspected and provided with certificates by the State Inspector of New York.

The spark trouble—a matter of considerable moment where a boiler is fired in the neighborhood of inflammable material or buildings—is effectually done away with. The sparks are drawn down through the upright tubes and dropped in water on the base; and, as an additional preventive, the exhaust steam passes through the heater into the smoke stack, also giving aid to the draft.

Nothing in the shape of gages, oil cups, fittings, etc., is omitted to render the machine complete. All parts are made in duplicate. The various portions of the engine may be easily adjusted, even when steam is on, thus avoiding delay. The sizes made are 5, 8, and 12 horse power.

Patented February 10, 1874. For further particulars, address Messrs. Tully & Wilde, General Agents, 20 Platt street, New York city.



Chinese or Indian Ink.

Although the Chinese prepare their ink from the kernel of some amygdalaceous fruit, yet, by the aid of our present chemical appliances, we are able to produce a composition in no way inferior to the best Chinese ink, by the adoption of a formula which is given in Riffault's treatise on the "Manufacture of Colors." The following is the formula:

Calcined lampblack, 100 parts; boghead shale black, in impalpable powder, 50 parts; indigo carmine, in cakes, 10 parts; carmine lake, 5 parts; gum arabic (first quality) 10 parts; purified oxgall, 20 parts alcoholic extract of musk, 5 parts.

The gum is dissolved in 50 to 60 parts of pure water, and the solution filtered through a cloth. The indigo carmine, lake, lampblack, and shale black are incorporated with this liquor, and the whole ground upon a slab, with a muller, in the same manner as ordinary colors; but in this case the grinding takes much longer. When the paste is thoroughly homogeneous, the oxgall is gradually added, and then the alcoholic extract of musk. The more the black is ground, the finer it is. The black is then allowed to dry in the air, until it has acquired sufficient consistency to be molded into cakes, which in their turn are still further dried in the air, out of the reach of dust. When quite firm, these cakes are compressed in bronze molds, having appropriate designs engraved upon them. The molded ink is then wrapped in tinfoil, with a second envelope of gilt paper. The ink which has been prepared in this manner possesses all the properties of the real Chinese article. Its grain is smooth; it flows very well, mixes perfectly with many other colors, and becomes so firmly fixed to the paper that other colors may be spread over it without washing it out.

Cultivation of Castor Beans in California.

The method of gathering and preparing for market is as follows: Every day the ripe spikes are gathered by hand, put in sacks, and hauled to the "popping ground," which is a space of about an acre, made smooth and hard, like an old fashioned buckwheat threshing ground. Here the spikes are spread; and during the day they pop open, from the heat of the sun, throwing out the beans. Each morning the straw is raked off, the beans shoveled up, cleaned in a fanning mill, and sacked, ready for market. By the time the field is once picked over, it is ready for another picking, like cotton, and the season, commencing in August, is not yet over. The yield is estimated at fifteen hundred pounds per acre, worth four cents per pound, or a gross yield of $60 per acre. The expense of cultivation, etc., is estimated this year at one half this amount, but is greater than it probably will be another season, owing to inexperience and preparing new land. There is probably no crop so easily raised that will yield so large a return.

THE AMERICAN ELECTRICAL SOCIETY.—An association to be known under the above name was recently organized at Chicago, Ill. The objects are an interchange of knowledge, professional improvement of members, the advance of electrical and telegraphic science, and the establishment of a central point of reference. General Anson Stager, of Chicago, was elected president, and Mr. C. H. Haskins, of Milwaukee, vice president.

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NEW YORK, SATURDAY, NOVEMBER 28, 1874.

Contents:

(Illustrated articles are marked with an asterisk.)

EXHAUST STEAM FOR HEATING PURPOSES.

In a previous article, reference was made to the gain to be derived from the use of a feed water heater, in connection with a non-condensing engine. It must be evident, however, from the figures given in that article, that the heater is far from utilizing all the heat that escapes into the exhaust. When water is converted into steam, a large amount of heat is required, which does not raise its temperature, and, not being shown by the thermometer, is commonly called latent heat. Thus, if a pound of water at the temperature of 60° Fah. is heated until it is evaporated under the pressure of one atmosphere, the temperature of the steam will be 212°; but the heat which has been imparted to it is as much as would have sufficed to raise the temperature of more than $7\frac{1}{2}$ pounds of water from 60° to 212°. On the other hand, to convert this steam into water, a similar amount of heat must be abstracted, from which it will be seen that the exhaust steam—which only heats about an equal weight of feed water—parts with but a fraction of its heat. But, as before remarked, if the steam can be cooled sufficiently to convert it into water, or condense it, it gives up to the cooling medium all the heat that became latent when it was changed from water into steam. These facts have suggested to some the idea of turning the exhaust steam into places where it would be cooled and condensed, giving up its heat where it was wanted, as, for instance, in warming a building. The ordinary manner of effecting this is to turn the exhaust steam into heater pipes that are fitted up throughout the building to be warmed, and draw off the water of condensation, to be used for supplying the boiler. Under such circumstances, the exhaust steam encounters an increased resistance, in passing through the heating coils, and this has the effect of increasing the back pressure on the piston. In order to fix some limit to this increase of back pressure, it is usual to attach a loaded valve, opening into the atmosphere, to the pipe leading from the exhaust to the heating coils, so that, when the limit of back pressure is reached, the valve will rise and the exhaust steam will escape into the air. In order to diminish, as much as possible, the back pressure created by the passage of the exhaust steam through the heating coils, they require to be fitted up with the greatest care. Neglect of this precaution has induced many persons to abandon the use of exhaust steam for warming purposes. In the construction of the heating coils, the principal points to be observed are: First, to have sufficient area of pipe to permit the free passage of the exhaust steam; and secondly, to arrange the pipes in such a manner, with suitable traps, that the condensed water or air cannot accumulate in them, but will be continually drawn off. If these provisions are attended to, the heating pipes can be extended over a considerable distance, with but little increase of the back pressure. An example, representing the results of average practice, will illustrate the foregoing remarks more fully:

A non-condensing engine of 60 horse power, exhausting into the atmosphere, had a back pressure on the piston of 1 pound per square inch. The feed water was pumped into the boiler at a temperature of 65°, and the average pressure of steam in the boiler was 75 pounds per square inch. At this pressure, the boiler evaporated $6\frac{3}{4}$ pounds of water per pound of coal, the price of the coal being $6.50 per ton of 2,000 pounds. The consumption of coal was at the rate of 4,450 pounds per day, costing about $14 46. The factory in which the engine was located was heated with steam supplied by the same boiler, requiring a consumption of 1,000 pounds of coal per day, costing $3 25, so that the total cost of fuel was $17.71 per day. These facts having been ascertained by careful experiment, the heating arrangements were changed, in the manner described below.

A few of the connections about the heater pipes were altered, for the purpose of obtaining more direct circulation, a trap of improved form was attached, a back pressure valve was put on the exhaust pipe, arranged to open at a pressure of 3 pounds per square inch above the atmosphere; and this pipe was connected with the heating apparatus, and a damper regulator was put in. It was found that, on account of the increased back pressure, the cut-off of the engine had to be adjusted so as to admit steam for a greater portion of the stroke, so that the engine required about 12 per cent more steam. If this had been the total result of the change, the effect would have been to increase the coal consumption 12 per cent, in addition to the expense of the alterations. It was found, however, that the exhaust steam from the engine heated the building quite as well as, if not better than, this was formerly effected by live steam from the boiler; and the water of condensation was led into a tank, from which it was used to feed the boiler, being taken by the pump at a temperature of about 200°. The boiler, being no longer required to furnish steam for heating purposes, and being fed with hot water, gave much better results than before, the damper being generally partially closed—so that the consumption of coal was only 4,100 pounds per day, costing $13.33, the saving in the coal bill per day being $4 38.

Such extensive alterations are not often required as were necessary in this case, where all the arrangements seemed to be made with the intention of wasting fuel. The gain, of course, after making the change, was proportionately large, but the expense incurred was considerable. In many places, the exhaust steam can be used for heating purposes, with very little outlay for alterations. Many heating coils, however, are put up in such a manner as to have very little circulation, and require a high pressure of steam to make them effective. Cases of this kind require extensive alterations before the exhaust steam can be turned into them. But there are numerous owners of small engines and boilers who have small shops which they can easily heat in the manner described. Our hints will probably be sufficient for such ordinary cases, but it is impossible to lay down general rules for every case.

PRISON REFORM.

As evidence of the urgent need of the reform in prison management suggested in our article on "The Scientific Treatment of Criminals," a friend in St. Louis sends us a printed account of recent doings in the State Penitentiary of Missouri, the horrid details of which remind one of certain parts of Charles Reade's "Never Too Late to Mend." For the credit of humanity, we should be glad to believe the story a gross exaggeration. If the half is true, the officers of the institution (and its management as well) would be benefited by a personal experience of the foul food, floggings, blind cells, and other abuses which have driven the convicts into rebellion, to be administered, not vindictively, for that would be contrary to the scientific method, but educatively, so that they might understand what manner of motives they are employing for the discipline of the prisoners and the probable moral effect of them.

Knowing the brutal and brutalizing practices that prevail even in institutions which have the name of being well conducted, we can understand how keepers such as our correspondent describes may, through ignorance, fear, and passion, aided by a thoroughly perverse system of prison employment, gradually convert a penitentiary into a school of vice and vengeance, rather than a place for penitence and reformation. We appreciate, too, the crying need of a radical change in the management of all such institutions: but that the prison system of the country can be made what it should be, by any burst of individual enthusiasm, we very much doubt. It may be true enough that that there is a "noble band of Howards" ready to undertake the reform "at the call of the American people": the hitch lies in the indisposition of the people to make the call. Not until the masses —upper as well as lower—have been educated up to the scientific level, and have learned to consider social problems as scientific problems, to be solved on scientific principles, will they be able to treat this question dispassionately and wisely. When that time comes, there will be little need of Howards to stir the sensibilities of prison keepers.

To the question: "Can you not set some means at work to release these thousands of mismanaged criminals from the pernicious system which thwarts their reformation?" we can only reply that we have already, to the best of our ability, set such a means at work, and that is the SCIENTIFIC AMERICAN. It does not set itself up as a mouthpiece of social or moral reform; yet, by spreading abroad the results of scientific research, by familiarizing the reading public with the spirit and methods of scientific thinking, it is doing its share toward educating the community up to the level required for the scientific consideration of all questions of social policy—the prevention and cure of crime with the rest. The process is necessarily slow; but the appreciative responses that have been made to our bare suggestion of a scientific treatment of criminals—an idea that could not have been entertained a few years ago—are proofs that progress is being made in the right direction.

A POSSIBLE IMPROVEMENT IN HOUSE HEATING.

At this delightful season of genial sunshine and crisp cool air, we have a daily illustration of perfect, because healthful and intensely enjoyable, heating. While the lungs are regaled with an atmosphere which seems to stimulate every pleasurable sense and activity of the body, the sunshine warms without oppressing, and hightens our enjoyment of the sparkling air by force of contrast. If we could imitate —much more if we could reproduce—the same conditions indoors, it is obvious that the perfection of house heating would be attained. Can either be done?

First, let us notice what the conditions are, on a sunshiny day of fall or early winter, that is, the conditions which combine to make such weather so refreshing. Pure air is practically transparent to radiant heat. In summer time, the high temperature of the air comes as an indirect effect of the heat of the sun. The sun rays heat the earth and the objects on its surface, and these, by contact or otherwise, heat the air. In the fall, the period of daily sunshine is briefer and the sun rays fall more obliquely. The ground is heated less, and the nightly periods of radiation are proportionally longer. The air in consequence remains cool throughout the day. Nevertheless, when the sun rays strike our bodies and are absorbed, their heating power is almost as great as in summer, giving us the simultaneous sensation of vivifying warmth, with delicious coolness in the air we breathe. Pass indoors from such an atmosphere to that of a furnace-heated house. How great the change! The air seems stifling, and though the temperature of the room, as recorded by the thermometer, is much higher than that outdoors, the pleasant glow which was felt in the sunshine soon gives place to an extreme sensitiveness to chill. Sit near a wall or a window, and an unpleasant coolness creeps up the back, as though a cold wind were blowing across it, and we look for a draft, though the air is motionless.

The conditions of perfect heating have been reversed. The air is at dog days heat. The walls and furniture are cold. The bodily heat is depressed by breathing the hot air, yet streams of heat must flow out from us in all directions to make up the deficiencies of surrounding objects. The thermometer may declare that such a room is warm, but every nerve declares that it is not comfortable. Substitute for the furnace an open fireplace with a blazing fire. An approach is made toward perfect heating. The radiant heat passes like sunshine through the air without heating it; and if the fire is so placed that its radiations impinge on a considerable area of the enclosing walls, the walls will be warmed as they cannot be by hot air; the furniture will be warmed in like manner, and the occupants of the room will enjoy the cheerful influence of live heat while having sufficiently cool air to breathe. The great expense and inconvenience attending open fires must ever greatly restrict their general use. Only about one tenth of the heating power of fuel is developed by its combustion in an ordinary fireplace, and much of that escapes unused. Besides, to heat a room of considerable size uniformly, it would be necessary to have an open fire at each side, or better, at each corner; an arrangement not to be tolerated as a matter of economy.

To burn fuel economically, it is necessary to burn it centrally and in mass. The coal that would supply a number of separate fires would furnish an immensely greater amount of heat if burned in a single furnace, a fact more or less recognized in every contrivance for heating houses by hot air, hot water, or steam. But in all such arrangements it is deemed essential to distribute, not heat directly, but matter more or less highly heated. In other words, we first heat our air or water, and trust to the cooling of that to furnish the heat required, overlooking the well known fact that heat will travel alone quite as well as in company, and that it can be much more easily controlled than air or water.

Radiant heat, the sort required for perfect heating, obeys the same laws as light. By proper arrangements of reflectors and lenses, heat radiations can be massed into beams of parallel rays and sent where we will, with little or no wasting. It is not until the radiations are arrested that they become manifest as heat; a fact put to practical use two thousand years ago, when Archimedes burnt the fleet off Syracuse with mirrors. A stream of heat vibrations, intense enough to fuse gold, would pass through a tube of ice without affecting it, provided the air in the tube be sufficiently pure and dry. There appears to be no good reason, therefore, why we should not warm our houses by the direct distribution of pure heat, and so gain all the benefits of an open fire in each room, with none of its disadvantages.

Briefly described, the plan would involve (1) a central furnace, constructed of course with a view to the development of the greatest amount of heat from a given amount of fuel. (2) A system of tubes leading to the different rooms, terminated by radiators in each room. (3) A system of reflectors to throw the heat of the furnace into the conducting tubes in beams of parallel rays, with other reflectors at the bends and angles of the tubes to direct the course of the radiations properly. The radiators in the rooms might be placed so that every portion of the room would be flooded with heat rays, yet no part be heated beyond what would be enjoyable. As nothing would enter the rooms from the furnace save pure heat, the effect would be like that of a room warmed by direct sunshine. The surplus heat of the furnace might be utilized in warming, say to 50° or 60° Fah., and an abundant supply of fresh air led in from out-doors; a steady circulation being kept up, from the ventilating chamber, through the rooms, by the draft of the furnace. We should have then (theoretically) perfect heating combined with perfect ventilation, and at the same time the most economical combustion of our fuel.

Possibly there may be mechanical difficulties to prevent the successful carrying out of a plan of house heating of this sort. We do not anticipate any, and the advantages it promises, on the score of health, comfort, and economy, certainly justify its trial by any one possessing the requisite means. The plan could be easily tested in the laboratory of any institution having a few lenses and reflectors.

MECHANICAL AESTHETICS AND PRACTICAL MEN.

We met our practical man, him of the street car, who "never learned nuthin' from books", at the American Institute Fair the other night. He was slowly trudging through the machinery department, apparently devoting his attention to the steam engines. We noticed that, as he scrutinized the large driving engine, his brow clouded: by the time he had reached the nickel-plated Baxter, the cloud deepened into a frown; and when he arrived opposite the Myers rotary a fierce scowl overspread his features. Suddenly turning on his heel, he recognized us, and, without further preamble, burst out with: "Now, look here, boss, I wanter know if this is'nt cussed nonsense, all this 'ere frippery, nickel plate and red paint, and gildin', and stuff, about a masheen! What for, anyhow? Do'nt make the thing run no better, does it? What's the use er shinin' that Baxter like a lookin' glass? I do'nt fuss over my engine that way; much as I can do to keep the green off the brass. Have'nt had no paint near it for ten years. Do'nt see that it works any wuss, either."

We remarked that we supposed the exhibitors desired to attract public attention by uniting artistic beauty with mechanical excellence, and that the certainly augmenting tendency toward æsthetic refinement was— "Which? Oh, keep them big words for yer paper; I never was no shakes on the dictionary. Just you tell me what's got inter people, that they waste stamps on what ai'nt no use? Look at this, now." And here he fished from his overcoat pocket a dilapidated copy of the SCIENTIFIC AMERICAN of a few weeks back, containing the engraving of the new mold-ramming machine on the front page. "What's that feller in that picter for? Or that heap er dirt and the shovel? Could'nt any practical man understand that masheen without that chap a pullin' the handle? S'pose a mee-chanic wants all that shadin' and prospectiv' and figgers? When I see a masheen, I wanter see drawins', nice plans and things drawed out. Why do'nt yer print them, not picters, only fit ter hang in the parlor?"

"Advantageous advertisement," we insinuated. "No t'aint, nuther," he rejoined; "no more than these ere circu lars and books with fancy covers that these fellers is givin' away so loose for nuthin.' Nor them blue signs, nor that shiny engine. I do'nt do no advertisin'. Do'nt believe in it. Did'nt I try it? Did'nt I pay a dollar for puttin' my name in a pious paper printed out in Milwaukee, or Oregon, or somewheres? The chap that wheedled me in said he'd throw in a ten dollar chromo and a book about saint's rest by a man named Baxter (that engine feller', I s'pose). Did'nt get nary an answer. Catch me gettin' fooled by any noozepaper agin!"

"No, I ai'nt got nuthin showin' in this Fair. Anybody that wants ter see my work can come to my shop. There aint no gold and silver and red paint there, nor patent invenshuns, nuther. Feller wanted me to buy one er them new fangled emery wheels t'other day. But I said: 'No, sonny, I used this old grindston' and others like it goin' on thirty year; and I guess I can make it do a little longer. No sir, when I git any money to waste on advertisin' or fancy paint or blamed invenshuns, then I'll shut up shop. Good night. Come see us, sometime. Aint got no cards; shop's in the alley, fourth door back on —— street. There aint no sign. Just stand in the entry and yell; and if one of the boys hears yer, he'll let yer in."

Our meditations, as we watched our friend elbow his way out of the crowd, took about the following shape: Anything akin to beauty or taste, when brought in connection with the mechanical, is, by the self-called practical individual, resented as an unwarrantable encroachment. When the purpose of ornamentation is (besides gratifying the eye) thus to draw attention to the merits of an object, both end and means meet his wholesale condemnation. Strictly and purely utilitarian, he fails to see any benefit in a measure which does not instantly bring in pecuniary returns, or to perceive that increased gains are or can be due to the keeping of certain facts constantly before the world, or to presenting the same in some manner so unique as at once to attract the popular gaze. Since he cannot appreciate matters so clear to every rightly thinking observer, it is manifestly impossible for others more refined to impress him. He and his kind see nothing to praise in the fact that our American mechanics and manufacturers (though the country is destitute of museums of industrial art, those great educators of the Old World) nevertheless contrive to mingle the beautiful with the useful, with a delicacy and true art feeling elsewhere almost unrivaled. The visitor at any of our great fairs will find this æsthetic selfculture making itself everywhere felt. It appears in the graceful figures and neat proportioning of the ordinary implements of labor, in the exquisite finish of the metal and wood work, in the thousand tasty forms of the commonest minor appliances, in the dainty traceries which embellish the safes, the carriages, and the massive portions of the engines, in a bit of carving here, a dot of bright color there: and thus through all the different productions, gathered as representatives of the varied industries.

We may here be pardoned the apparent egotism of a word as to the artistic merit of the pages now under the reader's eye, and this with reference to the "pretty picters" objected to by our practical friend: not merely as to their intrinsic beauty, but to suggest the influence which they must exert in elevating the standard of popular taste. A diagram of mere lines may be intelligible to the professional engineer; but the man who proposes to buy a machine asks and needs a representation, showing it as it will appear when set up in the shop. True, a rough sketch would convey an idea, but we prefer to call in the aid of artists (to whom in their specialty there are no superiors), to employ the highest skill attainable in the engraving of their works, and thus to maintain a standard of artistic excellence, of the public appreciation of which we have abundant evidence.

If a little nickel plating or a neat coat of paint will render a machine (without detriment) more pleasing to the eye, it is not false economy to add such embellishment. A bright bit of glass will take the attention when a rough diamond may be a hundred times passed unnoticed; and even if ornamentation be deemed unnecessary for its attractive power, let the beautiful, where possible, be cultivated for itself alone. True art is both refining and ennobling; and it may be found in the harmony of tints in the decoration of an engine, as well as on the canvas colored by a master hand: in the molding of a tool, as well as in the forms which assume all but life under the sculptor's chisel.

SCIENTIFIC AND PRACTICAL INFORMATION.

PAINTING ON ZINC WITHOUT PAINT.

M. Puscher, of Nuremberg, has lately invented a simple process for coloring sheet zinc, based on the employment of acetate of lead. On applying this substance, mixed with a minium preparation, a reddish brown tinge is obtained. The cupola of the synagogue at Nuremberg was thus colored as an experiment over a year ago, and, to all appearance, is yet unaffected by the weather. By adding other bases, lighter or darker tints of gray and yellow may be obtained, giving the zinc work the appearance of carved stone. With a solution of chlorate of copper, the preparation turns the sheets of zinc black.

FISH BONES AS FERTILIZERS.

The *Moniteur Industriel Belge* states that German manufacturers are purchasing the fish bones gathered along the Norwegian shores, which result from the extensive fish-curing stations there located. These bones make a fine fertilizer, and, when pulverized by suitable machinery at the points of collection, are readily transported. The same journal suggests the more extended utilization of the bones from the establishments in Newfoundland, and estimates the product from American fisheries at twenty million pounds a year.

THE HOURLY DEATH RATE.

Dr. Lawson, an English physician, has recently published some curious observations regarding the time of the day when the greatest and least number of deaths occur. He finds, from the study of the statistics of several hospitals, asylums, and other institutions that deaths from chronic diseases are most numerous between the hours of eight and ten in the morning, and fewest between like hours in the evening. Acute deaths from continued fevers and pneumonia take place in the greatest ratio either in the early morning, when the powers of life are at their lowest, or in the afternoon, when acute disease is most active. The occurrence of these definite daily variations in the hourly death rate is shown, in the case of chronic diseases, to be dependent on recurring variations in the energies of organic life; and in the case of acute diseases, the cause is ascribed either to the existence of a well marked daily extreme of bodily depression, or a daily maximum of intensity of acute disease.

PEAT PAPER.

M. Bertmeyer has recently exhibited, in the Polytechnic Society of Berlin, specimens of paper and pasteboard obtained from the products of the peat beds about Königsberg, the quality of which is said to be excellent. The pasteboard was 2·4 inches thick, and sufficiently hard and solid to admit of planing and polishing. The paper made from peat alone was brittle, like that manufactured from straw; but the addition of fifteen per cent of rags produced the requisite toughness.

ARTIFICIAL EBONY.

