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[NEW SERIES.]

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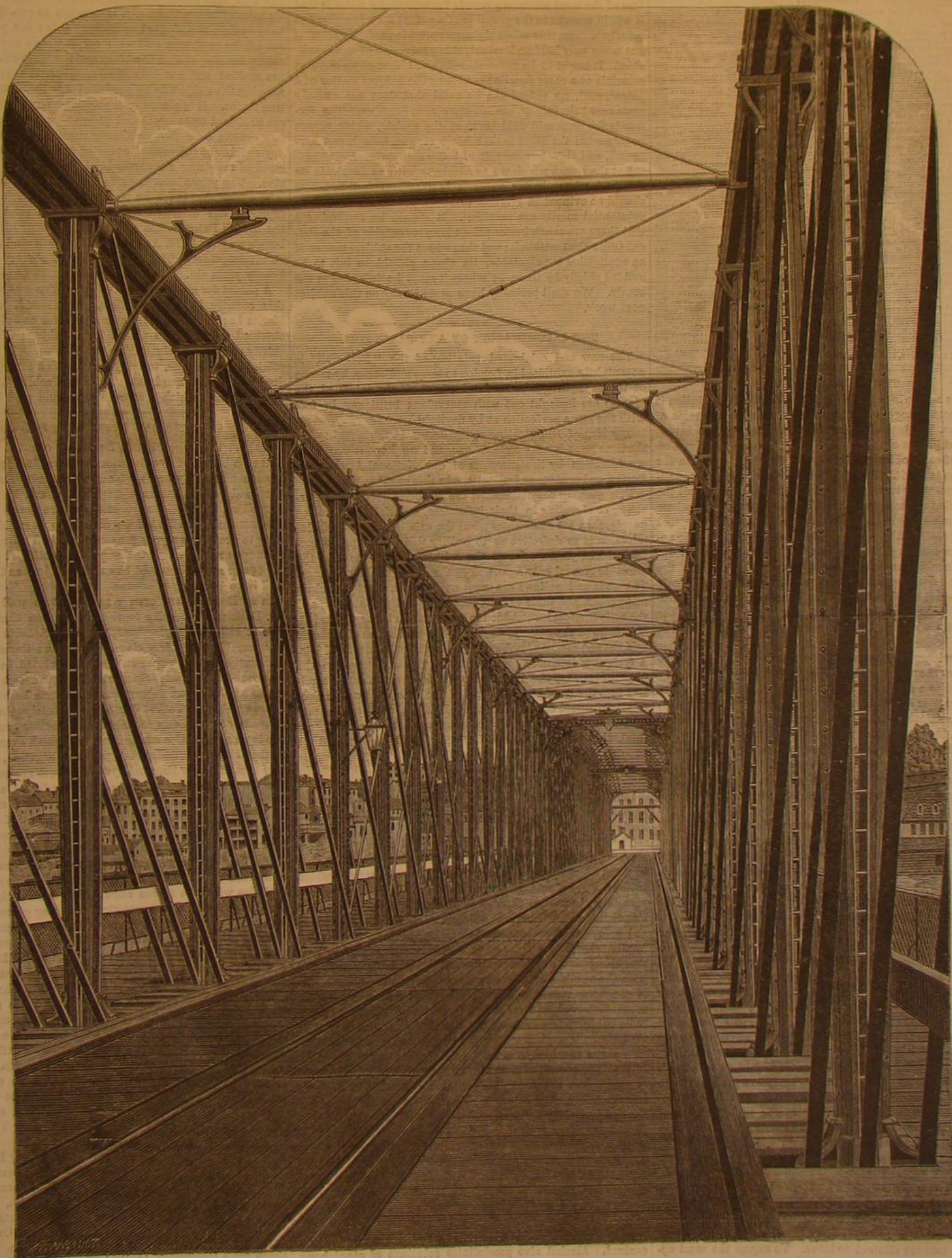
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THE KEOKUK (IOWA) BRIDGE.

We give herewith an interior view of the fine wrought iron road and railway bridge which spans the Mississippi river at Keokuk, Iowa, the general appearance of which was illustrated on p. 323, vol. 30. The builders were the Keystone Bridge Company of Pittsburgh, Pa., and the designs of the superstructure were made by Mr. J. H. Linville, C. E. Be-

ginning at the west or Keokuk end of the bridge, the spans are located as follows: Pivot span, total length of one truss, center to center of end posts, 376 feet 5 inches; opening under each arm, 160 feet, measured on the square; two spans, 253 feet 6 inches; eight spans varying in length from 148 feet 4 $\frac{3}{8}$ inches to 171 feet 6 inches; total length, backwall to backwall on bridge seats, 2,192 feet. It is a through bridge, built

on a skew of 17° 15', with a distance between the two trusses of 21 feet 6 inches, and carries a single line of railway track and two tramways for local traffic, the track being placed in the center between the tramways. On each side of the bridge, outside of the trusses, are foot walks 5 feet wide, protected by light and substantial iron lattice railings. We extract our engraving from *Engineering*.



BRIDGE OVER THE MISSISSIPPI, AT KEOKUK, IOWA.

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THE PATENT OFFICE.

There is a growing conviction that this great institution is not conducted altogether in accordance with the purposes of its creation. Instead of being made to encourage the inventor and aid him in obtaining his patent, it seems—at least on the part of some of its employees—to be administered in the very opposite spirit. Doubts are resolved against the applicant, unnecessary technicalities are interposed to prevent the consideration of cases on their substantial merits; and where patents can no longer be denied, they are often emasculated by some prescribed phraseology, instead of leaving to the applicant the largest liberty, in this respect, which is not incompatible with the rights of other parties. And even the astonishing doctrine has been avowed—and more frequently acted on—that the decisions of the courts are not to control those of the Office, and that a patent may be denied by the latter while admitting that it would be sustained by the former.

This tendency—which is all the while increasing—must be checked, or the whole system is in imminent peril. Already has it become a matter of serious consideration whether the present practice of examinations should not be discontinued, and the functions of the Office limited to those of an advisory character, leaving to the applicant the ultimate right to his patent in his own language, subject to such conditions as will prevent him from practising successful frauds upon others. The present discontent cannot be greatly increased before some radical change in our system will be far from improbable.

These untoward results have been influenced mainly by the head of the Office. Commissioners have done more than any other individuals towards perverting the system from its legitimate purpose, so that, instead of being an instrumentality for promoting the progress of science and the useful arts, by securing to inventors the full enjoyment of their property, the Office is becoming a means of frittering away their rights to their smallest practicable dimensions, or for denying them altogether.

We do not intend to impeach in the slightest degree the integrity of any of the individuals above referred to, but merely to point out and account for some of the errors which we believe they have committed. Commissioner Fisher, who, more than any other individual, has contributed to this perversion of the great purpose of the Office, was placed at its head after an extensive practice before the courts in patent cases. His continuance in office was always regarded by him as a temporary means of securing a still more extensive practice in the future. Now the most profitable clients are the large companies, whose interests are adverse to the multiplication of patents, and who often feel annoyed at being obliged to pay royalties on the patented improvements which they desire to make use of. How natural that the attorney should sympathize with his clients and honestly imbibe their notions. How, almost inevitably, will he take a one-sided view of the whole matter, overlooking the rights and interests of the inventor and contemplating in exaggerated proportions the inconveniences felt by the great manufacturers on account of the multitude of patents that are allowed to issue. To expect the most upright mind to be wholly unbiased under such circumstances

would be to look for something more than human. This is not the right training for a good Commissioner.

The tendency thus communicated from the head of the Office operated in a greater or less degree upon all his subordinates, and has influenced the course of decision ever since. General Leggett seems to have done nothing to correct these errors of administration. He followed, quite implicitly, in the footsteps of his predecessor, and perhaps also felt himself further swayed from a just perpendicular by similar influences. The present Commissioner has been in his seat for too short a time to enable us to judge whether any change of spirit may be expected to guide his course. Let him be fairly tried, and honestly judged by the result of that trial.

But an influence of a character different from that above stated often operates to produce a similar result. When an application is rejected, the case is disposed of and the object sought for is attained. Stimulated by the desire of thus ending the investigation, many minds grow more ingenious in tracing resemblances than in appreciating differences. At all events, they are apt to frame for themselves some technical rules, from which, as from official ruts, it is difficult to move them, however inappropriate to the case under consideration. One of the most common grounds for rejecting a claim is that it would amount to the granting of a patent for a function or a principle. The rule when rightly applied is perfectly correct; but when only half understood, it is productive of much mischief. It ought to be remembered that, although an abstract principle or a mere function cannot be the subject matter of a patent, still, no patent can be valid that does not embody some new principle or exhibit some new function. The former is the uncaught wild horse of the prairie, which cannot be property; the other is that horse caught, tamed, and harnessed, and therefore capable of being appropriated.

But the lesson which we particularly wish to inculcate on this and other similar subjects is that less fastidiousness should be evinced in relation to forms of expression, where substantial merits are manifest. It should be remembered that there are much better patent lawyers outside of the Patent Office than within it; and that where the subject matter of an application is patentable, its shape should be left to be molded chiefly by those by whom it must be defended in the courts. We shall probably have more to say on this subject next week.

THE ILLUMINATION OF ART GALLERIES.

The new and celebrated painting of the "Roll Call" is now nightly exhibited in London to large audiences, by means of the oxyhydrogen or lime light, and all the colors of the picture are brought out with marvelous brilliancy, in fact with the same perfection as by daylight.

The idea of illuminating art galleries in the evening by the lime light is an excellent one, and we hope it may have consideration by the directors of our National Academy of Design and analogous institutions in this country.

Few evening entertainments are in themselves more interesting or elevating in their influences, especially for young people, than art exhibitions; but the existing method of illumination is so defective as to nullify their principal attractions. The yellow color of the ordinary gas flame has the effect to reveal only a portion of the colors of the paintings. The reds and yellows are seen well enough; but the blues and greens, and their various tints, are sadly distorted, and the artistic effect lost. Added to these defects is the vitiated atmosphere of the gallery, caused by the production of carbonic acid gas and escape of unburned gas from the hundreds of jets. A feeling of lassitude comes over the visitor, interest in the pictures lessens, and relief is sought by escape from the gallery into the open air. The use of the lime light or the electric light would obviate all such difficulties, as they generate no deleterious gases. By the exercise of a little skill, we think that either of these methods of illumination might be adapted with advantage for art galleries.

SOLVENTS FOR RUBBER.

For the information of correspondents, several of whom have made enquiries on the above subject, we give the following:

The proper solvents for caoutchouc are ether (free from alcohol), chloroform, bisulphide of carbon, coal naphtha, and rectified oil of turpentine. By long boiling in water, rubber softens, swells, and becomes more soluble in its peculiar menstrua; but when exposed to the air, it speedily resumes its pristine consistence and volume. Industrially, the ethereal solution of caoutchouc is useless, because it contains hardly more than a trace of that substance. Oil of turpentine dissolves caoutchouc only when the oil is very pure and with the application of heat; the ordinary oil of turpentine of commerce causes india rubber to swell rather than to become dissolved. In order to prevent the viscosity of the india rubber when evaporated from its solution, one part of caoutchouc is worked up with two parts of turpentine into a thin paste; to which is added $\frac{1}{2}$ part of a hot concentrated solution of sulphuret of potassium in water; the yellow liquid formed leaves the caoutchouc perfectly elastic and without any viscosity. The solutions of caoutchouc in coal tar naphtha and benzoline are most suited to unite pieces of caoutchouc, but the odor of the solvents is perceptible for a long time. As chloroform is too expensive for common use, sulphide of carbon is the most usual, and also the best, solvent for caoutchouc. This solution, owing to the volatility of the menstruum, soon dries, leaving the latter in its natural state. When alcohol is mixed with sulphide of carbon, the latter does not any longer dissolve the caoutchouc, but simply softens it and renders it capable of being more readily vulcanized. Alcohol also precipitates solutions of caoutchouc. When caoutchouc is treated with hot naphtha distilled from

native petroleum or coal tar, it swells to thirty times its former bulk; and if then triturated with a pestle and pressed through a sieve, it affords a homogeneous varnish, the same that is used in preparing the patent waterproof cloth of Mackintosh. Caoutchouc dissolves in the fixed oils, such as linseed oil, but the varnish has not the property of becoming concrete on exposure to the air. Caoutchouc melts at a heat of about 256° or 260°; after it has been melted, it does not solidify on cooling, but forms a sticky mass which does not become solid even when exposed to the air for months. Owing to this property, it furnishes a valuable material for the lubrication of stopcocks and joints intended to remain airtight and yet be movable.

POLYCHROME PRINTING.

"A remarkable innovation upon the ordinary process of color printing has just been introduced to public notice at the International Exhibition, London, by Messrs J. M. Johnson & Sons, printers, etc. The new process is perfectly distinct, in every respect, from any of this class by which it has been preceded. Although embodying some very striking features, it is in itself a very simple matter. So simple is it, in fact, that the first idea which suggests itself is: Why was it never thought of before? Briefly, it consists in printing any number of colors at a single impression; it is color printing without blocks or stones, and with colors which are not ink, the colors forming at once the block and the pigment. The colors are molded and cut into blocks, when the various pieces forming the subject to be produced are fitted together in an iron frame. It is placed on a printing press, and impressions are produced upon moistened paper. The advantages of the new system over that ordinarily practised are very marked; any number of colors can be printed at a single impression, instead of requiring a separate block or stone for each impression. The prints become perfectly dry in a few minutes," etc.

The foregoing is from a recent editorial article in *Engineering*. If our esteemed cotemporary will send 3d. over to the British Patent Office and procure a copy of Robert Reynburn's patent 14,078, April 20, 1852, it will find an answer to its interrogatory. This supposed new discovery is more than twenty years old.

A patent for substantially the same idea was applied for in this country by E. B. Larcher, but rejected, in 1868. But Moritz Laemmel was more successful, for on July 4, 1871, he obtained an American patent for the thing; which grant is chiefly of value as illustrating the little worth of our so-called official examinations, to carry on which an army of five hundred men and women is maintained at Washington, at an enormous expense, which is assessed upon and paid by inventors.

AMERICAN OYSTER CULTURE.

A short time ago, Frank Buckland counted forty oyster spat on a bunch of five American oysters, in a lot sent to the London market by some of our exporters. Such apparent disregard for the future alarmed him, and he straightway warned us, in *Land and Water*, that we were squandering our resources, and that if we did not do something immediately to protect our young oysters against rapacious oyster catchers, or to increase the supply by artificial propagation, our oyster grounds would be exhausted, just as those of England have been.

In an Englishman, even a naturalist so well informed as Mr. Buckland generally is, the assumption that oyster culture is something practically unknown in this country may be excusable; but for a clever writer like the author of the pleasantly written paper on oysters, printed in the current number of the *Popular Science Monthly*, to assert that nothing in the way of oyster culture has been done here is altogether unpardonable. To set forth so minutely the antiquated methods of Europe as models for our oyster growers to imitate is an aggravation of the fault for which even a residence on the Jersey coast offers but partial mitigation. It is fortunate that our New England oyster growers are not vindictive, else they might overwhelm our erring friend with remorse by sending him a few hundred "extras" as a sample of what are covering hundreds of thousands of acres of the bed of Long Island Sound, all natives raised from the spawn by a system of culture developed on the spot. To a writer accustomed to be accurate, however, it may be sufficiently humiliating to learn that of late years the finer grades of the varieties which he writes about with such enthusiasm have been transports from Connecticut breeding grounds, the fruit of a culture which he declares to be non-existent.

The French experiments in this line have been public undertakings, officially reported on: with us they have been the work of unpretending oystermen, whose aim was oysters, not fame; and having accomplished their object, they have gone about their business, quite unconscious of the service they were rendering the country. The consequence is that, though the business has developed to enormous dimensions, those not directly engaged in the work know little or nothing about it; and even those who have taken upon themselves the task of writing up the oyster trade of the country have missed its most important feature, by going to the markets instead of the oyster grounds for information, or by assuming that methods which prevail south of New York are also those of the East.

Ever since the country was first settled, Long Island Sound has been noted for producing oysters of superior size and quality. They are of the northern species, characterized by great breadth and thickness, firm white meats, and delicate flavor, qualities which the southern oyster cannot rival even when transplanted into the same waters. Owing to the streams which freshen the water along the Connecticut shore from Greenwich to Bridgeport, and to a less degree farther east, where the influence of the open sea is more

strongly felt, the oysters along this coast attain a quicker and finer development than elsewhere, the culminating point being in the swift channels among the rocky islands off Norwalk—the home of the original "Saddle rocks," the "Sounds," and other standard varieties: all the same oyster though differing, in size, shape, color, and flavor, with the position and character of their bed and the accidents of their development.

Twenty years ago, the oyster business of this region was carried on precisely as described in the *Popular Science Monthly*; that is to say, artificial propagation was unknown, and, when the native grounds were exhausted, the supply was kept up by restocking them with "seed," or small oysters brought from the Chesapeake Bay or the Hudson river. Among the oystermen of Norwalk at that time were the Hoyt Brothers, young men who brought to the business more than the usual allowance of brains. Not satisfied with merely handling oysters, they sought to understand them, studying them in the water and out of it with a persevering directness that would have delighted the heart of Agassiz. Observing that native spat would sometimes settle upon seed brought from abroad, they set to work to discover the conditions of such fixing of the spawn, rightly arguing that, the secret once penetrated, they might save themselves the trouble and cost of going elsewhere for seed, besides securing a better breed of oysters.

Had they known anything of European experiments in oyster culture, they might have got on faster at first: they might also have been led astray and discouraged, as others have been, by fruitless imitations of foreign methods. The climatic and other conditions here are so unlike those of France or Italy that entirely different methods of oyster culture are required. On the whole, therefore, it was fortunate that the Hoyts had to begin at the bottom and learn everything by personal observation and experiment. It was fortunate, too, that with Yankee common sense they pitched upon the master key to the problem at first, and sought to discover the natural conditions of oyster propagation on their own grounds. One year the Sound's bed will be literally covered with oyster spat; the next, it may be, though the oysters spawn as abundantly, scarcely a young oyster will be found. Again there will be a year, like 1873, when there will be no spawn. Their problem, it will be seen, was no easy one to solve.

After much study of oysters and oyster grounds, and many trials with different materials for fixing the spawn, our experimenters learned at last that the securing of a crop of seed depends upon two essential conditions: first that the parent oysters spawn; second, that, at the time of spawning, the floating spat must have presented to them something clean to which to attach themselves; it may be stone, shell, glass, iron, wood, leather, anything, in short, provided it is perfectly clean. The first great point in artificial oyster propagation is therefore to know just when to have the stools on the ground. The time of spawning varies with the season, the position of the bed, and the depth of water over it, so that it requires close watching, with frequent dissections, to determine the precise moment when the spawn begins to run. If the stool is presented too late, the spawn is lost and the stool worse than wasted; if too soon, it is equally thrown away, since it becomes covered with white slime in a few days, and then the spat cannot strike. Sometimes a heavy storm at spawning time comes to the aid of the oyster farmer, and adds immensely to the productiveness of natural beds: it churns up the gravel and shells on the bottom, scours them clean, beats the slime off the rocks, and brightens things generally for the reception of the coming spat. Last summer the spawn was abundant; the natural conditions for its lodgment were unusually favorable; and if the starfish and other enemies of the oyster do not destroy the crop, it will be an unusually productive one. But we are getting ahead of our history.

Having come to the conclusion that clean stools at spawning time were the one thing needed to fix the native spawn, the Hoyt brothers gathered up some thousands of bushels of weather-worn shells and scattered them over their grounds. Naturally they were laughed at by "practical" oystermen, who had been in the business for years and knew "all about it"; while other men threatened them with all sorts of penalties for filling up the channels and otherwise interfering with the natural order of things. Their venture, however, proved eminently successful; the clean shells were quickly covered with spat, and sixteen years ago they reaped their first crop of artificially propagated oysters.

There is nothing that commands respect like success. Seeing the result, those who had scoffed at the method were eager enough to try it. A new impetus was given to the oyster business. Exhausted oyster grounds were restocked, and miles of hitherto unproductive ground were brought under cultivation. From Greenwich to Westport there is not a break in the oyster beds, the great bulk of them owing their existence to artificial propagation.

The stools chiefly prized are shells and screened gravel, ranging in size from a hickory nut to a hen's egg. The fragile amber-colored shells which abound throughout the Sound—the oystermen call them "gingles"—make excellent stools: so do scallop shells, boat loads of which are brought from the Rhode Island shore for this purpose. Large stools are less desirable, since the oysters crowd and pinch each other on them, and the bunches are harder to separate when the time for transplanting arrives. Still in many cases it is necessary to scatter comparatively large shells and stone, among the finer shoals, their action being apparently to create little rests or eddies in the water flowing over the bottoms, thus enabling the spawn to strike.

In the costly tile and cone devices for taking spat, employed by the French systems, which have, by the way, superseded

the methods described in the *Popular Science Monthly*, the fixing of a few hundred thousand spat is accounted something wonderful; and much to the amusement of our oyster growers, American newspapers have copied French reports, wonderment and all, when within an hour's ride of their publication offices are breeding grounds of many acres, sown with spat in countless millions. Our oystermen number such small things only by the bushel. Over large areas, this year's seed is so plentiful that an ordinary "drag," holding a bushel or more, will be filled by drawing it loosely over a strip of bottom a yard wide and a rod long. A bit of shell as big as one's finger nail will carry perhaps half a dozen spat, and as many as sixty or eighty may be counted on a single valve of an oyster shell.

The diminutive breeding grounds which the French make so much of—creeks and puddles, we have heard them called by men accustomed to the larger spaces under cultivation here—compare with those of Long Island about as a kitchen garden with a Californian wheat farm. The difficulty along the Connecticut shore is not in propagating the oyster—that is easy enough now—but in maintaining the crop until it is mature. It is only by the most persistent warfare against star fish and other oyster enemies that uniform success is possible.

In another article, we propose to describe more minutely the processes of oyster culture and the effects of it, also the obstacles which our oyster breeders have to contend with.

THE COAL AND IRON PRODUCTS OF THE WORLD.

M. Gruner's report on the coal and iron industries of the world, which has lately appeared in France, is a document evincing laborious research, and one which, to the student of political economy and to the statistician, cannot but be of the highest practical utility. The author was a member of the International Jury at the Vienna Exposition, and it has been his object to compare the conditions of the two great industries as existing in 1873 with their state at the time of the French Exposition in 1867. While we cannot follow the details of the long report, there are, nevertheless, many general results and conclusions which will prove both instructive and interesting.

M. Gruner estimates the entire fuel production of the world at 250,000,000 tons, and he calls attention to the fact that the value of the mineral combustible annually consumed largely exceeds that of the ores mined. In England, in 1871, the total coal yield was valued (in round numbers, which for convenience' sake we shall use throughout this article) at \$92,000,000, while that of all the other mineral products, including refractory clays, marine salt, phosphorites, etc., did not exceed \$62,000,000. In Germany and France the same excess in favor of coal also appears. Throughout the entire world during 1872, the author places the value, of all the minerals but fuel, mined at \$320,000,000: of the fuel at \$620,000,000, or nearly double.

Referring to the English coal production, the author states that, for the forty years from 1831 to 1871, the ratio of increase has been as from 1 to 6. The present rate of production per workman is about 299 tons per annum in England, 220 in Prussia, 159 in France, and 157 in Belgium. It is believed that these figures will never exceed 300 tons in England, and 160 in France and Belgium; so that, estimating by the present English yearly increase in fuel mined, in the year 1910 fully 3,000,000 men will be actively engaged in the industry. This is hardly possible, since the above number of working men support a population five times greater; and for this aggregate to be maintained by a single industry, there must be a corresponding increase in all the other branches of English labor. Hence, from the nature of things, a maximum of coal production must be eventually reached. Regarding the final exhaustion of the English mines, the author places their duration at 750 years.

The aggregate production of 250,000,000 tons in 1872 is made up by the various countries in the world contributing as follows: Great Britain, 133,000,000; United States, 40,000,000; Germany, 40,000,000; France, 15,900,000; Belgium, 15,600,000; Austria and Hungary, 10,000,000; Spain, 1,000,000; Russia, 800,000; and English colonies, China, Chili, and Japan, 3,700,000. It is believed that within thirty years the American coal production will exceed that of England; but the indefinite increase of the yield, it is thought, will be prevented by the absence of a corresponding increase in the demand, in the same manner as in Great Britain.

After thus dealing with coal, the subject of iron is discussed, and the value of its ores stated to exceed that of all those of other minerals save gold. At a minimum, the annual value is placed at \$70,000,000, or \$2 per ton on the aggregate extraction of 1872. From the 35,000,000 tons then mined, 14,000,000 were made into cast iron, 8,500,000 into rolled or forged iron, and 1,000,000 into homogeneous iron and steel. On comparing these figures with those given for 1865, the iron production is shown to have become still more rapidly developed than that of coal. In seven years the coal yield increased from 9 to 12½, while that of iron increased from 9 to 14. The steel manufacture has tripled in the same period.

The *Pittsburgh Commercial* explains the origin of a very foolish, sensational story as to the possibility of Pittsburgh being destroyed, wholly or in part, by the caving-in of the soil from the action of subterranean fires. It is merely a deserted coal pit, which has been smoldering for 30 years past, without damage or danger.

THE death is announced of the General Marquis de Laplace, son of the great astronomer, at the age of eighty-five. He began his military career under the first French Empire.

TO OUR PRESENT AND FUTURE SUBSCRIBERS.

We call the attention of our subscribers, and the public generally, to the new prospectus of the *SCIENTIFIC AMERICAN*, for the year 1875, published on another page of this issue.

In about ten days, each one of our mail subscribers will receive a handsome subscription list, printed in colors, a catalogue of publications issued from this office, and a chromo pocket calendar for 1875. The publishers of the *SCIENTIFIC AMERICAN* will esteem it a personal favor if every present subscriber will take the trouble to circulate the subscription list when he receives it, and ask some of his friends to join him in taking the paper for the coming year.

Notwithstanding that the *SCIENTIFIC AMERICAN* has a much larger circulation than any paper of its kind ever attained, and the fact that each year its sale increases several thousands over that of the previous year, we believe that it merits a still larger patronage; and we shall not be satisfied until its weekly issue reaches one hundred thousand copies.

Next week we shall print both our Special Edition and the regular issue, amounting to ONE HUNDRED AND FIFTY THOUSAND COPIES, and we shall commence the new volume by printing fifty thousand every week, relying upon our old friends and subscribers to furnish new names, enough, with the renewal of their own subscriptions, to enable us to exceed that number soon after the commencement of the year.

The public attention is called to the inducements for new subscribers, published in the prospectus already alluded to.

SCIENTIFIC AND PRACTICAL INFORMATION.

THE CHEMICAL EFFECT OF THE PHYLLOXERA ON GRAPE VINES.

To those who may be experimenting in search of a remedy for the phylloxera, so as to gain the \$60,000 reward offered by the French government, the following table, showing the chemical effect of the insect upon the vine, will be of interest, and perhaps may lead to a more intelligent investigation.

	Healthy vines, per cent.	Attacked vines per cent.
Bark of fresh roots: Cane sugar.....	2	0
Glucose.....	0	1
Fresh roots without bark: Albumen.....	2	0.6
Oxalic acid.....	17.80	4.04
Roots dried at 212° Fah.: Pectic acid.....	6.20	1.96
Tannin.....	9.60	7.68
Radicles dried at 212° Fah: Car- bonate of potash }	1.48	0.428
Total ash.....	6.42	12.85
Leaves dried at 212° collected in } June: Carbonate of potash }	1.35	0.72
Total ash.....	8.80	2.95
" collected in Septem- } ber: Carbonate of potash }	0.73	0.39
Total ash.....	13.25	13.00
Branches dried at 212°: Carbonate } of potash }	1.90	0.26
Total ash.....	3.45	3.49

RECENT EXPERIMENTS ON EXPLOSIVES.

In experimenting upon dynamite, not long ago, M. M. Roux and Sarrau found two kinds of explosions. The simplest, or, as it is termed, of the second order, is caused by the ordinary inflammation of the substance; the explosion of the first order, or detonation, is produced by the percussion of a powerful priming such as fulminate of mercury. These two explosions are such that the same quantity of the substance, deflagrating in the same capacity, causes therein very different pressures. Later investigations prove that this remarkable quality of dynamite belongs also to the majority of explosives. Nitro-glycerin, pyroxylin, picric acid, and the picrates of potash, baryta, strontium, and lead, detonate by fulminate of mercury. Ignited with an Abel capsule (or when this does not suffice, with a small quantity of powder), an explosion of the second order is produced.

Gunpowder, either in grains or in a dust, does not detonate with fulminate of mercury; but by using nitro-glycerin as an auxiliary detonator, itself being excited by the fulminate, an explosion of the first order is obtained in the powder, very different from the ordinary explosion. This takes place under all the conditions in which gunpowder is commonly employed.

ZINC A PREVENTIVE OF BOILER INCRUSTATION.

An engineer on board the *St. Laurent*, a steamer plying between this port and France, after making some repairs in the boilers, left accidentally therein an ingot of zinc. Some time after, in searching for the bar in the generator, in which, meanwhile, steam had been maintained, he found to his surprise that the metal had disappeared, and also that the incrustation left by the water, instead of being hard and firm, was a mere mud, easily washed out. Repeating the experiment over another voyage, the same result was reached. M. Lesueur, of Angers, France, after examining into this circumstance, thinks that the zinc forms a voltaic couple with the iron of the boiler, zinc being the negative pole and the iron the positive. It then happens, as in all batteries, that the zinc is consumed; while the iron is protected both from oxidation and dissolution.