This material is made of sawdust mixed with other substances and powerfully compressed in molds. The following is the process of manufacture, as now largely carried on by Messrs. Latry & Co., of Paris: The sawdust, reduced to a fine powder, is mingled with a suitable quantity of water and blood, and dried at about 112° Fah. The albumen of the blood is thus agglomerated with the powder. The compound is then packed in heated molds, into all the crevices of which it is forced by strong hydraulic pressure.

A NEW RUSSIAN CANAL.

The Russian Government, says the *Revue Industrielle*, has recently completed negotiations with a Russo-English company for the construction of a canal from Cronstadt to St. Petersburg. The work is to occupy six years in accomplishment and will cost $5,530,000. This will render St. Petersburg the finest port on the Baltic, and besides greatly benefit the city as a commercial center, since the railways to Moscow, Warsaw, and all parts of Russia will be in direct communication with the docks.

A CURIOUS PROPERTY OF SAND AND ITS APPLICATIONS.

If a quantity of dry silicious sand be placed in a bag of canvas or thin box of sheet iron, the mass, after slight compression, forms a conglomerate, capable of resisting pressures of over 60 tuns. So far as the envelope is concerned, the sand withinacts as if it were an enclosed solid, producing no effect on the covering except a trivial amount where the contact occurs with the load. The sand, however, remains perfectly divisible, and, no matter what may be the superincumbent weight, escapes freely though slowly out of a small aperture made in the bag or box. A simple piece of paper, however, placed over the orifice, is sufficient to stop the flow, even under the load above noted.

M. Beaudemoulin, who discovered this peculiar property several years ago, has lately published in France a work suggesting various modes of its application. For building walls it is well adapted, since the filled bags or boxes need merely be held in place by a framework; while, being very thick, they would form a protection, in case of being used for dwellings, against variations of temperature. Such walls, beside, would be fireproof. It is also suggested that for lowering heavy weights or even entire buildings, which, by a change of street level, have become located too high above the roadway, the sand bags could be placed beneath, and their contents allowed gradually to escape, thus letting the load slowly settle down.

NATURAL ANTISCORBUTICS.

General Sherman says that the *agava Americana*, or Spanish bayonet, the fruit of the common prickly pear, and the succulent leaves of some of the varieties of the cactus that abounds on the deserts of Texas, New Mexico, and Arizona, furnish excellent specifics for that horrible disease, the scurvy.

BROMHYDRIC ACID.

M. Melliés states that a much simpler way of making this acid than that now employed, and which besides ensures a more copious supply, consists in passing a current of sulphydric acid into a small flask containing bromine. Bromide of sulphur is formed and bromhydric acid disengaged.

Intercolonial Exhibition at Sydney, New South Wales.

We have received from M. Jules Joubert, Secretary of the Agricultural Society of New South Wales, the first number of the society's *Journal*, in which are published full particulars of an exhibition to be held at Sydney in April, 1875. There is a long list of premiums, to be awarded for merit in all branches of agriculture and manufactures, the prizes for wines, sugar, and silk indicating the growth of three important industries in the Australian colonies. Agricultural implements are much required in Australia, and competition by American manufacturers is especially invited, communication *via* San Francisco being rapid and convenient.

The Secretary writes us that the Agricultural Society and the Chamber of Commerce of Sydney are, together, making liberal arrangements for an adequate representation of Australian products at our Centennial Exhibition of 1876.

An Early Opinion of Railroads.

An old copy of the English *Quarterly Review* of the year 1819 contains an account of a scheme for a railroad, on which it is proposed to make carriages run twice as fast as stage coaches. The editor evidently failed to appreciate the idea, or to believe in its possibility, for he comments upon it thus wise:

"We are not partisans of the fantastic projects relative to established institutions, and we cannot but laugh at an idea so impracticable as that of a road of iron upon which travel may be conducted by steam. Can anything be more utterly absurd or more laughable than a steam-propelled wagon moving twice as fast as our mail coaches? It is much more possible to travel from Woolwich to the arsenal by the aid of a Congreve rocket."

M. De Lesseps' plan of changing the Algerian shotts or lakes into an inland sea is shown, by a French engineer, to be little value. He has recently visited the country, and reports that the lakes are higher than the Mediterranean, and that a canal would merely drain them. Beside, the project would cost $60,000,000, and it is difficult to see, even were the scheme feasible, any prospect of substantial returns.

PROFESSOR PURSER believes that the moon, in revolving around the earth and drawing the tides behind her, causes the latter to act as a brake on the revolution of the globe, and he considers that it may be mathematically shown that this action is slowly but surely checking the earth's speed of rotation, so that the days and nights are gradually lengthening. In a thousand million years or so, they may become each a month long.

THE UNDERGROUND RAILWAY, NEW YORK CITY.

NUMBER III.

[Continued from page 323.]

In our paper for November 14, page 307, we began our description of this great engineering work, giving a diagram of New York city and the adjacent territory, showing the position of the Underground Railway, now nearly completed through the northerly portion of the city, 4½ miles, and the route of its authorized extension down town, under Broadway to the Battery, 4½ miles. We also gave a profile of the railway, showing its grades, depths below surface, street grades, character of the work, etc.; also the contract prices paid for the work, outline of the law for construction, names of the official supervising engineers, names of the engineers in charge, contractors, etc. We also gave a view of the first bridge over the railway, at 45th street. In our following number, November 21, page 323, we gave a cross sectional elevation of the open cut of the railway on Fourth avenue, with a view of the bridge over the open cut between 52d and 53d streets, with a description of this open portion of the line, dimensions, etc. We now come to that section of the railway passing entirely under the surface of the ground, where the construction of what are known as the beam tunnels begins.

Fig. 6 is a view on Fourth avenue, looking north, from 59th street to 76th street, and shows the appearance of the surface of the street under which these tunnels pass, and the ventilating openings of the tunnels. Fig. 7 is a cross sectional elevation of the same, showing the mode of construction.

This iron beam tunneling is only resorted to where sufficient headway could not be obtained for the arched brick tunnels. By again referring to the profile (page 308), it will be seen that it has been found expedient to use this latter kind of tunnel only where the difference of railroad and avenue grades is greater than 19 feet, while the beam tunnel is used, with a slight alteration of the street grade, at points where this difference is as small as 11 feet, and, as a consequence, more than five thousand feet, of what would otherwise have been open cut, has been covered in with beam tunnels.

Like most of the other tunnels used on the work, the beam tunnels are divided into three separate tunnels, contained within four walls, two outer and two inner, upholding the roof, which is composed of wrought iron beams with turned brick arches between them; the roof, in its turn, sustains the earth and paving of the street. The two outside walls are a continuation of the retaining walls of the open cut, described in our last paper, and are built of gneiss rubble masonry of the same class as that used in the before described retaining walls, seven feet thick at railroad grade, and sloping off thence with a batter, on the inside face, of one inch to the foot, to a thickness of three feet at top of the wall, which, in general, is fifteen feet above grade. The top course of this masonry is composed of stones fourteen inches thick, two feet wide, and three feet long, with pointed beds and joints.

Between the two outer walls and thirteen feet distant from them in the clear, are placed the two inner walls of brick, resting on a stone or gneiss rubble foundation, three feet thick and three feet wide below railroad grade. The walls which rise from these foundations are built of brick without batter, are twenty inches thick and high enough to receive the roof beams, and are tied with fine courses of North River blue stone, five inches thick and well dressed. Along the top of each of these two inner walls run, side by side, the flanges touching, two H-shaped wrought iron girders, twelve inches deep and bound together by half inch bolts, in the manner shown in Figs. 10, 11, which illustrate the method of binding together the girders, and of fastening the roof beams to the girders. These longitudinal girders are of the best wrought iron, weighing one hundred and twenty-five pounds to the linear yard, and are joined longitudinally in such wise that, should any portion of the brick wall supporting them be by any accident thrown down, the longitudinal girders will offer a rigid support to the roof beams and the earth resting upon them. On top of the longitudinal 12 inch girders and bound to them by half, in bolts passing through the flanges, as shown in Figs. 10, 11, rest the iron beams composing the roof. These are also H-shaped

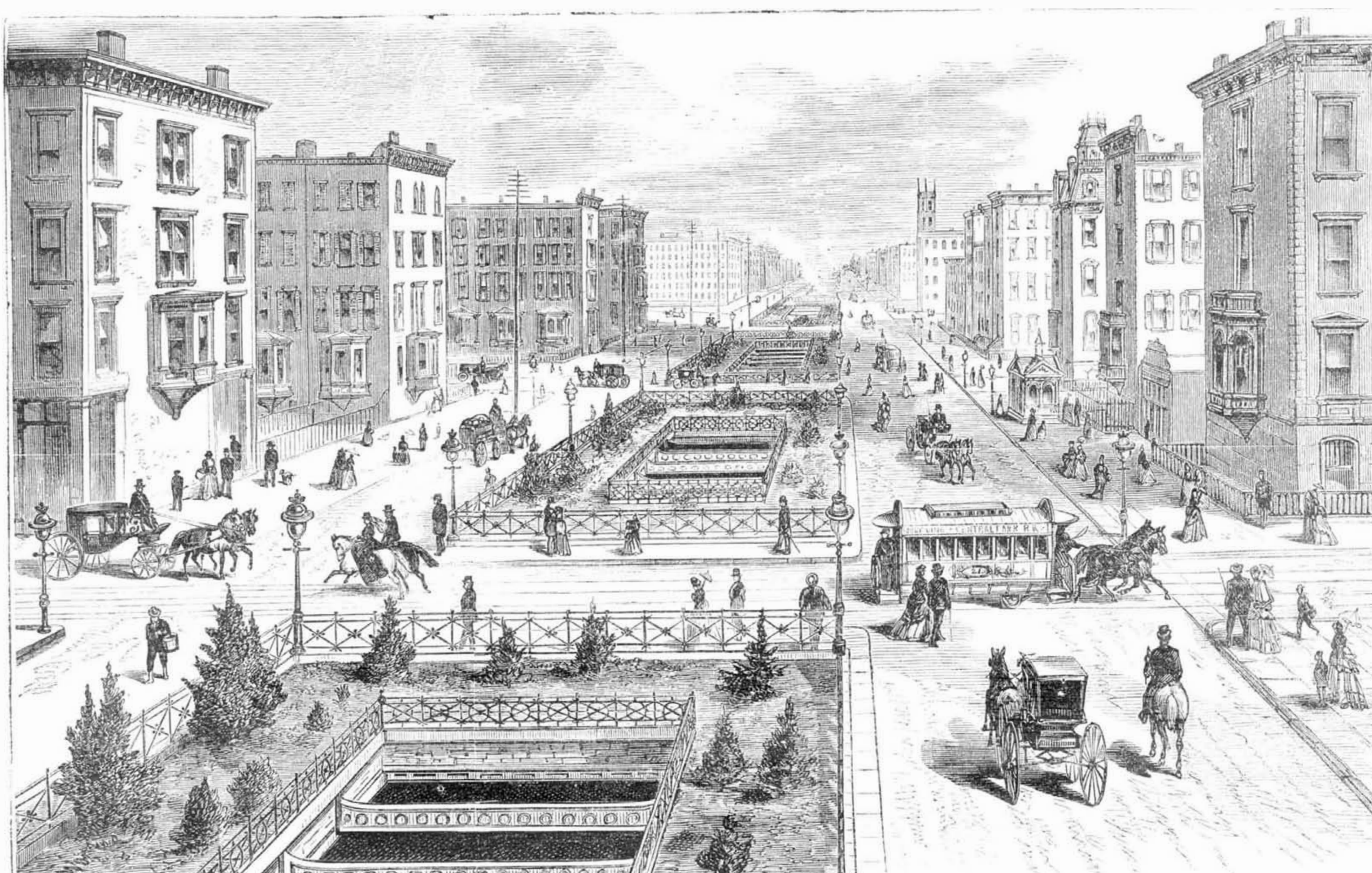


Fig. 6.—THE UNDERGROUND RAILWAY, NEW YORK CITY.—BEAM TUNNEL OPENINGS ON FOURTH AVENUE, 59th TO 76th STS.

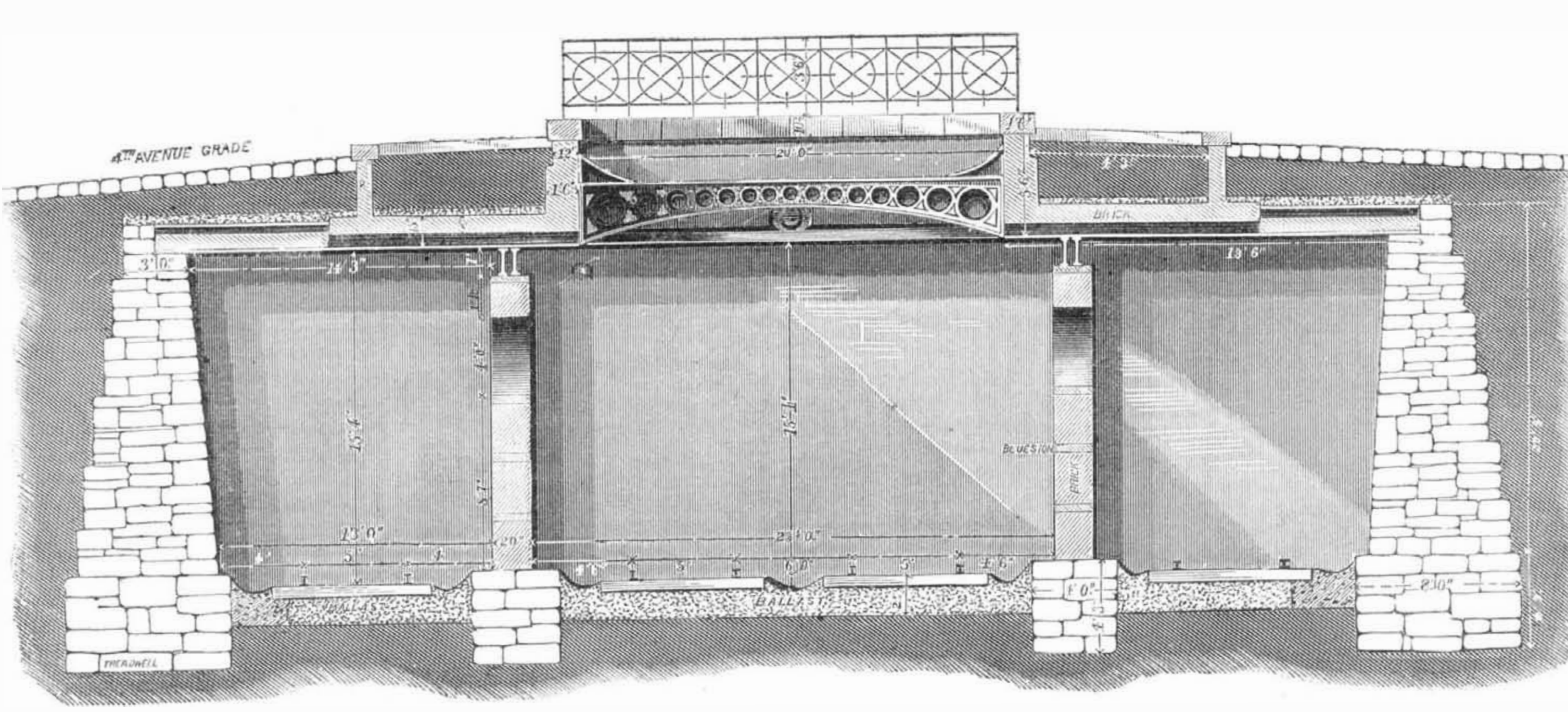


FIG. 7.—THE UNDERGROUND RAILWAY IN NEW YORK CITY.—CROSS SECTIONAL ELEVATION OF THE BEAM TUNNELS AND VENTILATORS 59TH TO 76TH STREETS

but very much heavier and deeper than the girders on which they rest, being fifteen inches deep and weighing two hundred pounds to the linear yard, and varying in length from sixteen to twenty-seven feet. They are placed upon the walls, at right angles to the length of the tunnel, and three feet five inches apart from center to center, strapped and anchored, and tied together with one inch iron tie rods, cast iron thimbles being placed between the beams at each tie rod and at the ends. This manner of tying the beam is illustrated in Fig. 11, which represents a cross section through two of the beams placed over the large central tunnel, as also the horizontal projection of a longitudinal section through the center, showing the thimble at the tie rods. The strapping consists of two iron bands or straps, one of which passes from the top flange of one beam under the bottom flange of the second, and to the top flange of the third; the other, from the bottom flange of the first beam to the top flange of the second, and thence to the bottom of the third, the straps being fastened at each flange.

Over the small side tunnels, whose span is but 14 feet 3 inches, the roof beams are placed singly; but over the central tunnel, which has a span of 25 feet, they are placed in pairs, that is to say, two beams are placed side by side so that their flanges touch, each pair being 3 feet 5 inches apart from center to center. See Fig. 9.

Between the beams are placed the turned brick arches, 8 inches thick. The whole is then covered, to a depth of 4 inches above the tops of the beams and arches, with concrete, composed of one part Ulster county hydraulic cement and two parts sand and gravel, or stone, broken so as to pass every way through a two inch ring; over this is placed a coating of three-ply roofing felt and cement, and then the earth and paving.

The main central tunnel is lighted and ventilated through openings, twenty feet wide and one hundred and fifty feet long, placed one in each block.

We mentioned that the roof beams varied in length from sixteen to twenty-five and twenty-seven feet. The reason for this variation will now be quite apparent. The sixteen feet beams are used to span the small or side tunnels, which have a width at top of 14 feet 3 inches; the twenty-seven feet beams span the large central tunnel, whose breadth at top is twenty five feet, while the twenty five feet beams are used where the openings occur in the large tunnel, one end resting on the outer wall and the other projecting over the inner brick wall into the central tunnel. See Fig 7.

Around these openings are placed brick retaining walls, which rise to the level of the street and are then coped with a coping of first class pene-hammered granite coping, sixteen inches by ten inches, which supports a light iron railing. The brick face of the opening is faced with cast iron and braced with cast iron beams placed about seventeen feet apart, two feet three inches high, twenty-five feet long, bound to the roof beams by bolts, and anchored in the brick wall. Immediately beneath these openings there occur, in the brick walls which separate the central from the two side tunnels, a series of arched openings, which give light and ventilation to the small side tunnels (see Fig. 9). These openings in the brick walls are placed all along the upper part of the wall for the entire length of the central opening, and are four by eight feet.

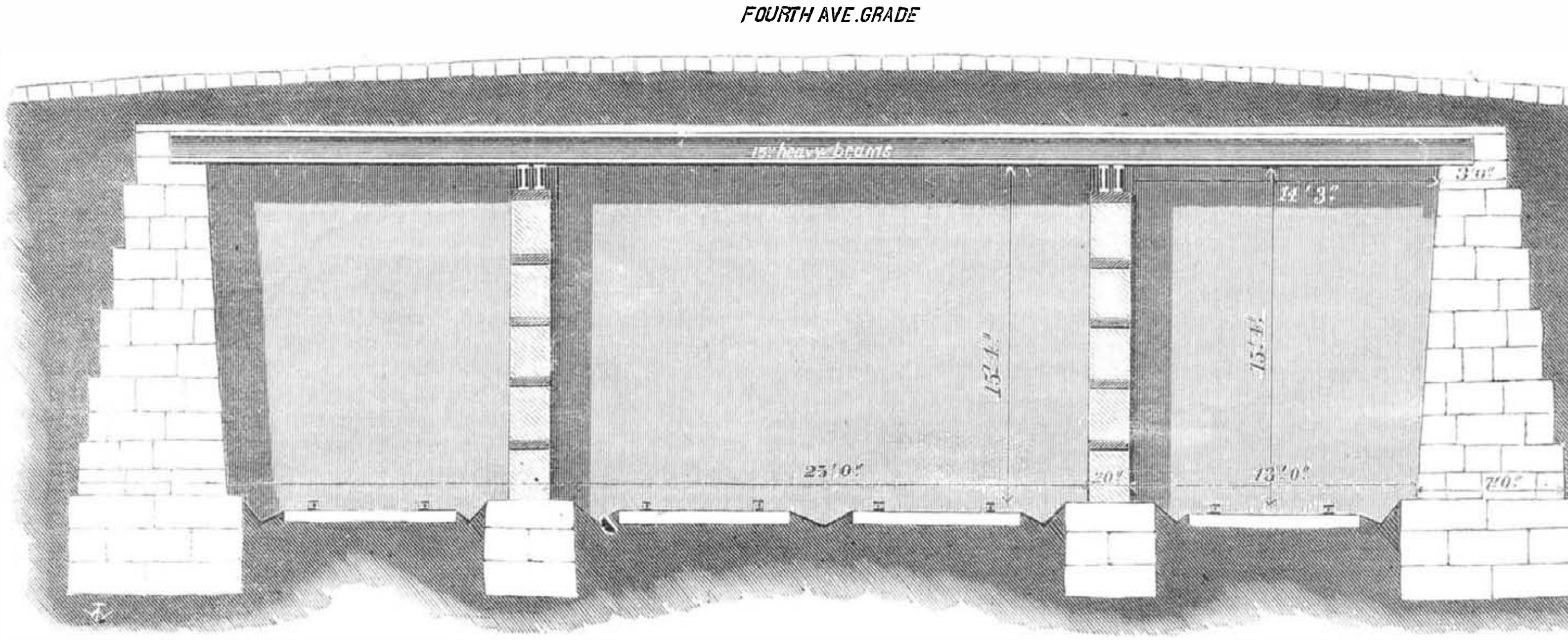


FIG. 8.—THE UNDERGROUND RAILWAY, NEW YORK CITY.—SECTIONAL ELEVATION OF THE BEAM TUNNELS, BETWEEN THE VENTILATORS,—59TH TO 76TH STREETS.

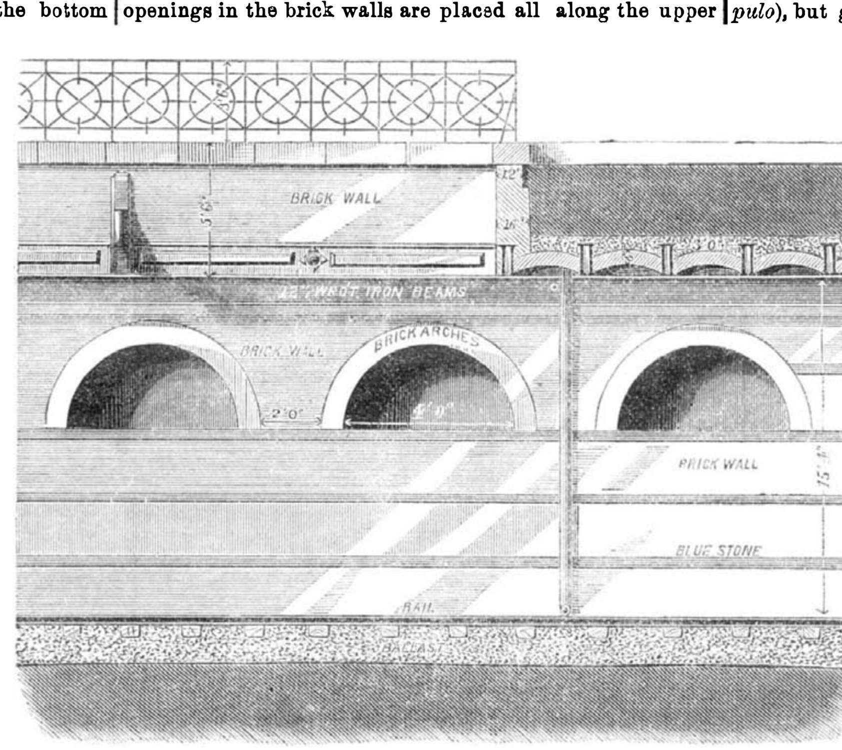


FIG. 9.—THE UNDERGROUND RAILWAY, NEW YORK CITY.—LONGITUDINAL SECTIONAL ELEVATION OF THE BEAM TUNNELS.—59TH TO 76TH STREETS.