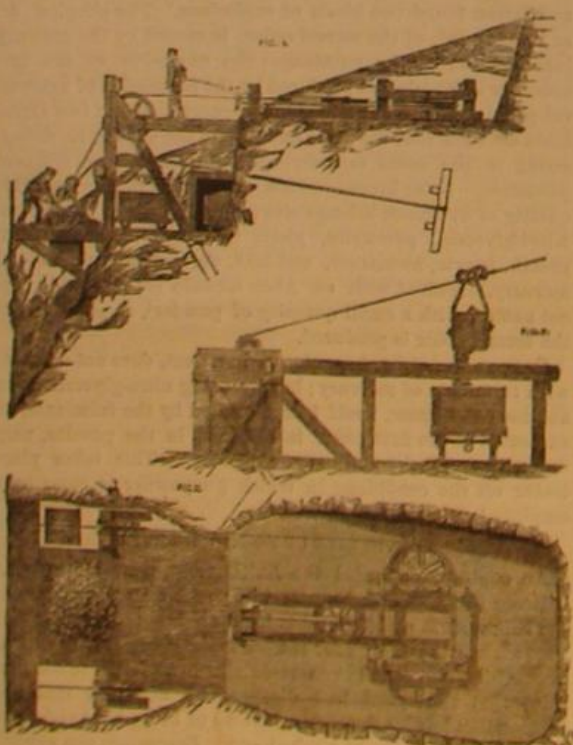
WE are informed that the Attorney General has considered the question, whether the subscribers to the Patent Office Tea Party Testimonial are liable to the penalty prescribed in the Act of Congress in such cases. It is further stated that, for reasons of State, the decision is withheld from the public. Can any one inform us whether there has really been any official action in the matter?

WIRE TRAMWAYS.

The use of wire rope ways for transporting minerals, etc., especially in hilly countries, is becoming very general, and a company is now constructing them in many parts of the world, an improved design by its engineer, Mr. W. T. H. Carrington, being usually adopted. We give herewith a view of the line erected in Norway, in the iron mines at Aalsund. Many such mines have been for a long time worked only to a very small extent, or even left unworked, owing to their being placed at such inaccessible spots as to preclude the possibility of economically transporting the ore to a port of shipment. Frequent examples of such are found on the coast of Norway, situated high up among the mountains, which tower above the numerous fiords which indent its seaboard. The only approach to these mines consists of a rugged and zigzag road, quite unfit for the carriage of any large quantity of mineral, and, owing to the extreme steepness of the mountain side, often leading a circuit of many miles to reach a spot which is less than half a mile distant in a straight line. To accommodate such cases an arrangement of wire rope incline has been designed and successfully worked, as shown in the engravings, the details being represented in the second illustration. It consists of two steel ropes of about 40 tons breaking strain, fixed at the mines and stretching direct to the small pier at the foot of the mountain, spanning a distance of 750 yards without support. On it are run two cages with small grooved wheels, in which are placed about 12 cwt. of iron ore, the fixed ropes being kept in tension by means of weight boxes at the bottom. The loaded cage is made to draw up the light one by means of a light steel rope, which passes round suitable brake sheaves at the mine, and by which the speed of the descending load is governed. On arriving at the bottom, the cage is discharged into a large truck ready to receive the ore, which, when full, is, in its turn, discharged into the ship to be loaded. The light cage has, meantime, arrived at the top, and, being filled, is allowed to descend, and to draw the emptied cage up. The incline is an angle of 45 degrees, and the speed at which the cages are run is about 15 to 20 miles per hour. By this means about 100 tons per ten hours are transported at



WIRE TRAMWAY AT THE IRON MINES, AALSUND, NORWAY.



a very low cost, the only expense being the men required to work it, namely, about three at the top and two at the bottom.

The Detection of Suet Butter.

We have had occasion repeatedly to allude to the various imitations of butter, mainly compounded of suet, which have found their way into our markets, sometimes under fanciful names which indicate their composition, and in some cases marked as and purporting to be the genuine article. Owing to the determined opposition of the butter and cheese trade of this city, but little, we believe, is here consumed; but it is credibly stated that quantities are shipped to the South and to other sections of the country, where a less careful supervision is exercised over the quality of the staple or the condi-

tion of the markets. We also learn that, of late, various disagreeable compounds, known in England as "French" and "Australian" butter, have been imported into this country by British dealers desirous of avoiding penalties under the adulteration acts of their own nation; so that altogether it would appear that there is sufficient of the artificial material in the United States to render the following method for its detection valuable to merchants or consumers who desire to avoid investments in it.

Mr. John Horsley, F. C. S., furnishes to the *Chemical News* a record of the results of recent experiments, which were directed toward the detection of meat fats mixed with butter, and therefore the process indicated will prove useful both to

those suspecting such adulteration in genuine butter, as well as to others who are not sufficiently expert to distinguish the artificial from the inferior qualities of the real article.

Fresh butter is permanently soluble in methylated ether of specific gravity 0.730 at the temperature of 65° Fah. With the view of determining whether any other substance contained in the butter could be precipitated from it, Mr. Horsley first placed 25 grains of the fresh material in a test tube with 1 dram of methylated ether, in which ready solution took place. Thirty drops of methylated alcohol, 68° over proof, were added, and the whole agitated, but nothing was precipitated. The experimenter then mixed 10 grains of fresh butter with 15 grains of mutton fat, and added the liquids as before, when, in less than half an hour, the fat was precipitated, the heat of the room being 68° Fah. Lard, beef, mutton, and tallow fats, properly melted together in proportions of 60 grains of butter and 40 of fat and stirred until cold, can each, by a similar operation, be precipitated in a few minutes. As much as 30 per cent of the fat first used has thus been recovered. This is a simple and direct way of dealing with such adulterations, and is superior to the process of estimating the butyric acid. It should be observed, however, that crystallization of butter out of the ethereal solution at a lower temperature than 65° must not be mistaken for the fats precipitated by the alcohol alluded to, since the butter, besides being so much lighter, occupies the upper layer, and is different in character and easily remelted by the application of the warm hand for a minute or so.

The One Rail System.

A contract has been taken by Messrs. Whitaker & Woodward to build a railroad on Crew's prismoidal one track system, from the depot in Austin, Tex., to some quarries near that city. It is built by the contractors at their own risk, as an experiment, and, if successful, is to be paid for at the rate of \$4,000 per mile.

We have heretofore illustrated this novel style of railway. We have no doubt as to the success of the above example. The Crew plan is one of the cheapest and best plans for railways that has been devised.

A Large Trip Hammer.

The largest trip hammer in the United States has recently been completed at Nashua, N. H., at an expense of \$75,000. The weight of iron used in it is about two hundred tons. The ram weighs twelve tons, its striking force is about one hundred tons, and four large boilers are brought into use to furnish steam to run the six hundred horse power engine required to successfully operate it. The immense crane, with which the iron that is manipulated is hoisted into position, is the largest in the country, and is rigged with modern mechanism, so nicely that two men can easily hoist fifty tons dead weight.

The above devices are pigmies in comparison with some of those used in England and on the Continent. For example, the new hammer at Woolwich, Eng., made by Nasmyth, Wil-

son & Co., weighs forty tons, and its blow under steam is equivalent to a fall of that weight from a height of 80 feet. The actual force of the blow has not yet been determined. The total weight of the machine is 665 tons, and its cost \$250,000.

Coppering of Iron Rollers for Calico Printing.

Th. Schlumberger cleanses the iron cylinders with a concentrated alkaline ley, washes well in water, and goes over the whole surface with the file. The surface is then very bright, and is not to be touched with the finger or soiled with the breath. It is then plunged in an alkaline bath composed of: Sulphate of copper, 1 part, dissolved in water, 12 parts; cyanide of potassium, 3 parts; carbonate of soda, 4 parts, dissolved in water, 16 parts. Or: Ammonia, 3 parts, acetate of copper, 2 parts, dissolved in water, 10 parts; cyanide of potassium, 3 parts, carbonate of soda, 4 parts, sulphate of soda, 2 parts, dissolved in water, 10 parts. The cylinder is allowed to remain twenty-four hours in one of these baths, subject to the action of a battery of four or six pairs, till the surface is coated with a slender but adherent layer of copper. It is washed and cleansed with pumice stone. If in this operation the iron should be laid bare in any part, the cylinder must be anew submitted to the alkaline bath. As soon as the coating of copper is uniform, it is washed in acidulated water and immersed in an acid bath of sulphate of copper. This bath is composed of solution of copper at 20° B., to which $\frac{1}{10}$ of its volume of sulphuric acid is added to facilitate the solution of some metallic copper, which is also immersed in the bath for the purpose of maintaining the solution in a

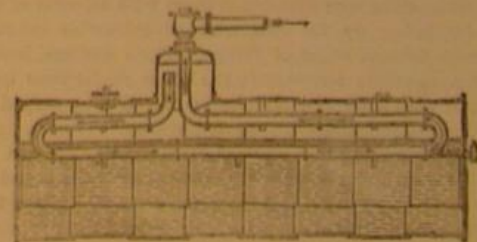
uniform state of concentration. Here the cylinder is left till the layer of copper has attained the desired thickness, a galvanic current being kept up by a battery of four pairs. If the temperature is between 60° and 65°, three to four weeks are required to produce a deposit of one thirty-third of an inch in thickness. The cylinder is turned one quarter round daily to change the portion of its surface which faces the sheet of copper used as a positive electrode.

A Good Suggestion.

A writer in the *London Builder* suggests that thick glass might be easily and cheaply cemented to the walls of hospitals, etc. It would be non-absorbent, imperishable, easily cleaned, readily repaired if damaged by accident, and, unlike paper and paint, would always be as good as at first. Glass can be cut or bent to conform to any required shape. If desired, the plates may colored any cheerful tint. The non-absorbent quality is the most important for hospitals and prisons, and, we should think, is worthy the consideration of architects.

A DEVICE FOR PREVENTING PRIMING.

The difficulty of securing the dryness of steam, as it leaves the boiler, has lately engaged much attention, and many devices for the purpose have been invented. We give herewith a sectional view of one of the latest, which is the idea of Mr. Robert Johnson, of Haughton Place, Bradford, England, and which has already been successfully applied by him to a



number of boilers. The arrangement—to which Mr. Johnson gives the name of anti-primer—consists simply of a pipe extending from the dome down into the barrel of the boiler, the whole length of which it traverses below the water line, then returning again to the dome, where it joins the stop valve through which the steam is drawn off. As seen from the engraving, the steam on its way from the boiler has to traverse the pipe, and during its course any water which may be mixed with it is evaporated by the heat communicated from the surrounding steam and water through which the pipe passes. The arrangement can be easily fitted to existing boilers, and we hear, says *Engineering*, that it has given very good results.

The *Jaborandi* is the name of a Brazilian plant, which, it is said, has lately been found to be the most powerful known sudorific. It is stated that the medicine therefrom is effective against even rabies.

THE UNDERGROUND RAILWAY, NEW YORK CITY.

NUMBER IV.

continued from page 339.

For the many interesting details connected with this great work, that have been already published by us, with engravings, the reader is referred to the *SCIENTIFIC AMERICAN* of November 14, 1874, page 307, where the series begins. In our last paper on the subject, page 338, we printed engravings and descriptions of the novel iron beam tunnels. We now come to the masonry tunnels, which start at the end of the beam tunnel, 24 feet 9 inches south of the south side of 67th street, and extend thence 1,150 feet, to a point 29 feet 2

at the springing line of 4 feet 6 inches. The backs of these walls, however, are carried up 5 feet above the springing line, as shown in Fig. 12, which is a cross section of the tunnel, and the spandrels are filled in with rubble masonry. The masonry of these abutments is gneiss rubble work, laid in cement mortar, with vertical and horizontal joints on the face, the stones being moderately well dressed.

The two inner abutments, which form a continuation of the two inner brick walls of the beam tunnel, are also founded 3 feet below railroad grade, but with a thickness below grade of 5 feet 6 inches. At the grade line, the offset of 6 inches, back and front, again occurs, giving them a thickness of 4 feet 6 inches. From this breadth of bottom, they taper off,

thoroughly drained with clay pipe drains 6 inches in diameter and placed every 50 feet. The backs of the arches are covered with three-ply felt and roofing cement. The centering used in building these arches does not differ so greatly from that in common use as to warrant a detailed description. As regards the manner of joining these arched brick tunnels to the flat roof beam tunnels, it may be mentioned that this connection is always made at one of the rectangular openings which are placed in the roof of the beam tunneling. Thus, for example, the brick tunnel we are describing begins at a point 24 feet 9 inches south of the south side of 67th street, at which point the opening in the beam tunnel ends, the face of the brick tunnel acting as part of the retaining wall of the open-

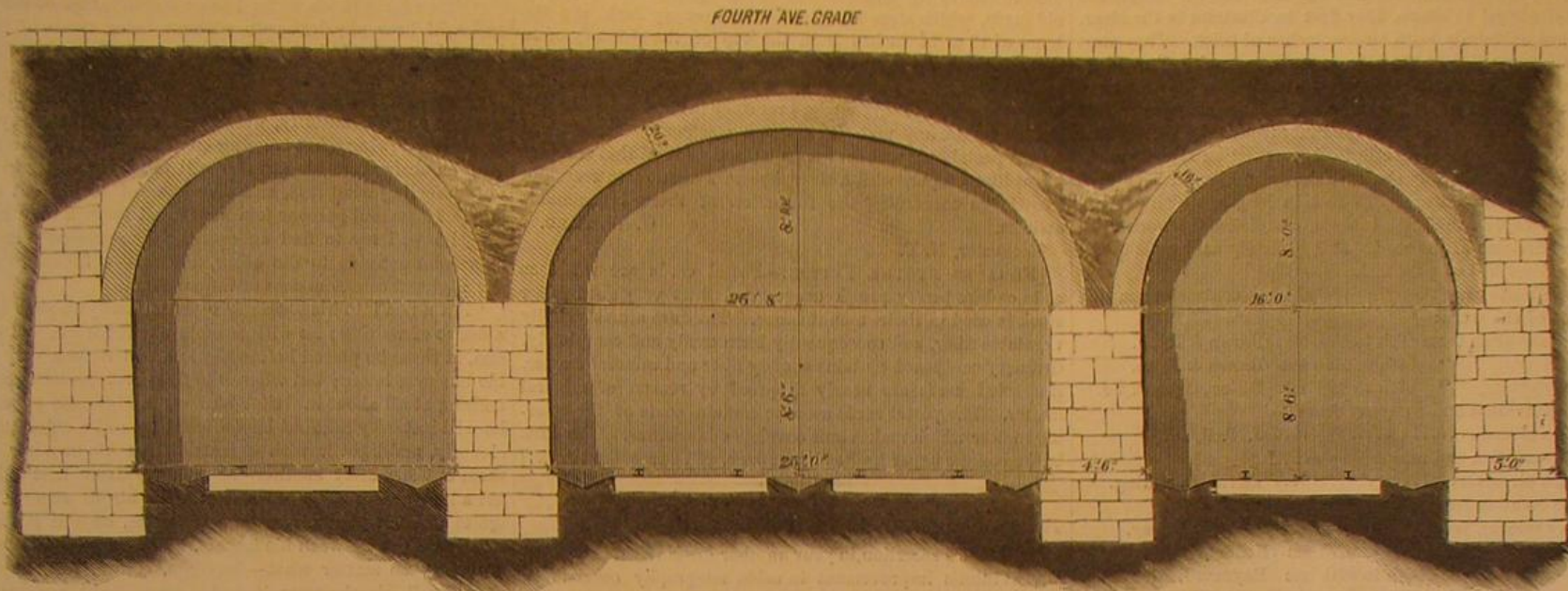


Fig. 12.—THE UNDERGROUND RAILWAY IN NEW YORK.—CROSS SECTIONS OF THE MASONRY TUNNELS.

inches north of the north side of 71st street. By reference to the profile of the road, published in our impression of November 14, 1874, it will be seen that, at 66th street, the grade of the avenue commences to ascend a pretty high ridge, thus increasing the headway so much that the difference of railway and avenue grade is 25 feet at 67th street, 33 feet at 69th street, and 23 feet at 71st street. The height of the main central tunnel is 21 feet in the clear from railroad grade to the crown of the arch, which thus, at 67th street, gives the ventilating shaft a depth of 4 feet, and at 71st street, a depth of 2 feet.

Like the beam tunnels, the brick tunnels consist of three parallel tunnels, a large central one and on either side a small single track tunnel, having no connection with the central tunnel save by an occasional manhole and the ventilators to be hereafter described. The roofs of the tunnels are semicircular brick arches, resting on four stone abutments. The two outer abutments, which form a continuation of the outer rubble walls of the beam tunnel, are founded 3 feet below railroad grade, and are 6 feet in thickness up to grade, where an offset 6 inches back and front occurs, giving a thickness of 5 feet, as shown in Fig. 12. From this point the wall rises 8 feet and 6 inches to the springing line of the arch, vertical in the inner face but battered on the back $\frac{1}{4}$ of an inch to the foot, which gives the wall a thickness

with a batter on each face of about $\frac{1}{4}$ of an inch to the foot, to a thickness of 4 feet 2 inches at the springing line, which is also 8 feet 6 inches above the railroad grade. These abutments are also constructed of gneiss rubble masonry, of the same class as that used in the outer abutments and retaining walls. On top of the four abutments rest three semicircular brick arches, forming the roof of the three tunnels. Each of the arches of the two side tunnels has a span of 16 feet in the clear, from abutment to abutment, and 8 feet rise. These tunnels have thus a width 3 feet greater in the clear than that of the corresponding tunnels in the beam tunneling. Their height from grade to the crown of the arch is 16 feet 6 inches in the clear. The arch is formed of brick, laid in the usual way and keyed with stretchers, well laid, and has an uniform thickness of 20 inches. The arch spanning the large central tunnel has a span of 25 feet and a rise of 12 feet 6 inches. It is also of brick, laid in the usual manner, but of varying thickness. Its general thickness is 20 inches, but for a distance of 3 feet north and south of the ventilating shafts, its thickness is increased 4 inches, thus forming a kind of rib, 16 feet broad by 4 inches thick. The necessity of this thickening of the arch will appear obvious by a glance at Fig. 13, which represents the tunnels and ventilator, where the thickness is indicated by the dotted lines of the central arch. The spandrels are filled in with rubble masonry and

ing. Some idea of the excellence of the work may be formed from the following fact: Although the work was carried forward with such expedition that the centering was knocked away but a few hours after the arches were turned, and the arches in their green state loaded with earth, sometimes to a height of eight feet above the street grade, the greatest settlement has in no case exceeded one quarter of an inch, while in many places no settlement whatever is appreciable, though levels have been taken several times. Such a result, after such a severe test, is one most flattering to the engineers and contractors.

In front of the Normal College, which fronts the work on Fourth avenue at 69th street, the work on this tunnel was carried on both day and night. The tower of the college stands within a few feet of the tunnel walls, and the excavation for the latter was carried 21 feet below the tower foundation. The total depth of the cut was 33 feet. Not the least injury to the college walls ensued. This portion of the work was done during the protracted drought of the last summer, which was most favorable to its success. The side abutments were raised just as fast as the earth was taken out.

The manner of ventilating these last tunnels is quite a simple one and clearly shown in Fig. 13, which gives a section of the tunnel through one of the ventilators. Those of the central tunnel consist of cylindrical shafts or openings, built

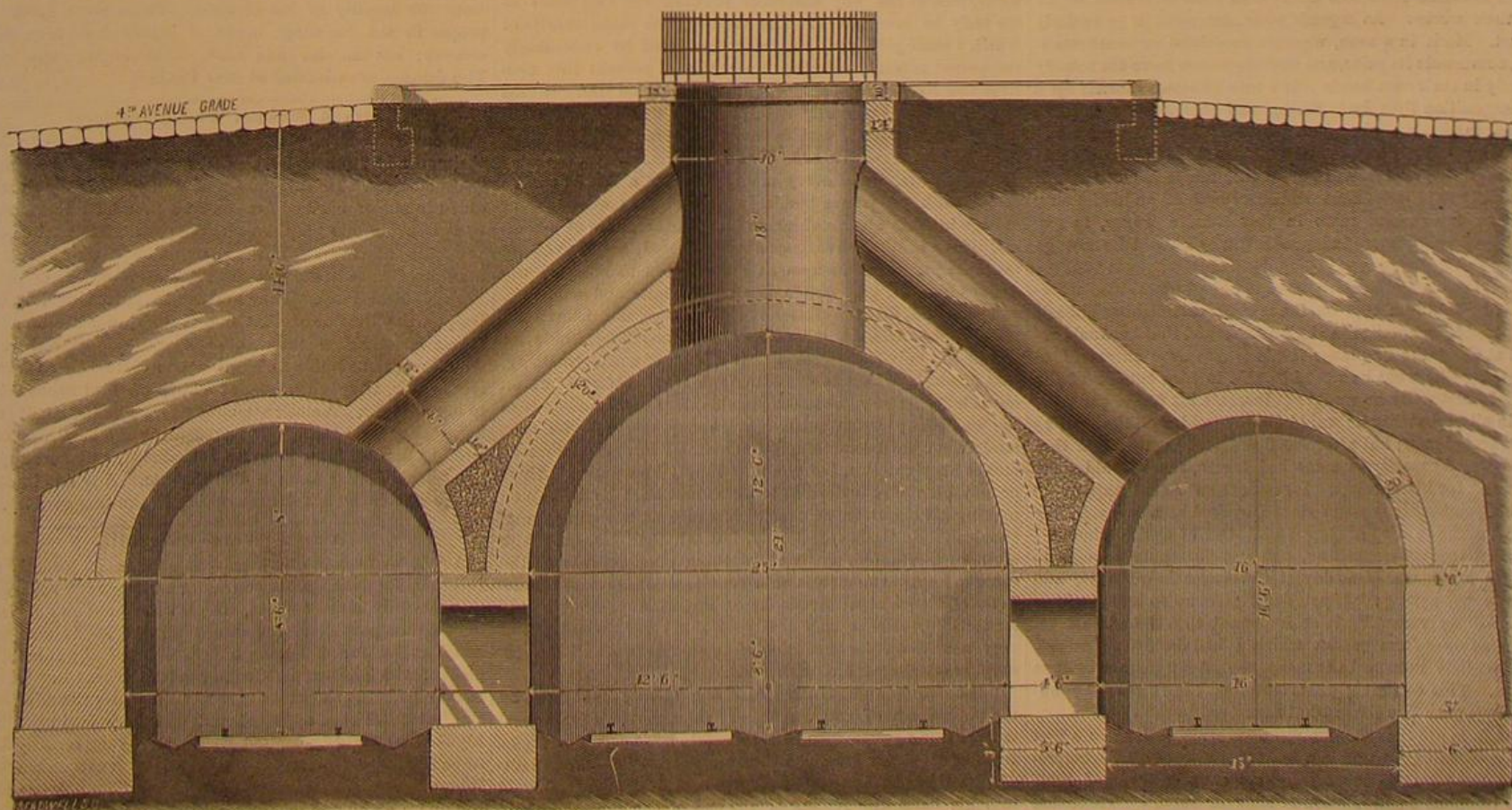


Fig. 13.—THE UNDERGROUND RAILWAY IN NEW YORK.—CROSS SECTIONS OF THE MASONRY TUNNELS AND VENTILATING SHAFTS.

in the crown of the arch, 40 feet apart from center to center, extending from the surface of the street to the roof of the tunnel; they are ten feet in diameter in the clear and lined with brick throughout their whole extent. The thickness of this brick lining varies in the manner shown in the figure. At the street level, this opening is coped with granite coping 10 inches by 18 inches, which is in turn surmounted by an iron railing three feet six inches high, consisting of wrought iron uprights, one inch square, pointed at the top. These uprights are alternately three and six inches above the top rail and are placed four inches apart. The top and bottom rails are one and one half inches by half an inch cross section.

Into the sides of this large ventilating shaft, enter the ventilators of the side tunnels, one for each tunnel. These are also cylindrical in shape, four feet in diameter in the clear, and lined uniformly with twelve inches of brick. They start from the inner side of the side tunnels, some four feet seven and three quarters inches above the springing line, and run out at an angle of 45°, entering the large shaft four feet four and a half inches above the inner face of the central tunnel, which gives them an elliptical cross section at their opening into the ventilating shaft, as shown in Fig. 13. The piece of iron beam tunneling, 2,835 feet in length, which extends northerly beyond the brick tunnels, completes the work upon the first division of the road. It is precisely analogous to the portion described on page 338.

The following are the names of the sub-contractors on this division of the work:

Earth excavation from 49th to 56th sts.	Brown & Ryan.
" " " 56th to 67th sts.	Brown & Ryan.
" " " 67th to 73d sts.	Dillon, Clyde & Co.
Earth excavation and masonry from 73d to 77th streets.	J. C. Ryan.
Earth excavation and masonry from 77th to 79th streets.	David Flemming.
Rock excavation from 49th to 56th sts.	P. Sessions.
Masonry (stone), from 49th to 56th sts.	Blake & Ripley.
" " " 56th to 67th sts.	Redfield & Whittlesey.
" (brick), " 56th to 67th sts.	Raymond, Rice & Co.
" (both), " 67th to 73d sts.	G. A. Williams & Co.
Iron work from 56th to 67th, and from 73d to 79th streets.	Watson Manfg. Co.



The Mechanic of the Future.

To the Editor of the Scientific American:

In your issue of December 5, you have an article with the above caption, commenting upon the difficulty of finding mechanics qualified to undertake the direction of special works requiring the application of their technical experience in new lines, and you give, as a reason for this difficulty, the animosity of trades' unions to the elevation of their members. I do not dispute this position, for it is not in my line of experience, but may I not take the liberty to point out the fact that there are plenty of skilled mechanics, outside of trades' unions, who are ready and willing to fill any situation they are qualified for? If your correspondent had made a direct appeal to the trade at large, he would not have been disappointed.

You also remark that the ambitious and skilled mechanic leaves his shop and establishes himself as a professional man, living on fees instead of wages, to the detriment of the interests of manufacturers who desire this class to remain to direct their works. As regards your statement, it is entirely correct. Merit in a man, whether machinist or mathematician, commands its price, and manufacturers have the remedy entirely in their own hands. If a man educates himself for a higher position than he is filling, and obtains an opening in another market, in what does he differ from the manufacturer who sells his wares at the highest price he can obtain? If a machinist, by reason of his skill, comprehensive mind, and ability to judge of cause and effect better than his fellows, sees that he can earn more in fees than in wages, to say nothing of being more independent, why should he not go for the fees?

Would any manufacturer listen to one of his skilled workmen if he told him that he thought of establishing himself as a possible competitor in the business, and that he would remain at the lathe or planer if his wages were increased to something like what he would be able to earn outside of the works? Naturally he would not increase his wages one cent, and in all probability he would discharge him on the spot as a disaffected man; but after the disaffected man showed that he possessed capacity in a marked degree, there would arise a demand for his services. I speak from actual experience on this point. Many years since I worked at a lathe in the largest machine shop in New York. Out of working hours, I practised in another calling, and was fortunate enough to make it a success. One day the manager heard of it, and came to me, saying: "If you don't give up so and so, your place will be vacant." It so happened that I had just received an offer from parties which I had decided to accept, and I politely informed the manager that my place was then vacant. This was many years since, and I have earned annually more than five times what I received in the shop.

The facts are that the qualifications which belong to a first class mechanic (manager is a better term, because it comprehends the situation more fully) are entirely removed from mere technical manipulation of tools or metals. There are plenty of good workmen in a shop, who, so far as mere handiwork is concerned, could excel their overseer; but they are

not fit for superintendents. A methodical, systematic, and comprehensive mind, joined to workshop experience and thorough knowledge of human nature, are what make the successful superintendent, and such men are to be found if sought after; not at the wages of a workman, however, for their qualifications command more in other spheres. If manufacturers need them, they will come to the surface fast enough.

42 Cliff street, New York.

ROBERT P. WATSON.

Incendiary Postal Cards.

To the Editor of the Scientific American:

Of what materials are postal cards composed? I came very near to having my office burned by the ignition of a parcel of old cards, which were hung on hooks over my desk, at a distance of 12 or 14 inches from the top of the chimney of an argand oil lamp, the light being turned down. When I went to tea, the light was burning, and the office was left alone during my absence. Fortunately, I returned in time to extinguish the fire before any material damage was done. After this, I took a postal card and set fire to it; and I found that the card burnt like a taper, with a clear flame. I am now in search of knowledge concerning the formation of these inflammable articles.

G. W. FORD.

Rochester, N. Y.

[REMARKS BY THE EDITOR:—Postal cards are made so as to endure pretty rough usage, and thus very good paper stock is used in their manufacture. They are almost wholly vegetable fiber, and consequently burn easily and completely. Ordinary cardboard contains shoddy fiber and mineral matter. Enamelled cards are nearly fireproof by reason of mineral matter. The postal cards seem to contain some of the coloring matter which makes buff envelopes dangerous. The dark buff envelope paper ignites by a spark, and burns like tinder.]

Cable Telegraphy.

To the Editor of the Scientific American:

Mr. Little's assertion, in your number for November 21, that Mr. Winter's improvement in cable telegraphy consists in working a galvanometer by an induction coil having primary and secondary wires, is incorrect, as a reference to the diagram and description printed in a previous number of the SCIENTIFIC AMERICAN will show.

Newark, N. J.

T. A. EDISON.

Curious Effects of Brain Wounds.