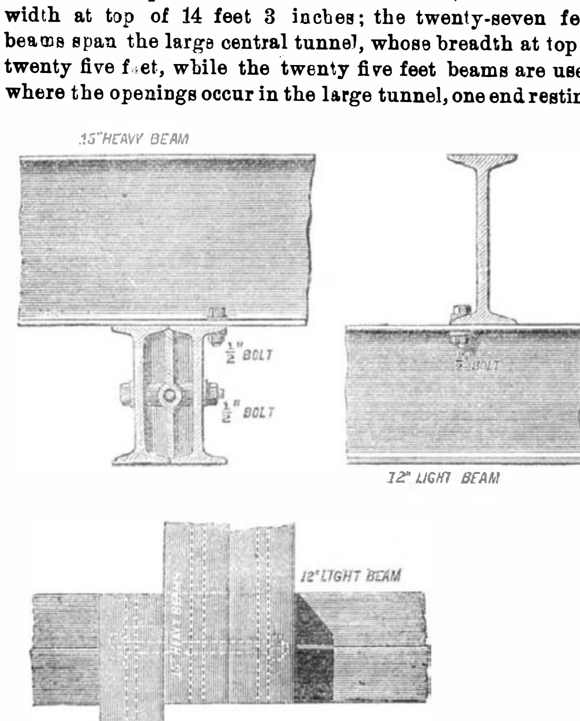


FIG. 10.—THE UNDERGROUND RAILWAY, NEW YORK CITY.—JOINTS AND COUPLINGS OF THE IRON BEAMS.

The Temperature of the Sun.

M. Violle considers that the emissive power of the sun at a given point on its surface will be the relation between the intensity of the radiation emitted at such point and the intensity of radiation which a body, having an emissive power equal to unity and carried to the temperature of the sun at the considered point would possess. So that he defines the true temperature of the sun as the temperature which a body of the same apparent diameter as the sun should possess in order that this body having an emissive power equal to the average of the solar surface, may emit, in the same period, the same quantity of heat as the sun. From experiments made at different altitudes, M. Violle determines the intensity of the solar radiation, as weakened by passage through the atmosphere, and finds, for the effective temperature of the sun, 2,822° Fah.

Investigations conducted with an actinometer by the dynamic method lead the investigator to conclude that steel, as it emerges from a Siemens Martin furnace, has a temperature of 2,732° Fah. If it be admitted that the average emissive power of the sun is sensibly equal to that of steel in a state of fusion, determined under like conditions, it appears that the mean true temperature of the solar surface is about 3,632° Fah.

THE Patent Office has granted a patent for a dummy, for dry goods merchants, to enable them to make a large show on a small stock. It consists of a block of wood, neatly done up in a cover of cloth, labeled and ribboned to represent, in exterior appearance, a full package of real goods.

American Iron.

It is proverbial, at least among the Americans themselves that they, of all nations, possess in its greatest plenitude the faculty of recuperation. From time to time the American world of business is distracted by financial typhoons; the vessel of state is laid on her beam ends; hotels, and even theaters, reduce their prices; and stern admonitions issue from press and pulpit that the period of piping and dancing is over, and that the—possibly mythical—homely habits of the ancient settlers must be revived before there is again health in the land. These lessons are received with very different feelings in various parts of the country. Boston and Providence may perhaps abase themselves in private (for no man has seen them performing that operation *coram populo*), but gay New York and the great West maintain a hopeful, not to say defiant, attitude. Better times must come. Things will get "fixed" at last; and if ruin has been incurred, the boundless resources of a great country will help everybody to begin over again.

This hopeful spirit is not without some admixture of solid truth. A lapse of twelve months has brought about a notable change in the feeling of financial circles in New York. To a less extent this reactionary spirit has made itself felt in other great speculative centers, such as Chicago, St. Louis, and Boston. Especially in the direction of railroad securities has renewed confidence been manifested. Shares long neglected have recently met ready purchasers, and there exists that general disposition to invest which is an infallible sign of the revival of business. Under the influence of the late panic, railway property—the *teterrima causa* of the crash of last autumn—suffered most severely; but recent advices show that things were not so bad as they seemed. Stocks have advanced, and chances are in favor of greater activity and heavier investments than have been known for a long time past.

This revival of railway enterprise is not without significance to the iron trade, both of England and of the United States, which latter country has, within the last few years, immensely advanced in the production of iron.

The Americans have a splendid "forest primeval," but the blast furnace is a great devourer, and will thin the surrounding country in an alarmingly short space of time. Possibly improved railway communication will more than keep pace with the rapid destruction of timber, but the significant fact yet remains that, out of 630 furnaces in blast in 1873, 265 were supplied with charcoal. No charcoal smelting of iron can be long lived; and it is, therefore, clear that, unless increased railway communication be provided, a certain section of the iron industry of the United States will

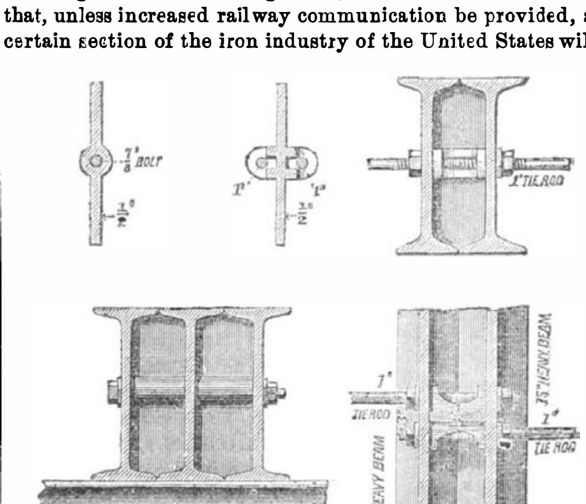


FIG. 11.—THE UNDERGROUND RAILWAY, NEW YORK CITY.—JOINTS AND COUPLINGS OF THE IRON BEAMS.

be soon "played out." Vigorous efforts will undoubtedly be made to put other iron producing centers on a level with Pittsburgh, by improving the communication between coal and iron regions; but the truth will always remain constant, that, however rich iron ore may be, it will not pay to carry it too far.

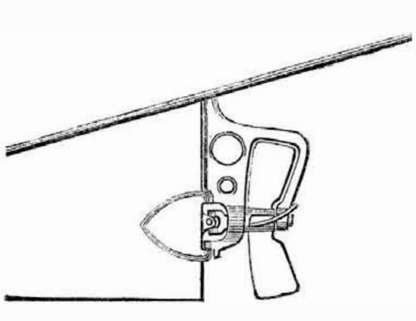
For a long while the American makers had a heavy uphill journey, as, although they were protected by an enormous tariff, and were supplied with a huge home demand, English makers of railway material swept the market. An unprecedented advance in the price of English coal, and consequently of iron, during the last three years, deprived English makers for a while of their advantage, and, despite dear labor, the American ironworks rose last year to a high pitch of prosperity. The delicate conditions of business in the United States failed, however, last autumn to withstand the tension of the financial world, and the American iron and steel trade suffered a paralysis which it communicated in no small degree to the trade of Great Britain. With a keen eye to the wants of the future, the American makers apparently foresaw that the wants of the railway world would be confined to Bessemer steel, and have made great efforts to compete—under the ægis of their duties—with English makers in the production of this important metal. So long as exaggerated prices for fuel and labor prevailed in England, a chance of success remained; but so soon as the period of inflation in England ceased, it at once became evident that steel rails were wanted for America. Barrow-in-Furness is likely to prove for some time a hard nut to crack for all her competitors in Bessemer steel, be the same English or Welsh, Belgian, French, or American. She has the precise kind of ore required under her feet, and in this particular possesses an undoubted advantage over American rivals. That a country may escape ridiculous smallness by being inconveniently large, is proved by the significant fact that Algerian and Bilbao ores cost at the furnace in America $20 per tun, when they may be bought at Barrow or at Cardiff for $6.25. Without "magnificent distances", the superb supplies of iron ore in "the States" would be speedily utilized; but until increased and cheaper railway communication has brought her coal and iron closer together, America will need all her unquestionable energy and ingenuity to compete with England in the world of iron.—*Iron*.

Correspondence.

Universal Joints in Screw Shafts.

To the Editor of the Scientific American:

I have lately noticed in your valuable paper a number of references to the use of Hooke's universal joint in a screw shaft, but I have seen nothing resembling an invention of my own in that direction, and I would like to call your attention to it. The engraving, I think, explains itself, and it



is designed to facilitate the handling of small boats, like launches intended for torpedo work.

The propeller and that portion of the shaft beyond the universal joint is hung in a composition frame, which takes the place of the ordinary rudder. A line passing through the axis of motion of the pintles and gudgeons would also pass through the center of the ball of the universal joint; and by means of the frame, the propeller is thrown to the right and left in steering. My invention has been applied to one of our torpedo launches, and has been in operation for several months. The speed of the boat is exactly the same as it was with the same propeller fitted in the ordinary way; while the rapidity with which she can turn to starboard or port is very much increased, the diameter of her circle being much decreased. The rudder framehead is fitted with an arc which gears into a rack on the side of a cylinder moving athwart the stern of the boat, so that she can be steered by steam or compressed air. An ordinary wheel is, however, fitted, which answers every purpose in a small launch, as it requires very little force to throw the propeller from one side to the other.

I have no patent on my invention; and perhaps, if you print my sketch, some one may get an idea from it.

F. M. BARBER, Lieutenant U. S. N.

Torpedo Station, Newport, R. I.

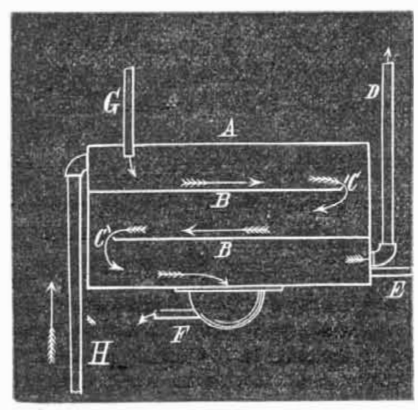
Small Steam Engines.

To the Editor of the Scientific American:

Several of your correspondents having written somewhat upon the performance of small engines, I would like them to see what I am doing.

My engine cylinder is 4 inches by 10 inches stroke, and runs at 120 revolutions per minute; it has a common D valve, and cuts off at $\frac{5}{8}$ of the stroke; it has a boiler pressure of 60 or 70 pounds. With this engine I run my machine shop, which has 52 feet of $1\frac{3}{4}$ inch shafting, running at 200 revolutions, driving two engine lathes of 8 and 6 feet bed respectively, one planer of 6 feet bed, one upright drill (medium size), one small drilling lathe of 4 feet bed, one drop hammer (hammer weighs 300 pounds), one blower, one grinding machine for grinding rolls, etc., beside a grindstone and an emery wheel. These tools are in my own shop. I run a quarter-turn 4 inch belt into the next building, and drive 32 feet of $1\frac{3}{4}$ inches shafting, and one large iron blacksmith's or boiler maker's punch and shears combined, and one medium-sized upright drill. I also take another quarter-turn 4 inch belt from my shaft, and (by three countershafts and pulleys) reach the second story of the second building, and go thence up into the third story of the same, and there drive 54 feet of one inch shafting, and 30 sewing machines running upon heavy cotton goods. I also take from my main line in my shop a rope belt of $1\frac{1}{2}$ inches diameter, and drive (in the third store adjoining me on another side, 56 feet distance between shafts) some coffee-roasting and spice mills.

My boiler is of locomotive style, with a 26 inch shell, 6 feet long, with twenty-nine $2\frac{1}{4}$ inch flues; the fire box or grate surface is 22 x 28, with a smoke stack 40 feet high and 10 inches in diameter, with a damper. I use no blower; I burn coke and bituminous screenings mixed (about 2 barrels per day). I evaporate about 20 gallons of water per hour, introducing it into the boiler, through a heater of my own construction, at about 206° Fah.



A, heater of sheet iron; B B, two sheet iron pans; C C, points where the pans are turned up a little, and small holes drilled through; D, pipe where steam escapes; E, overflow pipe; F, pipe by which hot water is taken to pump; G, cold water pipe from tank; H, exhaust pipe from engine.

You will see that I introduce the exhaust steam and cold water at a point as near to each other as possible, and that both steam and water travel together over the two pans to their exit, the water falling down upon each pan successively, and through little holes drilled in the ends of the pans for that purpose, in order to expose as much of the surface of the water to the action of the steam as possible, until it reaches a little well in the bottom of the heater, whence I convey it to the pump. I admit only just enough water to this heater to keep my boiler supplied.

If any of your readers are doing more work with less engine, I would like to hear from them. O. B. FENNER.

San Francisco, Cal.

Cribbing in Horses.

To the Editor of the Scientific American:

The letter upon cribbing in horses, from D. Cook, Elmira O., is calculated to do a great deal of harm, without any advantage arising therefrom.

He says that the habit is caused by some foreign substance being pressed between the teeth, or by the front teeth growing too close together, thus causing pain. If this were the case, I ask him: Why a great many horses, during the act of cribbing, always apply the under jaw, instead of the teeth, to the manger? His treatment for the same, which no doubt he offers as an entirely new idea, has been known to horsemen for years, but is seldom practised by them.

Instead of crib-biting or wind-sucking being caused by pain in the teeth, it is due to a derangement of the stomach.

Filing the incisor teeth apart, in the place of relieving pain, very often produces it; and therefore, whenever it is successful in preventing the animals from indulging in the habit—which is but seldom—it is on account of the soreness of the teeth occasioned by the operation.

To enable a horse to swallow wind, it is necessary for the muscles of the neck to contract, and the only object in applying the teeth or jaw to the post or manger is to afford a fulcrum for these muscles to act from. J. C. HIGGINS.

Millstone, N. J.

Forming and Tempering Taps.

To the Editor of the Scientific American:

I find that T. I. B.'s tap, a quarter inch in diameter, which has tapped "over two hundred thousand hot forged nuts," was made according to the instructions given by Mr. Rose in his valuable practical essays. It was forged to as near its finished size as possible, so that it would true up. It was passed through a hardened steel gage. It had three half round grooves, the only clearance being to ease off the tops of the threads. It was heated to a cherry red, "red without being hot enough to scale," then dipped endways, and the shank made the softest and tempered on a piece of iron, as given in "Practical Mechanism" for dies. All these operations are precisely those recommended by Mr. Rose: and it is curious that it broke from being applied to a hole that was too small, giving it, as Mr. Rose puts it, "more duty than it should be required to perform."

As a mechanic, I agree with T. I. B. as to his method of making and of sharpening a taper tap, and thank him for giving to the world, through your columns, the method and result of his practice, which is truly remarkable.

East New York, L. I. MACHINIST.

[The above is only one out of many scores of letters which we receive, constantly testifying to the value of the articles on "Practical Mechanism."—EDS.

A New Friction Brake.

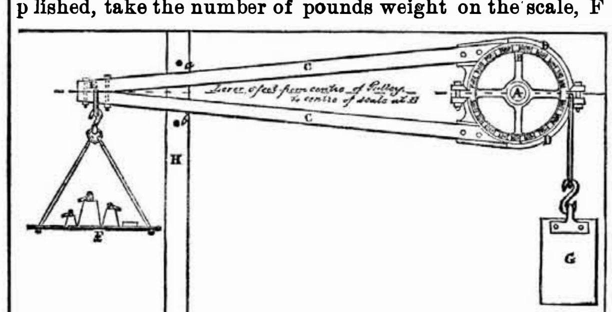
To the Editor of the Scientific American:

In your issue of October 31, 1874, is an illustration and description of a simple friction brake for testing the power of small engines. Having given some attention to the various kinds of dynamometers for such purposes, I submit for your inspection a modification of a brake somewhat similar The difference between this brake and that referred to consists in the weights of my brake being suspended from a center line horizontally through the shaft. It does not require the piston in oil which forms a part of your brake; and instead of two wooden blocks, I use a metal ring in two pieces or sections, each piece being less than the half circle and lined with wood, leaving an opening between the pieces, and turned on a face plate to the exact diameter of the pulley. Each half ring is provided with a flange, to which the arms are bolted, and which meet in a point at a certain distance from the center of the pulley, and form the lever by which the power is measured. There is also a box partly filled with scraps to act as a counterbalance, which, with a common scale and weights, completes the apparatus. As a matter of convenience, in using the brake, a temporary post with two pins is used for securing the lever in an approximately horizontal position, which tends to simplify the operation.

A is the shaft, revolving at seventy revolutions per minute; B, a pulley fastened on the same, the diameter of which is immaterial, but should neither be very small nor very large; C C, two wooden arms which form the lever; D D, two pieces of a metal ring, each piece being less than the half circle: F, a scale whereon weights are placed in making a test; G, a box with scrap which counterbalances the lever C C, and scale, F, when hanging loosely on the pulley; H, a temporary post, with two pins, *a* and *b*, for securing the lever in nearly a horizontal position. The weight of the lever, with rings, scale, and counterbalance, is 300 pounds, when the said lever is perfectly level and loose on the pulley. The length of lever from center of shaft, A, to point, E, is 5 feet.

First find the friction caused by the lever and counterbalance when loose upon the pulley. The coefficient of friction with wood or cast iron, lubricated, is 0·21; $300 \times 0{\cdot}21 = 63$ pounds.

Tighten up the brake until the speed of the shaft, A, falls a revolution below its usual speed; slack the brake until the speed comes close up to the full number of revolutions; place weights on the scale, F, adding thereto until the lever, C C, falls down to a perfectly horizontal position. This accomplished, take the number of pounds weight on the scale, F



and multiply this by the circumference of the circle in feet of which the lever, C C, is the radius, measured on the horizontal line, and by the number of revolutions of the shaft, A, per minute; this will give the number of foot pounds (or the number of pounds raised one foot high in one minute), to which product add the friction of the lever as previously found, and divide the whole by the standard horse power, 33,000 lbs. raised one foot per minute, which will give the horse power transmitted by the shaft, A, which shaft may be either that of a small steam engine or a countershaft in a factory or mill.

Example: A lever is 5 feet long; this gives a circumference of a circle described from the center, A, through the point at E, 31·4 feet. Weight in scale when lever is level, 75·05 pounds; speed of shaft, 70 revolutions per minute; $31{\cdot}4 \times 70 = 2{,}198$ feet per minute; $2{,}198 \times 75{\cdot}05 = 164{,}959$, and $164{,}959 + 63 = 165{,}022$, and $165{,}022 \div 33{,}000 = 5$ horse power transmitted by the shaft, A.

I consider this apparatus better adapted for the purpose of testing power than the one referred to in your journal. The friction brake in this apparatus is more rigidly secured, and will not cause the end of the lever to vibrate when testing, so that it will come to the desired position more readily than that with the two blocks and long bolts, which latter will cause vibration of the lever. Secondly, the center line is the proper line to hang the weights on. Thirdly, the piston in oil will affect to a certain extent the accuracy of the test.

Toronto, Canada. WILLIAM GILL.

Wear of Grindstones.

To the Editor of the Scientific American:

W. Kapp's idea, on page 228 of your current volume, for arranging grindstone spindles to prevent the uneven wear of the stone, is good. But the difficulty is not wholly removed by his plan, as the greatest cause of uneven wear is attributable to the stone being softer on the lower side, caused by the drip or by standing in the water. A good idea is to remove the crank, and this may apply advantageously to his plan. C. C. BLAKEMORE.

Washington C. H., Ohio.

THE NATIONAL ACADEMY OF SCIENCE.

The second session of this body (the first meeting was held, it will be remembered, at Washington, during the spring) met on November 3, at Philadelphia. The attendance has been large, and includes the names of many of the most distinguished scientists and scholars in the country. We give below brief abstracts of the papers read.

CAUSE OF SUDDEN COLD WEATHER.

Professor Elias Loomis has made careful studies of the weather maps of 1872–3, with a view to the discovery of laws governing the relation between the direction and velocity of the wind and barometric pressure. In the center of an area of low barometer, a strong upward movement has been observed, and it now appears certain that a downward movement prevails over areas of high barometer. The result of this downward flow must be a considerable fall of the thermometer. These considerations appear to prove that the extremely low temperatures which occur at irregular intervals in every month, and particularly in the winter months, are due mainly to the descent of cold air in the neighborhood, and that this descent of air results from the outward movement which generally takes place from the center of an area of high barometer. In summer, during a thunderstorm, the temperature often falls 10° in a few minutes, but observations show that there was no current of air from the north. These sudden gusts of cold must descend from the higher atmospheric regions.

In the discussion which followed the reading of this paper, Professor Joseph Henry suggested the possibility of currents from the north in the upper atmospheric regions bringing down the cold air, which is afterward precipitated on the earth's surface in the areas of high barometer where the outward motion of the wind is observed.

Professor Packard detailed some observations on the specific gravity of water in the Gulf of Maine, and stated that the bottom water is considerably denser than the surface. The average specific gravity of bottom water is slightly less than that of surface water; yet, from 50 to 800 fathoms, the specific gravity increases with the depth, from 1·0272 to 1·0277.

Professor Sterry Hunt delivered an extemporaneous address on the

DECAY OF CRYSTALINE ROCK.

In Western Connecticut, the brown hematite iron ores of Salisbury and Kent are associated with what is locally called fuller's earth, but consists, according to Shepard, of nearly vertical strata of crystaline formation decayed in place.

From a comparison of the masses of iron ore thus found with the similar masses observed in the decayed crystaline rocks of the Blue Ridge, which were recognized as the results of the alteration of beds and lodes of iron pyrites, and in some cases of beds of spathic iron ore, found in these rocks where the decay has not reached them, professor Hunt argued that such had been the source of much of the hematite ore found along the great Appalachian Valley.

The iron oxide in these and similar decayed rocks had, by its solution, furnished the whole of the iron ore which, in various forms, is interstratified in our palæozoic rocks at different horizons. From these decayed strata had also come the materials for all the clay rocks and sand rocks of various ages.

RELICS OF AN ANCIENT RACE.

Dr. F. V. Hayden mentioned his discoveries of ruined cities in the cañons leading to the Colorado river. He said that there once existed, in what are now the arid plains and savage gorges of Southeastern Colorado, a race so far civilized that they built large cities, constructing their houses of well hewn blocks of stone, with timber floors, well formed windows and doorways, and smoothly plastered walls, and that they possessed the art of making glazed pottery.

Professor Henry produced a eulogy upon

JOSEPH SAXTON,

the inventor of the magneto-electric machine, who died October 26, 1873. Mr. Saxton also invented the locomotive differential pulley; an apparatus for measuring the velocity of vessels; and a metal ruling machine, a contrivance for tracing lines on metal or glass at a minute distance from each other. Mr. Saxton returned to this city in 1837, and during his connection with the United States Mint constructed the large standard balances still used in the annual inspection of the assays and the verification of the standard weights for all the Government assay and coining offices of the United States. Mr. Saxton's inventive powers were exercised rather for the pleasure their employment gave him than for any gain to himself. Others reaped the profit from many of his most valuable inventions. He rarely sought to bring into use his devices and discoveries. Among a great many valuable inventions, for which he never received proper credit or any pecuniary return, was that of metallic cartridges.

Professor Packard described the indications of the nervous system of the limulus (king crab) which he succeeded in discovering in a fine transverse section of an embryo in an early stage of development. He also mentioned a bright red gland in the crab, hitherto undescribed, which, he thinks, is renal in Nature, and homologous with the green glands of normal crustacea.

MEASURING MINUTE CHANGES IN ATMOSPHERIC PRESSURE.