In the recent brilliant address of Professor Huxley, before the British Association, "On the Hypothesis that Animals are Automata," he says:

"I am indebted to my friend General Strachey for bringing to my notice an account of a case which appeared within the last four or five days in the scientific article of the *Journal des Débats*. A French soldier, a sergeant, was wounded at the battle of Bazailles, one, as you recollect, of the most fiercely contested battles of the late war. The man was shot in the head, in the region of what we call the left parietal bone. The bullet fractured the bone. The sergeant had enough vigor left to send his bayonet through the Prussian who shot him. Then he wandered a few hundred yards out of the village, fell senseless, but, after the action, was picked up and taken to the hospital, where he remained some time. When he came to himself, as usual in such cases of injury, he was paralyzed on the opposite side of the body, that is to say, the right arm and the right leg were completely paralyzed. That state of things lasted, I think, the better part of two years, but sooner or later he recovered from it, and now he is able to walk about with activity; and only by careful measurement can any difference between the two sides of his body be ascertained. The inquiry, the main results of which I shall give you, has been conducted by exceedingly competent persons, and they report that at present this man lives two lives, a normal life and an abnormal life. In his normal life he is perfectly well, cheerful, does his work as a hospital attendant, and is a respectable, well conducted man. This normal life lasts for about seven and twenty days or thereabouts, out of every month; but for a day or two in each month he passes suddenly and without any obvious change into his abnormal condition. In this state of abnormal life he is still active, goes about as usual, and is to all appearance just the same man as before, goes to bed and undresses himself, gets up, makes his cigarette and smokes it, and eats and drinks. But he neither sees, nor hears, nor tastes, nor smells, nor is he conscious of anything whatever, and he has only one sense organ in a state of activity, namely, that of touch, which is exceedingly delicate. If you put an obstacle in his way, he knocks against it, feels it and goes to the one side; if you push him in any direction, he goes straight on until something stops him. I have said that he makes his cigarettes, but you may supply him with shavings or anything else instead of tobacco, and still he will go on making his cigarettes as usual. His actions are purely mechanical. He feeds voraciously, but whether you give him aloes, or assafoetida, or the nicest thing possible, it is all the same to him. The man is in a condition wherein the functions of his cerebral hemispheres are, at any rate, largely annihilated. He is very nearly—I don't say wholly, but very nearly—in the condition of an animal in which the cerebral hemispheres are extirpated.

"His state is wonderfully interesting to me, for it bears on the phenomena of mesmerism, of which I saw a good deal when I was a young man. In this state he is capable of performing all sorts of actions on mere suggestion. For example, he dropped his cane, and, a person near him putting it into his hand, the feeling of the end of the cane evidently produced in him those molecular changes of the brain which, had he possessed consciousness, would have given rise to the

idea of his rifle; for he threw himself on his face, began feeling for his cartridges, went through the motions of touching his gun, and shouted out, to an imaginary comrade, 'Here they are, a score of them; but we will give a good account of them.' But the most remarkable fact of all is the modification which this injury has made in the man's moral nature. In his normal life he is an upright and honest man. In his abnormal state he is an inveterate thief. He will steal every thing he can lay his hands upon; and if he cannot steal anything else, he will steal his own things and hide them away."

The London *Lancet* gives the following additional particulars concerning the same patient, whose original profession was that of a café ballad singer:

"When he is in his fit, he has no sensitiveness of his own, and will bear physical pain without being aware of it; but his will may be influenced by contact with exterior objects. Set him on his feet, and, as soon as they touch the ground, they awaken in him the desire of walking; he then marches straight on quite steadily, with fixed eyes, without saying a word or knowing what is going on about him. If he meets with an obstacle on his way, he will touch it and try to make out by feeling what it is, and then attempt to get out of its way. If several persons join hands and form a ring around him, he will try to find an opening by repeatedly crossing over from one side to the other, and this without betraying the slightest consciousness or impatience.

"Put a pen into his hand; this will instantly awaken in him a desire of writing; he will fumble about for ink and paper, and, if these be placed before him, he will write a very sensible business letter; but when the fit is over, he will recollect nothing at all about it. Give him some cigarette paper, and he will instantly take out his tobacco bag, roll a cigarette very cleverly, and light it with a match from his own box. Put them out one after another, he will try from first to last to get a light, and put up in the end with his ill success. But ignite a match yourself and give it to him, he will not use it, but let it burn between his fingers. Fill his tobacco bag with anything, no matter what—shavings, cotton, lint, hay, etc., he will roll his cigarette just the same, light and smoke it without perceiving the hoax. But, better still, put a pair of gloves into his hand and he will put them on at once; this, reminding him of his profession, will make him look for his music. A roll of paper is then given to him, upon which he assumes the attitude of a singer before the public, and warbles some piece of his repertory. If you place yourself before him, he will feel about on your person, and, meeting with your watch, he will transfer it from your pocket to his own; but on the other hand, he will allow you, without any resistance or impatience whatever, to take it back again.

We may add that Dr. Brown-Séquard, during his recent course of popular lectures in this country, mentioned a number of cases that had come under his notice, presenting phenomena analogous to the foregoing.

Bursting of a Fly Wheel.

On the morning of November 27, the first coupling of the main shaft in Clark's spool thread mills, at Newark, N. J., suddenly broke, releasing the 600 horse power engine from its work, and instantly increasing its velocity to such a speed that the cogged fly wheel, weighing 20 tons, and another wheel geared with it, weighing 8 tons, exploded, tearing away the ends of the engine house and stripping the roof off. Some of the fragments of the fly wheel were four tons each in weight, the other wheel breaking into small pieces. One piece of the former, weighing three tons, crashed through the roof, struck the tall chimney of the factory, and afterwards buried itself in the earth at a distance of 60 yards from the locality of the disaster. There were 1,100 work people in the building, many of whom had very narrow escapes; but no one was hurt. The engine was ruined. The damage is estimated at over \$25,000.

Hard Rubber Thermometers.

In our issue of November 28, we drew attention to the experiments of Kohlrausch on hard rubber for the making of thermometers. He suggests that a strip of ivory should be glued to one of hard rubber, as in a Breguet's thermometer, so as to bring into play the great expansibility of the rubber. We learn, however, that instruments on this principle have been long in use in the Meteorological Observatory of the New York Central Park. They are the invention of Mr. Daniel Draper, the director of that observatory, and are on a much better construction than those suggested by Kohlrausch, which would be liable to hygrometric disturbances from the ivory. Mr. Draper's consist of a strip of hard rubber riveted to one of brass. A clock attachment renders them self-recording. They are considered as presenting the best form of registering thermometer hitherto introduced, and as supplying what has thus far been a desideratum. Any one interested in the matter can see them working in the Observatory.

A Soda Water Law Suit.

A soda water manufacturer was summoned recently at the Longton, England, police court, for selling as "soda water" an artificially aerated water, which was found on analysis not to contain a particle of the alkali from which it was named, and, further, for depriving his customer of the antacid ingredient of which he was entitled to expect the benefit. The magistrate held that the case did not come under the adulteration act, but it has been appealed and will be passed upon by the higher courts. As so-called soda water is universally known to be nothing but water impregnated with carbonic acid gas, it remains to be seen how the English jurists propose to treat the queer social and legal question of a vendor selling wares under a false name, and the buyer hence presumably negotiating for what he does not wish to buy.

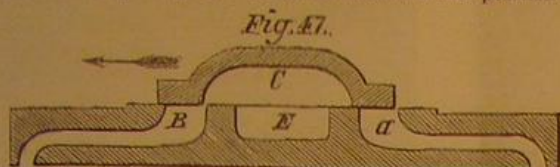
PRACTICAL MECHANISM.

NUMBER XIV.

BY JOSHUA ROSE.

THE SLIDE VALVE.

The common slide valve is a simple device for regulating the ingress and egress of steam to and from the cylinder, as illustrated in Fig. 47. It is here shown in the position in



which it would be when the piston of the engine had moved to the end of one stroke and was prepared to commence the next, *a* being the port through which the steam is passing into the cylinder, and *B*, the port through which the steam which propelled the piston on the previous stroke must now find egress.

The valve, *C*, is moving in the direction of the arrow, so that the port, *a*, is left open for the steam to enter as the valve recedes from it, and a free communication is at the same time being established between the port, *B*, and the exhaust port, *E*, of the cylinder, thus permitting the steam to escape through *E*.

When the piston has arrived at the other end of the cylinder, the valve, *C*, will have moved back, so that these conditions will be exactly reversed, *B* being the port through which the steam will then enter, and *a*, that through which the exhaust steam will escape from the cylinder.

The lead of a valve is the width of opening which the valve permits (by reason of the position to the crank in which the eccentric is set) to the steam port when the piston is at the end of the stroke, as shown in Fig. 47, at the port, *a*.

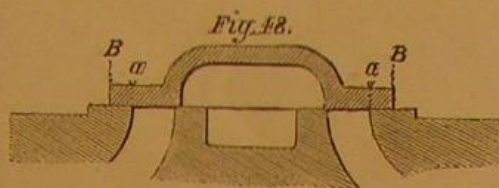
If the valve were set so that it had no lead, both the ports, *a* and *B*, would be closed by the valve, so that the steam could neither enter nor leave the cylinder until the momentum of the fly wheel had caused the crank to pass the dead center, and therefore the valve to open.

Lead is given to a valve to enable the steam to act as a cushion upon the piston, by admitting the steam to it before it has arrived at the end of its stroke, thus causing it to reverse its motion easily and without noise.

If the working parts of an engine have much play or lost motion in them, the steam admitted by lead will, by opposing a gradual force in a direction opposite to that in which those parts are moving, take up such play before the piston has reversed its motion, and therefore more gradually and less violently than would be the case if the force of the steam came upon the piston at the instant at which it reversed its motion. In the latter case the piston, after reversing its motion, would have no load against it until the play of the working parts was taken up, so that it would travel very fast during the instant of time in which such play was being taken up; and the check, given to it on meeting its load again, would cause a thump or pound to the piston. But if the working parts are a reasonably good fit, and the valve has lap on it to give a free exhaust, there appears no necessity for giving the valve more lead than is sufficient to about fill the steam passage and the clearance (that is, the space between the cylinder cover and the piston when the latter is at the end of its stroke) with steam at full pressure, by the time the piston arrives at the end of the stroke: the object of lead to this amount being to supply steam at full pressure to the piston from the instant the crank has passed its dead center and the piston has commenced its stroke, and at the same time to prevent any unnecessary amount of back pressure, for the steam admitted by lead acts at all times as a back pressure upon the piston; so that, if the valve has too much lead, not only is there a consequent loss of power from back pressure, but the piston receives a sudden and violent shock, which is sure in the end to result in damage to some part of the engine, such for instance as loosening the piston upon the rod, or either loosening or breaking the crosshead pin or the crank pin. It must be borne in mind that, as the steam admitted by lead commences to enter the cylinder before the piston has arrived at the end of its stroke, if the amount of lead is so great as to admit sufficient steam to the steam passages and cylinder, and to fill them at full pressure before the piston has arrived at the extreme end of its stroke, the advancing piston will have to force or pump part of such steam back again into the steam chest. At the moment at which this forcing back will take place, the center line of the crank will be nearly parallel with the center line of the bore of the cylinder, so that the effect will be that the whole momentum of the fly wheel, which is traveling fast, is concentrated upon the piston, which is then moving very slowly, to force it ahead against the full head of steam (admitted by the lead); and the whole strain of these opposing forces is accumulated upon the pillar block holding the crank shaft, bearing the crank pin and the crosshead pin in a direction the most favorable for bursting them apart, resulting in a serious loss of power, and (as before stated) in ultimate damage to the engine. In the case of a locomotive, where the piston speed and the wear and tear of the working parts is very great, an extreme amount of lead is admissible to take up such wear and prevent pounding at each end of the stroke; the lightness of locomotive frames (as compared to the heavy frames of stationary engines) enables them to spring from the strain created by any excess of lead, and hence the crank and crosshead pins do not encounter so severe a strain as would be the case if the same amount of lead were given to a stationary engine. One eighth of an inch of lead is sufficient for an ordinary freight and $\frac{3}{8}$ of an inch is sufficient for passenger or express locomotive, the difference being in con-

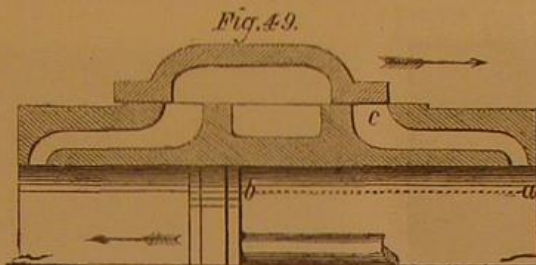
sequence of the greater running speed of the latter. Engines whose cylinders are vertical and above the shaft are given more lead on the bottom than on the top of the cylinder, because the wear of the various moving parts of the engine is mostly downwards and away from the cylinder, so that the lead becomes more on the top and less on the bottom as the engine wears. If, however, the cylinder is vertical and below the shaft, these conditions are exactly reversed.

The steam lap of a valve is the amount by which it exceeds the extreme width of the cylinder ports, as illustrated in Fig.



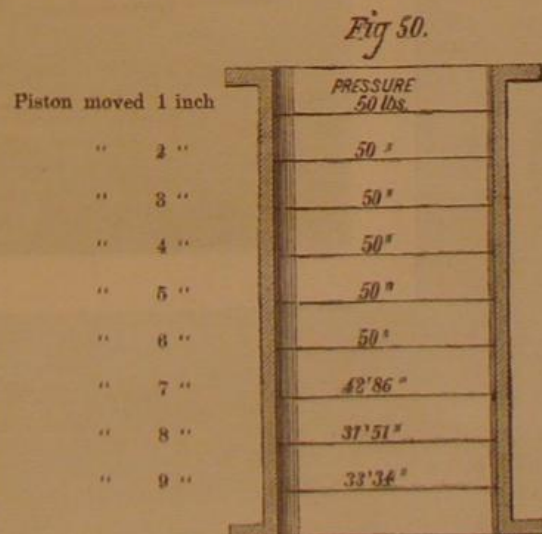
48, from *a* to *B* being, in each case, the lap.

By means of giving steam lap to the valve, the engine is enabled to use its steam expansively, that is, the valve cuts off the supply of steam to the piston before the latter has traveled to the end of the stroke, as shown in Fig. 49, in which the valve is shown as having just closed the port, *C*, the direction in which the piston and valve are respectively moving being denoted by the arrows.



Lap on the exhaust side of a valve is a subject to be hereafter treated upon. The advantage derived by using steam expansively may be perceived by supposing the stroke of a piston to be 9 inches, and the steam supply to be cut off by reason of the lap on the valve when the piston has traveled 6 inches; it will then have to travel the remaining 3 inches of stroke, receiving only such pressure as the steam already in the cylinder will impart. The pressure of steam increases or diminishes in exact ratio to the space it occupies, the temperature being maintained equal; that is to say, if the steam occupying one cubic foot at a pressure of 50 pounds is permitted to expand its volume so that it occupies two cubic feet, its pressure will decrease to 25 pounds; but if it were compressed so as to occupy one half of a cubic foot, its pressure would rise to 100 pounds.

In Fig. 49 the steam would occupy that portion of the cylinder from *a* to *b* (that is, 6 inches of its length, supposing the whole length to be 9 inches), at a pressure of, say, 50 pounds per inch. When, therefore, the piston has moved another inch, the steam will occupy $\frac{1}{4}$ more space (that is, 7 inches instead of 6 inches of the length of the cylinder), thus reducing its pressure by $\frac{1}{4}$, bringing it down from 50 to 42.86 pounds per inch, and so on, as illustrated in Fig. 50, in which *a a* represents a section of a cylinder.



During the first five inches of the travel of the piston, the steam port is open, and the full pressure of the steam is continuously exerted to move the piston; but at the sixth inch, the steam lap on the slide valve closes the port. Going now to the seventh inch, we find one seventh more space between the piston and the cylinder head, while there is only six inches of steam at normal pressure; and so we have one seventh less pressure, or 42.86 pounds. At the eighth inch, the space and the steam are still more disproportionate, there being one fourth more space and of course one fourth less pressure; and at the ninth inch, the end of the stroke, there is, similarly, one third more space and one third less pressure.

The whole pressure of steam on the piston during the last 3 inches of the stroke has been obtained without any supply of steam to the cylinder from the steam chest, and constitutes the gain due to using the steam expansively.

It must be borne in mind that, when the piston commenced its seventh inch of stroke and first inch of expansion, the pressure of steam upon it was 50 pounds, and that not until it had reached its seventh inch of stroke and completed its first

inch under expansion had the pressure fallen to 42.86, so that 42.86 is less than the average pressure the piston received during that inch of its stroke, but is as near as we can arrive at it unless we take the movements of the piston and pressures of steam at a greater number of points, as, for instance, at every half inch of piston movement.

It would appear that this saving of steam had been obtained at some sacrifice of the power of the engine, since the piston performed the last 3 inches of its stroke under a reduced pressure of steam; but such is not the case, for if the valve has no steam lap on it, the exhaust port is not sufficiently open when the piston is at the end of the stroke to permit the steam to escape freely; hence it puts a back pressure on the piston, which is a greater loss to the engine than is caused by the reduced pressure due to working expansively: so that an engine whose valve has no lap will not only use less steam, but will become more powerful if lap be added to the valve.

An experiment made two years ago by the author clearly demonstrated this fact. A new engine, fitted with a common slide valve which had no lap upon it, was attached directly to a pump, which drew water 4 feet and forced it through a $1\frac{1}{2}$ inch nozzle, a pressure gage being attached to the air chamber of the pump. Steam at 60 pounds to the square inch was supplied to the engine, whose performance then was to maintain an even pressure of 17 pounds per inch in the air chamber, the engine making 120 revolutions per minute. After running a few days, the slide valve of the engine was taken out and $\frac{5}{8}$ of steam lap was added on each side, a new and larger eccentric being fitted to the engine in order to give the slide valve the necessary increase of stroke. No other part of the engine or pump was altered or removed; but upon turning on the steam, the engine ran up to 175 revolutions, and maintained an even pressure in the air chamber of 34 pounds to the inch.

The Common Hammer.

Few people, says Mr. J. Richards, in witnessing the use of a hammer, or in using one themselves, ever think of it as an engine giving out tons of force, concentrating and applying power by functions which, if performed by other mechanism, would involve trains of gearing, levers, or screws; and that such mechanism, if employed instead of hammers, must lack that important function of applying force in any direction that the will may direct.

A simple hand hammer is, in the abstract, one of the most intricate of mechanical agents, that is, its action is more difficult to analyze than that of many complex machines involving trains of mechanism; but our familiarity with hammers makes us overlook this fact, and the hammer has even been denied a place among those mechanical contrivances to which there has been applied the mistaken name of mechanical powers.

Let the reader compare a hammer with a wheel and axle, inclined plane, screw, or lever, as an agent for concentrating and applying power, noting the principles of its action first, and then considering its universal use, and he will conclude that if there is a mechanical device that comprehends distinct principles, that device is the common hammer; it seems, indeed, to be one of those things provided to meet a human necessity, and without which mechanical industry could not be carried on. In the manipulation of nearly every kind of material, the hammer is continually necessary in order to exert a force beyond what the hands may do, unaided by mechanism to multiply their force. A carpenter in driving a spike requires a force of from one to two tons, a blacksmith requires a force of from five pounds to five tons to meet the requirements of his work, a stonemason applies a force of from one hundred to one thousand pounds in driving the edge of his tools; chipping, calking, in fact nearly all mechanical operations consist more or less in blows, and blows are but the application of an accumulated force expended throughout a limited distance.

Considered as a mechanical agent, the hammer concentrates the power of the arms and applies it in a manner that meets the requirements of the work. If great force is needed, a long swing and slow blows accomplish tons; if but little force is required, a short swing and rapid blows will serve, the degree of force being not only continually at control, but the direction at which it is applied also. Other mechanism, if used instead of hammers to perform the same duty, would from its nature require to be a complicated machine, and act but in one direction or in one plane.

Tin-Canned Butter.

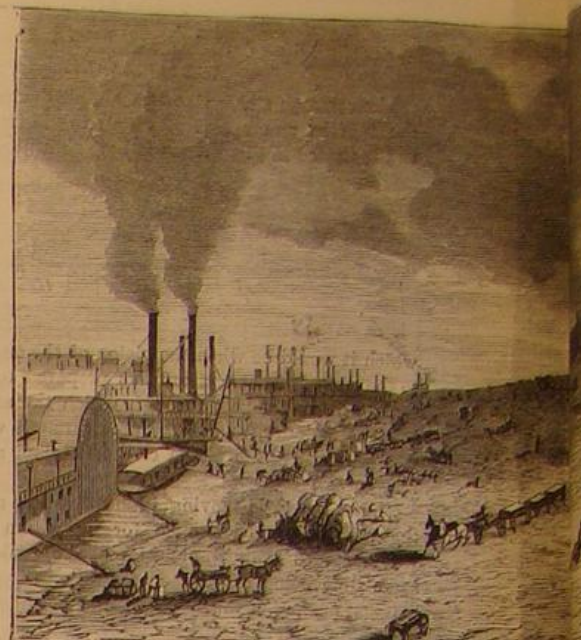
The president of the New York Butter and Cheese Exchange lately received a package of Danish butter, which, although it had been packed in tin for more than seventeen months, was in excellent condition. It came from Bolivia, where it had been sent from London, and was accompanied by a note addressed to the New York butter and cheese merchants, asking if as good a quality of butter could be produced here. If as good butter could be made here, New York would soon have control of the trade of the South American markets, as the cost was too great to get their butter direct from London. It was decided that butter of as good quality could be made in this country. Arrangements will be made to secure the South American trade, and tin will be used for packing purposes instead of wood.

MR. I. LOWTHIAN BELL, President of the Iron and Steel Institute of Great Britain, and one of the most eminent iron masters of England, is now in this country. He is visiting our principal iron works and mining regions.

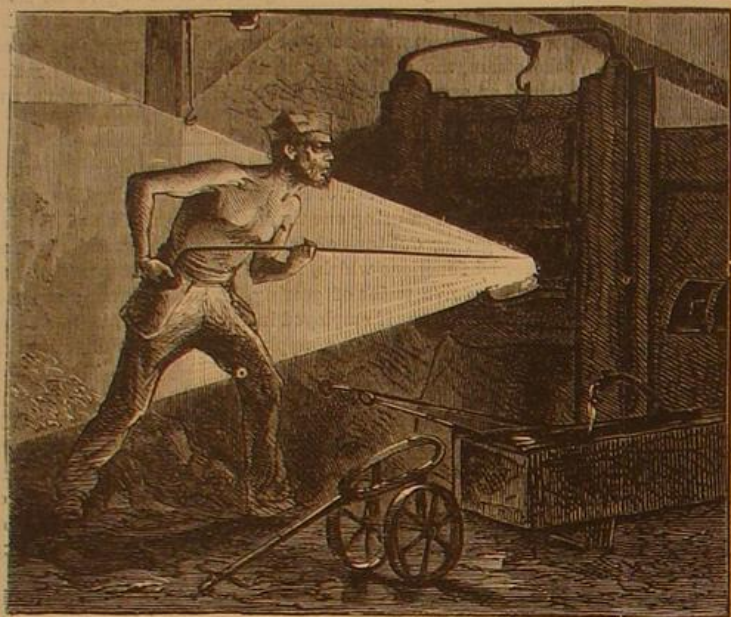
CHIANG-QUAN-WA, an intelligent Chinaman of San Francisco, has applied for a patent for an improved overall.



MELTING STEEL.



LEV



PUDDLING IRON.

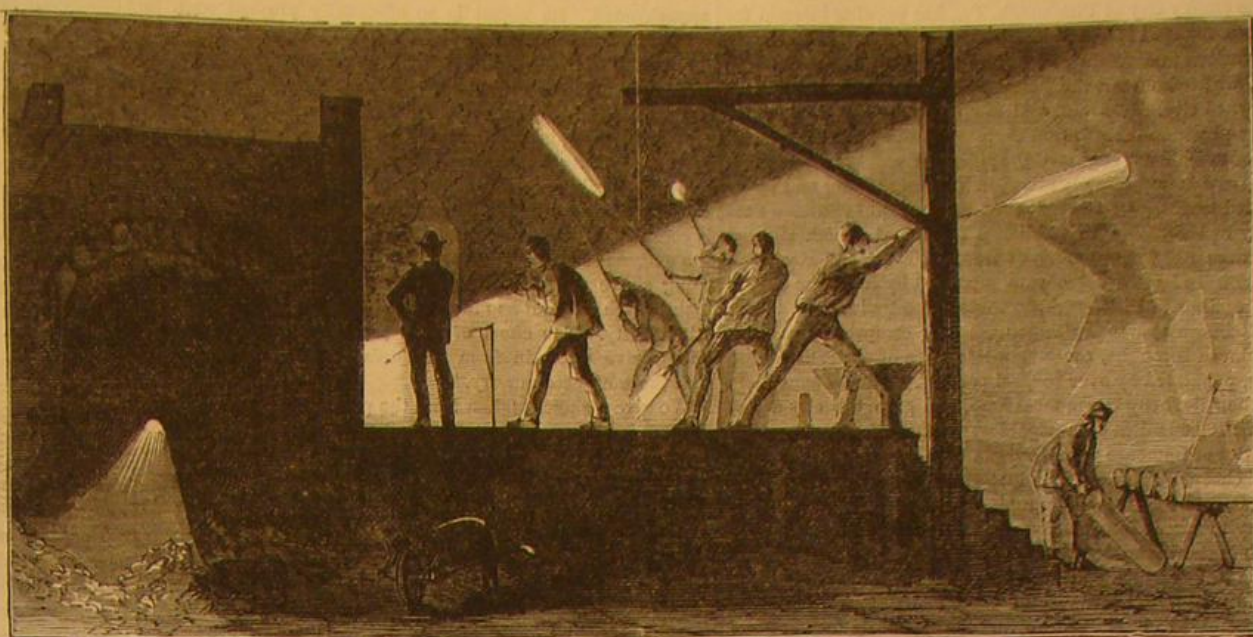
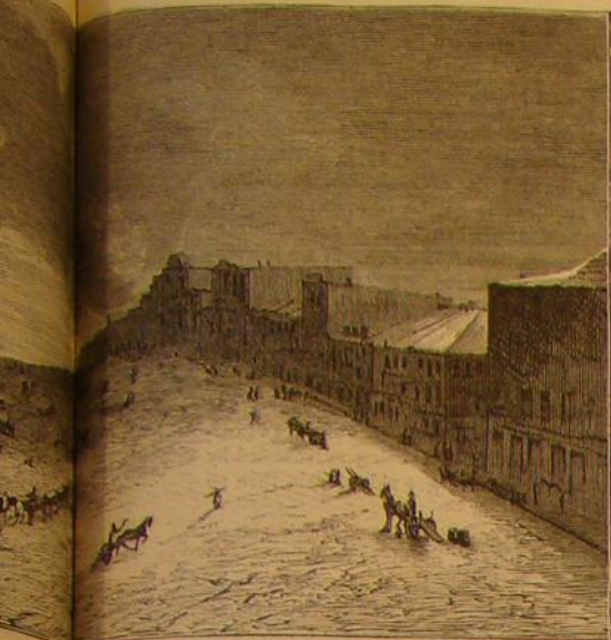


C.S.R.

VIEW FROM MON



ON THE MONONGAHELA RIVER



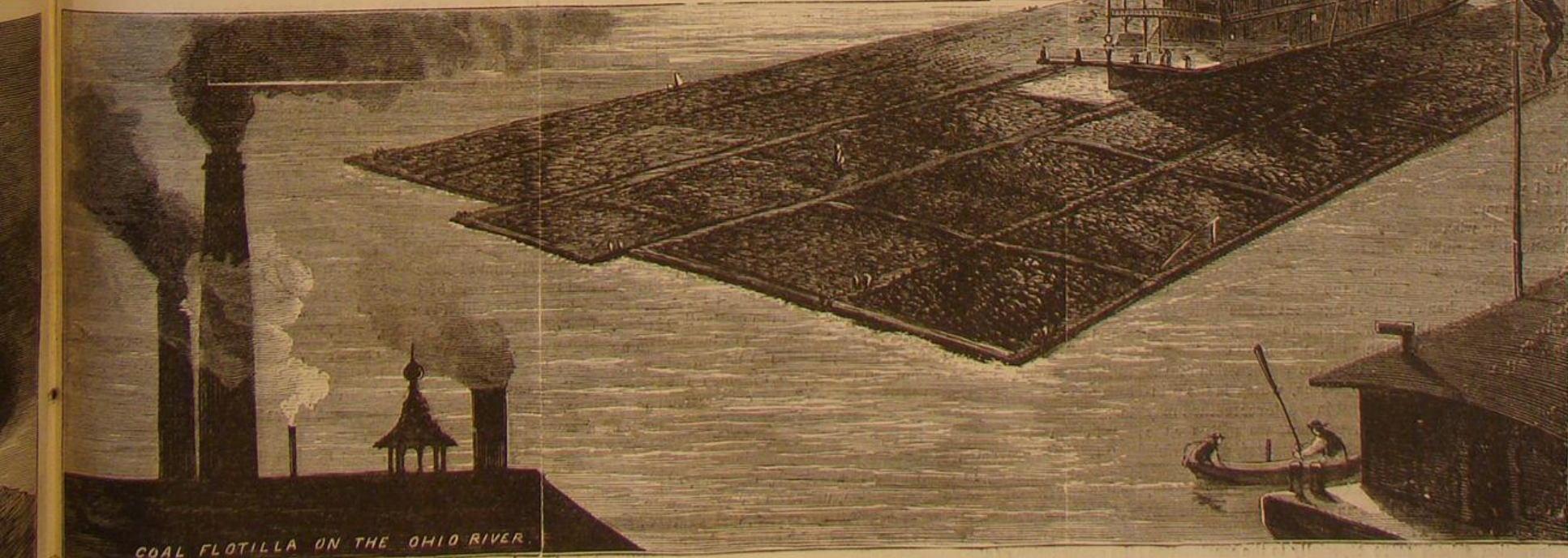
BLOWING GLASS



FROM MOUNT HILL.



STEAM HAMMER.



COAL FLOTILLA ON THE OHIO RIVER.

THE CITY OF PITTSBURGH AND ITS INDUSTRIES.

The smoky city of Pittsburgh, Pa., has peculiar interest for all men engaged in the industrial arts, on account of her many and various manufactures and the enterprise of her leading men, which hold out the promise of a great future for this renowned city. Iron and coal are of course her leading staples, and where there is iron there is naturally a large production of machinery, engineering appliances, and hardware; and cheap coal is immediately attended by glass making and many kindred trades. Of the extent of these manufactures we recently had occasion to publish a statement, which showed that over \$10,000,000 value of iron, \$4,000,000 of steel, and \$3,000,000 of glass wares were produced by forty-one of the leading firms in Pittsburgh, in these three trades only.

Pittsburgh as a manufacturing center comprises two cities and eleven boroughs, covering a total area of about 25 square miles, populated by over 263,000 persons. The Monongahela and the Allegheny rivers meet here, and give the city access to over 12,000 miles of navigable streams, affording carrying facilities of immense value, especially in a country where coal is so cheap. The two principal rivers are crossed by nine bridges, and the river shipping is stated by a competent authority to exceed in tonnage even that of New York city.

While the manufactures of Pittsburgh are found in every city on this continent, her supplies are drawn from all parts of the world. The copper of the Lake Superior region is brought here to be worked up, and the chemicals for her glass houses are produced in all parts of Europe and America. The mechanics who form the larger part of her people, renowned everywhere for their ingenuity and skill, are chiefly Americans, but number among them natives of nearly every country which has achieved fame in the industrial arts. The Welsh and Cornish miners, the steel melter of Sheffield and the glass mixer of Birmingham, and the gunsmith and fine metal worker of Liège are here to be found, uniting with the Americans in striving to maintain and extend the renown of the chief manufacturing city of our Great Republic.

We publish on the two previous pages a series of views of this most interesting city, and of some of her manufacturing processes. These engravings explain themselves, and will be examined with interest by our readers, for they represent scenes which all Americans view with pride in the present and hope in the future.

NEW RAILWAY TUNNEL UNDER THE HUDSON RIVER, BETWEEN NEW YORK AND JERSEY CITY.

For many years the project of building a railway tunnel under the bed of the Hudson river, between New York and Jersey City, has been discussed, its importance and feasibility agreed upon, and its successful completion, upon paper, established. Only two things have been lacking for the actual realization of the work, namely, the money to build with, and the company of individuals enterprising and bold enough to assume the risks incident to such a task.

The bed of the Hudson, at New York, is a treacherous substratum, so far as tunneling is concerned, being porous, leaky, and lacking in firmness. All engineering experience in the construction of works in such soils has shown that their prosecution is attended with unusual risk and cost. But now comes along a new and enterprising engineer from California, Mr. D. C. Haskin, inventor of a new improvement in the Art of Tunneling, expressly designed to make difficult works of this kind easy, patented February 3d, 1874. Mr. Haskin has organized a strong and wealthy company for the trial of his improvements, and the first essay is to be made upon the Hudson river tunnel, work upon which has recently been commenced. The vertical shaft has already reached a considerable depth. It is located near the river shore at the foot of 15th street, Jersey City, and from thence the tunnel will extend across under the Hudson river to or near the foot of Canal street in New York, thence up Canal street to a connection with the Broadway Underground Railway.

The greatest depth of water on the Hudson river over the tunnel will be about 100 feet; the total width of the river, 4,000 feet. The actual length of the horizontal tunnel, however, will hardly be less than 6,000 feet. The *New York Sun* states that Colonel Haskin "is confident of success, that there is no stock for sale, and that the members of the company have plenty of money to complete the work, and are willing to pay all costs and expenses."

It is rumored that the Delaware, Lackawanna & Western Railway Company claim that the Tunnel Company do or will infringe on their landed rights, and that they will obtain injunctions from the Court to stop the operations. We trust that this powerful corporation will do nothing of the sort. Instead of preventing, it should be the aim of the railway company to promote the work. In common with all our citizens, we heartily wish the Tunnel Company success.

We believe the public will resent any attempt, made by railway monopolists or others, to interfere with the work. The citizens of New York want the tunnel built, and will cordially extend the hand of encouragement to the builders.

We will now describe this New Art of Tunneling, premising, however, that the failure of the plan, which we consider inevitable, will not, necessarily, stop the construction of the tunnel, as the air-compressing apparatus, which is the principal item of expense, will be useful in whatever method may be hereafter adopted. In our description, we will, for the most part, follow the language of the patentee, who, in his patent, says:

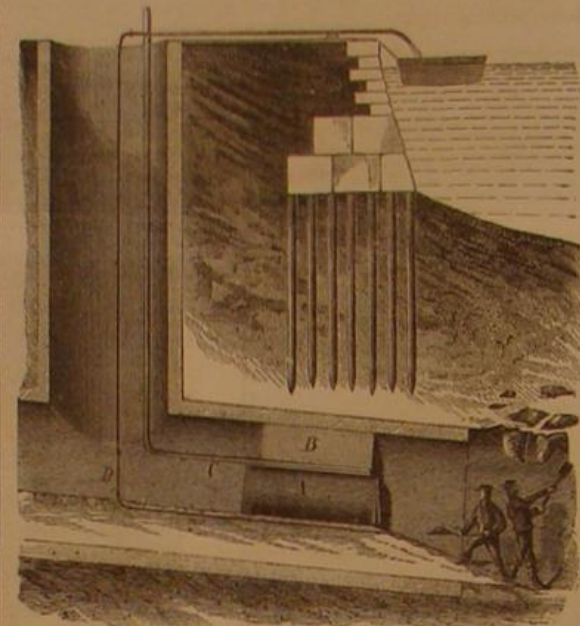
"Be it known, that I, DeWitt Clinton Haskin, of Valejo, Solano County, California, have invented a new and useful Improvement in the Art of Tunneling.

"My invention relates more especially to the construction of tunnels through sands, wet earths under water courses, and under such like conditions where the caving-in of the walls of

the excavation or the infiltration or irruption of water is to be apprehended. Its object is to effectually prevent such incidents in a cheap and simple way, to which end my improvement consists in filling the excavation with compressed air of a density sufficient to resist the inward pressure during the construction of the shell or wall of the tunnel.

"The distinguishing feature of my system, however, is that instead of using temporary facings of timber or other rigid material, I rely upon the air pressure to resist the caving-in of the wall or the infiltration of water until the masonry wall is completed. This pressure is, of course, to be regulated by the exigencies of the occasion, and may be varied from anything above that of the atmosphere to 50 lbs. to the square inch, which is about as much as the human system will bear with safety. The effect of such pressure has been found to be to drive water in from the surface of the excavation, so that the sand becomes dry."

We give a sketch, taken from the patent.



HASKIN'S NEW ART OF TUNNELING.

Within the tunnel, a short distance back of the heading where the laborers are at work, is an air lock, A, composed of an iron cylinder, having entrance valves at each end, so arranged that when one is opened the other closes, thus permitting egress or ingress to the front. Above the lock is an airtight packing, B, while below the cylinder is a packing or filling of earth. When the air lock is duly set and sealed within the tunnel, compressed air is driven to the heading in front of the air lock, through air pipe, C. The excavated earth will be discharged from the heading, by the air pressure, through the pipe, D, and delivered into boats or other suitable receptacles at the ground or river surface, in the manner commonly practised in sinking caissons.

In carrying on the work, the laborers will excavate a chamber in the earth in advance of the finished masonry, which will then be carried forward, while the men dig out a new space in advance, and so on until the tunnel is completed. Any loose boulders, stones, earth, quicksands, or water, encountered in the roof or walls of the heading, are to be held up and prevented from caving-in upon the workmen by the air, like flies upon the ceiling. The clumsy, costly caissons, shields, and other appliances, heretofore deemed necessary by cautious engineers, are discarded in this New Art. It is, indeed, a new wrinkle in the science of engineering.

But we think the statement of the patent, that only 50 lbs. air pressure will be required, must be a mistake. Several cyphers have evidently been omitted from the figures, perhaps by a blunder at the Patent Office. A cubic foot of air weighs only 0.075 of a pound, while a cubic foot of stone weighs 165 lbs. To buoy up such a stone in air, requires a corresponding density of the air: which involves the compression of 2,200 cubic feet of air into every cubic foot of air contents within the heading, or a pressure of 33,000 lbs. to the square inch.

Our author makes another rather incongruous statement in his patent. He says: "In case a jet seam or small stream of water is encountered, I supply a temporary shield of canvas, leather, or other light flexible integument to the wall, against which the pressure instantly forces it and seals the leak."

Water weighs only 62½ lbs. per cubic foot, or less than half the weight of granite. If the direct air pressure, against the loose earth, sand, and stones, is sufficient to prevent their downfall in the excavation, surely no streams of water can come in, and the leather will be unnecessary.

"These three features," says the patentee, "constitute the leading characteristics of my invention, namely: First, the use of compressed air acting directly upon the excavation walls to prevent leakage or caving; second, the use of temporary flexible integuments to stop leaks; third, the partial refilling with earth of the completed tunnel, to diminish the area of the surface exposed to the action of the compressed air."

"I claim as my invention:

"1. The improvement in the art of tunneling herein set forth the same consisting in excavating in a working chamber, of which the tunnel head forms a portion, under an air pressure acting directly upon the surface being excavated, and sufficient to prevent the caving or leakage of said surface during the construction of the masonry walls.

"2. The method herein set forth of preventing leakage in the excavation surface of the working chamber, by the appli-

cation thereto of a flexible integument held in position by atmospheric pressure.

"3. The method herein set forth of partially refilling the completed tunnel in advance of the air lock, to diminish the air surface thereof.

"In testimony whereof I have subscribed my name."

The Economy of Powdered Fuel.

With a quick draft and a thick fire, as in locomotives, 18 lbs. of air suffice to burn 1 lb. of coal; but in ordinary furnaces the quantity required is 24 lbs. or even more. We have seen that the temperature, when 1 lb. of coal is burned with 12 lbs. of air, only amounts to 4,580° Fah. If we increase the admission of air to 18 lbs., the resulting temperature falls to 3,200° Fah. while if we double the quantity of air it falls to 2,440° Fah. Oxygen of dilution is only required because the carbon cannot, unless oxygen is present in the furnace in excess, obtain what it wants; and this is due to the fact that the coal in combustion does not expose sufficient surface to the air passing over it. If we can increase the surface of carbon exposed, prevent the carbon from being surrounded by an atmosphere of carbonic acid, and get rid of ash, then no excess of oxygen will be required.

Now this is just what Mr. Crampton does. Taking small coal, he grinds it between a pair of ordinary millstones, and bolts it in a coarse bolting machine. He thus procures coal flour. This coal is fed by a most ingenious machine into a nozzle or twee through which air is forced from a fan. The coal flour is thus blown in a cloud into the furnace or combustion chamber; and there igniting, it is converted into a body of flame. The grinding of the coal really is nothing more or less than an expedient for increasing the oxidizable surface exposed to the air; for let us suppose that one pound of coal in a block has a surface of, say, one fourth of a square foot, it is obvious that by grinding this pound of coal to flour its surface will be augmented, possibly a thousandfold, and each little molecule will expose to the oxygen an enormous surface as compared with its cubic capacity—indeed, a surface out of all proportion greater than that supplied by a pound of coal in mass as compared with its cubic capacity. The direct result is just that which might be anticipated. Mr. Crampton burns powdered coal with as little as 13 lbs. or 14 lbs. of air per pound of fuel, and has, we believe, obtained satisfactory results when but 12 lbs. of air were admitted.

The direct effect of the admission of a minimum quantity of air to a furnace is a direct and enormous saving in fuel. Let us take, for example, the operation of puddling. In the ordinary puddling furnace, at least 20 lbs. of air are burned per pound of coal. Now, to puddle a ton of iron with a ton of coal is an exceedingly good result. Let us say that in ordinary fair work 2,500 lbs. of coal are required. By an actual experiment, if such it may be called, which we saw carried out at Woolwich with the Crampton furnace—10 cwt. of old shells were charged into this furnace, and at the end of about one hour and forty minutes, 11 cwt. 2 qrs. of excellent iron was taken out of it. During the puddling of the charge in question, 4½ cwt. of damp coal was blown into the furnace per hour. Thus 11½ cwt. of wrought iron were made, while about 7½ cwt. of coal was consumed.—*The Engineer*.

New Telegraph Relay.

A new form of relay, the invention of Mr. E. P. Warner, of the Western Electric Manufacturing Company, Chicago, has lately been introduced. The objects sought to be gained in this relay are the reduction of the coercive force of the iron cores to a minimum, the exemption from the retractile force of springs acting in opposition to the force of the magnets, the abolition of an unpolarized armature, and the utilization of the attractive and repulsive force of a permanent magnet upon the tongue operating the local circuit.

It is well known that soft iron armatures retain the polarity impressed upon them by the electromagnets for a short time after the current ceases, also that the longer the electromagnet the greater its retaining power and consequent sluggishness. In the Warner relay, these disadvantages are overcome by having magnets one half the length of the shortest used in the best style of horseshoe relays. This insures the quick discharge of each core, and reduces its retaining power to the lowest point, especially as the purest iron is used.

No armature has to be magnetized by induction from the poles of an electromagnet. The cores are simultaneously magnetized by the same current, and their extensions have sufficient metal section to reduce their magnetic resistance to a very low point, and, at the same time, the weight of the movable core, its extension and tongue, does not exceed, to any great extent, the weight of an ordinary armature tongue and axis.

The relay has been severely tested in circuits of all conditions, and performed admirably. Unlike many other relays, the permanent magnet stands separate and apart from convolutions and reversing coils of every kind, and will not undergo that deterioration which is experienced in other combinations. One of the Warner relays, 150 ohms, was worked on a straight wire, between Chicago and New York, with no intermediate battery, and recorded fairly the signals, which were very light and unsteady on a 600 ohm testing relay of usual make. The *Journal of the Telegraph* says that the result of a comparative test, however, made at the Western Union Telegraph Office in this city, does not indicate any superiority over the regular form of relay now in use.

THE Academy of Sciences of Berlin has offered a prize of \$200, payable July, 1876, for the best essay recording experiments as to whether changes in the hardness and friability of steel are due to chemical or physical causes, or both. Papers, in German, Latin, English, or French, are to be sent in before March, 1876.

A NEW HOT AIR BALLOON.

The possibility of ascending in a balloon filled with hot air was long since demonstrated, but the death of one of the earliest experimenters, followed by the manufacture of coal gas, led to the abandonment of the system. A Frenchman named Ménier has recently revived the idea, and has made experiments on a scale of considerable extent. His scheme is to employ a balloon filled with hot air, in a captive condition only, as a means for obtaining observations from a considerable altitude for an army upon the line of march; and experiments have been instituted at the Woolwich Arsenal, England, with a balloon of gigantic size, which has been constructed under the supervision of the well known aeronaut, Mr. Simmons, for this purpose, a paraffin lamp being used for heating, which is the invention of M. Ménier.

The accompanying plan engraving will give the reader an idea of the proportions of this balloon, and of the apparatus employed for heating it. The balloon is nearly circular, 70 feet in diameter, the aperture at the neck being almost closed by a tin diaphragm which separates the balloon from the car, suspended 4 feet beneath by cords surrounding the balloon. A man-hole is contrived in the diaphragm, so that observations can be taken of the interior of the balloon during an ascent. The car is of wirework, with a wooden hoop round the top and bottom, and runs upon three light carriage wheels, by means of which it can be transported from one place to another, with the whole of the balloon and its attendant gear packed upon the top. The wheels remain attached to the car during an ascent. The heating apparatus, which consists of a huge paraffin lamp with a copper chimney, the whole being 25 feet high from the ground, rests upon the tin diaphragm, being supported by light girders of wrought T iron, crossing the ring round the diaphragm (see the section, at the upper part of the illustration, for the girders). The furnace for the lamp, the details of which will be described presently, rests within a tin cylinder projecting beneath the diaphragm, being supported by bent rods of iron crossing the cylinder. It has four feed pipes, leading into it and communicating with two oil cisterns suspended from the diaphragm ring, two to each cistern. The cisterns are filled from cans of oil, by means of small force pumps and a supply pipe—a waste pipe being also attached to each, leading away into an empty can. The furnace is immediately beneath the chimney, which is constructed of thin sheet copper, having a bulb at the bottom 6 feet in diameter. The chimney is divided into several portions, as may be seen in the engraving, which take to pieces, and are capable of packing into a small space for easy transit. At the top is a head of open wirework, crowned with an asbestos mat or damper, to prevent the heat striking directly upwards and burning the roof of the balloon. The substance of the balloon is French cambric, an excessively fine fabric, with a double crossed woof, so as to be impervious to the air. It is slightly heavier than the silk usually employed for balloons, but requires no preparation or dressing of any kind to render it airtight. The furnace or burner is of annular character, constructed of copper, hollow, with a bulge all round at the bottom, to contain the oil. At the junction of the bulge and the walls of the furnace, on both sides, is a ring of wick (see AA.) At the summit of the burner or furnace are numbers of perforations piercing into its interior. A wall or ring of metal is erected on the top to direct the flame upwards. The action of the apparatus is as follows: Upon filling the bulge with oil and lighting the wicks, the walls of the furnace are quickly heated, the surface of the oil inside being rapidly converted into inflammable gas as its body becomes hot. The gas escapes at the perforations before alluded to, and very shortly ignites outside the burner with a loud roar, contin-

uing to burn fiercely until the cisterns are exhausted. These are of course replenished from the tin cans carried in the car, as previously explained. The average heat generated throughout the balloon is about 100° above the surrounding atmosphere, a higher temperature than that being considered dangerous for the fabric of the balloon. It has been found, however, experimentally, that a temperature of 22° above the surrounding atmosphere will actually lift the balloon off the ground.

The actual lifting power of M. Ménier's hot air balloon, says the *Engineer*, from whose pages we select the engraving, can easily be calculated. Air, when heated from 50° to the

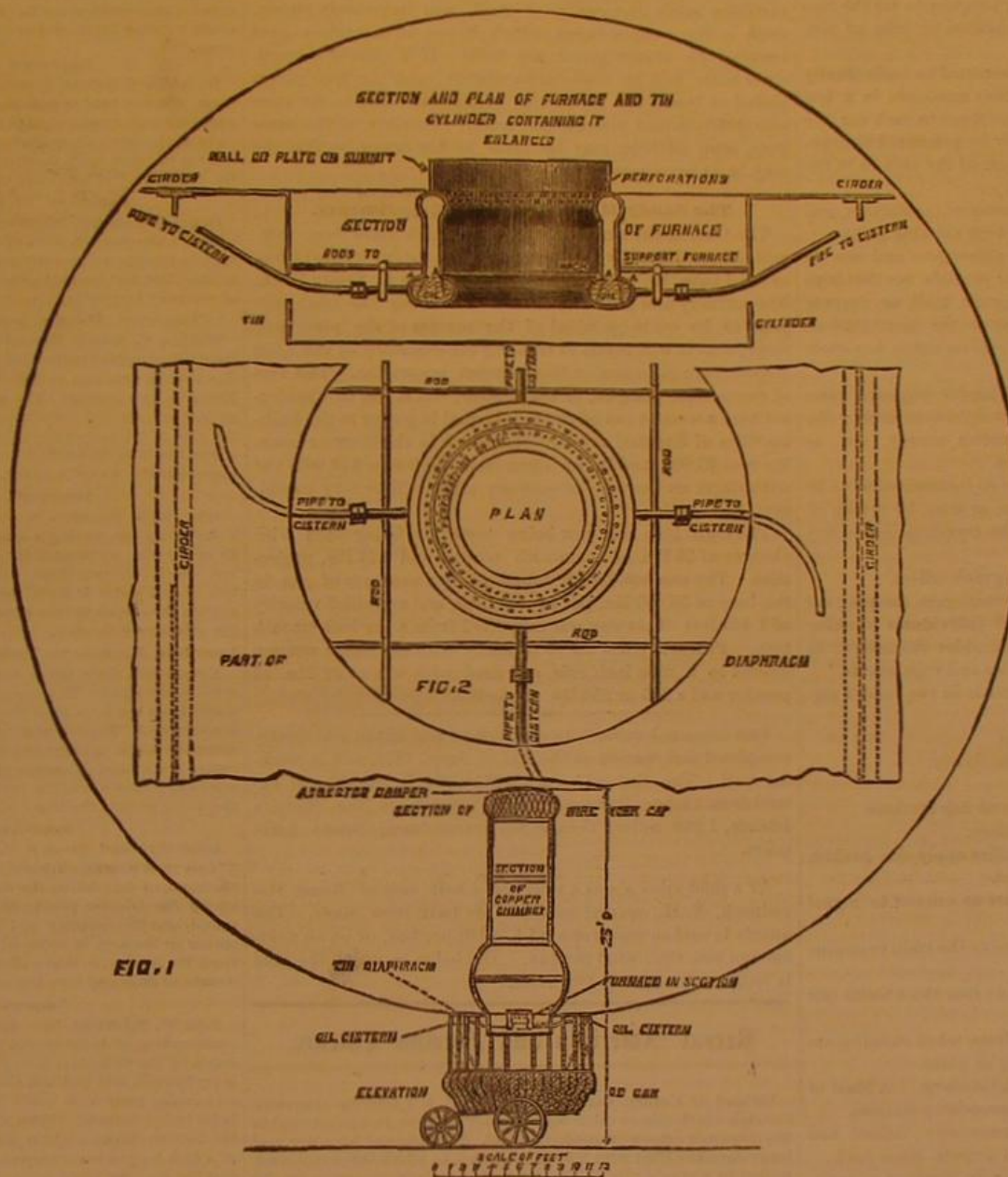
would weigh, in pounds, $70 \times 70 \times 70 \times \frac{1}{28}$, or 13,720 lbs., because the contents of spheres are directly proportional to the cubes of their diameters. Hence, by the above process we should reduce this weight by 13,720 divided by 5, or 2,744 lbs. This, then, would be the total lifting power of the balloon, or exactly 23½ cwt.; and deducting 13 cwt. for the weight of the entire apparatus, we find that 10½ cwt. is the excess of lifting power arrived at. Occupants, freight and ballast to that extent could therefore be carried in M. Ménier's balloon.

Magnetic Condensation.

It is well known that a bar of soft iron, surrounded by an induction coil of wire, becomes magnetized on the passage of a current through the latter. Large magnets are frequently thus constructed; and in one capable of sustaining 330 lbs., M. Lallemand has noticed a curious condition. He states that, after allowing the above weight to be supported by the magnet, he removed all but 110 lbs., and then interrupted the current. The weight, however, remained supported, as it appeared, by residual magnetism in the iron. On removing the armature and weight, and then trying to replace the armature, it was found that the magnetism in the bar had disappeared and that there was not sufficient to hold the armature alone. *La Nature* mentions this as a new discovery, and suggests experimenting them. In this view our cotemporary is at fault, as a well known electrical expert informs us that, in using large magnets, he has repeatedly remarked the same phenomenon, and is, besides, under the impression that even a greater proportion than one third the weight can be sustained by the residual magnetism left in the bar. The explanation is doubtless to be found in the re-arrangement of the atoms of the iron under the influence of the current, a condition which, though of course not visible, can nevertheless be made to demonstrate its presence, as Professor Tyndall has shown, by a click at the establishment and interruption of the electric flow. The magnet and its armature and weight thus form a circuit, which may be likened to a band of steel held in annular form. The atoms retain their altered places even after the stoppage of the current; but the instant the continuity of the ring is broken, they return to their normal position, just as do the particles of steel when strain is removed.

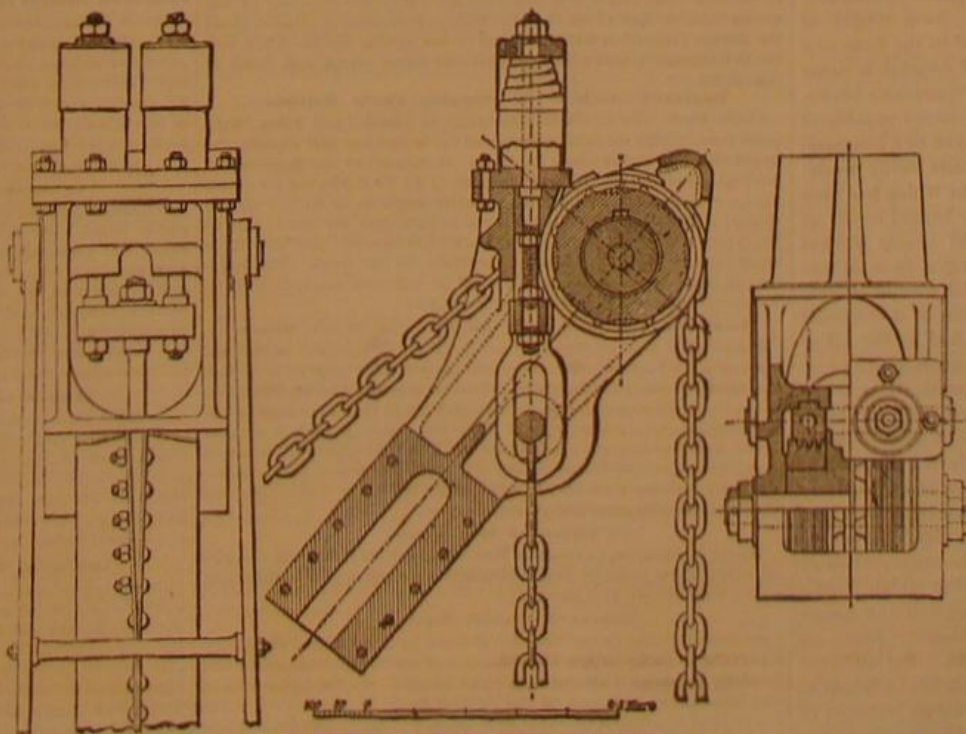
SAFETY CATCH FOR CRANES.

Accidents from overloading cranes frequently take place, as the weight of heavy masses is not always known; and men are apt to risk a catastrophe rather than stop work or wait for assistance. The Northwestern Railway of Austria has recently brought into use an appliance which prevents the machine being overtaxed, and makes it impossible to lift a weight heavier than that for which the crane is designed. The end of the lifting chain, instead of being fastened to a fixed link at the end of the jib, is attached to a link hung to a crossbar, at each end of which is a vertical bolt rising through a casting in the head of the jib, and carried by a pair of volute springs. The arrangement is clearly shown in the engraving. These bolts can be adjusted with the greatest nicety, and the strength of the spring is made to correspond with the maximum load that the crane is to lift. Fastened to each of the bolts is a triangular block, with a feather at the back, serving as a guide, and moving in a groove, and with a number of V grooves in the front or inclined side. The sheave, over which the chain passes, is indented to a pitch corresponding to that of the chain itself, and on either side, and being a part of it, it is formed with a number of V grooves corresponding to those in the blocks above mentioned. So long, therefore, as the



MÉNIER'S HOT AIR BALLOON.

boiling point, 212°, expands to the extent of 33 per cent beyond its original bulk. Assuming then the average temperature of the surrounding atmosphere up to a short distance from the earth's surface, say 300 yards, to be 50°, we should expel from the balloon, by heating it to 150° of heat, about 20 per cent. of its original contents. Now a globe of air 1 foot in diameter weighs as nearly as possible $\frac{1}{16}$ th of a pound; and as Ménier's balloon is very nearly spherical, its contents



SAFETY CATCH FOR CRANES.

side the burner with a loud roar, contin-

weights placed upon the crane do not exceed the set limit, these blocks are not moved, but if a heavier load is added, the springs are compressed, and the brake blocks, coming in contact with the sheave, lock this latter, and prevent all motion.—*Engineering.*

Pennsylvania Railway Regulations.

A new book of orders has been recently issued, which contains some rules which are worthy of notice and imitation, and which, if enforced, will certainly add much to the comfort of passengers. Among them are the following:

"Brakemen must announce the name of each station, and the length of stop when it exceeds two minutes. Baggage masters are prohibited from receiving perquisites for the care of articles. The order will go into operation as soon as possible.

"Newsboys on trains will not be permitted to individually importune or annoy passengers, but may announce in a low voice, or at intervals not exceeding four times in each car, the articles offered for sale. Nor will they be permitted to deposit their papers, books, etc., on the seats of the cars or in the laps of the passengers.

"Depot masters and assistants, passenger conductors, and brakemen and baggage masters must wear suitable badges.

"Passenger conductors must seat passengers and see to their comfort and enjoyment as much as possible, see that none stand on the platforms, or ride on baggage, mail, or express cars; put off passengers refusing to pay at the next station; not permit drunken and disorderly persons on trains, nor allow profanity.

"Baggage agents and masters must handle baggage carefully; the former to charge for extra weight invariably; the latter to carry only such packages, bundles, money, etc., as the Division Superintendent authorizes.

"No tickets must be sold to persons so intoxicated as to be incapable of taking care of themselves, or who, by reason of such condition, might risk their lives by traveling, nor to any one incapable of self care.

"Loungees are not permitted in telegraph offices.

"United States mail agents, express managers, sleeping car conductors, porters, news agents, and individuals running private cars are to be regarded and to consider themselves as employees, and to conform to these rules and regulations."

Some important changes have been made in the code of signals used. They are now as follows:

- "Red signifies danger, and says stop.
- "Green signifies caution, and says go slowly.
- "White says go on, all right.
- "Green and white is a signal to stop at flag stations.
- "Blue is a signal used by car inspectors.
- "One short blast of the whistle signifies apply the brakes.
- "Two long blasts, release the brakes.
- "Two short blasts, when running, are an answer to signal of conductor to stop at next station.
- "Three short blasts when standing mean the train or engine will back.
- "Four long blasts call in the flagman; four short blasts call for signals.
- "Two long followed by two short blasts, when running, are a signal on approaching a road crossing at grade.
- "A succession of short blasts is a cattle alarm. A blast of five seconds duration is a signal for approaching stations.
- "A lamp swung across the track means stop; raised and lowered vertically, go ahead; swung in a circle, come back.
- "The engine bell is always rung before starting a train, when passing or meeting trains, through tunnels or through streets; also, until each road crossing is passed."