Professor Mayer described a machine accurately measuring the most minute variations in the pressure of the atmosphere—changes so slight as not to affect the barometer. A hollow metallic vessel, with unyielding walls containing air, has adapted to it an open glass tube. In this tube is a short liquid column. The glass tube is in a horizontal position. The vessel is surrounded with melting ice, which keeps the air in the vessel at a constant temperature. In this condition the liquid in the tube remains stationary, if the pressure of the air outside the apparatus remains constant; but any increase of pressure in the atmosphere will cause the liquid in the horizontal glass tube to move toward the vessel. The contrary motion takes place when the atmospheric pressure diminishes. These motions of the liquid column are registered continuously by photography. A standard mercurial barometer is observed at stated times, so that the values of the motions of the liquid column can be determined. This apparatus, if placed at certain important stations of the United States Signal Service, would be of good use in studying the variations in atmospheric temperature in connection with the development and progress of storms.

Professor Mayer spoke afterward of the change in dimensions of solid and hollow iron cylinders on their magnetization, and described experiments made on solid and hollow cylinders of iron three feet in length and five or six inches in diameter. He found that solid cylinders elongate on being magnetized, but at the same time so contract in their transverse dimension that the volume of the cylinder remains constant. In the case of hollow cylinders, however, it was found that their interior capacity increased on their magnetization.

Professor Henry replied briefly to the criticisms upon our lighthouse service, which appeared in the recent report of Major Elliott, an abstract of which has appeared in these columns. He said that lard oil made a brighter light in large lamps than kerosene; and that as most lighthouse keepers were appointed by politicians, they were ignorant of their business, and could not be trusted with gas-generating apparatus. There was often trouble in teaching them to manage the simple steam boilers used with fog whistles and sirens. An electrical light had been proposed instead of oil, but such light was deficient in the red ray. No light was strong enough to penetrate fog. A mile of cloud shut out the sun's rays, and we could not hope to get a light superior to the sun.

Professor Silliman described a method for the

REMOVAL OF AMMONIA FROM ILLUMINATING GAS,

and obtaining it in the form of a dry salt, adapted to the uses of agriculture. When nitric acid salt cake, a by-product of acid works and of small value, ground to powder, was placed in an apparatus similar to that used for lime purification, all the ammoniacal compounds were completely removed from the crude gas, while the salt was enriched by about 13 per cent of sulphate of ammonia, or 3½ per cent actual salt. It appeared on investigation that all the cyanogen compounds had been decomposed by the salts of iron in the nitric acid salt cake, derived from the action of the acid on the iron retorts, and excited a ferro- and ferri-cyanide of iron action in the mass, staining it distinctly.

The so-called commercial superphosphate of lime also effectually withdraws every trace of ammonia from gas. An acid salt of this sort is found in ammonia, which yields a soluble monobasic calcic phosphate of 6 76 per cent of phosphoric acid; when saturated with ammonia composed from gas, it yields 6·11 per cent of salts.

The ammonia may be completely withdrawn from coal gas in its crude state by acid salts, and presented in a dry and manageable form, without further labor or expense in solution, crystallization, or manufacture; and also it is easily deprived of the poisonous effects of cyanogen compounds by a proper use of salts of iron. Analytical chemists will be glad to know that, by using either sodic or potassic bisulphate in a U tube, it is quite easy to withdraw ammonia from a gaseous mixture containing ammoniacal compounds, and to obtain it in a condition to be weighed.

Professor W. B. Rogers, on

NEWPORT CONGLOMERATE,

said that there is nothing in the structure calling for further agency than the ordinary transporting and wearing actions under which such products have generally been accumulated.

Professor Rogers described a

SIMPLE METHOD OF GENERATING POSITIVE ELECTRICITY

wherever a steam boiler exists in the building.

He attached a pipe to an ordinary boiler used for heating purposes, and carried it through the window to the outer air. To the end of the pipe where the steam escaped he attached what are known as Faraday's nozzles—15 of them—with applewood apertures. In front of these nozzles he suspended, by a brass rod, a piece of brass foil, cut so as to present a bristle of points to the escaping steam. He had only to provide an insulating support for the rod, and carry a wire through a pane in the window to a long rod held by ribbon silk in the room where he desired to use the electricity, to have a strong positive current. A tube inserted in the steam pipe, with a valve opening inwardly, admitted air sufficient to produce a uniform condensation of the steam.

Professor Mayer's paper on the composite nature of electrical discharges, that of Professor Henry on the effect of wind on sound waves, and Dr. LeConte's address on the use of mineral poisons by farmers, we reserve for fuller consideration.

The meeting adjourned on November 5.

A NEW SOURCE OF COAL.—The English engineers sent by the Viceroy of Egypt to examine the carboniferous deposit of Dranesta have recently forwarded to England 300 tuns of the fuel to be experimented upon. Dranesta is situated 108 miles south of the city of Salonica, in the midst of the mountains which extend to the southward of Mount Olympus.

Character of Electric Discharges.

A flash of the duration of $\frac{1}{1000000}$ of a second is instantly recognized by the retina, but the effect on the eye lasts fully $\frac{1}{8}$ of a second. The duration of the flashes recently examined by Professor A. M. Mayer, of the Stevens Institute, varied from 0·124 to 0·0416 of a second. An idea of the length of this last mentioned interval may be obtained by recalling the fact that a rapid involuntary wink takes place in nearly the same time. That the Leyden jar discharge is multiple was discovered by Professor Henry, and this has been subsequently confirmed by Cazin, Tedderson, and Rood. Professor Mayer, however, has sought more definite results, and the object of his investigations has been a permanent record of the character of the discharge, of its duration, and of the intervals separating its constituent flashes and sparks. To this end he prepared disks of thin printing paper, blackened over burning camphor, and of a diameter of 5·8 inches. When one of these was revolved very rapidly, it became quite flat by centrifugal action, and in this position the discharge between points or balls perforated it, leaving the required record. By presenting momentarily to the rotating disk the delicate point attached to a vibrating tuning fork, the number of vibrations per second of the fork was determined to the last degree of precision by means of a break-circuit clock, which at each second sent a spark from an inductorium through the fork. The result was traces on the blackened disk; and by tracing the axis of the sinuous line with a needle point, and then drawing radii through symmetrical intersections of the axis on the line, the disk was divided off into known fractions of time. These marks were then rendered permanent, the disk centered on a dividing circle, and the indications read by a low power microscope, determining with accuracy intervals and durations to one 50,000th of a second.

The results thus far obtained we summarize below, and we understand that others have been reached which the investigator withholds until he has subjected them to more careful examination.

The first discharge was between large inductorium points, 0 39 inches apart, the striking distance of the coil being 17·7 inches. Thirty-three clear round holes were made in the disk by a portion of the discharge lasting $\frac{1}{23}$ of a second. The average interval between the perforations at the beginning was $\frac{1}{759}$ of a second; then followed a period of quiescence of $\frac{1}{1500}$ of a second, and then a shower of 30 minute sparks, lasting $\frac{1}{330}$ of a second. The average interval separating these was $\frac{1}{9900}$ of a second. The second discharge was between platinum points, 0·39 inches apart, of a large inductorium, with a Leyden jar of square inches, connected with the terminals of the secondary coil. The discharge on its path around the disk dissipated 91 little circles of carbon, each perforated by from 1 to 4 holes. The discharge lasted 0·124 second, and the intervals were $\frac{1}{555}$ of a second up to the tenth flash. For four fifths of the discharge they were separated by $\frac{1}{5882}$ of a second, and at the last by $\frac{1}{1000}$ of a second.

We understand that Professor Mayer is examining the discharges of the frictional and Holtz machines, as well as of the Leyden jar and inductorium, so that results of considerable scientific interest and importance may be expected.

Rubber Thermometers.

M. Kohlrausch, having several times noticed that glass flasks, closed by stoppers of hard rubber, burst, concluded that this substance must be very dilatable. This hypothesis was fully verified by experiment, for the expansion of this body was found to be about three times that of zinc. From his measures, the coefficient of dilatation for 1° between 16 7° and 25·3°=0·0000770, and between 25·3° and 35·4°=0·0000842. Thus, not only has hard rubber a very great coefficient of dilatation, but the latter increases very rapidly with the temperature.

This remarkable property can be applied to the construction of very delicate thermometers. Thus, with a small instrument, consisting of two strips of rubber and ivory, 8 inches long, glued together and fastened at one end, we obtain, at the other extremity, a considerable movement for a change of temperature of one degree. The coefficient of hard rubber is equal, at zero, to that of mercury; above, it is greater. We can, then, as a curiosity, construct a mercury thermometer with a reservoir of this substance, whose changes will be the opposite of those of a common thermometer, and which will fall with an increase of temperature.

The Pennsylvania Railway Company's Figures.

The Pennsylvania Railway Company owns about 16,000 eight-wheeled freight cars, valued at $512 each; 1,800 four-wheeled freight cars, worth $170 each; 521 passenger cars of all grades, worth $3,550 each, and 879 locomotive engines, worth $11,000 each. Total valuation of the rolling stock, twenty millions of dollars. The length of the company's tracks, or those controlled by the company, is 5,934 miles.

MUSCARINE is a new alkaloid obtained from poisonous mushrooms, and especially from the *agaricus muscarius*. Dr. Provost, of Geneva, has shown that, when muscarine is injected into the veins of an animal, the heart is arrested in its diastole. The action of this poison is so much the more remarkable, since in such a case the heart is not dead, nor even paralyzed, and its contractions can be aroused after several hours' silence.

ACCORDING to Képesy, the surgeon to the Austrian Polar Expedition, chocolate, as a beverage, proved most valuable of all; the preserved meat and vegetables in tins being also of the greatest service in sustaining the strength and spirits

IMPROVED PINKING IRON.

This is an ingenious and handy substitute for the old fashioned pinking iron, or one under which the cloth is usually laid and the cutting done by pounding on the end of the tool with a hammer.

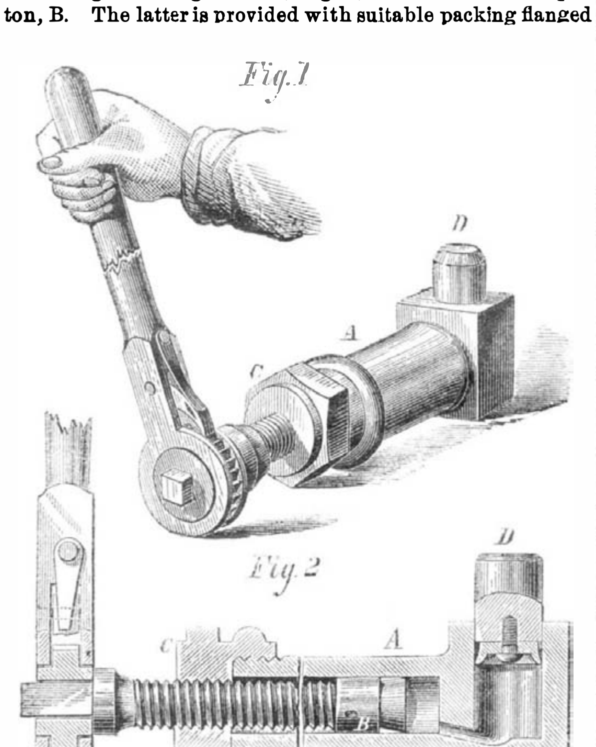
The present invention is nothing more than two cutting blades, of any desired form, attached to levers which are jointed like pincers and are operated like scissors. The upper blade does the cutting, and the lower one is made to correspond to it in shape, having its edge made, however, by beveling one side only. Both are so constructed that, when the jaws are closed, the edge of the upper blade sinks slightly below the surface of the lower tool and just back of the same, so that at each stroke the beveled parts of the blades bear against each other, and the cutting edge strikes against nothing but the fabric.

Of course the dies or blades are varied in form for different patterns, but it is considered cheaper to have an entirely separate instrument for every pattern instead of providing detachable blades.

Patented September 1, 1874. For further particulars regarding sale of State rights, etc., address the inventors, Mrs. Eliza P. Welch, Groton, Caledonia county, Vt.

BIDDLE'S HYDRAULIC JACK.

For forcing crossheads out of piston rods, bolts from engine frames and cylinders, crank pins out of locomotive driving wheels, and for performing similar work in which it is necessary to employ a tool of large power in a small space, the invention herewith illustrated will, it is claimed, prove excellently adapted. It is a novel form of hydraulic jack, consisting of a long tube, A, Fig. 2, in which works a piston, B. The latter is provided with suitable packing flanged



at the circumference, for expanding and closing tightly the more the pressure is increased, and is connected by a universal or similar joint to its screw bolt. The screw nut, C, is affixed at the end of the tube, A, and through it the bolt passes, terminating in a square end, to which the ratchet wrench is applied.

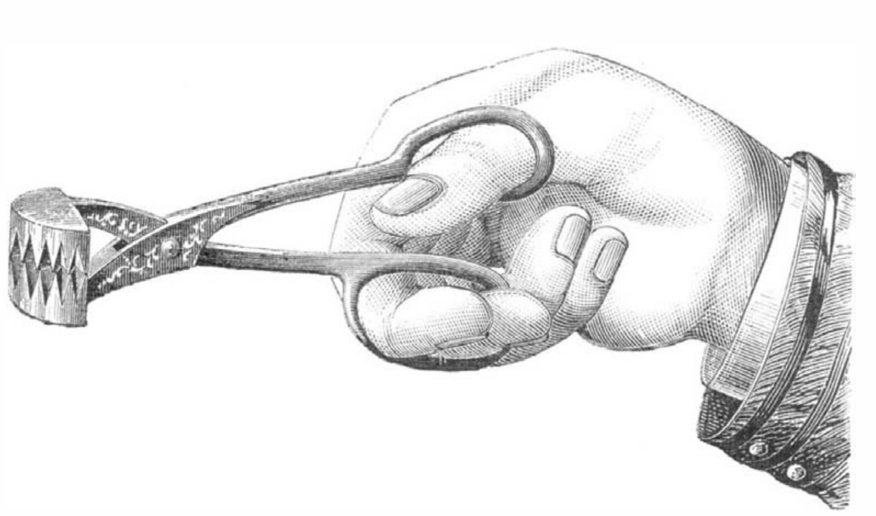
The liquid in tube, A, is forced by the advancing piston into the ram tube through a small connecting channel and against the lower end of ram, D, which is packed in the same way as the screw piston. The effect is to push the ram outward, and so to apply power to whatever may be in contact therewith. It will be seen from the exterior view, Fig. 1, that the device is quite compact, and it can be made of any size. It will doubtless prove a very useful implement for work in spaces too small for the employment of common tools.

Patented through the Scientific American Patent Agency, August 25, 1874; caveat also filed in Canada. For particulars regarding sale of rights and other information, address the inventor, Mr. Edward Biddle, Carlin, Elko county, Nevada.

Solid Metal Floating on Melted Metal.

It has been alleged that a cast iron cannon ball will float on molten cast iron, and Mr. R. Mallet, in a paper before the Royal Society, on the fusion of metals, explained the fact that some metals, when solid, float on a melted bath of the same metal, by the assumption of a "repellent force." Before definitely adopting this rather mysterious explanation, Mr. Adolf Schmidt advises all who are yet in doubt in regard to this subject to make the following experiment:

"Have a solid ball of cast iron, of 1½ to 2 inches diameter, cast and filed off pretty smoothly. Have a ladle or vessel, of at least ¾ cubic foot capacity, filled with molten cast iron. If then you lay the cold cast iron ball on the surface of the molten iron, you will find that the ball, in spite of the repellent force assumed by Mr. Mallet, will sink to the bottom of the ladle at once. With an iron rod you can feel the ball at the bottom of the ladle and roll it about. But, after twenty or thirty seconds, the ball will slowly rise to the surface of the bath and remain there. It is thus evident



WELCH'S PINKING IRON.

that cast iron at ordinary temperatures is both heavier and denser than molten iron; but that, as its temperature rises, the solid iron expands, and becomes lighter and finally floats on the molten iron. The latter fact shows simply that solid iron, when at a high temperature, approaching its melting point, is less dense and lighter than molten iron, which fact again implies that molten iron must undergo a rapid expansion in the moment of its solidification. The extent of this expansion is, however, less than that of the subsequent contraction in cooling, so that the cold iron is again denser than the molten iron.

The error of Mr. Mallet and of many preceding observers consists in this: Their observation, that the solid metal floats on the molten metal, refers to the former when heated, while their determinations of specific gravity of the solid metal are made with the metal, when cold. But my experiment, as above described, shows that this cold metal, which has the highest specific gravity, does not float, and the heated metal which does float has undoubtedly a smaller specific gravity. There is certainly nothing either incongruous or wonderful in all this, and nothing that would require or justify the assumption of a repellent force. None of Mr. Mallet's experiments prove anything against the temporary expansion of certain metals in the moment of solidification, and all the observations I made on this point in founderies verify it."

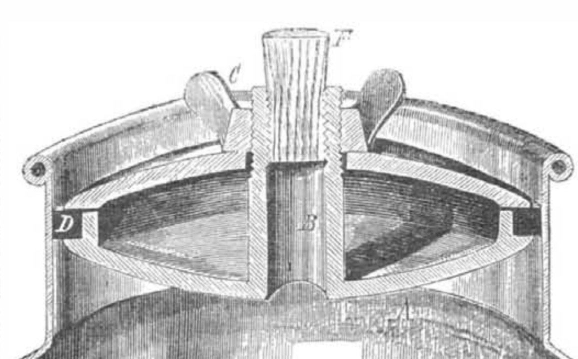
The Study of Chemistry.

We often hear it said, by way of excuse, that the study of chemistry is so dry, and the time required so great that the student must begin young or not at all. Now this is simply nonsense; there is no branch of Science so interesting, and none more easily acquired. Three or four hours a week for a few months would so open the eyes and interest the understanding of any ordinary mortal that, without laying any claim to the prophetic mantle, we may safely assert that he who will make the trial shall have provided for life a source of pleasure for himself, and a power to interest and instruct his fellow men.—*Western Photographic News.*

A NOVEL MILK CAN.

Mr. Marquis D. L. Gaines, of Boonton, N. J., has recently invented an ingenious packing for the caps of milk cans, and also a novel arrangement of plug for binding the milk in the receptacle to prevent its churning during transportation.

After the can is filled, the cap, A, made in two parts, as shown with the same slightly screwed together, is inserted in the neck of the vessel until the milk fills the plug hole, B. The thumbscrew, C, is then turned down, causing the upper plate of the cap to press upon a rubber ring, D (which fits in a rabbet of the lower plate), squeezing the same out-



ward against the inner surface of the can, making a rigid airtight joint. The plug, E, is subsequently screwed down into the milk, forcing it into every interstice of the can, and so preventing its shaking about during carriage. Patented February 24, 1874.

Two thousand millions of dollars ($2 000,000,000), in round numbers, was the total existing debt of the United States on November 1, 1874, according to the report of the Secretary of the Treasury. The debt is being steadily reduced.

Air Pressure in Wind Instruments.

Dr. W. H. Stone, in a paper before the Physical Society of London, describes some experiments on the wind pressure in the human lungs during performance on wind instruments. About six feet of water or 13 lbs. pressure per square inch was the ordinary maximum when a small tube was inserted between the lips. When the lips were supported by a capped mouthpiece, as in brass instruments, a much greater pressure could be sustained, and lip muscles invariably gave way long before the expiratory power of the thoracic muscles was exhausted. The following pressures were sufficient to produce an average orchestral tone: The oboe requires an air pressure of from 5 to 10 ounces per square inch, the clarinet 8 to 14 ounces, bassoon 7 to 14 ounces, horn 2½ to 5 ounces cornet 5 to 18 ounces, trumpet 7 to 18 ounces euphonium 1½ to 23 ounces, bombardone 1½ to 20 ounces.

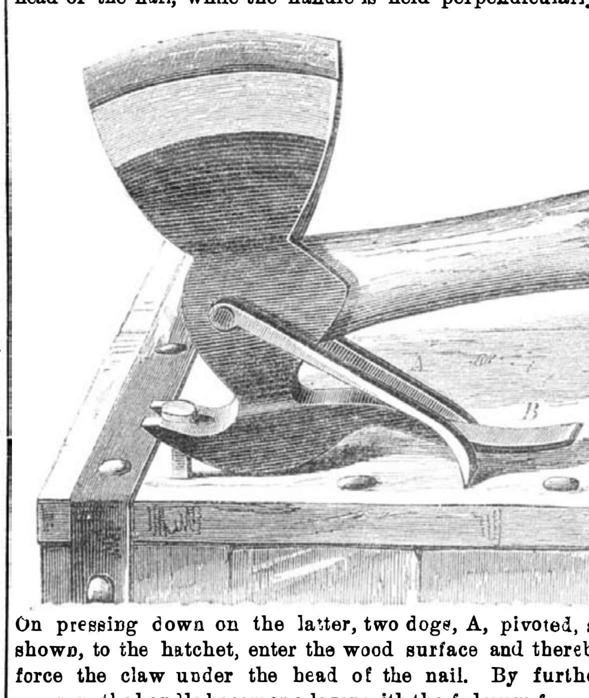
It will be noticed that the clarinet in this, as in some other respects, differs from its kindred instruments, and also that most of the pressures are small, not exceeding or indeed attaining the pressure of a fit of sneezing or of coughing. They are, therefore, very unlikely to injure the lungs, or to produce the emphysema erroneously attributed to them.

Vanilline.

At a recent meeting of the Paris Academy of Sciences, Dr. W. A. Hofmann announced that his two students, MM Tiemann and Haarmann, who had obtained vanilline (the aromatic principle of the vanilla bean) from pine sap, propose to manufacture this substance on a large scale. The sap of a tree of medium hight gives vanilline to the value of $20, and the wood is not injured by the extraction of the sap. This will be the second vegetable product manufactured by purely chemical methods.

IMPROVED HATCHET.

We illustrate a new hatchet which is provided with a claw attachment, by the aid of which nails can be withdrawn from the wood in a perfectly straight condition. To perform this operation, the claw of the tool is placed near the head of the nail, while the handle is held perpendicularly.



On pressing down on the latter, two dogs, A, pivoted, as shown, to the hatchet, enter the wood surface and thereby force the claw under the head of the nail. By further pressure the handle becomes a lever with the fulcrum formed by the projecting piece, B, so that the claw is carried straight upward, thus pulling the nail in that direction.

Patented May 12, 1874. Mr. James A. Wisner, of East Saginaw, Mich., is the inventor.

Watered Butter.

In the course of some investigations by Professors Angell and Hehner, England, out of analyses of fifteen samples of butter which were determined by them, twelve of the samples, which were undoubtedly good butter, contained 6 to 13 per cent of water; the astonishing quantity of 42 3 per cent was found in one sample from London, or an excess of about thirty-two per cent of water, for which Londoners pay from 32 to 48 cents per pound. Another butter from the same place had 24 per cent, these high ratios being due to the fact that the butter had been treated with milk. On the other hand, a sample purchased in Ventnor was found to contain under 4 per cent of water, and according to the authors it contained 50 per cent of foreign fat. The authors also found that genuine butter spread out on sheets of paper and exposed for a week to the air in the laboratory became, so far as the senses could judge, indistinguishable from tallow. With regard to the microscopic examination of butter, Messrs. Angell and Hehner think that Dr. Campbell Brown said too much when he declared that with polarized light it was the most reliable means of distinguishing pure butter from that containing other fats.

If the heat which a human being gives off in twenty-four hours could, consistently with life, be retained within the body, its temperature would, at the end of that time, have reached 185° Fah., a temperature above the point of coagulation of albumen, and high enough to cook the tissues.

THE LATE JOHN LAIRD.