An Eighty-Ton Gun.

The London Standard says: "It may not be generally known that the principle upon which all our guns are now made is that discovered by Colonel Fraser. Briefly, it consists of a series of coils, welded together in such a way that the grain of the iron is best opposed to the explosive force of the powder, and encircling a steel tube, the interior of which is rifled. A long bar of iron—say of eight inches square—previously prepared is slowly drawn from a furnace, to a length of about 300 feet, and wound in a double coil in the form of a cylinder. This is again heated and placed beneath a steam hammer, where it is welded together by tremendous blows, which so effectually do their work that a cylinder capable of bearing the greatest possible strain is formed at a comparatively trifling expense. Several of these coils being made, they are placed in order upon a long steel tube which has been made in Sheffield, and the weapon is finally turned out at an average cost of about \$300 a ton, as against nearly \$750 at Krupp's factory in Essen. Upon this principle, then, it was resolved to construct an eighty-ton gun, which should be able to pierce twenty inches of iron at a distance of a thousand yards, with a shot 1,600 pounds in weight, and by the aid of 300 pounds of powder. The length of this magnificent piece of artillery was fixed at twenty-seven feet, its diameter at the trunnion six feet, and at the muzzle sixteen inches, inside measurement. It was calculated that such a gun would be able to deliver its mischief-working missile at a distance of nearly ten miles, and that it would, at the same time, be easily placed in the turret of a war ship or the embrasure of a battery, and worked quickly and without difficulty. Of course there were many difficulties in the way of the construction of such a weapon. No steam hammer such as that which Krupp possesses at Essen was to be found in England; no forges were built large enough for such a tremendous heat; no cranes were in position to hoist such a weight. But all these difficulties were speedily overcome by the skillful officials at Woolwich. The forges were built, a huge steam hammer of forty tons weight, with double action arrangement and a

striking power of nearly 1,000 tons, was made, and very soon all was in readiness to begin the construction of the great gun. Curiously enough, His Majesty the Emperor of Russia was the first to see one of its coils welded, and since that time the work has been gradually going on, till now the steel tube, the breech piece, one coil, and the trunnion are finished; so that it is certain that by June next the gun will be ready for trial. It will then consist of the following parts: A tough steel tube inside, weighing nearly sixteen tons and measuring about twenty-four feet in length, a breech piece coil twelve feet in length, one central coil, another coil nearer to the muzzle, and the trunnion coil. The cascade through which the fire from the friction tube is communicated to the cartridge inside the gun is of steel, and immensely strong. Such is the weapon upon which hopes of a victory over twenty-inch armor plates are built. If it should succeed, three more will be made immediately, and the four pieces placed on board the Indefatigable, which will then be the most powerfully armed vessel in the world. Possibly, at the same time, some addition may be made to her armor, so that she may be as invulnerable as she is terrible."

The Sandy Hook Ordnance Experiments.

The tests of the smooth bore guns which have been converted into rifles, by the insertion of a grooved wrought iron or steel tube, are making favorable progress at Sandy Hook. The artillery and ordnance officers conducting the trials appear to be quite confident of the success of the plan, and assert that it will result in trebling the efficiency of the 2,000 smooth bore guns now in Government possession. The cost of conversion, per gun, is about \$500; and if for this moderate sum a weapon can be produced equal in power to the built-up rifles of England and Prussia (which in the former country cost \$5,000, and in the latter from \$8,000 to \$10,000) the advantages on the score of economy alone will be very considerable.

The eight inch rifle now being tested is being fired with charges of 35 lbs. of mammoth powder and 175 lbs. projectiles. The one hundredth round gives a pressure of gas in the bore of 35,000 lbs. per square inch, and an initial velocity of 1,420 feet. This gun was converted from a ten inch smooth bore. Further trials are to be made with the same weapon altered to a nine inch rifle, and fired with 40 and 50 lbs. of powder and a 225 or 250 lbs. projectile.

THE telegraph cable between Europe and Brazil was finally completed and opened on the 23d of June, 1874, and is working well. The line cables are 3,213 miles in length, and extend from Lisbon, Portugal, to St. Vincent, in the Madeira Islands, 1,260 miles, thence to Pernambuco, Brazil, 1,953 miles.

At a gold mine about a mile and a half east of Mount Monadnock, N. H., several assays of ore have been made. The quartz is said to vary from \$5 to \$840 per ton, or on an average not less than \$100 per ton. The ledge in which the gold is found covers thirty-two acres.

Recent American and Foreign Patents.

Improved Filter.

Richard L. Gentry, Richmond, Ky.—This is a filtering apparatus through which rain or other water is passed before being collected in the cistern or otherwise applied for use. It consists of an outer and inner chamber filled with filtering material, to which the water is admitted by a supply pipe passing through a perforated bottom of the outer chamber and side apertures of the inner chamber into the latter, rising therein until reaching the height of the central discharge pipe, from which it is carried to the cistern or other place. A perforated outlet hole of the discharge pipe, near the bottom of the inner chamber, drains the filtering material from the remaining water, while a screw spout of the outer chamber allows the cleansing of the filter from impurities.

Improved Mainspring.

James C. Edwards, Binghamton, N. Y.—This invention consists of the mainspring of a watch, clock, or other spring power, having the hole which receives the stud pin in the face of the barrel, arbor, or hub, for attaching it thereto, placed the distance of one circumference of the barrel or arbor from the end, and tapered from the hole to the end. The object is to graduate the rise of the next coil of the spring from the face of the barrel or hub on to the spring, so as to avoid the abrupt projection which the end of the spring forms when left the full thickness, and which produces an extra strain and bend at that point.

Improved Machine for Shaping Chair Bottoms.

Jacob Shuh, Berlin, Canada, assignor to himself and John Shuh, same place.—This machine is designed for hollowing and shaping the upper side of wooden chair bottoms. It comprises mechanism for holding the plank, of which the bottom is to be made, upside down over a rotary cutter, and gaging it to the cutter so as to cut to the required depth and shape, both on the bottom and the back, and at the same time feed it forward and backward laterally, and also from front to rear, so that one tool will perform all the work. The holding contrivances are adjusted for seats of different sizes, as well as for varying the depth and form of the hollow.

Improved Combined Step Ladder and Wash Bench.

Frederick S. Bidwell, Thompsonville, Conn.—The object of this invention is to improve the combined step ladder and wash bench patented February 3, 1874. This invention consists in the introduction of a supplementary brace frame pivoted to the lower part of the ladder-supporting frame, so that when the ladder is used as a wash bench and the supplementary frame set into the sockets of the latter part, the supporting frame, jointly with the shelf brace, forms diagonal braces for the wash bench, and stiffens the same more fully for the heavy weight generally placed thereon.

Improved Iron Fence.

Henry D. Stinson, Covington, Pa.—This fence is formed of a series of overlapping metallic rings, attached to central connecting bars, and secured below to a base sill.

Improved Pruning Implement.

Samuel J. Vance, Palmyra, Ill.—This is a pruning knife, which cuts the limbs or twigs by lever power exerted on the cutting knife and hook by the downward pulling of the handle. To the upper end of the handle, the rear end of the cutting knife is pivoted, while the front part is pivoted sidewise to a hook, having a slide guide plate and a guide band for sliding along the handle part.

Improved Litholyte.

Henry W. Bradford, Randolph, Mass.—The inner tube of the apparatus is arranged within another tube, which forms the confining tube for holding a bag, and springs within such compress as will admit of inserting both in the bladder and withdrawing them from it. Spring jaws have the edge of the mouth of the bag fastened to them, and are pivoted together at one end, and at the other end are connected to small steel rods between the tubes. These jaws are provided with mechanism so as to grasp the stone, and a small tube of platinum is inserted after the stone has been secured in the bag, for conducting nitric acid into it for dissolving the stone, so that it will flow out through the inner tube. The invention mainly consists of ingenious mechanism for governing the jaws, etc., to understand which a drawing would be requisite.

Improved Door Check.

Conrad W. Breidenbach, Dayton, O.—This consists of a stud, provided with a cushion for the door to strike against and having beneath a spring latch, which catches under the door and holds the same.

Improved Shutter Fastening.

Josephine S. Keator, Kingston, N. Y.—This consists of an angular hook, which is held in position by the window sash, and which engages with the staple of the blind. The butt end is turned to form a right angle, and a lip projects upward from said portion and bears against the sash when an effort is made to unfasten the blind from the outside. The lower rail of the sash bears against the lip.

Improved Steam Fountain Washer.

Henry R. Robbins, Baltimore, Md.—This invention relates to means whereby the steam boilers of hotels, laundries, and other buildings may be readily utilized for washing purposes, thereby greatly economizing fuel, and lessening the cost of washing over ordinary methods of specially generating steam for each tub or vessel.

Improved Handle and Covering for Burial Cases.

William S. Wood, Newtown, N. Y.—This handle is attached to rounded or angled corners of the lid, so that there will be two handles at each end, and so that thus the lid can readily be lifted and adjusted by two persons. The same inventor has also patented an improved process for covering metallic burial cases. The shells and the caps of the casket are submerged in a vat of melted beeswax, and while the wax is warm the cloth or velvet is put on and rubbed or pressed to the waxed surface.

Improved Carpet Stretcher.

John Niver, Sherman, N. Y.—The invention consists of three parts, a stretching bar, having a series of hooks and a perforated flange on its under side, a standard for supporting it, and a detachable brace rod, which connects them, and is made adjustable. The construction of said parts is such that the stretching bar may be used to stretch the carpet in two opposite directions from the point where the standard is located.

Improved Machine for Trimming Keys of Musical Instruments.

Milton Pratt, Deep River, Conn., assignor to himself and Pratt, Read & Co., same place.—This is a machine for trimming off the wood remaining on the keys after the pieces commonly known as "sharps" are removed. The keyboard is moved along under a cutter, and the spaces between the keys are cut on a bevel down to the ivory. The cutter is actuated by means of a treadle applied to the pitman. By means of a gage screw, the cutter is made to stop when it cuts through the wood, so that the ivory is not injured.

Improved Coupling Rod.

John Way and Alvan S. Hoffman, Napanock, N. Y.—This consists mainly of a weight attached, by an arm, to the coupling rod, and in the mode of supporting the weight before coupling. The arm is held up by the friction produced by a spring; but when the weight is raised, and the coupling rod is set for coupling, the pressure of the spring on the arm is reduced by a catch, which holds the spring out from the hanger, so that a slight concussion releases it, and allows the weight to drop and turn the coupling rod.

Improved Lamp Stove.

John W. Schreiber, New York city.—This invention relates to the construction of lamp stoves, in which a lamp or burner, already patented by the same inventor, is employed. The bottom of the fire box is perforated, and beneath are a series of wires. Beneath the wires is an annular plate with holes, which are arranged directly below the holes in the bottom. There is a space beneath this annular plate and the bottom through which air is furnished to the burner, the bottom of which burner is perforated. The bottom of the fire box, the wires, and the annular plate are arranged in two separate parts, one part being stationary and forming the greater portion of a circle, and the other part being attached to the door. When the door is closed, the two parts form a complete circle. The annular plate has a narrow flange on its outer edge, which prevents the air from escaping outward.

Improved Cone for Smoke Stacks.

James Hughes, Scranton, Pa.—The object of this invention is to break the striking force of the products of combustion before they reach the reticulated cover of the bonnet; and it consists in placing under the cover, and directly over the top of the smoke pipe, a concave spiral plate, which will readily allow the products of combustion to pass through the center and between the convolutions, but will cause all to strike the plate at some point.

Improved Process for Restoring and Purifying Caustic Alkali.

David Hanna, Jersey City, assignor to Henry C. Ohlen, Madison, N. J.—The lye is gathered in iron tanks and agitated to throw off the gaseous residuum it retains from the oils. After filtering, it is run into evaporating pans, where it is kept boiling till reduced to 30° or 40° gravity, and is then drawn off into settling tanks, and a quantity of finely pulverized quicklime added; also a little ammonia is sprinkled over the top. After standing a few days, the alkali is drawn off and put up in packages.

Improved Sewing Machine Table.

William Whitworth, Cleveland, Ohio.—The middle piece is of soft cheap wood. The side pieces and the end piece are of walnut or other fine and expensive wood. The soft wood portion is arranged with the grain running crosswise of the table, and it will be tongued and grooved to the side and end pieces, and these pieces will be framed together at the ends in any approved way. The veneer will be glued on in the ordinary way. The table thus constructed will not shrink, nor swell, nor warp by atmospheric influences, and will have the appearance of a table of solid fine wood.

Improved Detachable Horseshoe Calk.

Bushrod O. Bradford, Pittsburgh, Pa.—This horseshoe calk has a rear aperture and horizontal lips, the lower preferably a little longer than the upper, and somewhat thicker. These lips embrace the body. A bolt is passed diagonally from the highest point of the calk through the body and lip. The lip, being comparatively thin, will not be objectionable, while the rivet or pin is out of the way of the hoof, and is yet made to take a good hold upon the shoe.

Improved Traveling Bag Retaining Device.

David L. Holbrook, Sing Sing, N. Y.—This invention consists in an improved traveling bag fastener formed of an angle plate, provided with a bent arm with a chain and a link or ring. In using the device, the chain is passed around the arm of the car seat, or around any other object to which the bag is to be secured. The angle plate is then passed through the ring, and placed within the traveling bag. The jaws or frame of the traveling bag are then closed upon the arm and the bag locked. With this fastening, the bag cannot be removed without first unlocking it.

Business and Personal.

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

Agricultural Implements, Farm Machinery, Seeds, Fertilizers. R. H. Allen & Co., 199 & 191 Water St., N. Y.
Wanted—A Mechanical Draughtsman. Address P. F. Benck & Co., Printing Press Manufacturers, Canton, Ohio.

Right for Sale—Useful in every family. Samples by mail, 25c. T. S. Macomber, Hamilton, N. Y.

Notice—500 Agents wanted. New articles of merit for housekeepers—used every day, or 1000 hundred times a year. G. J. Capewell, Cheshire, Conn.

Wanted—Responsible parties to take the General Agency of States for the Improved Horse Detacher. For particulars, address Philip & Mayer, 38 Reed St., Milwaukee, Wis.

Wanted—Address of Manufacturers of Calenders or Machines for finishing dyed goods. O. G. Morse, Binghamton, N. Y.

John W. Hill, Mechanical Engineer, Dayton, Ohio, Drawings, opinions, and advice.

Small Electric Engines, with battery complete, 44. Without battery, 44. Electro-Magnetic M.T.G. Co., 36 Broad St., P. O. Box 1804, New York.

The Mystic Puzzle, or the Yankee's Dream, sent by Mail. Address, with 25 cts., P. & J. Barnes, Rockford, Ill.

For full description of the most useful and amusing article in the world, for a present, address, with stamp, W. F. & J. Barnes, Rockford, Ill.

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Hand Fire Engines, Lift and Force Pumps for fire and all other purposes. Address Ramsey & Co., Seneca Falls, N. Y., U. S. A.

Dickinson's Patent Shaped Diamond Carbon Points and adjustable holder for working Stone, dressing Emery Wheels, Grinding Stones, &c., 64 Nassau St., N. Y.

Engines, 2 to 8 H. P. N. Twiss, New Haven, Conn. Matson's Combination Governor, sold under full guarantee. Address Matson Bros., Moline, Ill.

Steam and Water Gauge and Gauge Cocks Combined, requiring only two holes in the boiler, used by all boiler makers who have seen it. T. Holland & Co., 62 & 64 Gold St., New York. Send for catalogue.

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Engines and Boilers a Specialty—1st class; new patterns; late patents; reduced prices. Plain and Cut-off Horizontal and Vertical Engines; Hoisting Engines; the celebrated Ames' Portable Engines; Boilers of all kinds; Climax Turbine; and the best Saw Mill in the market. Large stock always on hand. Hampson, Whitehill & Co., 35 Cortlandt St., New York. Works at Newburgh, N. Y.

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Mechanical Expert in Patent Cases. T. D. Stetson, 23 Murray St., New York.

Tingue, House & Co., 66 Duane St., N. Y., Manufacturers of Machine Blanketing, Felts, and Cloths. Endless or in piece, for Printers, Engravers, Polishers, Piano Forte makers, Paper Makers, Calico Printers, Punching or Washer Cloth, Filter and Strainer Cloths for all kinds of liquids. Sample sent on application.

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Deane's Patent Steam Pump—for all purposes—Strictly first class and reliable. Send for circular. W. L. Chase & Co., 93 & 97 Liberty St., New York.

Brown's Coal Yard Quarry and Contractor's Apparatus for hoisting and conveying materials by iron cable. W. D. Andrews & Bro., 44 Water St., New York.

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Best Philadelphia Oak Belting & Monitor stitched. C. W. Army, Manufacturer, 301 & 303 Cherry St., Philadelphia, Pa. Send for new circular.

Buy Boulton's Patenting, Moulding, and Dove-tailing Machine. Send for circular and sample of work. B. C. Mach'y Co., Battle Creek, Mich., Box 22.

For First Class Steam Boilers, address Lambertville Iron Works, Lambertville, N. J.

The Patentee of the U. S. Patent Autographic Safety Incisions for prevention of alteration of Checks, Drafts, Notes, Due Bills, &c., approved and commended by the Banks, is desirous of a party with Capital to introduce the same. Full preparations already made for the Manufacture of the Instruments. Address E. J. Fischer, 313 N. 10th St., Philadelphia, Pa.

Wanted for all Steam Boilers—A great economizer for Fuel. Send for Circular. George E. Parker, Man'fr of Light Machine Work and Brass Founder, 117 & 119 Mulberry St., Newark, N. J.



C. J. A. can repair his rubber boots by following the directions on p. 233, vol. 30.—E. A. A. can Japan iron castings by the process described on p. 298, vol. 29. Bronzing is detailed on p. 298, vol. 29.—M. can remove fruit and wine stains from table linen by the process explained on p. 171, vol. 30.—A. F. can repair his glue kettle with the cement described on p. 42, vol. 25.—A. E. S. will find a recipe for paste for paper labels on tin on p. 235, vol. 30.—W. H. P. does not send his name and address.—F. H. B. will find directions for making modeling wax on p. 58, vol. 24.—E. will find that Colburn's books on the locomotive engine are complete and authentic.

(1) P. asks: If two horses are drawing 1 tun with a four foot double tree, and one of them be given his end shorter by 1 inch, what would be the apportionment of the draft to the horse with the shorter end of the double tree? What would be the proportion if his end were two inches shorter? A. This case is analogous to that of two men carrying a weight suspended from a pole, the force exerted by each being inversely proportional to the length of lever between the hand and weight.

(2) H. P. asks: Does color exert any influence on the heat-radiating powers of bodies, boilers, etc., being usually painted black in preference to any lighter color? A. According to Melloni, color exerts no influence upon the radiant power of surfaces, white, black, and red radiating alike; so that, as regards the loss of heat from this source, the color of a substance is of no importance. On the contrary, color powerfully influences the absorption of luminous heat. Dr. Franklin spread differently colored pieces of cloth upon the snow in the sunshine. The black sunk farthest, that is, melted the most snow, and of course received the most heat. The blue sank to a less depth, the brown still less, and the white hardly at all. Hence by scattering soot over snow, its melting may be hastened.

(3) E. M. W. asks: Has anything been discovered that will harden gutta percha as sulphur hardens rubber? A. We believe not.

(4) A. M. asks: How can I construct a battery strong enough to charge a horseshoe magnet 12 inches long, with an electromagnet 5 inches long made out of 3/4 iron, wound with 800 feet of No. 22 wire? A. A Bunsen battery would be the best for the purpose, and your cheapest plan would be to buy it from the regular dealers in the article.

(5) L. P. asks: Is white a color? A. If the separate colors of the spectrum are considered each as an element, white light is a compound, formed by perfectly blending together all these elements, and cannot, therefore, be properly termed a color.

(6) G. C. J. asks: 1. How long does it take to transmit one word across the ocean by cable? A. About one minute, although it is constantly varying. 2. What is the charge per word? A. To England, the charge per word is \$1, gold.

(7) W. L. C. asks: How can I preserve the color of fasciated evergreen leaves, and prevent them from falling from the branch? A. Try dipping in pure dammar varnish.

(8) P. E. W. says: I wish to make brick out of the clay dredged from a channel at a seaport. The salt causes the bricks to glaze, and makes them worthless. How can the difficulty be obviated? A. To our knowledge, there is nothing that would accomplish this.

(9) F. R. R. says: I have a large glass globe, mounted on a pedestal of the same material. In the former, near its junction with the latter, is a fracture extending around two thirds of its circumference at that point. Can you tell me of a composition with which I may cement the interior of the globe, so as to strengthen it at the fractured point, have no deleterious effect upon the water contained therein, and at the same time prevent leakage? A. Try diamond cement.

(10) M. C. asks: 1. Can you give me a good recipe for soft soap, made with potash and domestic grease? A. Add 3 galls. rain or other soft water to 1 lb. of concentrated ley; boil it and put into it 4 lbs. tallow and soap fat. When the solution becomes clear, add 12 galls. more water. It is ready for use when cold. 2. Is a cellar a good place to keep it in? A. Yes. 3. Would freezing hurt it? A. Very probably. 4. Does the addition of salt to soft soap (to make hard soap) injure its quality? A. Yes.

(11) G. W. D. asks: What kind of varnish can I put on metal, so that the latter will not be injured when coming in contact with a solution of nitrate of silver? A. Try paraffin varnish. See p. 91, vol. 31.

(12) J. A. asks: Is there any elastic substance that would take the place of rubber in cloth, and resist boiling water? A. We do not know of any such substance.

(13) P. V. C. asks: Please give me a description of the spectroscope. A. You will find descriptions on pp. 64 and 276, vol. 30.

Can iron be decomposed by any acid, and will its decomposition generate electricity? A. Iron, being an elementary body, cannot be decomposed; but with strong nitric acid, it may be used as the positive element in the battery.

(14) S. A. asks: Is there any means whereby the color may be taken from the heavy black residue or tar left in the still after running the burning oils off from the crude petroleum, at the same time letting it retain its former body or consistency? A. This cannot be done without altering some of its properties.

(15) H. P. G. asks: 1. What will effectually disguise the smell of ammonia? A. The smell of free ammonia, that is, ammonia not in combination, cannot be disguised nor destroyed; but by combining it with a base, not volatile at ordinary temperatures, this may readily be accomplished. 2. What will prevent alcohol from evaporating? A. We know of no better method than that of keeping it in airtight vessels.

(16) H. C. J. asks: What book explains the terms marcasite, blende, muscovite, blende, etc.? A. If you do not possess a dictionary, we cannot help you, since a certain amount of knowledge must be possessed by all readers of scientific publications. You can find full definitions of the names of these minerals in Webster's "Unabridged Dictionary."

Can you explain scientifically the operation of salt raising bread? A. Your meaning is not very clear. Raising salts or yeast powders commonly consist of such salts as cream of tartar (bitartrate of potash) and bicarbonate of soda. The leavening is due to the action of the liberated tartaric acid on the soda salt, which liberates the carbonic acid.

(17) W. E. J. asks: What kind of battery is required to operate the Atlantic cable? A. A modification of the Daniell battery, called the Minotto or sawdust battery, is employed for the purpose, twenty cells being used.

(18) J. C. C. asks: 1. What should be the temper of the steel in a permanent U magnet? A. See p. 175, vol. 30. 2. Which will magnetize a U magnet the better, a helix in two parts, one for each leg of the magnet, or a single coil? A. The latter.

There is a law in Ohio imposing a fine or imprisonment upon any person who sells, or offers for sale, a patent in any county without having first exhibited the letters patent to the probate judge of the county wherein the patent is sold or offered for sale, and having made oath, in his presence, of ownership, name, and place of residence. Is such a law constitutional? A. No. See p. 137, vol. 25.

(19) G. H. J. asks: How is black paint for steam boilers made? A. Common asphalt dissolved in turpentine is a very good paint for this purpose.

What is Venice turpentine? A. Turpentine prepared from the sap of the large *Europa*, or larch.

What is the theory of a draft in a chimney when there is no hot air to produce a draft? A. Unless there is a difference of temperature, between the air within and the air without the chimney, there is no draft.

(20) S. W. says: When our nickel five cent pieces were issued, it was reported in newspapers that their diameter was a certain number of centimeters, so that the measures of the French metric system might be derived from them. Is this true? A. The diameter of our five cent nickel coin is two centimeters.

How shall I rid my house of roaches? A. There are several good preparations for this purpose for sale by druggists and others, than which we can recommend nothing better.

In making a chess board by gluing veneers upon a board, the veneers curled up as soon as wet with the glue. How can I get over the difficulty? A. It is common, on applying the thin glue to such veneers, to moisten the opposite side with warm water.

(21) W. D. P. K. asks: Is there any chemical that, placed on or near a gas jet, will increase the luminosity? A. A device, used for this purpose, consists of a jet placed at the side of the gas burner, through which a supply of oxygen is allowed to escape.

Is there anything that I can take with me in a boat to keep me warm on a cold day? A. It is customary to use for this purpose, a watertight vessel, previously filled with boiling water.

(22) J. B. T. says: We have a drug store in a wooden building, and are using kerosene, as we have no gas. We are always uneasy for fear of fire. Would it cost very much more to light the store by electricity? A. Yes. An electromotive force equal to forty Grove cells is the least that a suitable light could be produced with, and this would cost at least \$1 per hour for one light sufficient for the store.

(23) L. F. R. asks: Can a Bunsen or a bi-chromate of potassa battery be changed to a Leclanché, simply by using the proper chemicals? A. Yes.

How are round balls of soap formed? A. They are cast or pressed in molds.

Please describe the manner of finding the latitude on board ship. A. The latitude is equal to the zenith's distance plus or minus the declination for the day. The latter is found by referring to the *Nautical Almanac*.

What is made of chromate of iron? A. Chromic acid.

(24) C. T., writing from Valley Falls, N. Y. says: A controversy has arisen in our community caused by the bursting of a flume, and we appeal to you to settle the question. All parties are agreed to abide by your decision. What is the difference between the side pressure of a flume of water ten feet deep and twenty feet square, and one ten feet deep and ten feet square? A. The pressure per square foot upon the sides of the flume is the same in both cases, namely, 312 1/2 lbs. per square foot. To compute the pressure in such cases, multiply the area of the side of the flume by the height of the center of gravity of the water in feet. In this example the height of the center of gravity is 5 feet. Multiply the product by 62 1/2 lbs., the weight of a cubic foot of water.

(25) J. S. H. says: On 203, vol. 31, you gave directions for making a phosphorescent lamp. I tried it, but the phosphorus would not dissolve in the oil. What shall I do? A. Phosphorus should dissolve in the oil. If you follow the recipe and your phosphorus and oil are pure, the process will not fail. Enough phosphorus should be used to keep the oil saturated.

(26) E. H. asks: 1. Does a large body of liquid require a greater proportion of battery power than a smaller one? I have a copper bath 2 feet long containing about 20 gallons, which I can drive with 4 Callaud batteries, the zincs of which are 5 1/2 inches in diameter, or with 3 small Bunsen batteries, and I have another copper bath 6 feet long, holding about 80 gallons, which I cannot drive with 14 Callaud batteries. If I put more goods in the large one than in the small one, the deposit is very slow, and soon ceases. Is nickel more easily deposited than copper, and does it require greater or less power than a copper bath of equal size, filled with the same amount of goods? A. So much depends upon the relative distance between your electrodes, the strength of your bath or electrolyte, and the coupling or arrangement of your batteries, as to the requisite quantity and tension of current, that, with so limited a description, we can give you no definite answer. 2. What is the relative power of Daniell's, Callaud's, and Smee's batteries? A. The electromotive force of a Grove being 100, Bunsen's is 98, Daniell's 86, Smee's about 25, Callaud's about 45.

(27) W. P. asks: In adding the malt or diastase to a mashing of raw grain (which action is supposed to first convert the raw grain into starch, then, after standing a proper time at a certain temperature, to transform the starch into grape or starch sugar), how am I to know when the starch sugar is formed? A. The boiling of the starch with dilute sulphuric acid is effected on a small scale in leaden pans, but in an extensive preparation iron pans are employed. The requisite quantity of water is first heated to the boiling point, and to this is added the sulphuric acid, diluted with about 3 parts by weight of water. The starch is also brought, by the previous addition of water, to a milky consistency. The liquids so prepared are mixed, and the boiling continued until all the starch is converted into sugar. An intermediate stage, not usually noticed by the manufacturer, is the conversion of the starch into dextrin, which in turn suffers decomposition into grape sugar. The entire conversion of the dextrin into grape sugar cannot be ascertained with certainty by the iodine test, as sometimes a purple-red tinge is produced, while in others there is no change. The most reliable test is that with alcohol, founded on the known insolubility in that menstruum. To one part of the solution to be tested there are added 6 parts of absolute alcohol; if no precipitate is thrown down, there is no dextrin remaining, and the conversion has been entire. The proportions of the materials are generally, to 225 lbs. of starch meal, 8 lbs. of ordinary sulphuric acid at 60° Baumé and 75 to 100 gallons of water. The separation of the sulphuric acid from the sugar solution is a most important operation, for the color, purity, and flavor all depend upon success in this stage of the process. The acid is neutralized by baryta or by lime, with either of which it forms an insoluble salt. The baryta can be employed as carbonate (with lime). Lime is most generally used, for its greater cheapness.

(28) I. F. A. asks: What is the best paint or coating to resist the action of sulphuric acid, to be applied to the inside of an open vessel? A. The best covering for the inside of tanks, etc., to hold sulphuric acid is sheet lead. This will perfectly resist all action.

(29) S. E. M. says, in reply to J. E. W., who asked how to burn coal slack: We use it all the time in our boiler, starting the fire with soft coal, and then using half soft coal, mixed with slack. Our draft is not very good. In one place they think they cannot burn this mixture, without wetting it and then draining well before burning. I have tried this, but failed to see any good results. If J. E. W. will fire often and break up the crust that forms on top, he will have no trouble in using this mixture. I have put in steam blowers above and below the fire, but was glad to take them out again, because they took too much steam.