One by one the founders of modern engineering science pass away. We chronicled the week before last (page 309 of our current volume) the death of Mr. John Laird, one of the originators and, for many years, the head of one of the largest iron shipbuilding works in the world, and a prominent figure in the industrial arts at a time when iron vessels were merely matters of theory; and we publish herewith an excellent likeness of this well known man. Birkenhead, the scene of the labors and prosperity of the Laird family, lies on the left bank of the estuary of the Mersey, immediately opposite Liverpool, and is renowned for its many important industries and its magnificent inclosed docks, cut out of the solid rock, which there forms a surface stratum of immense thickness. In 1841, William Laird, father of the lately deceased, commenced the shipbuilding and iron works, and lent his aid to establish many of the important steam-ship lines which have their headquarters in Liverpool and Birkenhead. In the year 1829, John Laird constructed an iron ship, which there is good reason to believe was the first ever built. She was a 60 tun vessel, built for inland navigation; and although many difficulties, owing to the novelty of the task, beset the builders, she was framed and plated very similarly to the largest and best ocean steamships of the present day. In 1834, Mr. Laird built a paddle steamship for the late G. B. Lamar, who recently died in this city; she was called the John Randolph, and the *Practical Magazine* asserts that she was the first iron vessel ever seen on American waters. She was shipped piecemeal from Liverpool, and set up on the Savannah River.

In the limits of a newspaper article, it is hardly possible to detail the development of the great industry of Birkenhead; suffice it to say that the firm of John Laird & Co. have, to this date, possessed one of the largest establishments for the special purpose ever organized. Between the years 1829 and 1873, they turned out 429 steamers, of 229,662 tuns builders' measurement, driven by engines amounting to 39,790 horse power. Half these engines were manufactured by Messrs. Laird & Co., as well as engines to the amount of 25,143 horse power, fitted in vessels constructed by other builders.

Mr. John Laird's administration of these large operations is noticeable in many ways. He was, as early as the year 1839, and previously, urging the British Admiralty to build iron ships only; and his iron steamers of that date became renowned for speed and durability. He built a vessel of 446 tuns burthen, which drew only two feet of water, and he obtained an advantage over many rivals by building, in three weeks, a gunboat for use in the Russian war. The splendid fast steamers plying between Holyhead and Dublin are his work; and, indeed, there is no quarter of the globe where his handiwork is not represented. The building of the notorious Alabama, for a Liverpool firm of merchants who were the financial agents of the South during our late war, and her depredations upon our commerce during the first few months of the rebellion (for which the English Government has already paid over fifteen million dollars for damages to our shipping), have given the Laird establishment great notoriety in this country. The Alabama was built after Mr. John Laird's retirement from business.

The works of this firm cover 20 acres of ground, and have held the chief position in Birkenhead since 1824. In 1831, the population numbered only 2,569; it is now over 70,000. Three thousand skilled artisans are employed by Laird & Co., and, to their credit may it be said, the firm have made many liberal arrangements for the moral and social wellbeing of their employees.

John Laird retired from business in 1861, when Birkenhead became a Parliamentary borough, and was elected member for the town, retaining the seat to the day of his death. Since his withdrawal, the works have been carried on by his three sons.

SEVERAL years since a spontaneous explosion took place in a rock quarry near Nicholasville, Ky. The Lexington *Gazette* says that recently these explosions have begun again, two very violent ones having occurred, rending the rock in all directions and throwing up a vast amount of *débris*. The people of the neighborhood are very much exercised in reference to these unaccountable proceedings. The explosions are described as so violent that, if one should occur under a house, it would hoist it and its contents like a veritable torpedo.

THE LATE JOHN LAIRD.

The Great Suspension Bridge between New York and Brooklyn.

The engineers of the Brooklyn Bridge have prepared plans and specifications of the massive iron saddles upon which the cables are to rest, and bids for their construction will soon be called for. The saddles, four in number, will each have for a foundation a solid plate of iron, 16 feet long, 8 feet wide, and 1½ inches thick. The plates are to be provided with two flanges, which will be imbedded in the solid masonry of the tower. But in order to provide for the contraction and expansion of the enormous mass of metal in the cables, forty-three iron rollers, 3½ inches in diameter, will be inserted in a groove between the saddles and the saddle plates. The saddles will then be enabled to move backward and forward, and accommodate themselves to the strain of the cables, which is liable to differ in intensity according to changes of the temperature. Each saddle will weigh about 25,000 lbs., and will contain at its apex a rounded groove 19½ inches wide, through which the cable will find an exit. Each cable will be composed of more than 6,000 wires, and will sustain nearly 1,000 tuns. The stay cables will bear a portion of the weight, and it is computed that the entire structure between the spans will weigh about 5,000 tuns. It is predicted that the bridge will be completed in four years.

Car Brakes.

A series of experiments were recently made by the Baltimore and Ohio Railroad Company to test an improvement made by Mr. Loughridge in car brakes. The object was to determine in what time and distance a single car could be stopped at high speed in comparison with the old system where the hand brakes are used, which was determined by drawing the coupling pin and separating two cars from the train. The results were that, when the pin was pulled and the brakeman signaled to apply the brakes, the car with the new system was stopped when running at a speed of forty-eight miles an hour within a distance of 550 feet, and within 13½ seconds time, while with the other car it required 1,255 feet distance. Several stops were made, which showed great power and a remarkable uniformity of action in the new brake. Mr. Loughridge claims this as the shortest distance in which a car has ever been stopped with hand power, as some two hundred feet were required to fully apply the power with a brakeman, and that with this improvement the effectiveness of the air brake will be proportionately increased.

Mediæval Superstition.

The increased longevity of later times is less owing to improved therapeutics than improved hygiene. Dr. Lyon Playfair says, in a late paper read at Glasgow: When the Egyptian, Greek, and Roman civilizations expired, with their baths and divine maxims about ablutions and purifications, dirt reigned for a thousand years. Not a man or woman in Europe ever took a bath; hence the spotted plagues, the black deaths, the sweating sicknesses, the dancing manias, the mewing manias, and biting manias that ravaged the people, and cut off, in the middle ages, one fourth of the entire population. Religion came to the aid of dirt; the more filthy a saint was, the more saintly he was considered. Some of the hermits never changed their clothes, and only combed their hair once a year. St. Anthony never washed his feet, and St. Thomas à Becket's under garments acquired an additional sanctity from the vermin they contained. Nervous diseases, the result of superstition, were frequent, and often attributed to demons.

The Camacho Electro-Motor.

Several scientific men, at Havana, have been appointed to examine the electro-magnetic engine invented by J. S Camacho, and to report on its advantages for industrial purposes in general, and especially as motive power. So says the *Revista de Telégrafos.* In the Camacho electro-magnet each limb is formed of four hollow concentric iron cylinders, the inner one half an inch in thickness, and the three remaining one quarter inch. The interior diameters of the tubes are, respectively, 2, 3, 4, and 5 inches. Each of them is surrounded with a coil of copper wire, covered with cotton, and is one eighth inch in section, forming, on the three inner tubes, two complete layers with 180 turns, and on the outer tube seven layers with 630 turns.

The copper wire on each tube is coiled in the same direction, passing at its ends across the armature of the magnet, and uniting them, therefore, in the natural order, so as to form a single conductor through which the current from the battery may travel, magnetizing each tube, and endowing them all with magnetism of an equal nature. The length of the limbs of the magnet is 8 inches, the weight 77 lbs., and that of the copper wire 47 lbs. with a total length of 2,600 feet.

Repeated experiments have shown that this magnet requires the current produced by seven bichromate of potassa elements, and its power of attraction at a distance of one twelfth of an inch is more than 1,250 lbs. An electro-magnet of the ordinary construction, of equal exterior diameter and placed in the same conditions, is only able to support 25 lbs., a weight 50 times smaller.

Repeated experiments of physicists, as eminent and well versed in electro-magnetism as De la Rive, have shown that the main difficulty which has opposed the industrial application of the electro-magnetic force has been that hitherto it has proved from 25 to 30 times dearer than that of steam. If, therefore, M. Camacho has succeeded in obtaining electro-magnets so powerful, the following proposition cannot be pronounced too venturesome: "The new electro-magnets offer to industry a source of power much cheaper than animal labor, and capable of immediate application to urban railways. The same power is further destined, at no remote epoch, to replace advantageously that of steam."

The report is signed by D. Francisco Clerch, Professor of Physics and Chemistry at the College of Guanabacoa; D. Eu. de Aranlave, Inspector General of Telegraphs for Cuba; D. Antonio de Molina, Engineer in Chief on the staff of the roads, canals, and harbors, and of public works; and D. Alberto de Castro, Civil Engineer.

Red Wall Paper Dangers.

To the dangers due to the arsenic entering into the pigment used in staining green wall paper, must now be added others produced by coralline dye employed in the coloring of red hangings. It appears that the poisonous symptoms (extending to acute eruptions of the body, when under garments thus dyed are worn, and to eye diseases in papered rooms) are owing not directly to the coralline, since recent experiments have proved the substance to be harmless, but to an arsenical mordant used to fix it. This last acts as a poison, both topically upon the skin, through contact with garments, and also by its dust and vapors, disengaged from the stuffs which it colors.

PROFESSOR SCHIMPER has discovered a fossil plant in protogine, a rock hitherto considered as of igneous origin and found in the form of erratic blocks in the sides of Mont Blanc. The plant is of aquatic nature, and hence the aqueous origin of the rock is rendered probable.

THE FAIR OF THE AMERICAN INSTITUTE.

The closing days of the Fair have been marked by still greater throngs of visitors. Indeed, we doubt whether any previous exhibition during late years has met with so large a share of popular appreciation, and certainly none has more richly deserved the same. As a consequence, we hear from exhibitors on all sides self-gratulatory remarks as to the benefits gained. One manufacturer informs us that he has received orders for forty-five of his engines; another traces a large increase in his sales to his representation at the Fair; a company in need of working capital have negotiations well advanced for the same, simply through presenting their products under working conditions; and so on through a number of instances, all tending to show the value of such exhibitions, when rendered really attractive to the public, as a means of bringing together the seller and the buyer.

To the careful student of the gradual growth and establishment of new national industries, there are many evidences of progress which cannot but be gratifying. Two instances occur to us: the fine porcelain and elaborate paper hangings, manufactured respectively by the Union Porcelain Works, of Greenpoint, and Messrs. Beck & Company, of this city. The porcelain will, in delicacy of make and tasteful ornamentation, compare favorably with the best produced abroad. The wall paper presents a series of embossed, gilded, and colored designs, equal in every respect to those of the finest imported. We notice also fine collections of bronzes and chandeliers, also a variety of philosophical, dental, and medical instruments, the workmanship of which it seems hardly possible to excel.

There is a slight difference between swill or sugarhouse refuse and clear, bright honey, and yet the bees contrive to find the latter in the former waste as readily as in the sweetest of buckwheat fields. A neat hive at the Fair contains the comb, insects and all, and the visitor can see for himself that the neglected sweets of New York produce a by no means inferior article.

The Blake stone crusher, a machine which literally chews stone into fragments with a rapidity exceeding that to be found in the geological investigations of a whole regiment of convicts, is in full operation. It has just gained another medal—this time at Cincinnati. Snow's water wheel governor is also exhibited in motion. This device (which we illustrated on page 182 of our current volume), when the water is drawn down to a given point, automatically closes the gate so as to allow the water to regain the lost head, and, when at the available point, of itself resumes its natural action. Hall's universal emery grinder is a tool which will recommend itself to mechanics, on the score of handiness, if of nothing else. It is an emery wheel, arranged at the extremity of a long arm and actuated by elastic belts. By means of counterpoises and suitable attachments of the arm, the wheel can be carried to any point within the radius of the latter, turned upside down, carried to the floor or high in the air, and, when let go, remains in convenient position to be readily grasped.

Messrs. Merrill & Sons' drop hammer has been in operation, forging small articles, the metal being heated in a small portable forge near by. Phillips' corn husker deserves mention as an excellent machine of its class. The stalks, with the ears adhering, are fed in at one end, meeting toothed rollers and other devices which tear off the ear, husk it, and deliver it clean, on an endless band, while the stalk, thoroughly crushed, is thrown out beneath.

Stiles' patent hydrostatic mercury pressure gage is a novelty on which we have heard much favorable comment. Its principle is simply the counterpoising, weighing, and indicating the steam pressure by means of a low mercury column. The construction is quite simple, and there are no springs, levers, or other complicated mechanism.

The Value of Fresh Air.

Dr. Le Bow, of Paris, in a recent work on hygiene, speaking of the hygiene respiration, observes that typhoid fever, anæmia, typhus, and dysentery are the diseases to which those who breathe an atmosphere insufficiently renewed are predisposed. If these individuals are wounded, they are rapidly decimated by purulent infection. Of all the facts that can be cited to show the danger to human life that results from inspiring air vitiated by the products of our own respiration, especially when debilitated by disease, none is more convincing than the mortality which occurs in our American hospitals, and which can only be termed frightful when compared with that of foreign hospitals, where the system, always adopted by us, of immense wards containing many patients, has been completely abandoned. In comparing the mortality of patients operated on during the wars of the Crimea and of the Secession, we see, from the statistics of Chénu and of Woodward, that, while the French army lost 73 per cent of all operations, the English army only lost 40 per cent, and the Federal only 34 per cent. In this case it might be objected that the English and American wounded were, as has elsewhere in this work been stated, well fed, while the French were very badly fed. Insufficient food will always increase the bad effects of imperfect aeration, and it is difficult, perhaps, to assign to each the exact part that it plays. But in the example which follows, this reason cannot be invoked, for the patients were well cared for in time of peace, and in the most renowned hospitals.

In some statistics in which M. Lefort compared those who had suffered from the same lesion, amputation of the thigh, he arrived at the following results, which he communicated in 1868 to the Society of Surgery:

In a hospital containing 100 patients, 25 per cent died; n one containing 200, 31 per cent died; in one containing 300, 37 per cent died; in one containing 400, 40 per cent died; in the hospitals of Paris, there die 74 per cent.

It thus appears that the most dangerous fields of battle are less murderous than for a wounded man to take refuge in one of the hospitals of Paris, and it may well be open to question whether any advantage they afford can counterbalance a sojourn in these dangerous establishments.—*Medical and Surgical Reporter.*

Co-operation.

We have recently had to call attention to several new phases of the coöperative movement, which has done so much in many countries to induce the industrial classes to economize their means and invest their savings in mills, mines, factories, and stores. One of the largest of such associations (which illustrates the principle admirably, though it can scarcely be considered as a workmen's movement) is the Civil Service Supply Association, of London, England. It was begun by a few government clerks, who united to purchase their own tea by the chest and calicoes by the piece.

In six months just ended, goods to the amount of nearly $2,000,000 were purchased by the Association; these goods were retailed at a gross profit of about 10 per cent, showing a nett result of 2½ per cent on the whole, after payment of expenses. But the remarkable feature about this associated trading is that these large operations sprung from and were transacted on an original capital of $10,890. The profit of 2½ per cent on $2,000,000 is $50,000, equivalent to more than 500 per cent on the original stock of the Association. It would be difficult to find a better illustration of the value of small profits, quick returns, and prompt payments than this.

Substitutes for Rubber Insulators.

Th. du Moncel examines the manner of rendering wood non-conductive—a question of some practical importance, since the only insulator free from brittleness hitherto known, suitable for the construction of electric insulators, is ebonite, a substance both costly and liable, in course of time, to an efflorescence of sulphur.

Ivory and guaiacum wood, which are both relatively good conductors, become nearly non-conductive if stove-dried and saturated with certain oily and resinous liquids, which close up the pores of the bodies in question, and prevent moisture from penetrating within. Other kinds of wood can be modified in the same manner.

Sawdust of hard wood, agglutinated with blood and submitted to a considerable pressure, so as to mold it into a solid tenacious body, like the hardened woods of M. Latry, is a good insulator for voltaic currents. After remaining six days in a damp cellar, it showed no galvanometric deviation.

Samples of wood baked and soaked in paraffin, and then exposed to moisture, were sensibly conductive.

Wood, stove-dried and soaked in different varnishes, proved also still capable of re-absorbing moisture, and, consequently, of becoming conductive. Compression diminishes the conductivity of wood for the time being.—*Chemical News.*

Albumen.

Albumen is an organic compound found both in animal and vegetable substances. Its properties are best studied in the white of an egg, which is a very pure form of albumen. It also abounds in the blood and chyle, and more or less in all the serous fluids in the animal body; it also exists in the sap of vegetables and in their seeds, and other edible parts. Albumen forms the starting point of animal tissues. The chief component elements of albumen are carbon, hydrogen, nitrogen, and oxygen, with small proportions of sulphur and phosphorus. It is believed to be a definite chemical compound, though the exact proportions and the rational formula have not been definitely ascertained. Carbon forms fifty-four per cent of it, nitrogen sixteen, and sulphur two. The disagreeable smell arising from the decomposition of eggs is from the generation of sulphuretted hydrogen.

Albumen is capable of existing in two states: in one of which it is soluble, in the other insoluble, in water. As soluble in water, it is found in the egg, the juice of flesh, the serum of blood, and the juice of vegetables. Soluble albumen may be converted into the insoluble form in the following ways:

1. *By the application of heat.*—A moderately strong solution of albumen becomes opalescent and coagulates on being heated to about 150° Fah., but a temperature of 212° is required if the liquid is very dilute.

2. *By addition of strong acids.*—Nitric acid coagulates albumen perfectly, without the aid of heat. Acetic acid, however, acts differently, appearing to enter into combination with the albumen.

3. *By the action of metallic salts.*—Many of the salts of the metals coagulate albumen completely. Bichloride of mercury, acetate of lead, sulphate of copper, and nitrate of silver form insoluble compounds, and the egg is therefore used as an antidote to these poisons. The white precipitate formed on mixing albumen with nitrate of silver is a chemical compound of the animal matter with protoxide of silver, and has been termed albuminate of silver. Albumen also combines with lime and baryta. When chloride of barium is used with albumen, a white precipitate usually forms. By long keeping, albumen loses its alkaline reaction and becomes sour and more limpid than at first. Mucous threads like cobwebs form in it, which appear to be caused by oxidation.

Ammonia added to albumen is said to preserve it for a longer time, and a lump of camphor floated in the liquid has a good effect. Alcohol, ether, creosote, and tannic acid likewise cause the coagulation of albumen.—*Western Photographic News.*

Recent American and Foreign Patents.

Improved Heating Furnace.

Adolphus F. Bishop and John H. Aiken, Norwalk, Conn.—The boiler contains two air chambers near the ends of the cylinder, the faces of which are concentric rims. Said chambers are connected by air tubes extending all the way round, except in front, where the fire doors are. In a central space is placed a furnace, above which is a smoke chamber. The furnace, air and fire tubes, air and smoke chambers, are watertight, and the air and fire tubes are sufficiently apart to permit an easy circulation of the water between, around, and among them.

Improved Car Coupling.

Frank W. Rowe, Hardwick, Vt.—A frame is placed a little below and in the rear of the draw bar, and a bar is connected with it, so as to have a small longitudinal movement. The forward end of said bar receives a hinged block. The forward end of the block projects a little in advance of the drawbar, and has a flange, the upper edge of which has two notches formed in it to receive the link, so that the link may be raised into a horizontal position by raising the forward end of the block. To a lever is attached an arm which projects forward into such a position that, when the free end is moved forward, the said arm may pass in beneath the hinged block, and raise its forward end to raise the link into a horizontal position. With the lever and frame is connected a spring, which, when the lever is released, forces the said lever back, withdrawing the arm and allowing the flanged block to drop away from the link and the drawbar.

Improved Animal Clipping Machine.

Warren S. Burgess, Norristown, Pa., assignor to himself and Charles P. Bickings, same place.—The cutter is attached to the end of a vibrating lever, and vibrated on the cutter plate. An air engine gives the vibrating motion to the lever. The machine is connected with the pump or compressed air reservoir by a flexible tube, so that it may be conveniently moved over the animal. By means of a fly wheel, the cutter is given a steady and regular motion, and the machine is guided with great ease and accuracy.

Improved Crosscut Sawing Machine.

Jefferson Thompson, Mexico, Ind.—The saw is supported on guides or ways as it is moved back and forth by a pitman, clasps serving as slides on the ways. A cord attached to the forward end of the ways extends upward, and passes between pulleys in a stand, consisting of the two inclined posts. From this stand the cord extends through a plate, which is adjustably attached to a back post, and thence to an adjustable arm. The arm is adjusted on a circular plate, so as to arrest the downward movement of the saw at any desired point by means of a pin through the plate. The saw is also lifted up and supported by the cord when it is not in operation.

Improved Manufacture of Glass.

Hugh Percival, Bishop Wearmouth, Eng.—This invention consists in the adaptation of covered pots or coverings to be used in connection with ordinary tanks, and also in the adaptation of ordinary tanks to be worked in connection with covered pots or coverings. Said pots or coverings are constructed with an opening at or near the bottom for the inflow of refined glass, as well as an opening at the upper part, where the glass is gathered and worked into merchantable articles. Two or more tanks are also connected together, and with the tank containing the pots, by conduits below the surface of the glass.

Improved Cotton Planter.

Oliver H. Trout, Honey Grove, Texas.—The opening plow is attached to the lower end of a standard inserted and pivoted in a slot in the rear end of the tongue. The draft strain upon the standard is sustained by a brace bar which is curved and passes through a slot in the tongue, and has a number of holes formed through its upper part to receive a pin which rests upon the tongue. The lower end of a forked lever receives the upper part of the brace bar, and can be operated by the driver from his seat to raise the opening plow from the ground in passing.

Improved Cotton Tie.

Alexander A. Szabo, Houston, Texas.—This invention consists in a block for holding the ends of bale wire, it having an open cross slot on each side leading to an inner aperture, as well as a cramping groove running longitudinally from the latter to the end of block. This enables the baling to be effected very rapidly, while the tie is reliable under all contingencies.

Improved Grain Separator.

Hermann Kurth, Milwaukee, Wis.—This invention relates to certain improvements in machines for cleaning grain of cockle, garlic, and other impurities. It consists in the combination of a perforated revolving cylinder with an internal oppositely rotating reel, and the relative adjustment of the two, through friction wheels. Also in the combination, with the reel, of an internal and external spiral conveyer, and furthermore in the combination, with the perforated revolving cylinder, of an endless apron passing over adjustable rollers.

Improved Reel or Carriers' Aprons of Threshing Machines.

George C. Dodge, Millburn, Ill.—This invention consists of a reel with a hand crank arranged at the rear of a thrashing machine, so that the carrier can be readily rolled upon the shaft, so as to save the labor and time lost in taking it off and packing it when the machine is to be moved from place to place, or when it is necessary to put it under shelter from rain and snow.

Improved Washing Machine.

George D. Berdan, Saddle River, N. J.—This invention consists in the application of circular guards to the lower head of a vertical revolving rubber having fluted rollers, which act on the clothes placed between them and the corrugated sides of the tub. The guards are of galvanized wire, and keep the clothes away from the pivot of the head, forcing them out against the sides of the tub.

Improved Ironing Table.

Francis Harvey, Renovo, Pa.—A bracket is attached to the wall for supporting a knuckle which has a pivot passing through a plate, and secured by a pin which allows it to revolve a quarter of a turn, and arrests its further movement by stops. The table is connected to the knuckle by a vertical pivot projecting from its under side. The leg is pivoted at the outer end of the table, so as to be folded up and secured by a button. The plate turns on its pivot to swing the table to or from the wall when folding up or down, and the knuckle turns in said plate, for shifting the table to a horizontal or vertical plane.

Improved Grubbing Machine.

George E. Reyner, Clay, Iowa.—Power is applied to this device by attaching a horse to the outer end of a beam, which end is supported by a wheel. The mechanism at the other extremity is adjusted and operates as follows: The machine is raised from the ground, and a loop is dropped over the stump. A ring is then placed upon the stump, and a wedge is driven into the top of the said stump, which spreads it sufficiently to fasten the ring. The ring prevents the loop from slipping off the stump, and at the same time serves as a band to prevent the wedge from spreading the lower part of the stump, so as to tighten said loop. The knife is then forced into the ground five or six inches, more or less, and the horse is driven around the stump, the knife cutting off the side roots that may be in its path. At each round the knife is forced deeper into the ground until all the side roots have been cut off. A hook between the knife and staple or loop is then dropped to the ground, and is held down with the foot until it catches upon a root, when a few rounds will twist off the top root, and allow the stump to be raised from the ground.

Improved Ice Creeper.

George F. Lemon, New York city.—The upper and lower plates are cut of soft rubber, corresponding to the shape of the shank or hollow of the shoe, the upper plate being made tapering toward the front part for fitting the curve of the shank, and producing a nearly horizontal position of the studded plate, which projects slightly with the points of its studs below the level of the base of the heel. Both plates are riveted to a latcral strap which is interposed between them, and applied by a buckle at the ends to the foot.

Improved Key Fastener.

Alfred W. Sperry, Wallingford, Conn.—This invention consists of a pointed shaft or arbor with a hooked-shaped part keyed thereto. A slotted and pointed cam slides thereon for being opened and attached to the key by a pivoted lever acting on a projecting pin or stud of the cam. The slotted cam slides in the circumferential groove of the shaft, and resists, by its steady position thereon, any attempts at pushing the shaft inward from the outside.

Improved Grain Binder.

William Lenz and Robert Wittke, Glenwood, Iowa.—This grain binder is operated by following the reaper, taking up the grain left at suitable intervals by the same. The attendant is seated on the front frame of the binder, operating with his foot the lever mechanism for throwing the spider frames in and out of gear. He places the serrated clasp with one hand into the grooved jaws of the lock, places with the other hand the end of the binding cord from the outside below the lock and up the inside over the clasp, winds it around one jaw and secures then the end to the band spring at the rear of the lock. The turning motion of the tines unwinds a sufficient length of the cord from the spool to extend from the guide rod along the circumference of the tines over the supporting springs of the same, till the turning of the tines is nearly completed. The cord has then loosely encircled the gathered grain on the tines. The toothed segments of the spider frames gear at this point with the spool shaft, and produce the rewinding of the cord on the spool, and the stretching of the same, to such a degree that the supporting tine springs give way and allow the formation of the loop around the grain. The cord is then tightened until the strain throws the spool shaft out of gear by means of the tension springs. The lever of the lock mechanism is engaged almost simultaneously with the rear extending spring of the front frame, so as to clamp the clasp into the cord ends and cut the cord by the shears. The sheaf is then dropped and taken up by the gatherer.

Improved Folding Seat and Table.

William Tetley, Pana, Ill.—This invention consists of folding seats and tables, contrived to fold into recesses into the floor of a building flush with the surface. The object is to provide public and other halls, market and other buildings, with seats and tables that can be more readily disposed of when it is desired to clear the floor of them.

Improved Earth Auger.

Don Juan Arnold, Brownville, Neb.—The improvements consist in the construction of devices for guiding the bit into proper position when lowered on the shaft, and in the provision of a socket arm on the sweep which connects with the windlass gearing and causes the bit to be raised when a certain predetermined depth has been reached, and in improved means for coupling the shaft sections. There is a square lower end on the lower section of the shaft, and on a square lower end on the bit sleeve, for connecting the bit to the shaft in such a way that the said bit may be operated by turning the said shaft.

Improved Opera Chair.

Bernhard H. Koechling, New York city.—By suitable construction, when the seats are turned up, the seats and backs become vertical and parallel with each other, so as to take up the least possible space, and the seats are thrown back by angle irons, so as to considerably widen the passage in front of the chairs, giving more room for a person to stand while another is passing.

Improved Steam and Water Heater.

Edward B. Light, Westfield, Mass.—The sections of the boiler, each of which consists of a hollow hub and hollow ring, are connected with each other by radial tubes. Any desired number of the sections may be used. Upon the outer sides of the hollow rings of the sections are formed a number of hollow radial arms, which are flattened toward their outer ends to furnish a large amount of radiating surface. These are provided with a horizontal diaphragm or partition, extending from their inner ends nearly to their outer ends, so that, as the stream rises and enters said arms above the diaphragm, it may force the air out beneath them.

Improved Post Driver.

Ira M. Hardy, Oshkosh, Wis.—The upright guides are attached to the hind bolster, and the bolster is provided with an adjusting brace and connected at the top to uprights, so that they can shift laterally to the wagon. The uprights have a cranked pinion gearing with a toothed portion of the brace, by which to shift them along it for righting them when the truck stands on uneven ground. The uprights are shifted forward and backward by an extensible brace, made of two parts, which slide along each other. One is toothed, to be worked by a pinion on the other, turned by a hand crank. The rope for hoisting the hammer passes under a guide pulley at the hind axle and along to the front of the wagon, where a horse will be hitched to it for hoisting the hammer.

Improved Car Coupling.

Jacob Shaaber, Reading, Pa.—As the cars are run together, and as a lower loop or clevis slides up on a hook, it will raise the upper loop into an erect position, so that it will be caught by an outwardly projecting hook pivoted to the front of the car, so as to be entirely out of the way.

Improved Machine for Transmitting Power.

Albert Reed, Oroville, Cal.—This invention consists of suitable weighted, swinging, and regulating levers, which produce, when set to work, a uniform degree of motive power. By setting the operating handle in motion, the various parts are consecutively brought into active operation, until the final reciprocation of a single lever is obtained.

Improved Combined Scrubber and Mop.

George Pirrung, Ravenswood, Ill.—This invention consists of a mopping contrivance attached to a handle. There is a water-receiving box and a piece of thick flexible rubber, so contrived that, by placing the edge of the rubber on the floor and pulling quickly along, it will spring back from the water box, forming an opening into the same, through which it will force the water which it gathers from the floor at its front, and then, being quickly lifted from the floor, it will instantly spring up to the box and close it, and confine the water to be removed and poured out.

Improved Wagon Body.

Frank Clemens, La Fayette, Ind.—Strap hooks, attached to the side boards, hook into the eyes of an eyebolt attached to the ends of cross bars. The ends of the two middle cross bars connect with short bars, which serve as a platform to the wagon bed, and to which braces are bolted near one end. The braces rest against the side boards, and are secured in place by hand screws. Other arrangements are provided, so that, by removing a rod from either end of either end board, the end board can be swung out upon the rod as a hinge, and, by removing several rods and hand screws, the whole bed can be taken apart.

Improved Car Coupling.

Alexander Neel, Richwood, Ohio.—The drawhead of one car is provided with a pin, which is connected by an extension rod with the top of the car. A band spring of the car is bent forward and locks into a notch of the pin when the same is raised, the pin being readily released from the spring catch on the sliding back of the drawhead. The drawhead of the adjoining car has the common coupling pin, but is provided with a lever rod, which swings on a perforated bracket bar, and supports, by a bottom guide loop, the coupling link in horizontal position for coupling. The top end of the lever rod is retained in position for holding the link by a catch piece. When the link is thus held horizontally, and the coupling pin of the other drawhead raised, the approach of the cars produces the entering of the link, and, by the contact of the lever rod with the drawhead, the dropping of the same and its swinging back over the other drawhead toward the car. The link enters then the drawhead until the concussion of the drawheads releases the raised pin and causes the dropping of the same.

Improved Fare Register.

Emanuel P. Loveman and Herman H. Loveman, Atlanta, Ga.—This invention relates to fare-register boxes, which not only register, on an inside dial plate, the number of fares taken by a car conductor, but simultaneously strike an alarm that notifies each passenger that a record of his particular fare has been made. The invention consists in novel means whereby the conductor can make his register and strike the alarm in a more rapid and convenient manner than heretofore.

Improved Centering Device.

William D. Slack, Lewisburg, Pa.—This invention relates to certain improvements in centering tools. It consists in a flanged annular ring, to the under side of which is pivoted the ends of several gripping arms. Inside said ring is a centrally perforated disk, which is attached to the gripping arms by links. This said disk is extended above the outer ring in the form of a boss or hub, in which is contained a pointed punch, usually held up by a spiral spring and provided with a knob. Attached also to the hub is a radially moving lever. When said lever is moved, the gripping arms beneath clutch the shaft to be centered, and a blow upon the knob of the punch taps the same in the center by causing the punch to descend through the hub and the hole in the disk.

Improved Fire Shovel and Tongs.

Harvey Maranville, Akron, Ohio.—One arm of the tongs has a shovel end, and the other terminates in a plate. The rear extremities are pivoted to a short bar. Arrangements are provided by which the shovel arm may be thrown in advance of the other, while the latter is closely held thereto, making the implement into a shovel; or both arms may be brought down evenly, so converting it into a tongs.

Improved Circular Saw Guide.

Calvin H. Husted and Charles H. McPherson, Southwater, Col. Ter.—The guide consists of two arms and a guide plate, which latter is made to slide transversely on an adjusting plate. A supporting roller, for the purpose of supporting the overhanging portion of the log, having its upper surface on a level with the lower surface of the log, is connected with the adjusting plate, and, by means of a slotted flange in which it revolves, is made adjustable as to hight, and may be entirely detached from the adjusting plate and saw guide. This saw guide may be adjusted to the saw with safety when the saw is running as well as when it is at rest.

Improved Fermenting Vat.

John C. G. Hüpfel, New York city.—The object of this invention is to provide for brewers' ice houses an improved fermenting vat, in which the beer may be exposed in large quantities to fermentation, and kept at the requisite temperature, without the use of ice floats. The device consists of an open vat with vertical cooling tubes, attached securely to the bottom for the free circulation of the air, or the application of ice by means of a detachable bottom at the lower opening of the cooling tubes.

Improved Hat Ironing Machine.

Antoene Giraux, Louis Drovon, and Claude Sturel, Newark, N. J.—The block for ironing the brim is arranged in a large hole in the center of the table with its lower end resting on a vertically adjustable stand, so that it can be taken out after the brim has been ironed on the upper side and reversed, to iron the under side, the crown being placed in the hole in the table. The stand for the block is adjustable, high or low, to adapt it to crowns of different hights.

Improved Process of Concentrating Copper Pyrites.

François A. H. La Rue, Quebec, Canada.—This is a process for eliminating impurities from and preparing copper pyrites for convenient transportation, by partially reducing the previously roasted and carbonized ore with heat until it becomes magnetic, and then passing the product through an electro-magnetic machine, whereby the copper and iron ore are separated from the earthy or other matter.

Improved Wagon Tongue Support.

Joseph Oehler, La Fayette, Ind.—The pole is provided with rear extending side pieces, by which a fork-shaped end is produced. A center piece is interposed between the front part of the hounds, and projects, by a tongue extension, into the forked pole end and is pivoted therein. The center piece is further strengthened by a longitudinal bar, extending back to the under side of the front axle and fastened thereto.

Improved Check Row Attachment for Planters.

Lysander L. Haworth, London, Ohio.—A cross board is secured to the frame of the planter, and to the end parts are pivoted two pulleys, around which passes a cord which is stretched across the field. The ends are secured to the ground, and it is provided with knots at the required distance apart of the hills. To the ends of a shaft are attached arms which receive the cord, so that the same can slide through freely, but not the knots. As each knot strikes the slotted arm, it turns the said arm to the rearward until it can slip through the outer part of said slot. The arm is then again carried forward by a weighted arm also attached to the end of the shaft. To the shaft are besides attached guard arms, which prevent the cord from getting out of the slot as the knots slip through. Suitable connection is provided from this shaft to the dropping slide and valve.

Improved Electric Railway Signal.

Paul Tesse, Henry Lartigue, and Pierre D. Prud'homme, Paris, France.—This invention is a semaphoric mast, to the top of which are pivoted two large arms fulcrumed so as to hang vertically, said arms being attached to the cranks of two similar electrical apparatus below by a traction rod. Just below these two large arms are two small ones, fulcrumed to said mast so as to hang horizontally, and connected, each by traction rods, with separate electrical apparatus similar to the first mentioned. The whole line consists of a series of these masts provided with arms and electrical apparatus, said arms being disposed vertically along the mast when not in use, and the electrical apparatus of the large arms of one station being connected by wires with the electrical apparatus of the small arms of the second station, etc. The large arms are locked or presented horizontally to the gaze of the engineer, mechanically by moving a crank of the electrical apparatus. Said motion, also, by means of a commutator, brings into play a battery, which, by communicating with the electric apparatus of the small arms of second station, allows them to fall horizontally. The mechanical effect of said fall, through a commutator and battery of second station, sends a current back to first station, which acknowledges, upon a bell and an annunciator at first station, the receipt of the original signal sent from said first station. By means of this arrangement the large arms of a mast at the first station serve as a signal to an approaching train, and the elevation of them notifies the agent at second station, through the electrical apparatus, battery, wires, and small arms of mast at second station, of the passage of the train past the first station. After the train has reached the second station, the agent there allows the small arms of his station to fall, which mechanical action, through a commutator and battery of the second station, allows the large arm of the first station to fall. Said fall, through the commutator and battery of first station, sends another current to second station, which acknowledges, by a bell and annunciator, the receipt of original signal, and announces the fact that the large arm of first station has fallen. This combined electrical and mechanical apparatus is situated in between the two tracks, one large arm and one small one on same side of the mast being used for the trains passing up, and the other large arm and small arm on the opposite side for the trains passing down.

Improved Washing Machine.

Daniel Kunkel, Oregon, Mo.—This is an improvement on the washing machine for which letters patent were granted to same inventor October 30, 1866. By suitable construction, as a disk is turned in one direction, a pin will rest against said disk and hold another pin projecting downward vertically, to take hold of the clothes and sweep them through the suds. As the direction of the disk is changed, rollers partially revolve, the projecting pins resting against the disk, and the others projecting to take hold of the clothes in another place and sweep them in another direction through the suds. Mechanism is provided which keeps the clothes away from the center of the tub, so as to be in proper position to be moved through the suds by the pins.

Improved Seed Separator.

William E. Lee, Swan River, Minn.—This is a machine for separating cockle from wheat, comprising a sheet metal cylinder perforated with holes just large enough to receive the cockle, but too small for the wheat, with a skin belt as wide as the length of the cylinder surrounding it. This causes the perforations to retain the cockle, carry it up, and throw it on a descending shaking trough, hanging in the cylinder above the wheat, to chute the cockle out at one end. Above the cylinder, where it is not covered by the belt, a revolving brush is arranged to brush back on the chute any grain that may stick on the perforations. The chute has a brush at one edge to brush down the wheat and leave the cockle in the hole.

Improved Shingle Block Sapper and Bolter.

John F. Bassett and James Nichols, Limestone, N. Y.—This invention consists of a sector-shaped table, pivoted to and moving by friction rollers on a truck of the usual construction. The table is provided with raised concentric rings for turning readily the block to be cut thereon, and also with a slot and segmentally cut-off side part corresponding with a saw recess of the truck. A stop pin at the bottom of the pivoted table and a spring latch define, in connection with a check block and stop pin on the floor, the position of the table toward the saw. A pivoted arm with center pin swings in a standard of the table, and is applied to the block or a center dog fastened to the same. A pivoted hand lever with adjustable dog swings on the center pin of the arm, and serves to adjust the block for sapping and bolting.

Improved Electric Car Detaching Device.

William W. Carson, High Bridge, N. Y.—This invention consists of a pivoted lever frame, which is applied above the rail between the wheels of each car truck, and placed in electrical circuit by means of spring contacts with a powder charge and detaching mechanism of the drawhead. The closing of the circuit, whether by the action of the lever frame on the spring contacts when the car is thrown off the track, or by direct action from the car, ignites the powder charge, separates thereby the drawhead and detaches the car.

Improved Power Hammer.

Alfred L. S. Chenot, Paris, France.—This invention consists in a percussion cylinder bearing upon its lower end a hammer block and hammer, and moving smoothly in an incasing cylinder, which acts as a guide, and prevents any lateral motion of the percussion cylinder resulting from the strokes of the same. Inside the said percussion cylinder is a piston rod bearing upon each end a piston which moves freely in the cylinder and between the two pistons and permanently attached to the cylinder, a diaphragm, which, with the two pistons, divides the cylinder into three air compartments. When the piston rod is elevated by the connecting mechanism, a vacuum is formed in the upper and lower compartments, a compressed plenum in the middle compartment, and the cylinder raised by the elasticity of the air. When the connecting mechanism drives the piston rod down, the force of the steam, gravity, and the elasticity of the air combine to give a heavy, quick, and elastic blow.

Improved Spring Saddle Seat.

John L. Sommerville, Maysville, Ky.—Between the sides of the tree and beneath the pommel, are spiral springs inclined in short tubes. A joint in the leather covering of the tree separates the seat from the pommel, and is laced up with elastic cord. Strong leather supports attached to the rear portion of the saddle tree extend forward to near the joint, the forward ends of which are attached together and to the leather covering of the seat. Wire rods are connected with the spiral springs at one end and with the leather covering of the seat at the other end, so that, when the seat is depressed by the weight of the person, the pressure will act upon the springs and render the seat elastic.

Improved Car Coupling.

Michael J. Roach, Middle Granville, N. Y., assignor to himself and R. L. Williams, same place.—The drawhead has an additional detachable face plate fastened to flanges, and cushioned off by packing. The approaching drawhead strikes against the face plate and carries a slide back until its pinhole is vertically below the pinhole of the drawhead, releasing thereby a pin from the slide and dropping it to couple with the link of the ordinary shape. An inclined movable plate is arranged in side grooves of the drawhead below, the slide plate, to protect the spring of the sliding plate from injury.

Improved Valve Coupling for Hose Branches.

James R. Higgs, Utica, N. Y.—This is an improved valve coupling for hose branches, by which two or more streams of water may be thrown on the fire from the same main hose, and thereby the extinguishing of the same facilitated. The hose branches are opened and closed by a sectional spring valve sliding on a guide tongue of the valve stem turning in suitable bearings.

Improved Reservoir.

Bennet Cohen, Jersey City, N. J.—This is a reservoir which may be attached to the water pipes in the upper stories of buildings, so that, should the water be cut off from below, there may be a sufficient supply retained above for temporary purposes. The upper part is made semicircular, and its lower portion tapers down to its junction with the water pipe. The back is perfectly flat, so that it may be secured to the wall. In the pipe near each reservoir is a check valve, so that the upward pressure of the water in the pipes will cause the water to run continuously up through the pipes and reservoirs. Each reservoir is provided with a ventilator, which will close automatically by means of a float valve when the reservoir is filled. A faucet taps the water pipe between the check valve and lowest part of the reservoir, so that it may be able to carry off all the water contained in the latter.

Improved Watchman's Time Detector.

Anton Meyer, Stuttgart, Germany, assignor to Theodore Hahn, of same place.—In this device the printed dials hitherto in use may be dispensed with and plain paper disks substituted, on which the marks of the stations and the time are quickly printed by suitable spring devices without the direct action of the keys on the marking parts and a bridge piece. There is a rotating steel dial, which has the hour and minute subdivisions engraved in raised figures thereon, and is set in motion by a suitable clock train. The numbers of the stations are arranged sidewise thereof, and marked on a plain paper disk, rotating with the steel dial, by means of strong band springs with steel marking plates. The last are actuated by the keys at the stations, so that one spring strikes on the steel disk at each station for indicating the time, while the springs for marking the stations strike their corresponding numbers consecutively in the customary manner.

Improved Wood Planing Machine.

John H. Russell, Milwaukee, Wis.—This is an improved system of springs for attachment to planer and sticker tables, to enable rake heads with tapering or arched backs and other different shaped pieces of wood to be planed upon three or four sides at a time, and which will hold the wood to be planed firmly in place while being operated upon.

Improved Rotary Steam Engine.

William Haab, New York city.—The shaft is attached to a piston plate enclosed between the two parts of a cylinder, to which the piston is secured. The abutment is given a horizontal reciprocating motion by the exhaust steam, and is fixed to one leg of a gate. On the other leg is a piston, which works in a small straight cylinder, which cylinder is connected with the main cylinder. The abutment plays back and forth in a chamber. A supplementary exhaust tube is connected with the cylinder and is for the purpose of exhausting any steam that may remain between the piston and the abutment after the piston has passed the exhaust cylinder. A spiral spring on this tube throws the abutment and the small piston back, the former into the cylinder and the latter to the cylinder, at each revolution of the main piston. The steam is admitted through the tube, in which is a rotating steam valve, which is alternately closed and opened by tappets on the shaft striking an arm attached to the valve stem.

Improved Liquid Compound for Burnishing Leather Goods.

James Clausen, New York city.—This compound is prepared of ground nutgalls and extract of logwood boiled in water, Castile soap, and glycerin. A few drops of the liquid are mixed with the common ink used for burnishing and finishing leather goods, the ink becoming thereby of superior blacking quality.

Improved Molding Machine.

Otto Meyer, Kansas City, Mo.—This invention consists of a barrel saw mounted on rollers, which are in adjustable supports adapted for shifting readily to suit saws of different sizes for sawing different curves. There is an adjustable work-holding table for presenting the work to the saw, by which it is designed to saw moldings to shape with less waste of time than attends the present mode of sticking moldings. The idea is to saw out whole strips in making grooves, and in cutting out corners and the like that may be used for window stops, beads, and the like, which are now cut into shavings.

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ANSWERS TO CORRESPONDENTS

E. A. C. will find a rule for proportioning cone pulleys on p. 180, vol. 26.—H. G. R. will find particulars of the reward offered for a car coupler on p. 161, vol. 29.—G. K. Jr. should consult a physician.—J.F. can galvanize cast iron by the process described on p. 59, vol. 24.—M. M. will find directions for gilding mirror frames on p. 75, vol. 28.—J. F. F. and others will find S. Hughes' book on "Gas Works and the Manufacture of Coal Gas" useful.—W. W. D. should consult p. 215, vol. 30, for directions for extracting essential oils.—P. H. can case-harden iron by the process described on p. 281, vol. 27.—J. M. W. and J. G. should refer to p. 140, vol. 31, for a description of the "horse hair" snake.—T. U. S. will find full directions for bronzing on brass on p. 331, vol. 29.—E. P. M. and S. G. A. will find directions for bronzing on brass on p. 32', vol. 26. A balloon (gutta percha) varnish is described on p. 279, vol. 30.—M. A. C. will find a recipe for bronze lacquer on p. 331, vol. 29, and verde bronze on brass on p. 283, vol. 31.—C. L. D. should refer to p. 212, vol. 26, for a method of tinning cast iron.—F. G. S. will find a good recipe for calcimine (sometimes spelt kalsomine) on p. 351, vol 24.—J. B. will find a recipe for a cement for leather on p. 138, vol. 25.—O. M. L. can waterproof cotton cloth by the process described on p. 90, vol. 30, and prevent mildew by the recipe on p. 138 vol. 27.—H. R. J. and C. G. J.'s rules for finding the radius of a circle, chord and arc being given, are correct, but neither is the solution that R. O. B. asked for.—J. S. E will find full directions for proportioning gears on p. 187, vol. 29.—C. E H. will find a description of a petrifying process, applicable to dead bodies, on p. 22, vol. 29.—G. A. S. should refer to p. 266, vol. 31, for a method of preserving flowers. For directions for crystalizing them, see p. 283, vol. 31.