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

C.I.P.—Your specimen of a Californian mineral is disintegrated mica schist, of no value.—J. P. L.—Your specimen is antimony.—I. P. D.—The quartz contains galena and iron pyrites.

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 Freak of Lightning. By E. J. M.
On Capital and Labor. By H. E. G. J.
On the Phylloxera. By L. W. G.
On the Squirrel Question. By L. M. B.
On Curious Apples. By A. T. N.
On Terrestrial Gyration. By J. H.
On Power in Cotton Mills. By T. T. D.
On the Business Outlook. By J.

Also enquiries and answers from the following:
H. R. S.—C. E. S.—E. J. G.—J. R. B.—W. T. B.—T. C.—J. R. V.—J. G.

HINTS TO CORRESPONDENTS.

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

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

Hundreds of enquiries analogous to the following are sent: "Who sells machines for hulling castor beans? Who sells cotton seed lint machines? Who makes match making machines, and what composition is required for the matches? Whose is the best force pump?" 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.]

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November 10, 1874.

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Window shade or Venetian blind, F. C. Martin..... 156,644

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:

31,378.—HARVESTER.—H. Dutton. Jan. 27.
31,391.—POTTERY MOLDER.—W. Linton. Jan. 27.
31,402.—GRAIN BINDER.—S. Reynolds. Jan. 27.
31,411.—LAMP.—C. W. Cahoon. Feb. 3.

DESIGNS PATENTED.

7,845.—FLOOR CLOTH.—J. Barrett, New York city.
7,849.—BOXES.—J. Comly, Philadelphia, Pa.
7,850.—CLOCK FRONT.—S. B. Terry, Waterbury, Conn.
7,851 to 7,853.—WOVEN FABRICS.—W. B. Weeden, Prov., R. I.
7,854.—CENTER PIECE.—H. Berger, New York city.

TRADE MARKS REGISTERED.

2,005.—RYE WHISKY.—T. G. Carroll, Baltimore, Md.
2,001.—DESICCATED VEGETABLES.—A. Goddard, N. Y. city.
2,002 & 2,003.—GRAIN BAGS.—Graham & Co., Rockford, Ill.
2,004.—COTTON RALE TIES.—C. G. Johnson, N. Orleans, La.
2,005.—CORN SALVE.—J. H. Richelderfer, Philadelphia, Pa.
2,006.—MUSTARD.—C. L. Stickney, New York city.
2,007 to 2,009.—FLOWER.—Thornton & Chester, Buffalo, N. Y.
2,017.—SPICES, ETC.—Welkel & Smith Co., Philadelphia, Pa.

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 filing a Disclaimer..... \$10
On an application for Design (3 1/2 years)..... \$10
On application for Design (7 years)..... \$15
On application for Design (14 years)..... \$30

CANADIAN PATENTS.

LIST OF PATENTS GRANTED IN CANADA,
NOVEMBER 17 to 18, 1874.

4,054.—D. Sullivan, Bangor, Penobscot county, Me., U. S. Improvements in steam boilers, called "Sullivan's Improved Steam Boiler." Nov. 17, 1874.
4,055.—F. A. Hibbard, East Stanbridge, Missisquoi county, Vt., U. S. Improvements in steamers and heaters, called "The Safety Combination Steamer and Heater." Nov. 17, 1874.
4,056.—A. De Garis, New York city, U. S. Improvements in apparatus for fattening fowls, called "Garis' Improved Fowl Fattening Apparatus." Nov. 17, 1874.
4,057.—E. B. Meystard, Geneva Lake, Walworth county, Wis., U. S. Improvements in elastic railway car wheels, called "Meystard's Patent Elastic Railway Car Wheels." Nov. 17, 1874.
4,058.—J. Bowman, Harrisburgh, Brant county, Ont. Improvements in hot air drums, called "Bowman's Revolving Angle Damper Parlor Heater." Nov. 17, 1874.
4,059.—J. M. Grover, Oxford, Oakland county, Mich., U. S. Improvements on a straw-binding attachment to harvesters, called "Grover's Grain Binder." Nov. 17, 1874.
4,060.—S. Rue, Philadelphia, Pa., U. S. First extension of No. 2,849, called "Rue's Little Giant Injector." Nov. 17, 1874.
4,061.—S. Rue, Philadelphia, Pa., U. S. Second extension of No. 2,849, called "Rue's Little Giant Injector." Nov. 18, 1874.
4,062.—E. S. Scripture, Brooklyn, Kings county, N. Y., U. S. Improvements on adjustable wrenches, called "Scripture's Champion Cast Steel Adjustable Slide Wrench." Nov. 18, 1874.
4,063.—J. E. Watson, Louisville, Jefferson county, Ky., U. S. Improvements on water gages, called "Watson's High and Low Water Alarm Gages." Nov. 18, 1874.
4,064.—A. Hadden, Goderich, Huron county, Ont. Machine for cramping, called "The Cramping Horse." Nov. 18, 1874.
4,065.—T. M. Chapman, Oldtown, Penobscot county, Me., U. S. Improvements on machine for sharpening saws, called "Chapman's Saw Sharpening Machine." Nov. 18, 1874.
4,066.—H. E. Champion, Detroit city, U. S. Improvements on steam boiler furnaces, called "Champion's Improvement in Boiler Furnaces." Nov. 18, 1874.
4,067.—T. Branigan, Beloit, Rock county, Wis., U. S. Improvements on a boot tree, or a device for treating boots, called "Branigan's Champion Boot Tree." Nov. 18, 1874.
4,068.—A. W. Covell, South Elmsley township, united counties of Leeds and Grenville, Ont. Improvements on saw sharpeners, called "Covell's Saw Sharpeners." Nov. 18, 1874.
4,069.—J. Steel and J. McInnes, Glasgow, Lanark county, Scotland. Improvements on apparatus for actuating the brakes of railway trains by compressed air, part or parts of which are also applicable for signaling in railway trains, called "Steel & McInnes' Improved Air Brake and Train Signal." Nov. 18, 1874.
4,070.—C. F. Murdock, Detroit city, Mich., U. S. Improvements in stop valves, called "Murdock's Champion Stop Valve." Nov. 18, 1874.

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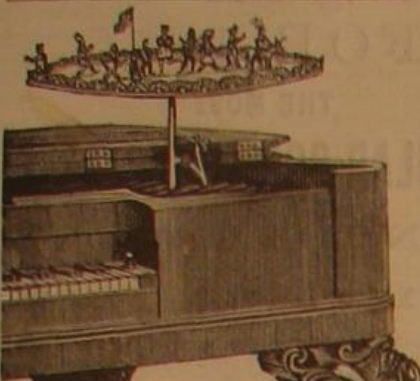
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SCIENTIFIC AMERICAN

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

Vol. XXXI.—No. 25.
[NEW SERIES.]

NEW YORK, DECEMBER 19, 1874.

\$3 per Annum,
[With Postage, \$3.20.]

THE WHITWORTH INDUSTRIAL SCHOLARSHIPS.

In publishing on this page a portrait of Sir Joseph Whitworth, a mechanic whose skill is known and valued wherever industrial knowledge has penetrated, we desire, not only to do honor to a master of his craft, but also to call attention to his liberal bestowal of a portion of his wealth to found scholarships to enable rising artisans to pursue their studies, and to the terms of the gift, which are commendable for their practical value to all who intend to employ their means for like noble purposes.

The rapid strides made by France, Germany, and other continental nations in the mechanical arts have forced the importance of technical education upon other people, and the English have recently made arrangements on the largest scale for embodying practical studies in the scheme of the common school curriculum. Sir Joseph Whitworth has taken the lead by presenting \$500,000 to be disposed of as follows:

The interest (at 3 per cent, \$15,000 annually) to be divided into 30 stipends of \$500 per annum, to be awarded to young men, natives of the United Kingdom, selected by open competition for their intelligence and proficiency in the theory and practice of mechanics and its cognate sciences. Each successful competitor is to receive the stipend for three years.

The liberal donor further proposed that as much latitude as possible should be allowed to each successful competitor, in reference to the natural bent of his inclination. If he wished to complete his general education instead of continuing his special scientific study, he might be permitted to do so; he might go to the universities or colleges affording scientific or technical instruction; or he might travel abroad. "The successful artisan should be encouraged to study theory; while the successful competitor in the theory should be aided in getting admission to machine shops and other practical establishments."

Competition was proposed to be in mathematics, elementary and higher; mechanics, theoretical and applied; practical plane and descriptive geometry; mechanical and freehand drawing; physics; chemistry, including metallurgy; and such handicraft processes as smith's work, turning, filing, fitting, pattern-making, and molding. Sir Joseph proposed that theory and practice should be placed on a level, by an equality in the maximum number of marks for the two classes of merit—*theoretical science and practical skill*. This he did to render the competition accessible on fairly equal terms to the student who combines some practice with theory, and to the artisan who combines some theoretical knowledge with excellence of workmanship.

Sir Joseph, having promulgated his ideas in May, 1869, saw the desirability of encouraging competitors by giving them twelve months' opportunity of improving themselves. To this end he established sixty exhibitions or premiums of \$125 each, to be held for one year; these were awarded to youths

and young men under twenty-two years of age, who were required to undertake to compete for the more valuable \$500 scholarships in May, 1869. In order to render these exhibitions as widely available as possible, they were placed at the disposal of a large number of educational bodies, including the universities of Oxford, Cambridge, London, Dublin, Edinburgh and Glasgow, and other colleges and schools.

The public value of this liberality is shown by the fact that in 1869, out of 106 candidates, only 10 reached the standard of knowledge set up as a necessary qualification, but the average acquirements of the youths have been steadily improving. The stipends, useful to the workmen for whom

to square up an octagonal block of wood, using the ax only, and to make the square as large as possible. He was also required to shape an ax haft to a given pattern, by means of an ax and spokeshave. The saw and plane: The competitor had to saw out of a piece of plank two square strips, and plane them up smooth and true; also to make two parallel strips 2 feet long, 2 inches wide, and $\frac{3}{8}$ inch thick. The hammer and chisel: The competitor had to chip a piece of cast iron all over the upper surface, leaving it as smooth as possible from chisel marks. The file: The competitor had to square any two adjacent sides of a cast iron tube, with a succession of 9 inch strokes of the file; also to file up an hexagonal nut on its six

sides to match a pattern.

The forge: The competitor had to weld together two pieces of square iron, using only a hand hammer; also to make the two halves of a pair of tongs from pieces of round iron. Turning: The competitor had to bore out a bevel wheel to $1\frac{1}{4}$ inches in the hole, using two drills and a punching bit; also to turn a piece of round iron to serve as a mandril, face it on the wheel with a mandril press, and turn and scrape it smooth and clean on the back, face, and teeth. Fitting: The competitor had to key a boss upon a short shaft, cutting a key way $\frac{1}{8}$ inch square, setting the key half into the shaft and half into the boss; to fill up the key and fit it well in; and to make the end of the shaft project 1 inch through the boss, to support the head of the key. Pattern-making: The competitor had to make a pattern of a short piece of iron girder, finished up ready for use in the foundry, including the core box for the two bolt holes in the flanges of the girder. The handicraftsman who could achieve these tasks moderately well could hold his own in any machine shop or engineering establishment of average character.

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Lord Kinnaird, a large and enterprising farmer of Scotland, writes to Mr. Mechi that he has had a most successful and satisfactory trial of reaping by steam power. He attached his trac-

tion engine to an enlarged reaping machine; and though the ground was soft, owing to wet weather, and the crop laid and leveled so that it could only be cut one way, yet he has no doubt that, in ordinary dry, harvest weather, an acre could be cut down within half an hour, and he confidently expects to be able not only to cut but, by the aid of steam power, to bind up the cut grain in sheaves, and thus gather in the crops—employing only some half dozen hands.

IMPROVED STUCCO.—M. Landrin recommends the mixing of the crude plaster in water containing 8 to 10 per cent of sulphuric acid. After allowing the compound to rest for fifteen minutes, he calcines the plaster. This gives a stucco of excellent quality in which all organic matters are burnt out leaving the material of exceptional whiteness.



SIR JOSEPH WHITWORTH.

they were intended, have been coveted as distinctions by persons whose means were ample, so that an indispensable condition of two years' previous service in a machine shop has been imposed.

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PUBLISHERS' CARD.

With the next issue, the time for which a large number of our subscribers have prepaid, will expire. In order that our readers may experience no stoppage in the receipt of the journal, and that we may not miscalculate the quantity of the paper to print at the commencement of a new volume, we hope our friends will signify their intention to continue the paper by early remittances.

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THE PATENT OFFICE AGAIN.

We last week reviewed some of the errors which had crept into the administration of the Patent Office. We shall now refer to others which are embodied in the statute. Both these classes of errors have sprung mainly from the same source, and are alike prejudicial to the inventor.

The act of July 8, 1870, which was a revision of all our patent laws, corrected or removed some of the defects which previously existed, but it introduced more mischiefs than it cured. Its chief changes interposed needless and unreasonable obstacles in the way of the inventor.

For instance, nothing is more important to him than the right to amend his patent through a reissue. Rarely does a patent, as first obtained, embody the invention in a fully available shape, and often is its real gist mistaken altogether. The common law authorized amendments by means of a surrender and reissue, and the statute regulated and rendered more definite the rights of the patentee in this respect. The great purpose, in both cases, was to limit the new patent to the real original invention, giving the full benefit thereof to the inventor, but nothing more.

To guard against abuse and to prevent a patentee from en-

larging the scope of his patent, or from wringing in a new subject matter through a reissue, the courts have—rather severely—held that oral proof of the full scope of the original invention was inadmissible, and that nothing could be claimed in the reissued patent unless either the model, the drawings, or the specification—as originally filed—showed the invention thereof.

The new law has taken a most indefensible step in farther limitation of a previously existing right, by rendering the most reliable of record evidence wholly incompetent in such cases. The model or drawings may still be called as witnesses, but not the specification. No matter how fully or how clearly the invention may be set forth in the latter, still, in cases where there are drawings, nothing can be claimed in a reissue which is not shown in those drawings or in the model. A credibility is thus given to a sign or a mute device, which is absurdly denied to a written declaration. Pantomime is regarded as more reliable than articulate language. This is all wrong.

Again, it has always been considered a sound and just rule of practice that an application for a patent should be wholly *ex parte*, that no outsider should be allowed in any manner to interfere in the proceeding, and that he should not even know of its existence. The reason for this rule is that, as inventors are generally poor, if wealthy companies were allowed to interpose, such expensive controversies and harassing delays would result as would often prevent the obtaining of a just patent. After having obtained his patent, the inventor will be in a better condition to face his antagonist by securing auxiliaries or otherwise.

The act of 1870 introduces the anomaly that, in all appeals from the Commissioner, he "shall notify all parties who appear to be interested therein." This would enable them to appear and oppose the grant of a patent. The applicant is also required in such cases to be at the extra expense of procuring certified copies of all the original papers and evidence in the case. Whether intentional or otherwise, these provisions would in many cases operate as the denial of undoubted justice. Quite as reprehensible is another provision connected with these appeals. When the act of 1870 was before the committee which framed it, the then Commissioner endeavored to so change the previously existing system as to render a decision by him final, by cutting off appeals to the court. This was, however, so strenuously opposed, by those who sought to protect the interests of inventors, that the committee refused to adopt it. They even went so far in the opposite direction as to determine that—in cases of interferences, where there are antagonist parties either of whom may appeal, and where cases of sufficient importance to be appealed to the Commissioner would generally be certain to be carried to the court—the unsuccessful party, before the Board of Examiners in Chief, might appeal at once to the court, without the useless necessity of an intermediate appeal to the Commissioner. But when the act came to be published, all was found to be so far most unaccountably changed, that in interference cases not only did an appeal still lie to the Commissioner, but his decision was made absolutely final. The appeal to the court was thus cut off in those cases which of all others it is best qualified to decide, while in questions of mere patentability, with which the Commissioner may be presumed to be most conversant, and therefore best qualified to judge, the appeal still lies to the court.

These are given as mere specimens of the mistakes and incongruities in the new law, not as an attempt at their enumeration. There are many others of no trivial importance, most of which equally militate against the interests of inventors. The only effectual remedy is to be sought for in a general change or codification of the statute. And in making this change, the spirit which dictated the provision in the Federal Constitution by which the statute is authorized should never be lost sight of. The law should be framed in aid of the inventor, and not as an instrumentality for circumscribing his rights within their narrowest limits, or for annihilating them altogether. This is a dictate of sound policy as well as of the plainest justice.

There are many unreflecting minds who honestly regard the whole patent system as being founded on error, and who look upon a patentee as the possessor of an odious monopoly. If their notions are correct, the institution of property of all kinds should be abolished, for every kind of property is a monopoly. A patent for an invention is no more so than is a patent for land. But who would build a house, or cultivate a field, or otherwise provide for the comforts or necessities of life, if he were denied all property in the fruits of his labor, in other words, if he were not to enjoy a monopoly in what he had thus created? Civilization could never have existed without the institution of property. It would soon take its departure from the earth if that institution should cease to exist.

These principles are as applicable to inventions as to tangible objects. The application of communist doctrines may sometimes seem enticing, but the general rule would operate as perniciously in the one case as in the other. Deny all property in inventions, and you paralyze the efforts of that class in the community which, more than any other, has contributed and is still contributing to human progress. The thousands of minds who are devoting their every energy to the promotion of human welfare would feel that their chief inducement to effort had ceased to exist.

Monopolies are justly odious when made applicable to what was before common property, but not when limited to the authors of new creations or even new discoveries. The government whose flag is first planted on an uninhabited island is, by common consent, the owner thereof. How much more complete would have been its title thereto had it created that island! Such is the title of the inventor. Under a proper ad-

ministration of a sound patent system, the patentee is only protected in his property to his own discovery, and, more generally, to his own creation. He would be allowed a limited monopoly in what, but for him, might never have existed, or, at all events, was previously unknown.

But we have heard it asserted that the inventor is only entitled to protection in the machine he builds, and that any mechanic ought to be equally protected in the work of his own hands, though identical in form and operation with that of the inventor. But in what does a real invention consist? It is not in the materials, nor in the contrivances out of which the machine is constructed. These are the mere instrumentalities which give expression to the thought that lies beyond. They bear the same relation to the real invention that the visible Universe does to its Creator, or that the material body does to the human soul. An invention is a soul or principle, which has found a material means of evincing its existence and character.

That many wrongs have resulted from the defects and abuses of our patent system no one will doubt, but these are certainly not greater than the frauds and crimes which have had their origin in the institution of property in material things. In both cases these evils are infinitely overbalanced by the advantages which result from that institution. Correction, and not annihilation, is the appropriate remedy for these mischiefs.

Our conclusion, therefore, is: *First*, that a well regulated patent system is of incalculable importance to the public welfare; *Secondly*, that the laws on this subject should aim primarily to encourage invention by facilitating the means of obtaining patents and protecting property therein; and, *Thirdly*, that in administering those laws the Office should be actuated by their spirit and purpose, and govern its conduct accordingly. To aid in bringing about these results has been the main purpose of these articles.

TWO TYPICAL EXPERIMENTS.

Dr. Bastian pursues his investigations touching the origin of life with praiseworthy energy. For every objection urged against the conclusiveness of his experiments, he straightway performs a new series to meet the difficulty, carrying the war into the very camp of the panspermists, and keeping them constantly on the defensive. Results formerly denied are now admitted; but they are met by raising the thermal death point of certain germs to 227° or 230° Fah., and alleging that the organisms developed in boiled solutions, hermetically sealed, came from invisible germs not killed by the heat to which the solution had been subjected.

For the benefit of those raising this objection, he now reports the following experiments, selected from several, in some of which, he says, even higher temperatures were resorted to:

Experiment I: To a strong infusion of turnip, made faintly alkaline by liquor potassæ a few separate muscular fibers of codfish were added. Some of this mixture was then introduced into a flask of nearly two ounces capacity, and the neck of the flask was drawn out and hermetically sealed by a blow-pipe flame while the fluid within was boiling. Thus closed, the flask was about half full of fluid. It was then placed in an iron digester, and gradually heated to a temperature from 270° to 275° Fah., at which it was kept for twenty minutes. For an entire hour the flask, heating and cooling, had a temperature exceeding 230° Fah., the alleged death point of bacteria germs. Withdrawn from the digester, the closed flask was kept at a temperature of 75° to 80° Fah., for eight weeks, a part of the time exposed to the influence of direct sunlight. After it had been ascertained that the flask was free from any crack or flaw, its neck was broken, and its contents examined. The fluid showed a decidedly acid reaction, and it had a sour though not fetid odor, as though fermentation had taken place. It was also slightly turbid, and there was a well marked sediment, consisting of reddish brown fragments and a light flocculent deposit. On microscopical examination, the fragments were found to be portions of altered muscular fiber; the flocculent deposit was composed for the most part of granular aggregations of bacteria. In the portions of fluid and of deposit which were examined, there were thousands of bacteria, of most diverse shapes and sizes, either separated or aggregated into flakes. There were also a large number of moribund chains of various lengths, of a kind very frequently met with in abscesses and other situations (where pyæmia or low typhoid states of the system exist) in the human subject. There were, in addition, a large number of *torula* corpuscles, besides brownish nucleated spore-like bodies, gradually increasing in size from mere specks, about one thirty-thousandth of an inch in diameter, up to one twenty-five-hundredth of an inch. Lastly, there was a small quantity of the mycelium of a fungus, bearing short lateral branches, most of which were capped by a single spore-like body.

Experiment II: A strong infusion of common cress, to which a few of the leaves and stalks of the plant were added, was enclosed in an hermetically closed flask, and treated in precisely the same manner, and at the same time, as the infusion of experiment I. The flask was opened the ninth week after heating. Before breaking the neck of the flask, the infusing of the glass under the blow-pipe flame showed that it was still hermetically sealed. The reaction of the fluid was found to be distinctly acid, though there was no notable odor. The fluid was tolerably clear and free from scum; but there was a dirty-looking flocculent sediment at the bottom of the flask, amongst the debris of the cress. On microscopical examination (with a $\frac{1}{2}$ th immersion objective), much altered chlorophyll existed, either dispersed or aggregated among the other granular matter of the sediment; and among some of this, three minute and delicate

protomata were seen, varying in form, and creeping with moderately rapid, slug-like movements. They contained no nucleus, and presented only a few granules in their interior. In the same drop of fluid, and also in others subsequently examined, more than a dozen very active *monads*, one four-thousandth of an inch in diameter, were seen, each provided with a long rapidly moving lash by which neighboring granules were freely knocked about. There were many smaller motionless and tailless spherules of different sizes, whose body substance presented a similar appearance to that of the *monads*, of which, in Dr. Bastian's opinion, they were in all probability earlier developmental forms. There were also several jointed bacteria, presenting most rapid progressive movements, accompanied by quick axial rotations. Many torula corpuscles and other fungus spores, also existed, as well as portions of a mycelial filament, containing equal segments of colorless protoplasm within its thin investing membrane.

Until the panspermists offset these experiments by an exhaustive series, showing that living forms do not originate under the conditions described by Dr. Bastian, there would seem to be but one escape for them, and that is to assert (contrary to all experience) that the temperature of 330° Fah., or even 275° Fah., is lower than the thermal death point of the invisible germs of these simple organisms.

MICA MINES IN NORTH CAROLINA.

Among the most interesting relics thus far discovered of the mysterious race of mound builders, who occupied the Mississippi valley previous to the advent of the more barbarous Indians, are numerous ornaments of mica. Like the weapons of hammered copper from Lake Superior, the shells from the Gulf of Mexico, the implements of Mexican stone and of iron ore from Missouri, these plates, of a mineral not found in the Great Valley, give a plain hint of the extensive commercial relations of those prehistoric people.

The mica was evidently mined in Western North Carolina where their long-abandoned workings have lately been reopened, and made the scene of a very modern enterprise.

Seven years or so ago, a prominent citizen of North Carolina set some laborers to work in one of the ancient mines, in search of silver, supposing that metal to have been the one sought for by the original miners. A considerable quantity of mica was thrown out, but its value was not recognized until a sample, which had been sent to Knoxville as a curiosity, was seen by a Mr. Clapp, who followed up the clue and leased the mine for its mica, and revived an industry which has added immensely to the wealth of the region. The mine is known as Blaylock's, about twelve miles from Bakersville, the county seat of Mitchell's county. Four or five other ancient mines have since been reopened in the same neighborhood, besides many new ones in the same and adjoining counties.

A correspondent of the *Tribune* reports that the mica trade has given general occupation to the population of Mitchell county, and has made money plentiful and thereby enabled the county to pay off its indebtedness, which it would otherwise have been unable to do. Mines have also been opened in Yancy, Heywood, Burcome, McDowell, and other counties. The business is still in its infancy, and the methods of mining are exceedingly primitive; yet the amount of mica produced is more than enough to supply the large and growing demand for the article. Dealers and manufacturers supply the mines with patterns ranging in size from two by three inches up to fifteen inches square, according to which the mica is prepared for market. The dark or brandy-colored mica brings the best price. Associated with the mica is an abundance of decomposed snow-white felspar, which will no doubt be utilized, in time, for the manufacture of porcelain.

TYNDALL ON TYPHOID.

Professor Tyndall has dropped for the nonce the role of physicist for that of physician, and deals, in a recent publication, with the subject of typhoid fever, discussing the important question as to whether that disease can ever have a spontaneous origin from fecal fermentation or must of necessity always spring from a germ, the last derived from a pre-existing case of fever. Following closely the data obtained by Dr. Budd, as well as those of other investigators in the same field, Professor Tyndall asserts positively that the weight of evidence is in favor of the view that the disease, like small pox, arises wholly from contagion. He holds that the body is the seat of the development of the germ, and that the latter is not originated from noxious effluvia, however foul; and in support of this, he cites the fact that, during the foul condition of the Thames in 1858, the community residing upon the banks enjoyed a singular immunity from fever. Even in rural districts, it is asserted that, where the air is purest, typhoid has been known to rage, and to be traceable directly to personal communication.

It would not be expected that so radical a denial of generally accepted views could be promulgated without arousing challenge from the medical profession, and already several of the most eminent English physicians have adduced strong evidence in contradiction of Professor Tyndall's assumptions. Dr. Alfred Carpenter states that typhoid is contagious only in a limited degree, and that by proper precautions its attack may be prevented. Dr. Murchison says that, during nine years, in the London Fever Hospital, 3,555 cases of enteric fever were treated in the same wards with 5,144 patients not suffering from any specific fever. Not one of the latter contracted enteric fever, although the use of disinfectants was exceptional, and they were brought in contact with the excreta of the former class. The same authority gives repeated instances, occurring in his own practice, confirming the opposite of Professor Tyndall's conclusions.

So many cases have occurred, where the existence of typhoid has been traced directly to sewers, foul drains, and similar receptacles of filth, that arguments far more cogent than those of Professor Tyndall will be required to convince us that no danger of pestilence lurks therein. Add to this that it has been repeatedly shown that hospital attendants in personal communication with typhoid patients are remarkably exempt from the disease, and without further review of the great mass of confirmatory evidence brought by medical writers against Tyndall's theory, we cannot but conclude with the *London Medical Journal* that the Professor has in this case, as was charged against him in his recent researches on sound, studied but one side of the question.

It may be well to remark in this connection that Professor Tyndall's most recent efforts are not wholly bearing out the reputation for scientific acuteness and philosophical caution so ably won by him in his earlier labors.

Dr. Lionel Beale—himself a scientist of no inconsiderable celebrity—makes a strong point against Tyndall in a recent communication to the *London Times*, in stating that, though he has followed Tyndall's track for years, he is unable to comprehend Tyndall's course of reasoning. Referring to the latter's Belfast speech, in which the speaker said that the material ideas were not his belief "in hours of clearness and vigor," Dr. Beale rather pertinently suggests the question of which Tyndall we are to believe, Tyndall whose brain, when weak and unhealthy, produces materialistic theories, or Tyndall, when clear and vigorous, repudiating the same ideas? Altogether the eminent Professor has latterly contrived to encircle himself in a kind of fog as to his doings and sayings, which prevents people of ordinary discernment from relying so implicitly on his conclusions as they otherwise might.

HOW TO INVESTIGATE SPIRITUALISM.

There has been lately an extraordinary revival of spiritualism, and it again challenges the general attention. Nearly all the newspapers, and some of the most respected of the literary magazines, without reservation or protest lend their columns to its advocates. The *Daily Graphic* for more than a month has made spiritualism its specialty, pursuing it with such pertinacious enterprise as it did the Atlantic balloon project of last year. And, most significant of all, many distinguished scholars and clergymen, to whom the *Graphic* had addressed a circular letter, inviting their cooperation in an investigation, signify their approval of the *Graphic's* plan and a profoundly respectful appreciation of the spiritualistic pretensions. This revival of spiritualism is probably due to the new phase which the spiritual manifestations have taken on: Materialization. In place of raps, tips, trumpet blowing, tying, levitations, ponderations, etc., performed by or through the medium, we now have the spirits appearing in *propria persona*, with bodies apparently of flesh and blood, and nicely dressed in such clothes as they wore when they dwelt in the mortal coil.

Now these things seem to justify us in recurring to the subject of spiritualism, and in improving the opportunity to point out some things which Science has to do with it. And to make the matter short, we will limit our remarks to the alleged physical phenomena, the movements or changes of matter. We leave out of view, of course, the religious aspects of spiritualism; and for its bearings on psychology and physiology, we refer to what Faraday, Carpenter, Tyndall, and others have written. We point out, however, the evident fact that spiritualism rests on the physical manifestations. Take them away, and its bottom is knocked out pretty clean.