(1) A. H. D. says: A friend of mine has recently purchased a 10 horse engine and boiler, in which the feed water of the boiler is heated by live steam taken from the dome on the boiler. The manufacturer recommends him, for economy's sake, to heat the feed water by the exhaust. Please give your opinion. A. It is more economical and usual to heat the feed water with the exhaust steam.

(2) T. D. says: 1. Given a piece of watch spring steel, 11 feet long, tightly drawn and securely fastened at both ends, at 110° Fah. what will be the contraction at 0°? Will the spring return to its original length at 110°, provided the fastenings have meanwhile been undisturbed? A. It seems to us that the spring would break if cooled under the given conditions. 2. Will steel wire deteriorate from constant contact with rubber, pure or vulcanized? What remedy, if any, can be used to prevent such deterioration? A. We think not; but in any event, a coat of varnish will act as a protection.

(3) G. asks: 1. Has there ever been a locomotive constructed with only one cylinder? A. We do not know of any. 2. Could a locomotive be worked with only one cylinder, and would there be anything objectionable in such construction? A. A locomotive can be worked with one cylinder, as is evident from the fact that it is done occasionally, in case of accident The principal objection to a single cylinder engine is the difficulty of starting and reversing.

(4) J. S. McK. says: I live in longitude 20° 30′ W. from Washington, and in latitude 32° 30′ N. What is the proper variation of the magnetic needle at this point? Is there a general rule by which I can find the variation of the needle at any point, knowing the latitude and longitude? On what degree of longitude is the variation 0? A. The variation must be found by observation. It is not constant at any one place, so that the agonic lines, or lines of no variation, are continually changing their position.

(5) J. C. W. says: In Pennsylvania and elsewhere, we use large quantities of soft coal for steam purposes, costing from $3.50 to $5 per tun. We can get slack or fine coal for about $2.50 per tun. We have tried several times to use slack, and as many times have failed to make it work satisfactorily. We have come to the conclusion that we do not know how to construct our furnaces and manage our fires, and we would be pleased to have your views on the question. A. Such coal requires a strong draft, and grate bars with small interstices. Steam is sometimes admitted beneath the ash pit. There are several patented devices for burning coal dust and slack that are well spoken of.

(6) G. H. G. & S. M. C. say: 1. We wish to conduct steam from boiler to engine, distance 350 feet. What would be the loss per cent of fuel by the condensation of steam in traveling that distance, and what sized pipe would be required to supply a 30 horse power engine under the above circumstances, provided the pipe be well packed? A. The loss would be inappreciable if the pipe was well covered and trapped. Use a pipe 3 inches in diameter. 2. What would be the cost of an air pump sufficiently large to furnish 30 horse power? A. Four thousand dollars. 3 Would additional distance require additional pumps? A. No, for a reasonable increase of distance. 4. Should a stationary engine have a slide valve set with lead or lap, and how much of either? Should it be set so that the instant it passes the center the port will open? A The steam port should commence to open just before the end of stroke. There is no general rule for the best amount of lap. 5. With what would you braze the bell of a steam whistle made of thin sheet copper? A. It is not probable that you can repair it successfully.

(7) W. S. H. says: I wish to make a model of a steamboat 248 feet long, 37 feet wide, 13 feet deep, and 72 feet wide over all. Would a model, 5 feet 2 inches long, 9¼ inches wide, 3¼ inches deep, and 18 inches wide over all, be in the right proportion? A. The proportions are correct.

(8) J. B. says: Please give me a formula for making best sewing machine oil. A. Sweet oil will probably answer this purpose better than any manufactured compound.

Having Brazil wax in powder, I wished to form it into tablets, and applied heat, but failed to accomplish the desired object. What will cause the particles to adhere? A. We think that the proper degree of heat would accomplish the desired result.

(9) C. M. A. says: I propose to ventilate my house by means of wooden tubes, starting from near the floor, passing inside partitions, and debouching at the roof. The house is warmed by a furnace. I am told by a builder that the draft in these tubes will be as likely to be down as up, and that the only proper way is to have the tubes terminate in a chimney. I can see that he may be correct so long as the temperature inside the house and outside is equal, as in summer; but would not a very slight addition of heat to the air of a room cause a current to pass up the ventilator? A. Yes. You are correct; experience proves that your tubes will work very well.

(10) E. asks: My driving pulley is 6 feet in diameter, and driven pulley is 9 inches in diameter. My belt is of india rubber, ¼ inch thick and 14 inches wide: it travels 2,043 feet per minute, and is 41 feet long. How much horse power am I using? A. You do not send enough data. The distance between the centers of the pulleys and the tension of the belt should be given. Probably the most satisfactory mode of settling the question would be to make a test, if the matter is of any importance.

(11) E. H. asks: 1. What should be the strength of a nickel solution? Do the salts merely require to be dissolved in water, or is cyanide required? A. If the salt you speak of is (as is highly probable) the double sulphate of ammonia and nickel, 100 parts of water at 60° Fah. will dissolve 5·8 parts of the salt. 2. How is the mottled or crystaline appearance given to galvanized iron, particularly that used for making ice water coolers? A. By the action of dilute nitric acid. 3. What is the latest and best work on electro-metallurgy? A. Roseleur's "Galvanoplastic Manipulation." 4. Is there any way of coating cast iron goods, such as door knobs, hollow and made of malleable iron, so as to prevent them from rusting? Plating with copper and nickel did not do in all cases, as the iron is porous, and electro-plating will not fill up all the small holes. A. Try Japan varnish.

(12) B. H. asks: What is the metal used, and what is the process of making galvanized sheet and other iron? A. The iron, after being cleaned and washed with muriate of zinc, is dipped into a bath of zinc with a little mercury, or zincalone. A little potassium or sodium is sometimes added to the amalgam.

(13) H. K. asks: If the normal temperature of air is 65° Fah., and it is compressed to 50 lbs. pressure to the square inch, what will be its temperature? A. Nearly 350°, if there be no loss of heat by radiation or conduction.

(14) R. T. asks: Will a thin steel spring, such as is employed on harness, lose its temper in the process of tinning? A. No.

(15) O. K. asks: What will be the working horse power of a boiler whose dimensions are 2½ feet diameter, 9 feet length, with 32 two inch tubes, and of an engine of 5 inches bore by 10 inches stroke, with 60 lbs. pressure per square inch? A. About 6 or 7 horse power.

(16) J. J. T. says: 1. I have a double chimney, each chimney of which is 4 by 20 inches, and 45 feet high. Sometimes I use one of them for a ventilator, and the smoke will go up the chimney and down the other into my room; at other times the draft is down both chimneys. What is the difficulty? A. The arrangement is bad. The ventilating flue would be better on the other side of the room. 2. Where is the proper place to put registers for ventilating a room, at the top or bottom in the side wall? A. At the bottom, with some exceptions. 3. Does one chimney or ventilator interfere with the other in the same room? A. Yes, more or less.

(17) J. S asks: Is the idea that powerful engines may be driven by compressed air in place of steam practical? A. The change would not be economical.

(18) A. V. asks: Has the low pressure pound of steam more volume and power than the high pressure? A. If the pressure is only 20 lbs., it must act upon 4 times as much area of piston as steam of 80 lbs. pressure, to produce the same effect, other things being equal.

(19) C. M. Q. and others.—The most important magneto-electric machines have been fully described, in many cases with appropriate illustrations, in these columns.

(20) W. H. asks: When, in painting walls, two or more coats dry spotted, is it caused by the unequal troweling in plastering, leaving some parts more porous than others, thus producing an unequal absorption of color? A. It is most probably caused by a greater amount of plaster having been incorporated with the lime in some places than in others. 2. What is the best preparation for coating the walls prior to painting, to obtain an even gloss? A. It is usual to repeat the coats of paint until the pores are well filled and an even gloss is obtained. Sometimes as many as five coats are necessary. The first and last application should be the paint. 3. In calcimining walls that are very porous (or, as some call them, lime burnt) the color is so quickly taken up as to prevent its being put on evenly, and dries shaded or clouded. A glue size will not stop the suction. What will? A. In calcimining, the walls should be first thoroughly washed; when dry, a coat of glue sizing may be put on; if the latter is of the proper consistence, the calcimining will finish of an even tint.

(21) J. F. asks: What is a simple way to line shafting? A. By running a fine line through the boxes, so adjusting them, and then putting up the shafting.

Are there any slide valve engines that can be reversed? A. Yes.

I have a spyglass with two glasses. The large glass is flat; would it not be better to grind it to a convex? A. Yes, if it is properly done. We do not think, however that the glass is flat.

(22) J. D. W. says, in reference to A. Z.'s difficulty with his blower: My blower would not blow when it was finished. Your answer to A. Z. was "that he had probably made the fans so that they only kept the air in the case in motion instead of forcing it out." How should a blower be made so as to force out the air instead of simply giving it motion? A. It is a good plan to arrange the fans in the case so that the air is slightly compressed after reception, and allowed to expand on reaching the discharge openings.

(23) S. asks: If it be true that a candle fired out of a shot gun will go through a board, what would happen if the candle was still and the board sent against it with exactly the same force as is required to shoot the candle through the board? A By parity of reasoning, the board should go through the candle, if the "wicked" part of the candle were not strong enough to resist it.

Which way would a compass point if it were placed exactly over the north pole? A If freely suspended, it would, no doubt, point to the north pole.

(24) F. S. Jr. says: 1. How long is a German mile? A. German short mile, 6,859 yards; German long mile, 10,126 yards; German geographical mile, 8,100 yards; German sea mile, 2,025 yards. 2. How long is a German foot? A. Prussian and Danish foot is 1·029722 English feet; Austrian foot is 1·037128 English feet; German foot 0·971 English feet.

(25) I. P. McD. asks: 1. Which has the more resistance to electricity, a relay or a sounder, and why? A. Commonly speaking, the relay, because of the greater number of convolutions of wire in its coils. In some main line sounders, the resistance is equal to that of the ordinary relay. 2. Will electricity separate in any degree, or travel in two different directions? A. Yes. 3. Is not electricity attracted to some extent by the north pole, and will it not take a northerly direction in preference to a southerly one? A. No. 4. Is water a conductor or non-conductor? A. Water is a conductor of electricity, although a poor one. 5. Will it form a good ground wire when not connected directly with the ground or earth? A. No. 6. Have the pores in any substance anything to do with its power of conducting electricity? A. Conductivity has been shown to vary with the density of metal conductors. 7. Do you think telegraphing a good business to follow? A. Yes.

(26) R. O. S. asks: How much nitrate of silver could I get by dissolving a silver dollar in nitric acid? A. The nitrate of silver will weigh a little more than half as much again as the coin. 2. Would it be sufficiently pure for photographic purposes after being fused and re-crystallized? A. You would probably have trouble. 3. In what sort of a vessel would the fusing have to be done? A. Fuse it in a silver dish. Your coin is probably made of an alloy of gold. The inscription signifies John V, King of Petalg. (untranslatable abbreviation). "In hoc signo vinces" means "by this sign" (the cross) "thou shalt conquer."

(27) N. A. W. says: My housekeeper went in the dark for some sugar, and came running back, saying that a witch, a wizard, or the devil was in the sugar barrel. "I considered myself equal to all three, and boldly went for them. The frightened housekeeper told me to stir the sugar; I did so, and to my astonishment it produced a white light resembling the light from electricity. Will you give an explanation?" A. It is well known that, when two pieces of sugar are rubbed together in the dark, a sort of electrical phosphorescence may be observed, due probably to the friction of the particles. Attention has been called to it in our columns.

(28) G. C. W. asks: How do astronomers calculate the distances of the sun and stars? A. The sun's distance is calculated in various ways, as by observing the time it takes for light to travel from the sun to the earth, by noting, from proper points on the earth's surface, the time occupied in the transit of Venus, etc. The distance of the stars is estimated from parallax.

1. What are meteors composed of? A. Principally of iron, nickel, hydrogen, and certain minerals. 2. What gives them velocity? A. Their orbital movement.

1. Which has the strongest attraction, an electro-magnet with one half inch core, containing fifty feet of copper wire weighing one half pound, or one of the same size containing one hundred feet of copper wire weighing one half pound? A. The latter. 2. What weight will an electro-magnet, containing 50 feet of copper wire, No. 22, with one half inch core, with one cell of Bunsen's battery, hold up? A. We can give you no general rule for determining magnetic energy in this manner.

What is the origin and chemical analysis of the aerolites? A. They are supposed to be of planetary origin. For analysis, see answer as to meteor, above.

What is the rule to find the convexity of a circle, such as the earth, reckoned from a level? A. See p. 122 vol. 30.

What is the length of the steamship Great Eastern? What is the size of her engine cylinders, and how many tuns of coal did she consume in 24 hours? A. Length 692 feet; cylinders of paddle wheel engines 74 inches diameter by 14 feet stroke; cylinders of screw engines 84 inches diameter by 4 feet stroke: coal consumed per diem in her voyage to New York in 1860, 261½ tuns. She indicated on this journey 7,352 horse power, by both sets of engines.

(35) W. O. says: My engine appeared to blow through when running light, or with little or no work on. The valves and piston work smoothly, and appear to be steam-tight. The question arises: What is the cause of this blowing through? The indicator diagrams exhibit an unusual amount of back pressure or compression; and although I did not have an opportunity of taking a diagram when running light, it is reasonable to suppose that the compression is the same as when in full work. The compression, which begins at half stroke, is equal to the initial pressure of steam at the end of stroke, the steam being cut off sharply. The forward pressure gradually runs down until, during the latter half of stroke, there is a point where the back pressure overbalances the forward pressure (namely, the pressure above the main valve, or between piston and cut-off valve), which forces the main valve up and allows the steam to escape during the latter half of stroke, the engine being carried over by the momentum of the fly wheel. It is necessary to state that the steam is regulated by a variable cut-off governor, which relieves the main valve of undue pressure. Am I correct? A. Your explanation seems plausible according to the diagrams, but we do not get a very clear idea of the arrangement of the valves. If the valve lifts on account of too much cushion, change it. The first thing to determine, however, is whether or not the valves are tight; as it is only when this matter is settled that the engineer can properly begin to theorize about the indicator diagram.

(36) R. M. says: I have been round Cape Horn and the Cape of Good Hope several times, and I have been round the globe twice in a sailing ship, but it is slow travel. I propose to make my next voyage around the globe in 24 hours. By going up in the air high enough to clear the current that follows the globe round, remaining there 12 hours, I will let the earth do the traveling; then I will descend, land the mails in China, take in the United States mail, ascend for 12 hours more, then come down and land the China mail in New York. I believe this can be done and will be done yet. A. We do not understand what you mean by the current of air that goes round with the earth, unless it is the atmosphere; in which case, we do not think that you will get out of it.

(37) I. L. T. says: I read that, after a house was struck by lightning, a tin cup had a tendency to adhere to the kettle spout, and finally the spout would suspend the whole weight of the tin cup. Upon further investigation, it was found that any nail in the house would suspend a common darning needle. Can you explain it? A. If the statement is reliable, the fact that every particle of iron about the premises was found to be temporarily polarized is a fine illustration of the power of the induced currents liable to be generated on the instant of the passage of the discharge.

(38) W. M. W. asks: How can I prepare heavy cotton cloth to prevent the evaporation of alcohol? I want to cover over open barrels, and would like some preparation that will be pliable. A. Melt paraffin with 5 percent of linseed oil, and run into cakes for use. When needed, melt, and spread the mixture over the cloth with a brush.

(39) F. W. D. says: I attempted to make the phosphorized oil light (described in a back number of the SCIENTIFIC AMERICAN) by placing a piece of phosphorus of the size of a hazel nut in a four ounce phial, filling one third full of boiling hot olive oil; but it and would not operate. Was the phial too large? What kind of phosphorus should I use? A. Use a larger proportion of phosphorus. The phosphorus should be that known as clear. The red variety will not answer the purpose.

(40) H. C. W. says. In the SCIENTIFIC AMERICAN of October 24 you state that a gallon of water will produce a gallon of steam if confined in the same space. I think you have made a mistake, as I do not think that it would produce steam at all, but would remain water. A. Have you any authority for your opinion? 2. Please give me a rule for finding the sizes of the pulley in the head of the lathe, to fit a fly wheel, so that the belt will be tight on each of them? A. See p. 98, vol. 22.

(41) P. H. asks: Is there any method of hardening steel so that it will drill a file or hardened steel? A. Heat the steel to cherry red and quench it in mercury.

(42) R. R. asks: 1. What is the best way to mend an overshoe that is all rubber? How can I mend one that is rubber and cloth? How can I mend a leather shoe without sewing a patch on, using cement prepared for the purpose? A. A solution of pure gum rubber in naphtha will answer these purposes. 2 Can the gum of an old overshoe be dissolved in any way to make it useful as a cement? A. Owing to the large amount of sulphur in such rubber, we do not think it would pay you to try the experiment.

I once saw a fire lighter of the shape and size of an egg, with a wire fastened in it, to be dipped in coal oil to kindle fires; can you tell me how to make it? A. Ordinary potter's clay is mixed with sulphur or other inflammable substance, molded into the desired form and thoroughly burned. It will then be found to be exceedingly porous and will then absorb, by capillary attraction, a large quantity of oil.

Is there any kind of preparation that will make any kind of goods waterproof without injuring the goods? How is it prepared and used? A. Ten pounds of alum and a similar quantity of acetate of lead are dissolved in sufficient warm water, and the mixture allowed to stand till the precipitate of sulphate of lead has settled down. The clear solution, acetate of alumina, is poured off, and mixed with water in which dissolved isinglass is stirred up. The articles to be made waterproof are steeped in this mixture for twelve hours, after which they are dried and subjected to pressure. This process will render the cloth both waterproof and moth proof.

(43) J. V. R. asks: What is carbolate of iodine composed of? A. This is not a chemical compound, known as such to chemists.

(44) J. H. M. says: 1. In looking over the back numbers of the SCIENTIFIC AMERICAN, I find a question by W. B. N. about the rack and pinion and eccentric set works for sawing lumber. There appears to me the greatest difference imaginable between the systems. In the first place, the rack and pinion block has a uniform motion throughout the whole of its movement; the first and last 1-32 of an inch is made at precisely the same speed as any of the intermediate parts of an inch, provided there is a uniform speed of the lever. Therefore, in order to set correctly and not throw a small log too far away from the knee, you are compelled to stop the lever very gradually, and at an exact point. If not, your lumber will be too thick or too thin, which is not the case with the eccentric head blocks. While the lever is being moved at a uniform speed, the motion imparted to the knee by the double eccentrics is an accelerated and a retarded motion, until the knee actually stops while the lever is still in motion, so that it is not necessary that the lever should be moved to any fixed point in order to make even lumber. With the eccentric block you have only to go through with a certain manipulation to get certain and accurate thicknesses. The manipulation need not be accurate, but the lever may vary two inches in one movement as compared with another. Another advantage is that, while the lever is moving either backwards or forwards, the knee always moves ahead. Therefore you can set as quick as you can with the rack and pinion, for you have only to go through with the same process. A. There are various devices for operating the rack and pinion set works, also for operating the eccentric set works. By a sudden or quick jerk on the lever, either device is liable to throw a light log too far away from the knee unless it is fastened to it. There are several effective devices for accomplishing the latter. The only liability, then, is to the extent of slack which may exist in the working parts. 2. In our mill, we have a cog wheel and pinion to drive 5 gangs and 2 large circular saws. This gear is driven by two 18x40 inch cylinders. The cog wheel is 10 feet diameter with 7 arms, depth of rim 5 inches, width of rim 16 inches, size of mortice for cogs 1⅞x12 inches, diameter of hub for shaft 16 inches, length of hub 12 inches. The cogs of said wheel are made of maple, well fitted and driven hard and fastened with dovetailed keys. The rim of this wheel has been broken; and in order to mend it we took two wrought iron rings, 1½ inches square, and put them on hot, to shrink the rim together. Would there be contraction enough to the shaft wheel to prevent our taking out the shaft? A. A shrinking of the bands on the blank cog wheel would undoubtedly diminish the size of the center hole, proportionately to the extent of pressure and size of wheel, causing it to grip the shaft.

(45) M. M. asks: In what months do the winds blow the strongest, and what are the prevalent directions? A. In February and March. From S. W., W. by S., and N. W.

(46) B. says: Some zinc castings are to be exposed to the weather; but as they are of an ornamental character, I want to wash them with some chemical that will oxidize them to some extent and give them a better color. I have tried ammonia, but find that the rain will run down on the castings in a milky stream, giving them a streaked appearance. Can you tell me what will oxidize the castings with a color that will stand exposure, or, in other words, what will hasten natural oxidation? A. Your best plan would probably be to try a series of experiments on the subject, by using the various acids beginning with nitric, and making them of various degrees of strength and different temperatures until the object in view is accomplished.

(47) R. C. asks: Is there any instrument to test the sourness of vinegar, so as to tell when it is fit for market? Is there any instrument to test the sweetness of cider, to tell if it will turn into vinegar quickly? A. The means employed require more apparatus and care than could be employed by one who is not a chemist.

(48) C. F. O. says: I have some very nice books which have been handled by careless persons. How can I clean off the finger marks and dirty spots? A. We do not know of any other method than the use of rubber.

(49) C. H. asks: What will clean hammered granite after it becomes dark or dingy? A. Try careful washing with a moderately strong acid.

(50) W. D. asks: How can I color paraffin yellow, red, blue, black, etc., so that it will retain the coloring when in a melted state? A. Except with black, we believe this has not yet been accomplished. By continued experiment you might possibly discover the true method.

(51) Z. C. B. asks: Is there a composition with which the insides of vinegar tanks, made of spruce lumber, can be painted to make them tight, which the vinegar will not affect? A. Pitch is used for this purpose.

(52) C. H. M. asks: Why are the brilliant jewels, that so much resemble diamonds, called paste? A. The ingredients (white sand, pearlash, niter, arsenic, manganese, etc.) are first made into a paste with red lead, which, after the mass has been fused, imparts to the glass beautiful prismatic colors.

Upon what does the magnetic tension of a helix depend, upon the number of turns of the wire, or upon the volume of electricity flowing through it? Which would induce the more magnetism, a helix of small wire composed of 400 spirals with 3 cups to excite it, or a larger wire of 200 spirals and 6 equally strong cups to produce the current? A. It depends upon the number of farads per second, and the compactness of the helix, for the inductive influence is inversely as the square of the distance from the core. As to electricity and crystallization see p. 187, vol. 31.

(53) G. H. H. asks: 1. Is there any test besides experience by which we may know that a room on the ground floor should not be used as a sleeping apartment, on account of dampness? A. The hygrometer is used for this purpose. 2. In ventilating a room, should the flue open near to the ceiling or near to the floor? A. Near the floor in many instances, but no general rule can be given. 3. Is the lightest air necessarily the impure air? A. No.

(54) O. B. says: From philosophical works, I find that gold as a conductor of heat is set down at 1,000, silver 972, tin 303, firebrick 11. Earthenware is composed of a substance that ranks it as a conductor with firebrick. From the above figures then, it appears that silver is more than 88 times a better conductor than firebrick or earthenware; yet Professor Tyndall in his work on "Heat as a Mode of Motion," in speaking of the comparative radiation of a silver teapot and an earthenware one, both being filled with boiling water, says: "The silver produces but little effect, while the radiation from the earthenware is so copious as to drive the needle to 80°." Why is it, toe, that in practice tin is always preferred for hot air pipes to flues that are smoothly plastered? Of course, some advantage would be derived from the superior smoothness of the tin; the ascending air currents would not encounter so much friction, but this advantage would not compensate for the difference in the conducting capacity of the two substances, tin being more than 27 times a better conductor than the plaster. Please explain. A. Good radiators are good absorbers of heat, that is, the surfaces which can easily communicate motion to the ether are equally capable of accepting it from the ether. On the contrary, a bad radiator, such as a metallic surface, is a bad absorber, and therefore a good reflector. Hence, the thinnest metallic film upon a surface powerfully protects "fro the action of radiant heat.