In the first place, then, we can find no words wherewith to adequately express our sense of the magnitude of its importance to Science if it be true. Such words as profound, vast, stupendous, would need to be strengthened a thousandfold to be fitted for such a use. If true, it will become the one grand event of the world's history; it will give an imperishable luster of glory to the nineteenth century. Its discoverer will have no rival in renown, and his name will be written high above any other. For spiritualism involves a stultification of what are considered the most certain and fundamental conclusions of Science. It denies the conservation of matter and force; it demands a reconstruction of our chemistry and physics, and even our mathematics. It professes to create matter and force out of nothing, and to annihilate them when created. If the pretensions of spiritualism have a rational foundation, no more important work has been offered to men of Science than their verification. A realization of the dreams of the *elixir vite*, the philosopher's stone, and the perpetual motion is of less importance to mankind than the verification of spiritualism.

But some may say that we exaggerate the pretensions of spiritualism, and that spiritualists, in the ratio of their intelligence, make claims which are modest and moderate; and perhaps the average man says that, although a great part of spiritualism is deception and imposture, yet there is something about it which is new and true. To such we say that if there is any truth in it, of interest to Science, however small, it is worth while to seek for it with great diligence and labor; its discovery will surely bring an abundant reward. If we positively knew that there was contained in spiritualism a scintilla of new fact about matter, though it were as the needle in all the haystacks or as the grain in all the sands of the sea, we would not discourage the ambitious man of Science in his search for it. Mr. Crookes, as the discoverer of thallium, has achieved a great eminence in Science, and he is now nobly employing his talent in the investigation of spiritualism, if he find in it, positively, something new to Science. He does not need to be told that, if he really discovers his psychic force or any other unknown force capable of acting on matter, all the future ages will name him with Galvani and Newton. Finally, say we emphatically, if there be truth in spiritualism, in whole or in any part, let it be investigated. But con-

cerning such investigations, in view of very serious harm which heretofore has often been caused by shallow and superficial dallyings with the subject, we thoughtfully and solemnly advise that no investigation is worthy of the name unless it is inspired by the passionless common sense of Science. Also remember this: The evidence required to establish a fact is proportioned to the improbability of the fact.

We come now to what with many readers will be reckoned the gist of the whole matter: How to investigate spiritualism. We name the plan which we are to propose, the scientific method of investigating spiritualism, and we thus name it, while feeling the most exalted respect for Science and knowing that some will discover in it only what they call horse sense.

These two theories, and these only, are tenable regarding most of the spiritual manifestations: They are real, and true, and honest, or they are a culpable fraud. The mediums in these cases are either the most worship-worthy of mortals, or they are cheats and liars. The raps and the materializations, the first and the last of the spirit exhibits, are surely of the sort in question. (And here we venture to suggest that if we take away from spiritualism all the alleged phenomena which belong to the same category, almost nothing is left.) Concerning raps and materializations, there is a question of fraud or no fraud; and this is a question of such a fundamental character that the answer to it is conclusive of the whole matter. It may seem to some that the case ought to be referred to the police detective rather than to the man of Science; and we are obliged to confess that a detective's advice may be as good as ours. The methods of Science are direct, logical, and on the shortest path to the truth; the man of Science always aims at the bull's eye. The method of the skilled and intelligent detective is, without doubt, identical with the scientific. Cases somewhat similar to that of the fraud or no fraud of raps and materializations have often come up for decision; an allusion to some of these throws a clear light on the present discussion. Our ancestors believed in ghosts, and they fired stones and bullets to test their faith. The proceeding was scientific, but suited only to an age ruder than ours. We warn the over-zealous scientist that, although a bullet could not harm a materialized spirit, no medium or his confederate is bullet-proof. An action for murder or manslaughter would probably lie in a case wherein any one was killed in a scientific investigation of materialization. The well known story of Fulton investigating the motive power of a perpetual motion by means of a hatchet is a fine illustration of the application of the principles of Science. Lamp-black, printer's ink, and green paint have been slyly smeared on the trumpets, ropes, etc., of the dark *séance*, and the truth was speedily declared in the unconscious ornamentation of the medium's lips or hands. And, best of all, strong lights have been turned on to the supposed spirits performing tomfooleries, and it was instantly manifest whether they were genuine or not. In all these cases it was a touch and a go, and the truth declared itself beyond any man's cavil. Devices which were so simple, and yet so sufficient, were surely scientific, and they indicate, and perhaps sufficiently describe, our notion of scientific investigation of one class of spiritual manifestations. But we add a few hints especially touching the investigation of materializations. Let the tests be applied directly, if possible, to the materialized spirit, with the intent to determine who or what it is. A dark lantern, or some other appliance for turning on light, is likely to be useful. A lasso would be very serviceable in the hands of one skilled in its use; it is said the Mexicans can lasso anything that runs or stands. A little squirt gun loaded with a few ounces of ink, or even the boy's blow-gun charged with Scotch snuff, might be available in eliciting truth where more pretentious instruments would fail. If the investigator, from doubts of his skill or other reasons, prefers to discard all the apparatus and appliances of art, let him, in the non-resisting spirit of a Quaker and in the name of Science, suddenly lay a strong and firm hand on the dress or the body of the spirit, and hang on like a Tartar till the whole truth comes to relieve him.

We repeat: Our scientific plan is simple, direct, conclusive. We commend it to Mr. Crookes and Colonel Olcott, and especially to all those who are in the road which leads to a faith which has lost its senses and is idiotic. To us, the Eddy materializations are supremely puerile and silly; they cannot appear differently until a scientific demonstration has shown that they are not the chicane of the practised and disreputable Eddy family. But the peace of society is disturbed, and something must be done for quiet, or many good friends will get to Bedlam. We earnestly hope that a scientific investigation of materialization will be made speedily; the investigator will receive our most cordial thanks. We have no hope of any good to come out of the class of spiritual manifestations which we have been considering. It is a notable fact that investigations so far have elicited absolutely nothing which was of moment to physical Science. Spiritualism has furnished striking illustrations to the expounders of mental pathology, but to the humanitarian it has seemed a terrible epidemic. In future times, it will probably be considered the blot and the shame of the nineteenth century.

AMERICAN apples, says the *London Grocer*, are now selling at moderate rates in provincial towns, both in England and Ireland. The highly colored and well flavored Baldwin is the commonest kind as yet. As usual, they come in barrels, without any kind of packing materials, and come, as a rule, in excellent condition. That apples should be sent several thousand miles, and then be sold as cheaply as home-grown fruit, is a noteworthy fact. At this rate of progress, fruitless and cold regions will soon be supplied with the finest fruits at a cost that places them within the reach of all classes.

FLOATING FIRE ENGINES.

We have heretofore called attention to the value of floating engines for extinguishing fires, especially to cities (like New York) having a large proportion of water front to the square mile. Messrs. Merryweather & Sons, of London, Eng., have been very successful in constructing these engines; and we illustrate, herewith, a vessel built for the Wear commissioners for protecting the shipping and docks of Sunderland and the adjacent ports from fire. It is intended, also, to use the engine for pumping purposes in general, such as for emptying sunken vessels, supplying ships with fresh water, etc.

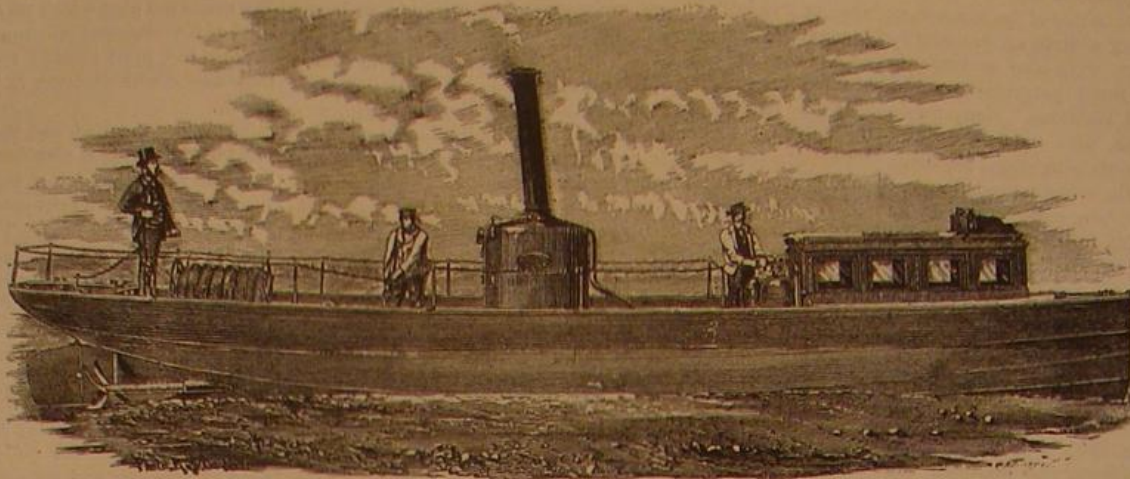
The boat is built of iron, and is 40 feet in length, with 9 feet 6 inches beam. It is propelled by a pair of independent vertical engines, each working a screw; this arrangement being adopted in order that the vessel may be steered in and out amongst the shipping. The draft is about 2 feet forward, and 2 feet 6 inches aft; the total depth is 4 feet 9 inches. The vertical engines are driven from the same boiler as the steam fire engine, and the speed averages 10 statute miles per hour; the diameter of screws is 28 inches.

In the fore part of the vessel is a cabin with sleeping accommodation for three or four firemen if necessary, and at the after part is a large hose reel fixed longitudinally, which will carry some thousands of feet of fire hose; there are in addition capacious fresh water tanks—these are fixed under the seats and platform, and are all connected. The steam cylinders are each 8½ inches diameter, with 24 inch stroke; the pumps have a similar stroke, and are 6½ inches diameter; the twisted bar motion, for which the makers' engines are so well known, is carried out in the above float. This engine, when in full work, is capable of discharging 1,100 gallons per minute through an open hose when used for pumping purposes; it also pumps, when in action as a fire engine, through a jet 1½ inches diameter to a horizontal distance of nearly 300 feet. Arrangements are made whereby two, four, six, or twelve jets may be thrown advantageously. The pump is entirely of gun metal, and consists of one solid casting weighing about 7 cwt.; the valves have a clear unobstructed waterway; the pump buckets are self-lubricating; and the valves being beneath the barrels, there is no fear of the latter being damaged by grit, sand, or other foreign matter. The valves, which are also of gun metal, are faced with india rubber attached with copper screw bolts. We may speak a word in favor of this class of valve, when we state that engines of this make in the royal dockyards, and in the service of the Liverpool, the Manchester, and the London Brigades, have run for 8 and 10 years without a renewal of the facings. The boiler is fitted with the Field tubes. Surrounding the outer row of tubes is a water space, which is well stayed to the fire-box. The boiler is fed by hand pump, feed pump on engine frame, arrangement for feeding direct from the main pump, and also by a Giffard's injector. It is capable of raising steam to 100 lbs. pressure within ten minutes from lighting the fire and from cold water. Had Liverpool been provided with such arrangements, says *Engineering*, to which we are indebted for the illustration, we should probably not have heard of the total destruction of the noble landing stage.

Animals as Motor Powers.

M. Marey gives some observations on the employment of animals as motor powers. He proves, by an instrument, that the movement of animated beings takes place by jerks, whence result shocks, and consequently a waste of labor. As an illustration of this theory, M. Marey cites the effort necessary to draw a burden behind one. If the necessary force be transmitted by means of a rigid or almost unextensible strap, for instance, of leather, the movement is jerky and more difficult than if it were transmitted by an elastic strap. It would, therefore be better to attach horses to the shafts with india rubber traces. He also gives in the

paper (which was read before the French Association for the Advancement of Science), as an illustration, the manner in which boats are always dragged along the towing paths by long ropes. It would be impossible, or at least very distressing, to employ short ones. The length of the rope, which alternately tightens or slackens by slow oscillations, has in this case the same effect as india rubber or other elastic material. Mr. Marey's instrument, by which these



MERRYWEATHER'S FLOATING FIRE ENGINE.

facts were ascertained, is an elaborate and ingenious piece of workmanship.

THE CRYSTALLIZATION OF GLASS.

An engineer of a glass bottle manufactory at Blanzay, France, recently substituted for the crucibles, ordinarily employed in melting the glass, a large cistern furnace heated by gas. An accident occurring rendered it necessary to withdraw the



CRYSTALLIZATION OF GLASS.

fire; and on scraping the glass from the inclined portions, a quantity of magnificent crystalline formations were found, produced during the cooling of the vitreous contents. These masses, a representation of one of which is given herewith, were sent to M. Peligot for examination, and that scientist has pronounced them different from any similar formations yet noticed in glass furnaces. The crystals are entirely isolated, and are not mixed with transparent glass. They are prisms of from 0.6 to 0.9 inch in length. The explanation given for the phenomenon is that the densification is due to a separation of the vitreous elements, which gives rise to a

definite silicate, crystallizing in the midst of the residual mass. This seems to be proved by an analysis of the crystals, in which soda is almost entirely absent, and magnesium present in large proportion. We extract the engraving from *La Nature*.

Compound Engines.

Nothing is more common than the removal of a pair of ordinary engines from a steamer, their replacement with compound engines, and a laudation of the excellent results obtained, which are invariably attributed to the fact that the steam does its work in two cylinders instead of one. It is not often that we are favored with a means of arriving at any really valuable conclusion in such a case, because some factor is always absent. A notable exception is afforded by the case of the steamship *Alexander*, the property of a firm whose steamers trade between St. Petersburg, Revel, Helsingfors, and Lubeck. She was originally fitted with ordinary engines of 80 nominal horse power. Messrs. Crichton were instructed to convert these into compound engines, retaining as much of the old machinery as possible. Cylinders wholly new were of course required. The old engines worked with 15 pounds steam, and consumed 36 cubic feet of coal per hour, with a speed of 9 knots and 60 revolutions in regular work. The engines were built by Earle Brothers, of Hull, fifteen years ago, and the *Alexander* was also built by the same firm. The engines were exceedingly trustworthy, and in their long life have cost very little for repairs.

A most important change was made in the screw, the pitch being considerably reduced. As to the results of the alteration, they may be briefly stated: With a pressure four times as great as that originally used, the engines make 90 revolutions per minute, and the boat goes at 10 knots, with 20 cubic feet of coal, per hour.

The boiler is so much smaller than the old one, and so much less coal is required for a voyage, that the midship bulkhead has been moved further aft, and 5,000 cubic feet of cargo space have been gained. The vibration, before excessive, has been greatly reduced.

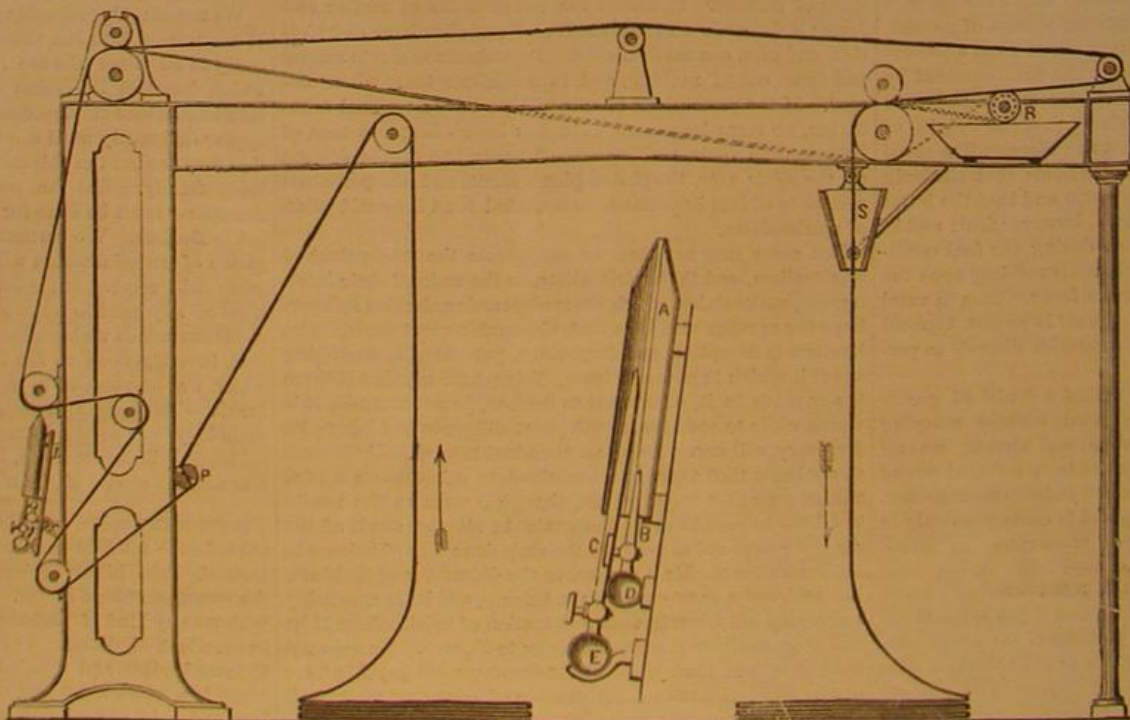
The benefits thus gained will, by some persons, be attributed to compounding. They are really independent of that principle, and better results would have been got by the use of two simple cylinders,

new boilers, high pressure and expansion, and a screw of proper pitch. The change might have been effected by fitting two liners into the old cylinders to reduce their diameter sufficiently, and the surrounding space between the cylinder and the liner could have been utilized as a steam or air jacket.

We understand that Messrs. Crichton are about to alter a sister ship, the *Nicolai*, in the same way.—*The Engineer*.

NEW CLOTH-SINGEING MACHINE.

The annexed diagram exhibits the essential features of a new machine for singeing fabrics, recently invented in France, by M. Blanche. It is claimed to use but 141 cubic feet of gas per hour in singeing cloth 2 yards and 7 inches in width, thus effecting an economy of some 40 per cent on the apparatus commonly used for this important operation in textile manufacture. The arrows indicate the movement of the cloth. At the left of the vertical standard is a stretcher, P. R is a brush which cleans the surface after the singeing, and at S is an arrangement for governing the folding. The burner used is shown enlarged in section, and consists in air jet, C, and a gas jet, B, which mingle at the extremity of the conical tube, A. The tubes for the gas and compressed air are represented at D and E. The flame from the burner may be accurately adjusted, so that the singeing may take place, after dyeing, without any disengagement of smoke or odor. Two men at the crank work the machine with facility.



BLANCHE'S MACHINE FOR SINGEING CLOTH.

THE UNDERGROUND RAILWAY, NEW YORK CITY.

NUMBER V.

Continued from page 371.

In our last issue, page 371, we gave drawings of the peculiar masonry tunnels of this great work, especially of those portions which occupy the subsurface of the street directly in front of the large edifice known as the Normal College, on Fourth avenue, at its junction with 69th street. The excavation for the underground railway began directly on the sidewalk in front of the main stairway entrance of the College, shown in our engraving. The cutting extended down to a depth of 33 feet below the ground surface, and 21 feet below the foundation of the tower of the College. But the angle of repose of the soil was not disturbed, and the stability of the College building was therefore at no time endangered, although, at the time, it appeared otherwise to the unexperienced eye. The work was executed last July. The successful carrying along the front of the College of so great a work as this underground railway, the outer walls of which at this point occupy a space of 78 feet in width, while the foundations are 33 feet below the street surface, is an example of the facility with which such works may be prosecuted in New York city without danger to adjoining buildings. In the case of the College building, no special excavations were required, not even the use of sheet piling at the side of the excavations. Our main streets are in general so broad and straight that underground railways may be constructed under their surfaces without difficulty or injury to adjoining property. Fear has been expressed in some quarters that the building of the Underground Railway under our great thoroughfare of Broadway, which, it will be remembered, was finally authorized by the Legislature in May last, might interfere with some of the adjacent buildings; but all such objections are idle, in view of the successful completion of the present great underground railway on Fourth avenue, where the works are much wider and often deeper than will be required on the Broadway line. The width of the Broadway Underground Railway will not exceed 32 feet, whereas 78 feet is the width of the work on Fourth avenue in front of the College. In our next article, we shall give drawings and descriptions of the great single arch masonry tunnel north of the Normal College. The arch of this section of the underground railway is 68 feet in diameter, and is a remarkable work.

THE NORMAL COLLEGE, NEW YORK CITY.

The Normal College of New York city, Fourth avenue and 69th street, is one of the most enduring and splendid monuments of the public school system of this country. Its proportions are large, the building covering an entire block. It possesses great architectural beauty, and is fitted up and ar-

anged in the most convenient and handsome manner; and eleven hundred female students daily assemble in the fine central hall, before proceeding to the rooms allotted to the different branches of study. It is a wise and foreseeing regulation of the New York Board of Education that all female teachers, appointed to the public schools, must be graduates of the Normal College. By this means, an unquestionably high standard of education and of personal character is assured among those on whom the welfare of our next generation primarily and chiefly depends. Admission to the Normal College can only be obtained by graduating from the public schools, in which, and also in the Normal College, the instruction is given free of charge.

The edifice was completed for occupancy on the 1st of September, 1873. The institution includes a training school to afford practice to teachers.

The course of study in the Normal College covers three years, and embraces many branches of instruction. President Hunter, in a recent address, made the following remarks concerning the curriculum:

"Geology, mineralogy, zoölogy, and physiology are taught in outline, and without requiring home study. The instruction is given in the form of lectures, and for the purpose of enabling the young ladies, when appointed to the primary schools, to become intelligent teachers. In order to impart instruction, particularly on natural objects, some acquaintance with the elements and outlines of the natural sciences is indispensable. Of course it would be absurd to expect profound scholarship in all of these, or indeed in any of them, in the short period of three years. It would take a whole life to make a scientific geologist. Nor can it be expected that we shall make profound Latin scholars; but we can impart such a knowledge of this completely inflected language as will make the graduates much better teachers of reading, spelling, and etymology. The study of Latin will increase their vocabulary, and strengthen their powers of thinking. We intend to make the young ladies so perfect in their German that they can pass from us to the regular staff of the grammar school. The English language, composition, rhetoric, literature, and history shall receive all the attention that their importance demands. Language is so interwoven with thought that the two are one and inseparable. They are almost synonymous. In cultivating language, apart from its intrinsic value, we are cultivating the highest faculties of mind—comparison and judgment. Perhaps we have a little more mathematics than may be necessary, and the Committee on Normal College may deem it proper to cut it down; and yet, young ladies, if you would have sound minds and habits of logical reasoning, you must study mathematics."

"The Normal College has more than fulfilled the expectations of its friends. By the testimony of experts and superintendents, it turns out the best scholars of any institution of

the kind in this country. Besides the regular course of three years, a post-graduate course, occupying an additional year, is in contemplation. Every precaution is taken to insure the health of the students. Air, exercise, frequent change, and short recitations are among the means taken to promote this end. The college has an attendance of over 1,000 students, from all parts of the city, and of all creeds, classes and nationalities. The number of graduates this year," says *Harper's Weekly*, from which we select the engraving, "is 184—about sufficient to supply the vacancies in our city schools."

Effect of Damp Air on Coal.

M. Varrenstrass finds by recently conducted experiments on this subject, that the loss in weight, due to a slow oxidation and to the disengagement of gases which form the richest part of the coal, may equal one third of the original weight. The heating power in such coal was lowered to 47 per cent of its former capacity. The same coal exposed to the air, but in a closed receptacle, did not lose more than 25 per cent of gas and 10 per cent of heating power. Bituminous coals alter most rapidly.

This shows the disadvantage of damp cellars, and of leaving coal uncovered for long periods and subject to bad weather. Judging from the large loss incurred, it would seem much the better economy to provide suitable receptacles for the fuel, the saving in the latter being sufficient to compensate for the extra expense.

THE manufacturers of firearms in this country are as busy as bees in clover time. Large orders from foreign governments are now being executed. Turkey is having 600,000 of the Peabody-Martini rifles made, Prussia lots of needle guns, Russia 100,000 of Smith and Wesson's pistols, while Spain calls for all that can be made of the Winchester and other breech-loaders.

A NEW DREDGING PROCESS.—M. Bergeron suggests that deposits of sand and mud in harbors might be cleared away by forcing into them the perforated ends of large tubes, through which a powerful stream of water is forced. The numerous currents would, he thinks, act upon the deposit in the same manner as so many underground springs, washing it away so that the soil could be distributed by the flow of the tides.

It is said in France that the quarries of lithographic stone in Bavaria are exhausted as regards the best kind, and that the only fine stones are now obtained by the Paris lithographers from Bruniquel, Tarn, and Garonne, in France. These stones are said to be well appreciated in the United States. There are quarries of the same stone at Vigan, France, but these are of an inferior description.



Fig. 13.—THE UNDERGROUND RAILWAY IN NEW YORK.—THE NORMAL COLLEGE FRONTING THE WORK.

RAPID ESTIMATION OF PHOSPHORIC ACID, MAGNESIA, AND LIME.

I attack in the cold 30-86 grains of phosphate with 3 cubic inches of hydrochloric acid or weak nitric acid, and filter it. I take 0.8 cubic inch of this solution, add at first some citric acid, then ammonia in excess, and lastly precipitate by a solution of chloride of magnesium, the liquid being maintained ammoniacal.

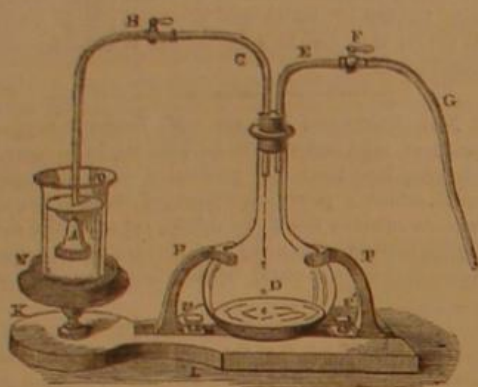
The phosphoric acid deposits in the form of ammonio-magnesian phosphate. By means of the exhausting filter I separate it from the supernatant liquid, wash it with ammoniacal water, exhaust again, and finally dissolve the precipitate, by means of some drops of nitric acid, and estimate volumetrically by means of acetate of uranium, according to M. Leconte's process, to which I have made several useful additions.

Thanks to my new apparatus, the union of the two methods is complete, and the quickness of the process is such that, in less than two hours, ten estimations, at the least, can be made. The estimation of phosphoric acid becomes as easy as that of nitrogen by soda-lime, while it is more general and not less accurate.

Suppose we have to analyze superphosphates of lime of commerce. The necessity of distinguishing phosphoric acid which is in the soluble state from that which is in the insoluble state requires two parallel attacks, one with distilled water and the other with weak nitric acid. The operation is always the same. We work on each liquid separately, as I have just pointed out in the case of natural phosphates.

I will now describe the apparatus that has so much expedited the work. A glance at the drawing is sufficient to under-

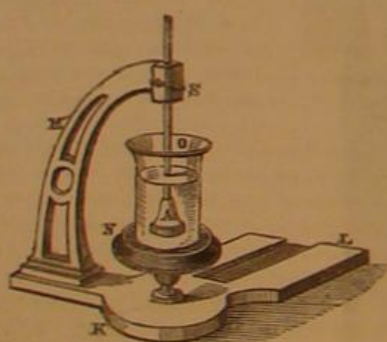
Fig. 1.



stand their arrangement and mode of action (Fig. 1). An exhaustion is formed, equal to a very few inches of mercury, in the globe, D, by the help of a small hand pump. The base of the cone, A, covered with one or two disks of blotting paper, held in place by a ring fitting tightly by friction, works as a true filter, which acts under pressure.

I have adopted two forms of apparatus, one of platinum and the other of glass (Fig. 2). The fragility of the latter is

Fig. 2.



obviated by means of the consolidation arm, M, which firmly fixes the exhausting tube.

The facility which this method gives of multiplying estimations has led me to define, experimentally, all the conditions which could affect the precipitation of the ammonio-magnesian phosphate. Among other results, I have discovered a means of rendering the precipitation almost instantaneous. To effect this, it is necessary to operate on a moderate quantity of phosphate, and to employ an excess of chloride of magnesium. With a small quantity of chloride the precipitation is slow, with more it is quicker, with an excess it is immediate. After waiting a quarter of an hour, we may proceed with the estimation of phosphoric acid, only the filtration takes a little longer; after an hour the result is perfect.

An excess of citrate of ammonia holds in solution very appreciable quantities of ammonio-magnesian phosphate; the loss, however, which results from it is very slight.

Citrate of lime dissolves nearly three times more ammonio-magnesian phosphate than citrate of ammonia. The intervention of 1 grain of lime has sufficed, in fact, to raise the loss of phosphoric acid from 0.033 to 0.066 of a grain; but I have ascertained that an excess of chloride of magnesium, so efficacious in hastening the precipitation of the ammonio-magnesian phosphate, completely neutralizes the solvent action of the citrate of lime and ammonia, and confers on the results both accuracy and concordance.

I have studied the precipitation of phosphoric acid in the presence of lime and aluminum, separately at first, then associated with lime; and I have arrived at the conclusion that, by keeping the quantities of citric acid, of chloride of magnesium, and of ammonia, and of the total volume of the liquid between certain limits which I point out, the process is of irreproachable accuracy.

Whether we are working with natural phosphates or with

commercial superphosphates; whether the product contains sulphuric acid or is free from it; whether the proportions of alumina, oxide of iron, and lime are great or small; the indications of the process are always exact and concordant.

The method possesses the two characteristics of accuracy and swiftness, and a degree of generality which renders it applicable in every case which may interest physiology, industry, and agriculture.—M. G. Ville, in *Chemical News*.

Correspondence.

How to Line Shafting.