(55) L. O. asks: What is a test for lard oil? A. The operation of determining the quality of the oil is one of considerable difficulty, and cannot be advantageously employed by one who is unacquainted with chemical operations.

(56) M. A. asks: Why do the leaves of one tree turn yellow and fall, while the rest are still bright and green? A. It is probably due to some accident that has befallen the tree, which has caused the premature change in the color of its foliage.

(57) W. A. C. asks: How can I make a good burnishing ink for the heels of boots and shoes? A. Take soft water 1 gallon, extract of logwood 1 oz; boil them until the extract is dissolved, then remove from the fire and add copperas 2 ozs., bichromate of potassa and gum arabic, each ½ oz., all to be pulverized. This makes a cheap and good color for shoe or harness edge; but for cobbling and for new work, upon which you do not wish to use the hot kit, but finish with heel ball you will find that if, as you pour this out into the bottle to use, you put a tablespoonful of lampblack to each pint of it, it will make a blacker and nicer finish. It makes a good color for cheap work, but for fine work, nothing will supersede the following: Alcohol 1 pint, extract of logwood and tincture of iron each 1 oz., nut galls, pulverized, 1 oz., sweet oil ½ oz mix.

Will insects preserved in a solution of arsenic have any injurious effects if kept in a sleeping room? A. We think not. Arsenic is not a volatile poison.

Where can I obtain a *Nautical Almanac?* A. Of any dealer in nautical instruments.

Can you furnish back numbers of your paper? A. Generally. Send us a list of what you require.

How can I make a cheap telescope? A. See p. 186, vol. 30.

(58) M. K. asks: Do you recommend coal tar as the best preservative for the bottom of red cypress fence posts in the ground? A. Tar dipping is very good; solutions of chloride of zinc and of corrosive sublimate are also extensively used for this purpose. Another good method is that of slightly charring the ends of the posts, as charcoal is very unchangeable, resisting perfectly the action of both air and moisture. Timber and grains of wheat and rye, converted into charcoal 1,800 years ago, at Herculaneum, remain as entire as if they had been charred but yesterday.

(59) G. says: I have a glass 55 inches long with 2⅜ inch objective. It is a ship glass, with a power of only fifty times. You state that a glass with that sized objective may be made to magnify a hundred and fifty if it is to be used for an astronomical glass, which I often want to do. Can I have a stronger eyepiece, that I can use for such purposes? A. Yes.

What metal in common use would answer for a faucet for vinegar, and would not be affected by it? A. Block tin might be used, but faucets of wood are by far the best for this purpose.

What is the best to use on a boat to prevent its water-soaking? A. Try coal tar.

(60) S. J. L. says: I learn that Professor Bischoff, of Glasgow, filters water for drinking purposes through spongy iron and powdered limestone, The iron is procured in a powdery, spongy state by the reduction of an ore without fusion after the extraction of sulphur and copper by heat. Can you give me such information as will enable me to do this? A. Iron may be obtained in a finely divided state as the hydrated sesquioxide, by using nitric acid as the solvent and precipitating it with ammonia, decanting the supernatant liquid, and washing the precipitate several times with water.

(61) W. H. F. asks: What is best for filling such woods as walnut, butternut, oak, etc., previous to varnishing, and how is it applied? A. Boiled linseed oil and carbonate of lead is used for this purpose.

Can toy balloons be made by blowing the rubber into bubbles? A. No.

Wood expands with water, but a cord which is of woody fiber shrinks. How is this? A. Wood does not expand longitudinally, but transversely. This swelling, as in the case of the cord, causes it to twist very tightly, which accounts for the longitudinal contraction.

How can I gild or bronze the inside of a cocoa-nut shell that I have made into a bowl? A. First apply two or three coatings of boiled linseed oil and carbonate of lead. When quite dry, lay on a thin coat of gold size. This is prepared by grinding together some red oxide of lead with the thickest drying oil that can be procured, mixed, previous to using, with a little oil of turpentine, till it is brought to a proper consistence. When the size has sufficiently dried, the gold leaf is applied upon the point of a fine brush, and gently pressed down with a ball of soft cotton. The dextrous application of a camel's hair brush sweeps away the loose particles of the gold leaf without disturbing the rest.

(62) I. G. C. asks: I am making a hollow glass prism for liquids. Bisulphide of carbon smells too badly to suit me. I am informed that oil of cassia has a still higher dispersive power. Is this true? A. Yes. 2. What cement or varnish can I use, that is not permeable to or soluble in that liquid? A. Take a quantity of common shellac, dissolve it in alcohol, expel the solvent by evaporation, and melt. Apply hot.

(63) G. asks: 1. Does the nickel plating process without the use of a battery, devised by Professor Stolba, give as substantial a covering as the one with a battery? A. It gives a fine covering, which is quite durable. 2. Does the Stolba process deposit any of the zinc used in the solution? A. No.

How are chloride of nickel and sulphate of nickel made? A. Chloride of nickel is formed by dissolving the oxide in hydrochloric acid. Its solution on evaporation yields green hydrated crystals. Sulphate of nickel is obtained by dissolving metallic nickel, or its oxide or carbonate, in sulphuric acid. It crystallizes in green, rhombic prisms, which require 3 parts of cold water for solution.

(64) J. P. asks: How can iron stains be eradicated without damage to the fabric? A. Wet the spot with lemon juice, sprinkle with salt, and lay it in the sun to dry. Repeat the application until the stains are removed.

(65) J. T. V. asks: Can you inform me of a process for making sensitive paper? A. See p. 314, vol. 30.

What chemical is used for preparing the automatic telegraph receiving paper? A. If a current be made to pass through paper soaked in iodide of potassium, iodine will be separated at the positive wire, and a brown stain will be produced. It is more convenient to employ a mixture of equal parts of saturated solutions of ferrocyanide of potassium and nitrate of ammonia, diluted with an equal volume of water, one part of each solution to two parts of water. Any kind of fine, white, unglazed paper will answer the purpose.

(66) Q. asks: How is the crystalized or frosted appearance on galvanized sheet and cast iron produced? A. Immerse for a short time in dilute nitric acid.

(67) E. E. P. asks: What is the best sizing to apply to outside brickwork before painting? A. Try boiled linseed oil and carbonate of lead.

(68) J. D. asks: Is there any liquid substance as subject to capillary attraction as water, and not so easily evaporated? A. We know of no such liquid.

What would be the result if an irresistible came in contact with an immovable? A. The supposition is absurd, for there can be neither except as mere metaphysical conceptions.

(69) M. B. asks: 1. Where should a tree one hundred feet high break, in order that the part broken off may reach from the top of the stump to a point on the ground fifty feet from the root of the tree? A. At 37 feet 6 inches from the ground. 2. Will you please give me a rule by which all such examples can be worked? A. See Euclid, Book I, Prop. 47. "The square of the hypothenuse of a right-angled triangle is equal to the squares of the sides which contain the right angle."

(70) A. G. Jr. writes to correct statements made in our answer to A. F. O., on p. 135, current volume, in regard to the Leclanché battery, which were founded on misconceptions of its real action.. In the Leclanché, the conditions of ordinary batteries are not changed. In this, as in all other forms of battery where it is used, zinc is the electro-positive element, or one acted upon. The electro-motive force of a Grove being 100, this is 75 and Daniells' 59; or 3 cells of this battery are equal to 4 of the Daniells. It cannot be driven to do more than a limited amount of work (running down in a very short time if kept on closed circuit), and therefore continues its usefulness for a very long time.

(71) H. C. W. says, in reply to W. F. S., who asked as to the action of oils on rubber: Some time ago I put some kerosene oil in a bottle, closed it with a rubber stopper, and laid it down on its side, so that the oil came in contact with the rubber. In a day or two, I found the oil had swelled the rubber to about twice its original size, and forced it out of the bottle, spilling the oil. On drying the stopper, it took its original size and shape.

(72) H. P. says, on producing musical tones from thin goblets: I hear that it is now very difficult to find glasses which will produce a clear musical tone. Fine glass of old manufacture is lead glass, and has a beautifully brilliant appearance; and when struck, it gives a very clear note. If the edge is thin, it is very easily thrown into musical vibration. But very little of this glass is now made; a year ago there were but two manufacturers of it in this country, and one of those gave it up during the past year. The manufacture of lime glass has been so very much improved within a few years that it is taking the place of the more expensive lead glass, and it is sometimes difficult, even for an expert, to tell by the eye which is which but when the glasses are struck, there is longer any doubt. The lead glass gives a pure clear tone, in comparison with which the sound from the lime glass is weak and harsh; and no amount of rubbing will bring a note from the edge of the lime glass.

(73) J. H. G. says, in reply to H. H. M., who asks: "What will harden coal tar so that the heat of the sun will not cause it to run or melt?" I have an old fashioned steep shingle roof that I had covered with English roofing felt; then I had coal tar applied (about five feet square at a time) and then I sprinkled clean coarse bar sand on the tar. So far it has made a good, cheap roofing, which does not run. The roof is quite a steep one, and the tar was applied last August.

(74) J. K. says, in answer to C. M. C.'s question as to thumping in an engine: I think the center of piston and the center of crank pin are not in a straight line, and that the crosshead is too loose.

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

G. F. F.—It is an impure quartzose rock, colored by sesquioxide of iron.—A mineral sample with ... a quartzose or address contained galena.—E.—It is a quartzose pebble, with a seam coated with oxide of iron.—I. B. P. L.—Both specimens are chiefly microscopic crystals of magnetite, together with crystallized fragments of zircon and quartz.

P. B. asks: How can I get rid of rats, otherwise than by poison or traps?—M. A. H. & B. asks: I Will an 18 inch ourrstone mill grind corn into good meal? The mill is an under runner, hung stiff on the spindle, with a dress quite deep at the eye but shallow at the skirt; speed from 400 to 600 revolutions per minute. Some old millers say that such small stones have to be set so close that the meal will heat, and the speed is so high that the grain will be thrown out before the grinding has been completed. They also declare that such a mill will take more power than an upper runner of 48 inches diameter. Is this so? 2. We have 8 horse water power; how much corn ought this to grind per hour?—B. G. B asks: Of what material is the reed of the euphonic whistle, sometimes called the prairie whistle, made?—W. W. B. asks: What is the mode of operation for synchronizing the hair or balance spring of a watch?—A. F. W. asks: How shall I make a good article of candy, of various flavors?—T. S. M. & Co. ask: How is manganese converted into manganite?—J. McD. asks: What is the best method of drying corn and corn meal on a small scale, so that the meal may be shipped without danger of heating? Is it better to dry the corn or to dry the meal?—W. H. R. asks: How can I make muriatic salts of nickel?

COMMUNICATIONS RECEIVED.

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

On a Sliding Face Plate. By E. B. W.
On a Siphon Ram. By B. F.
On the Sun and the Earth. By W. L.
On Copper in Mineral Springs. By J.N.P
On Scientific Truths. By A. M.
On the Squares of Numbers. By E.B.W
On Lacing Belts. By C. McC.

Also enquiries and answers from the following:

K. L.—I. D. I. S.—C. W. C.—C. S. B.—G. W. B.—E.L.—J. S. J.—R. I. M.—J. K. P. W.—C. E. S.—L. S. H.—J. C. K.

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: "Where can a machine for making matches be obtained? Who sells a basket sifter? Who makes combined butter printers and scales? Whose are the best books on mechanical drawing? Who sells dies for cutting envelopes? Who makes a machine for dressing millstones? Where can lathes for turning butter ladles be bought? Who sells battery carbons? Where can a paper bag machine be bought? Whose is the best hammer hay press? Where can a computing machine be obtained? Who sells egg testers? Who makes pocket alarm watches? Where can information about the uses and selling prices of mica be found? Who sells flint glass for lenses? Whose is the best steam plow? What is the price of a terrestrial globe, 2 feet in diameter? How can the sugar-refining business be learned? Who sells corn mill apparatus, to do the best work with the least power?" All such personal enquiries are printed, as will be observed, in the column of "Business and Personal," which is specially set apart for that purpose, subject to the charge mentioned at the head of that column. Almost any desired information can in this way be expeditiously obtained.

[OFFICIAL.]

Index of Inventions

FOR WHICH

Letters Patent of the United States

WERE GRANTED IN THE WEEK ENDING

October 27, 1874,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

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APPLICATIONS FOR EXTENSION.

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

31,220.—FINGER GUARD.—M. L. Ballard. Jan. 13.
31,252.—IRON BALE TIE.—J. J. McComb. Jan. 13.
31,284.—FINGER GUARD.—M. L. Ballard. Jan. 13.
31,315.—GRINDING CARD TEETH.—C. Hardy. Jan. 20.
31,578.—PAPER FOLDER.—W. H. Milliken et al. Feb. 10.

EXTENSIONS GRANTED.

30,536.—FINISHING GAS FITTINGS.—J. W. Lyon.

DISCLAIMER.

30,536.—FINISHING GAS FITTINGS.—J. W. Lyon.

DESIGNS PATENTED.

7,806.—ENVELOPE RACK.—M. Bennett Jr., Hartford, Ct.
7,807.—VASE.—J. R. King, St. Paul, Minn.
7,808.—SPOON HANDLE.—C. Osborne, N. Attleboro', Mass.
7,809 and 7,810.—OILCLOTH.—C.T. Meyer et al., Bergen, N.J.
7,811.—OILCLOTH.—J. Meyer, Lansingburgh, N. Y.
7,812.—SIDEBOARDS.—L. E. Steinman, Cincinnati, O.
7,813.—BOTTLE.—J. H. Williams, Broadalbin, N. Y.

TRADE MARKS REGISTERED.

2,037.—BINDER.—J. R. Barrett & Co., Chicago, Ill.
2,038.—CIGARS, ETC.—Batchelor Bros., Philadelphia, Pa.
2,039.—MEDICINE.—E. Edmundson, Jr., Pittsburgh, Pa.
2,040.—NAILS, ETC.—Wallace & Sons, New York city.
2,041 and 2,042.—TAR CORDIALS.—H.R. Wisbart, Phila., Pa.
2,043.—CARBON BLACK.—The C. B. Co., New York city.
2,044.—PUBLICATIONS.—J. Gruber, Hagerstown, Md.
2,045.—MEDICINES.—J. C. Street & Co., New York city.

SCHEDULE OF PATENT FEES.

On each Caveat	$10
On each Trade Mark	$25
On filing each application for a Patent (17 years)	$15
On issuing each original Patent	$20
On appeal to Examiners-in-Chief	$10
On appeal to Commissioner of Patents	$20
On application for Reissue	$30
On application for Extension of Patent	$50
On granting the Extension	$50
On filing a Disclaimer	$10
On an application for Design (3½ years)	$10
On application for Design (7 years)	$15
On application for Design (14 years)	$30

CANADIAN PATENTS.

LIST OF PATENTS GRANTED IN CANADA, OCTOBER 29 to NOVEMBER 7, 1874.

3,999.—N. Stephens, Brooklyn, Kings county, N. Y., U.S. Improvement in cement lined pipes, called "Stephens' Improved Cement Lined Pipe." Oct. 29, 1874.

4000.—M. S. Schario, Village of Sunderland, Ontario county, Ont. Improvement in spring bed bottoms, called "Schario's Improved Spring Bed Bottom." Oct. 29, 1974.

4,001.—I. Fréchette and Louis Coté, St. Hyacinthe City, P. Q. Une machine à faire les cambrures de bottes et souliers, called "Le Tailleur de Cambrures de Fréchette." (Boot and Shoe Crimping Machine." Oc-29, 1874.

4,002.—J. O. Brown, Forestville, Chatauqua county, N. Y., U. S., assignee of O. M. Sweet, same place. Improvement in step ladders, called "Brown & Sweet's Improved Step Ladder." Nov. 2, 1874.

4,003.—M. J. Althouse, Wanpun, Fond du Lac county. Wis., U. S., assignee of G. Raymond, same place. Improvements on wind wheels, called "Althouse & Raymond's Wind Wheel." Nov. 2, 1874.

4,004.—D. Morse, Chicago, Cook county, Ill., U. S. Improvements in churn dashers, called "Moore's Improved Churn Dasher." Nov. 2, 1874.

4,005.—J. Head, Andover, Alleghany county, N. Y., U. S. Improvements on a machine for scouring leather, called "J. Head's Leather-Scouring Machine." Nov. 2, 1874.

4,006.—A. F. Cooper, Cambridge, Middlesex county Mass., U. S. Improvement on medicated pads or belts for the cure of rheumatism and other kindred complaints, called "Dr. Cooper's Medicated Pad or Belt." Nov. 2, 1874.

4,007.—N. H. Dolsen, Chatham, Kent county, Ont. Improvements on car couplings, called "Dolsen's Automatic Car Coupling." Nov. 2, 1874.

4,008.—O. P. Flynt, Boston, Suffolk county, Mass., U. S. Improvements on ladies' garments, called "Flynt's Dust and Weather Protector." Nov. 2, 1874.

4,009.—L. D. Adams, Buffalo, Erie county, N. Y., U. S. Improvements in car couplings, called "Adams' Car Coupling." Nov. 2, 1874.

4,010.—H. Servis, Rochester, Monroe county, N. Y., U. S. assignee of C. M. Coolidge, same place. Improvements on a process for producing caricature photographs, called "Coolidge's Process for Producing Caricature Photographic Pictures." Nov. 2, 1874.

4,011.—A. Goth and C. A. Wolle, Bethlehem, Northampton county, Pa., U. S. Improvement on machines for coating paper with oil colors, called "Goth & Wolle's Machine for Coating Paper with Oil Colors." Oct. 7, 1874.

4,012.—J. Authors and W. F. Munro, Toronto, Canada. Useful form for the head or the slot in the head of screw nails, called "Author's Improved Screw." Nov. 7, 1874.

4,013.—A. D. Cable, Montreal, Can., and O. B. Howard, Portland, Cumberland county, Me., U. S. Improvement on racks and safes, called "Cable & Howard's Rack and Safe." Nov. 7, 1874.

4,014.—F. S. Barnjum, Montreal, P. Q. Improvements on pantaloon stretchers, called "Barnjum's Patent Pantaloon Stretcher." Nov. 7, 1874.

4,015.—C. A. Hussey, New York city, U. S. Improvements on railroad axle boxes, called "Hussey's Railroad Axle Box." Nov. 7, 1874.

4,016.—G. Woods, Cambridgeport, Middlesex county, Mass., U. S. Improvements in processes for drying lumber, called "Wood's Process for Drying Lumber, etc." Nov. 7, 1874.

4,017.—K. McKenzie, Hamilton City, U. S. Improvements on cooking stoves, called "McKenzie's Revolving Oven Cook Stove." Nov. 7, 1874.

4,018.—L. B. Stilson, Minneapolis, Hennepin county, Minn., U. S. Improvements on safety car shoes, called "Stilson's Safety Car Shoe." Nov. 7, 1875.

4,019.—K. McKenzie, Hamilton city, Ont. Improvements on sheet pattern cutting blocks, called "McKenzie's Sheet Pattern Cutter." Nov. 7, 1874.

4,020.—C. Rommel, Elizabeth, Union county, N. J., U.S. Improvements on polychromatic printing machines, called "Rommel's Universal Polychromatic Printing Machine." Nov. 7, 1874.

4,021.—J. Ney, Jr., Ellice Township, Perth county, Ont., and A. Eby, Dowine Township, Perth county, Ont. Machine for the catching and collecting of the Colorado potato bug, called "The Colorado Bug Catcher." Nov. 7, 1874.

4,022.—T. E. Roberts, Ionia, Ionia county, Mich., U. S. Improvement on spark arresters and consumers, called "Roberts' Spark Arrester." Nov. 7, 1874.

4,023.—J. Tomlinson, Goderich, Huron county, Mich., U. S. Improvements in barrels, called "Tomlinson's Improved Barrel." Nov. 7, 1874.

4,024.—G. L. Anders, Boston, Mass., U. S. Improvements on printing telegraphs, called "Anders' Improved Printing Telegraph Instrument." Nov. 7, 1874.

4,025.—E. C. Tozer, Newcastle, Northumberland county, New Brunswick. Improvements on freezing and refrigerating apparatus, called "Tozer's Freezer and Refrigerator." Nov. 7, 1874.

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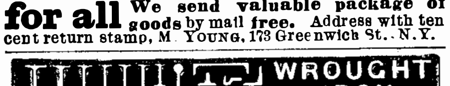

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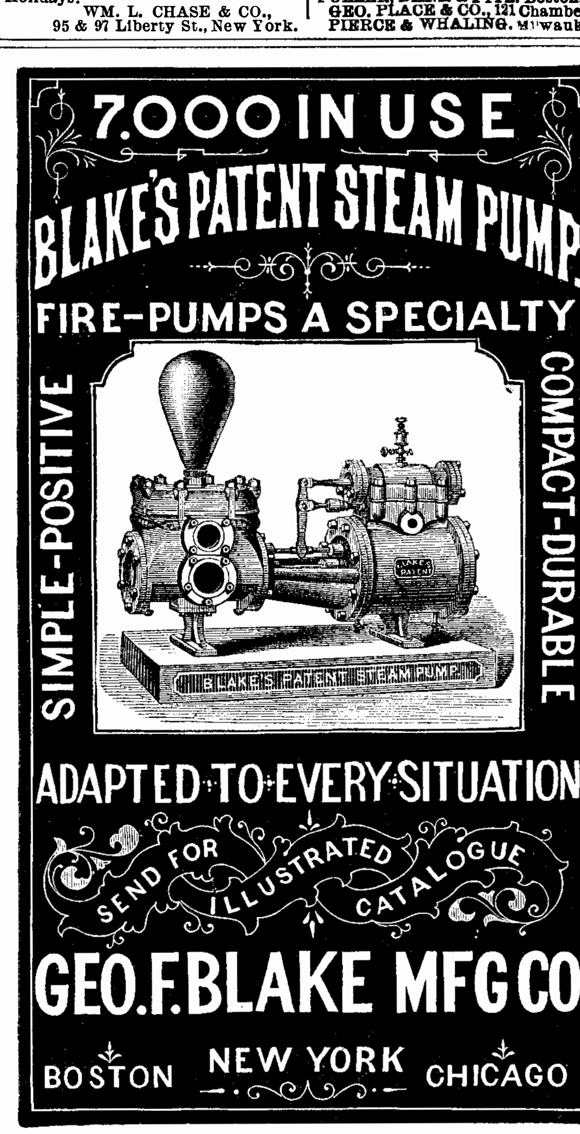

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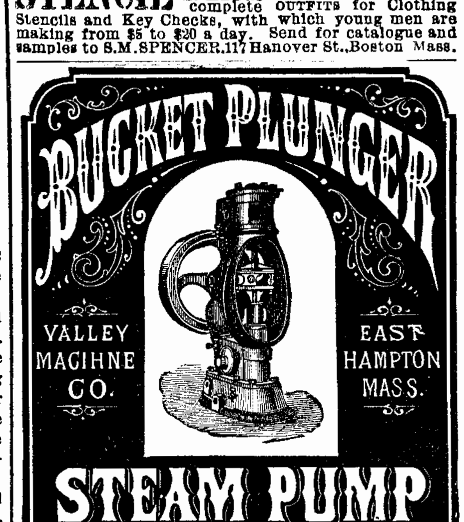

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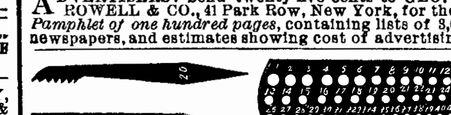

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