To the Editor of the Scientific American:

I noticed in your issue of November 28, J. E.'s query as to the best way to keep shafting in line. This is an important matter, as much waste of power is caused by working ill adjusted shafting. Every one operating long lines of shafting should provide an adjusting rod, as shown in the engraving. A may be a roll of wood or a piece of gas pipe, of sufficient length to reach from the shaft, O, to within about four feet of the floor; an offset piece, B, is fixed to the top of this rod, which carries a right and left hand screw, C; two jaws, D, travel upon this screw, one upon the right and the other upon the left hand thread, as shown. The screw may be worked by a $\frac{1}{2}$ inch wire, E, with a crank, F, at its lower end; if a gas pipe is used, the wire may pass through the pipe, and the lower end of the screw, C, enter the top of the pipe as a bearing. If the rod, A, is of wood, three or four wire staples will suffice as guides for the wire, as indicated. A target, G, with a clamp screw, slides upon the rod, for the purpose of easy adjustment to the sights of the leveling instrument.

Now it will of course be apparent to every one that, whenever several sizes of shafting occur in the same line, this adjusting rod will always give the exact central distance, O, of the shaft from the target; hence we have only to plant the leveling instrument in a position to command a view of the target when suspended from each of the several bearings of a line of shafting, in order to adjust the level of a line with the utmost expedition and accuracy. An engineer's tripod and level is of course the best instrument for this purpose, but, when this is not at hand, an ordinary builder's level may be used: the longer it is, the better. Fix a temporary sight at end of the level; a piece of tin (with a small pin hole) next the eye, and a piece of tin or thin wood with a large hole at the farther end, with a vertical and a horizontal thread stretched across the hole, with their point of intersection the same distance above the level as the hole in the eye piece. The level may be used upon a level stand or table, some five feet from the floor.

To adjust a line of shafting laterally, the adjusting rod must of course be used horizontally in connection with a strong line, stretched as taut as possible, at such distance from the shafting as to need nearly the full length of the rod to reach it. The reason for placing the line at such a distance from the shaft is to prevent the difference in level between the line and the shaft from materially impairing the truth of the result. If the line is very long, it will sag so much that a plumb line suspended from the measuring point of the target or rod may be necessary for perfect accuracy.

The jaws, D, should be so formed that they may be applied to the inside of boxes. Pivot boxes are now so generally used, however, that this application of the rod is not so common.

F. G. WOODWARD.

Curious Apples.

To the Editor of the Scientific American:

Your correspondent Fletcher Williams, in his attempted explanation of the curious apple mystery, advances a novel theory which, I think, will interest pomologists.

This is the first time I have ever heard that sweet apples were sour when unripe, or sour apples sweet in a green state; and I cannot fully understand which was the "abnormal growth" he speaks of. Was it the sweet or sour part of the apple? I know all about that tree of Dr. Ely's, in Monson, having myself picked many bushels of fruit from it, each of the apples being partly sour and partly sweet. As you observe: "The sweet was very sweet, and the sour very sour." The flavor of each was excellent, and the apple well developed and fully grown. The color of the sweet part was a bright lemon, and of the sour part a green, like the Rhode Island greening. I have kept many specimens until they decayed, no change different from any other apple appearing. There was no "suture" between the sweet and sour parts other than the difference in color, which was usually in a straight line and very marked. One part of the apple was no more fully developed than the other.

Probably your correspondent never saw such apples, and his explanation has as little to do with the case mentioned as it has in explaining why some apples are red and others green in color, when both are ripe. Dr. Ely grafted the tree himself, and was not aware that the process was in any way dif-

ferent from many others he had grafted. He simply grafted a sweet apple scion on a tree that bore sour apples, and the fruit was as I have stated. The fruit, however, after a few years deteriorated, and became altogether sour and of a poor quality. Would not the best plan be to leave it as a *lusus naturæ*, and not attempt to explain it by assuming a more wonderful condition of things?

New York city.

Our Lighthouses.

The annual report of the Lighthouse Board says. The magnitude of the lighthouse system of the United States may be inferred from the following facts:

- 1st. The coast, from the St. Croix river on the boundary of Maine to the Rio Grande on the Gulf of Mexico, includes a distance of 5,000 miles.
- 2d. The Pacific coast has a length of about 1,500 miles.
- 3d. The great northern lakes, about 3,000 miles.
- 4th. The inland rivers, of 700 miles, making a total of more than 10,000 miles.

The following table exhibits a synopsis of what has been accomplished in aid of navigation along these standard lines, by far longer than those of any other nation in the world:

Lighthouses and lighted beacons, 608; lighthouses and lighted beacons finished and lighted during the year ending July 1, 1874, 25; lightships in position, 21; fog signals operated by steam or hot air engines, 40; day or unlighted beacons, 346; buoys in position, 2,865.

The board do not deem it expedient to attempt to introduce the electric light, or that of gas, on account of the complexity and cost of the apparatus. It is their intention, however, to adopt any improvements in the lamps, of the importance of which they are assured by the results of photometric experiment.

The recent introduction of an improved wick has increased the capacity of their lamps of the first order to the amount of a hundred candles. This, however, is at a proportionately increased expense, on account of the oil consumed.

As to fog signals, the cost of no other country is so subject to fogs as that of some parts of the United States. On this account, fog signals in many places are almost as necessary as lighthouses. But abundant experience has shown that a sound of sufficient magnitude to become an efficient aid to navigation can only be produced by a large amount of power derived from steam or heated air and applied by means of complex machinery, expensive in first cost and in continued maintenance. Improvements are about to be introduced in regard to the fog signals, which, while they will greatly increase the range to which the sound may be heard, will of necessity increase the cost of their maintenance.

The New Laboratory at Oxford.

The building consists principally of three floors, and is surmounted by a tower of fifty-nine feet in height, and contains twenty-six large rooms and numerous apartments, each specially adapted and devoted to experiments in certain departments of physical science. In the magnetic room is placed the great electro-dynamometer of the British Association. The room used for the experiments in heat at present contains an apparatus devised by Professor Maxwell for determining the viscosity of air. The galvanic battery is connected by properly insulated wires with the lecture room and other portions of the building. The battery which will be employed is, of course, confined in a room fitted expressly thereto, and is of the style known as Sir William Thomson's tray battery. The lecture room will afford accommodation for about one hundred and eighty students, the seats for the class rising at an angle of about thirty degrees, and three doors providing sufficient means of egress for the audience. In the room allotted to experiments in electricity of high tension, an apparatus contrived by Mr. Latimer Clark has been introduced, for the purpose of keeping the air of the room dry. This consists of a heated copper roller, over which passes an endless band of flannel. The roller is heated by means of gas lights within it, by which, being constantly burning, every part of the flannel becomes hot. The vapor which arises from the heated flannel is carried off by the current of air which supplies the burners inside the roller. The flannel, when thus dried and cooled, passes into the open air of the room, where it again absorbs moisture, and thus the air of the room becomes so dry that the electrical instruments are preserved in a highly insulating condition. The electricity passes from the electrical machine to the table in the lecture room by insulated wires connected with the prime conductor of the machine. The highest room in the building occupies the upper portion of the tower. In this room will be placed a Bunsen's water-pump, the water from which will thus have a vertical fall of considerably more than fifty feet. This pump will be used to exhaust a large receiver, from which pipes will communicate with the different rooms; so that, if it be desired to exhaust the air from any vessel, it will only be necessary to connect it with one of these pipes, and turn on a vacuum. For a more perfect exhaustion, the Sprengel or other air pump can be employed. On the top of the tower will be fixed a wooden mast, carrying a pointed metal rod, for the purpose of collecting atmospheric electricity.

DR. A. WYSTER BLYTH, medical officer of health to the county of Devon, Eng., has made a series of experiments which show that water containing organic substances is purified by running through iron pipes.

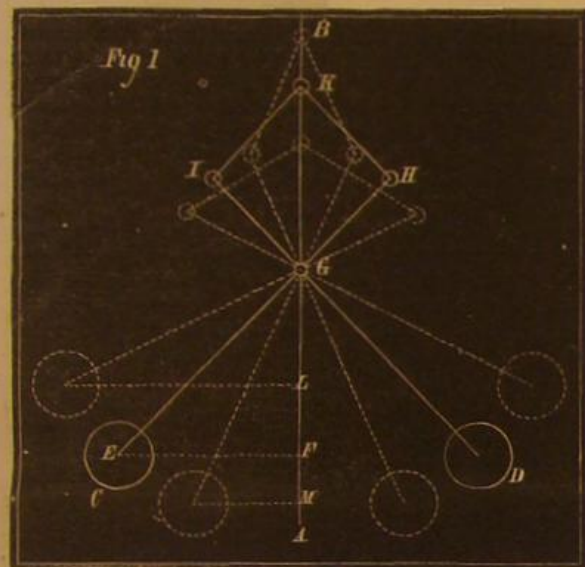
As an inducement to provide safety precautions, a reward of \$2,000 is to be given to that colliery owner in Belgium in whose pits the smallest number of workmen shall have been killed by explosions in the ten years ending in 1883.

PENDULUM GOVERNORS.

Number 1.

The essential features of the ordinary pendulum governor consist of a vertical spindle, which is made to revolve by suitable connections with the machine which it is to regulate; the spindle carrying, on opposite sides, a pair of arms, to which heavy weights are attached, forming revolving pendulums, which vary their positions at different speeds, and so control the machine. Such a governor is represented in Fig. 1. A B being the revolving spindle, C D, the balls attached to the spindle by the rods, E G, D G, forming the pendulums, which, as they assume different positions, act on the collar, K, moving up or down the spindle, being connected to this collar by the rods, G I, I K, G H, H K. A lever, not shown in the engraving, is ordinarily attached to the collar K, and thus operates mechanism which regulates the speed of the prime mover to which the governor is connected. The subject of steam engine governors is treated in nearly every work on the steam engine, and in numerous elementary treatises on natural philosophy, rules being given for proportioning the parts. In general, however, these rules, being founded on theoretical considerations which do not obtain in practice, are of very little value in designing governors. In works where the subject is presented in detail, the reasoning is often too abstruse for the general reader, and we propose, in these articles, to give the principal facts connected with the theory and construction of pendulum governors, in as simple a manner as possible.

A revolving pendulum, such as is shown in Fig. 1, assumes different positions if made to rotate at different speeds; and



supposing that there is no friction in the joints of the rods, and no other resistance to be overcome except the weight of its parts, the position assumed depends entirely upon the number of revolutions in a given time, no matter what may be the weight of the balls. In Fig. 1, the distance, F G, or the vertical height of the point, G, above the centers of the balls, is commonly called the height of the pendulum; and a revolving pendulum, under the conditions supposed above, makes just half as many revolutions in a given time as a common pendulum of the same height makes vibrations. Thus, if the height, F G, were 3.91 + inches, a common pendulum of the same height would make about 60 vibrations in a minute, and the revolving pendulum would make 30 revolutions in the same time. In general, the height of a revolving pendulum, in inches, when overcoming no resistance but that of its own weight, is equal to 35,208 divided by the square of number of revolutions per minute. If, for instance, the number of revolutions per minute is 100, the height will be 35,208 divided by 10,000, or about 3.5 inches.

Strictly speaking, the height of a pendulum revolving without resistance is slightly altered by the weight and centrifugal force of the connecting arms; but as governors are usually constructed, the weight of these parts is so small, in comparison with the weight of the balls, that the correction is unimportant in practice.

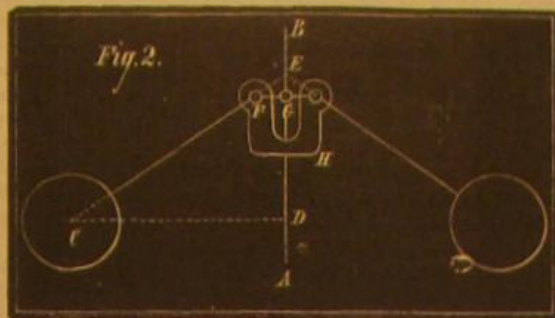
Below are given the heights, calculated by the foregoing rule, for different speeds:

Revolutions per minute.	Height in inches.	Revolutions per minute.	Height in inches.
10	352.08	275	0.4646
20	88.02	300	0.3912
30	39.12	350	0.2873
40	22.01	400	0.2201
50	14.08	450	0.1739
60	9.78	500	0.1408
70	7.184	550	0.1164
80	5.501	600	0.0978
90	4.347	650	0.0833
100	3.521	700	0.07184
125	2.253	750	0.06259
150	1.564	800	0.05501
175	1.150	850	0.04873
200	0.8802	900	0.04347
225	0.6955	950	0.03901
250	0.5633	1000	0.03521

A simple inspection of this table will suffice to show that the conditions, under which these heights were calculated, do not occur in practice. For instance, it is not unusual to run a governor at a speed of 250 revolutions a minute; but our readers must have observed that in such a case the vertical distance from centers of balls to point of suspension is always more than $\frac{1}{10}$ of an inch, which is about the height given by the table. The reason for this, and the proper cor-

rection for the height, will be found in another part of this paper.

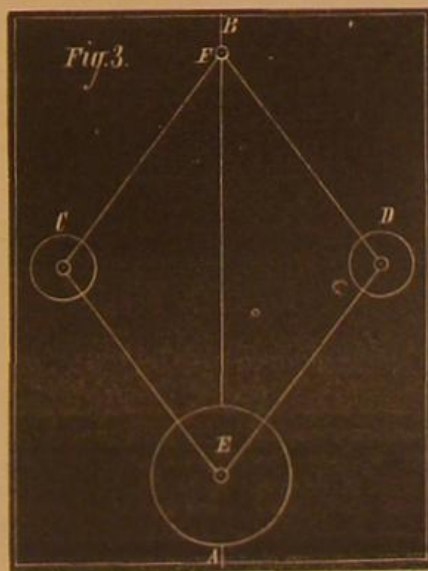
Referring again to Fig. 1, suppose that the full lines represent the position of the balls when the engine is running at the proper speed under the usual work, the lower dotted lines, the position at which the greatest opening of the regulator is effected, and the upper dotted lines, the position corresponding to the greatest slowing effect. These positions of the balls correspond to different speeds of the governor spindle, and consequently to fluctuations of speed in the engine,



which gives motion to the spindle. Suppose, for instance, that some work is suddenly removed from the engine; it will commence to run faster, and must increase its speed considerably before the governor can effect the regulation, since the required position of the balls corresponds to an increased speed. A sudden increase of work put upon the engine produces a contrary effect, the engine being slowed down considerably below its proper speed before the necessary regulation can be made. All that such a governor can do, then, under great variations of load in the engine, is to keep checking and increasing the speed, which will continually vary in inverse proportion to the load. This difficulty is partially obviated, in many forms of governor, by arranging the controlling mechanism so that a slight change in the position of the balls will produce a considerable movement of the regulator. The general idea is shown in Fig. 2, where the ball arms are not joined to the center of the spindle, and are connected to the regulating collar, K, by direct levers, which are very short in comparison with the length of the arms. In estimating the height of the balls of such a governor, it is to be measured from E, where the center lines of the ball arms produced cut the center of the spindle.

An inspection of the table of heights will show that, where a governor is run at a high number of revolutions, considerable variation in the speed only affects the height in a slight degree. Hence, in addition to a direct and effective connection, it is generally a good plan to give the governor a high speed.

A steam engine governor, when connected with the regulator, encounters some resistance in changing its position, and this resistance keeps the balls at a greater height than that given in the table. For the purpose of obtaining a considerably greater height of balls, when running at a high rate of speed, many governors have weights or springs attached to them. The most prominent governors of this form are: Porter's, in which a heavy weight revolving on the spindle is attached to the balls by rods, and Pickering's, in which the balls are attached to the spindle by stiff springs; but our readers must have noticed weights on many ordinary governors, connected with the spindles by levers. The general principle of all these arrangements is represented in Fig. 3,



which is an illustration of the simplest form of Porter governor. The weight, E, is connected to the governor balls by rods, E C, E D, of the same length as the ball rods, C F, D F. In such an arrangement, if there is no other resistance than that of the weight of the parts, the height of the balls corresponding to any speed of governor, can be found as follows:

Add twice the weight on the spindle to the weight of both balls, and divide that sum by the weight of both balls; multiply the quantity so obtained by the number in the preceding table.

For example, suppose that the weight of the two balls is 100 pounds, and the weight on the spindle is 500 pounds, the height corresponding to any given speed is 11 times the height in the table. It is evident from this that such a governor is much more sensitive than one in which no resistance is encountered, since the position of the balls changes much more rapidly with a given variation of speed.

Electrical Countries.

Certain interesting phenomena have recently been noticed by the Hayden Expedition in the mountains of Colorado, showing the high electrical state of the elevated position known as Station 9, Uncompahgre Peak, during the passage of a storm. Although the indications of the change in the weather could be seen at a distance, the electricity at the point of observation did not become plentiful until a characteristic buzzing was heard. Painful sensations followed, and at the back of the head and at the elbows a sharp pricking, like that of needles or a sharp knife, was felt. By this time the party came to the conclusion that they were standing on dangerous ground. Those standing on the very summit of the peak and along the sharp ridges leading from it experienced the severest shocks. After beating a hasty retreat, and remaining on the sides of the mountain to continue observations, it was noticed that after each discharge or flash of lightning a short rest ensued until a sufficient quantity of electricity had again accumulated. Those nearest the point struck would feel a heavy shock pass through them. These same phenomena were noticed during three days of continuous storms. At many places the rocks were glazed where the electric current had passed. The formation of tubes in sand from the same cause is well known.

A French meteorologist, M. Fournet, has suggested that it would be an interesting question for Science to determine whether certain countries or regions are in a higher electrical condition than others, and whether meteorological reactions do not result from the unequal distribution of the electricity. Similar phenomena to those detailed above have been noted upon the elevated plateaus of Mexico, and nearly a century ago Volney recorded remarkable noises occurring during thunderstorms in the neighborhood of Philadelphia. In South America, at Popayan, province of Granada, Boussingault says that thunder is heard every day and electrical phenomena are common. The extreme dryness of the Andine table lands also favors similar effects, and it is said that in the Chilean desert involuntary erection of the hair upon animals, as well as the appearance of sparks leaping from clouds to soil, is common. Dr. Livingstone notes that during the spring, a period of great dryness, the African deserts are traversed by a warm north wind so highly charged with electricity that the plumes of the ostrich stand upright, and that sparks are produced by the mere attrition of the garments.

In India, at certain localities, telegraphic wires are maintained with great trouble. It is stated that during storms of exceeding violence the conductors become charged almost to melting. Professor Loomis has observed abundant electricity in the atmosphere about New York city, especially during winter. We have repeatedly remarked the high electrical condition of the hair on cold nights, and also that the mere act of walking on a soft carpet in a heated room will cause a crackling sound under the foot.

From all the various examples which have been collected of this curious condition, it would appear that the abundant presence of electricity is not due necessarily to heat of the season, since in this country it is never more strongly manifested than after a cold northwest wind; nor are indications in any other region more clear than in the dry and icy air of Siberia. It would appear that reservoirs of electricity exist in the most widely separated parts of the globe. If it be admitted in accordance with the opinions of Fournet, Maury, and Admiral Fitzroy, that the ordinary winds are in relation with these great electrical sources, further and more extended observations upon them would be in the interest of meteorological progress. If, for example, the electricity of each great atmospheric current, tropical or polar, is regularly positive or negative, it may be, as Fitzroy suggests, believed that the changes of weather which supervene, at the moment when one electrical current succeeds the other, have on a small scale a certain analogy to the changing of the trade winds. Fournet remarks upon a natural relation of these phenomena with the meteorites produced during storms. These views are, however, mainly conjectural, so that there remains a large field for definite research.

Reform Needed at the Patent Office.

Unless there is an early and decided change in the practice of the Patent Office in its treatment of inventors, the institution will lose its character for usefulness. The annual report shows the enormous number of 7,500 applications for patents rejected last year, while probably as many more were delayed and their claims emasculated. We hope that the rejected applicants will all write to their members of Congress in complaint, and ask for official enquiry. The press is beginning to take the matter up. *The Technologist* says: "Commissioner Thacher will most promote the welfare of the Patent Office, and the rights of inventors, by putting his foot firmly down upon this uncalled-for practice of standing in the light of inventors, instead of giving to their applications the full, fair, and impartial consideration to which, in law, justice, and equity, they are entitled."

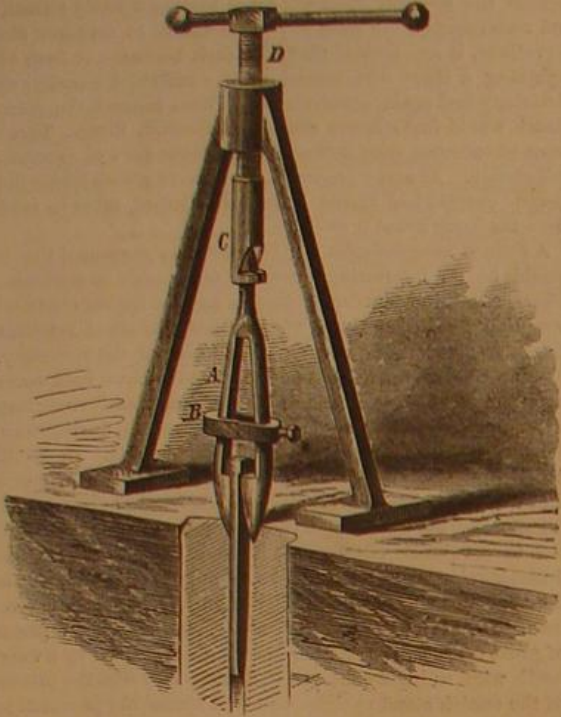
Blood Coloring Matter Free From Iron.

MM. Paquelin and Jolly announce that they have obtained the hematic pigment in a state of perfect purity and free from iron. Hematosine, as it is termed, burns without ash, similar to resinous substances. It is insoluble in pure water, and dissolves in small proportion in ammoniacal water, to which it gives a light yellow tinge. It is altered by potash and caustic soda solutions, to which it gives a brown color, and is lightly soluble in alcohol. The solvents of hematosine are ether, chloroform, benzene, and bisulphide of carbon. With these bodies the weak solution is amber-colored; when concentrated, red.

IMPROVED SPIKE EXTRACTOR.

The object of this invention is to remove railway spikes, heavy nails, or similar fastenings from wood, quickly and without bending the iron, so that the spike or nail can be used again without straightening. The arrangement of the device is also such that the extraction is easily accomplished, even when the spike is headless.

The arms of the grapple, A, may be hinged, or arranged to spring together, as shown in our illustration. The sharp corner ends of the jaws are driven into the wood on each side of the spike, and then, if hinged, further compressed by the becket, B. The head of the grapple passes through a notch into a tube, C, which last is swiveled to the lower extremity



of the screw, D. By turning the latter, the grapple and with it the spike—under the head of which the jaws catch—are lifted. The jaws have sharp cutting edges, which, when they are forced together, bite into the nail, so that a good purchase is gained on the latter, whether it has a head or not. A stout standard is provided, supporting the apparatus. The device seems to be an efficient and useful invention, and doubtless will meet a favorable reception from railway builders and others having occasion for its use.

Patented through the Scientific American Patent Agency, September 29, 1874. For further information, address the inventor, Mr. William Devine, Brownsville, Cameron county, Texas.

THE ERICSSON PNEUMATIC TORPEDO.

Through the courtesy of the inventor, Captain John Ericsson, of Monitor fame, we have been favored with sketches of the craft, from which the accompanying illustration has been prepared.

The body of the torpedo consists of a box of thin steel plates, 8 feet 6 inches long, 30 inches deep, and 20 inches wide. The explosive is placed at the bow. During the experiments a block of wood 27 inches long represented the containing vessel. A tapering block 18 inches long and secured to the rear of the box forms the stern, immediately aft of which are the propellers. These are of the two-bladed type, 3 feet 2 inches in diameter, with a pitch of 5 feet. Both revolve around a common center, yet in opposite directions, a necessary condition, since the powerful rotary movement of a single screw would cause the small hull to keel and probably revolve, unless retained in a vertical position by the ingenious expedient of causing the rotary tendency of one propeller to counteract that of the other. The displacement is greater than might be supposed, considering the small dimensions of the body, 2,000 pounds being barely sufficient to balance the weight of the whole apparatus.

The motive power is a small double cylinder oscillating engine, driven by compressed air, which is transmitted through a tubular cable, connected just abaft the stern, as shown in our engraving. The air pressure also governs an equipoise rudder, secured under the bottom and near the bow. The steering is effected by applying the force of the air against the tiller on one side, counteracted by the tension of a spring on the opposite side. The action of the apparatus is such as to be wholly independent of the differential force of the

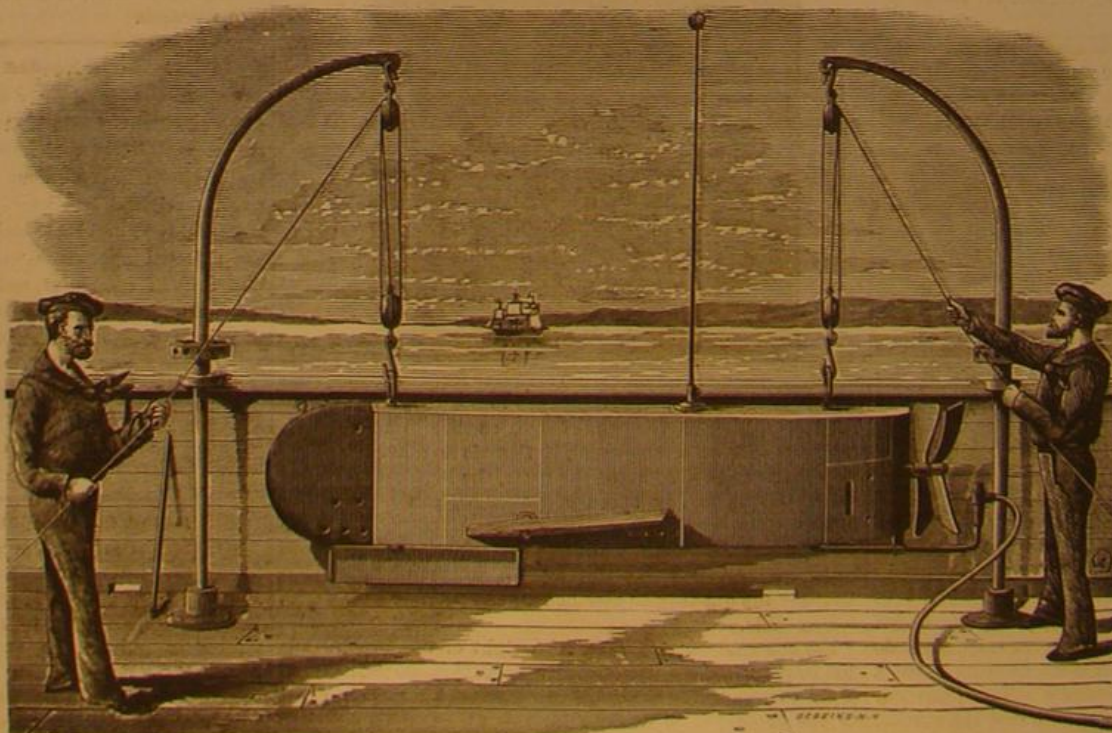
compressed air and the spring tension, and it is set in motion by admitting more or less air into the cable, thereby opening, more or less, a small connecting valve.

The submersion is regulated by two horizontal rudders turning on a transverse axle, which projects from each side near the bow. These wings or rudders are so contrived and governed that they keep the torpedo at a depth of from 7 feet to 12 feet below the surface, and are provided with automatic devices, so that the latter limit cannot be exceeded. In order to note the course of craft, a light steel mast is secured to the deck. This is 12 feet in length and terminates above in a wooden ball, the forward side of which is painted sea green, so as not to be perceptible to the enemy, and the rear white, so as to be easily distinguished above the water by those dispatching the torpedo. Openings are made in the engine compartment, through which the water enters, completely filling the interior space. The machinery is made of bronze with boxwood bearings, so that the water serves as a lubricant to every portion, thus doing away with stuffing boxes at the rudders, and, besides, avoiding any danger of the mechanism failing to operate through rust or neglect to oil.

To the engine power of the torpedo, no precise limit can be set. The whole force of the heavy engines of the torpedo boat, from which the weapon is dispatched, may be used to compress air up to almost any desired point. Captain Ericsson informs us that, small as the craft is, it towed a scow, forty feet long by fourteen beam and drawing two feet of water, without trouble. Driven at a high velocity by its large screws, it seems probable that the machine would make light work of piercing ordinary torpedo netting, or at any rate the explosion of its heavy charge of 400 pounds of nitro-glycerin, at such a short distance from a vessel as the length of her lower booms, would be sufficient to accomplish its purpose. Of course the torpedo hull is destroyed by the explosion but this would be a trivial loss in exchange for the total wreck of an enemy's man-of-war. The cable, however, remains uninjured, for it necessarily becomes detached and may be readily hauled in.

Our illustration represents the mode of launching the torpedo from the deck of the vessel. To this end the apparatus is hoisted up on swinging davits, the arms of which are previously turned over the deck. When lifted clear of the rail, the torpedo is carried outboard by revolving the davits, by bars inserted in the sockets in the broad portion of the davits, as shown. Nothing remains but to lower the machine into the water by the falls. The whole operation, we are informed, is accomplished in one minute.

A series of trials with the Ericsson pneumatic torpedo has lately been conducted on board the Intrepid, Commander A. P. Cooke, U. S. N., commanding, which has demonstrated the invention to possess a remarkable degree of efficiency. If further experiments, soon to be instituted from another torpedo boat, the Nina, prove, with the slightly modified steering gear, as successful as the initial tests above referred to, we may fairly conclude that that long-sought weapon, a reliable fish torpedo, has at length been devised. As to the probable result upon naval warfare, it is only possible to surmise. Against the attack of the torpedo, there is practically no defense, for its approach cannot be seen. Armor plating, even did it extend to the keel, would prove no shield, and the inflexible's one hundred and twenty watertight compartments, which the English constructors hope will render her proof against such attacks, would fare badly under the terrible effects of 1,200 pounds of gun cotton, with which Captain Ericsson says he could break any ironclad completely in two. We do not doubt but that the same ingenuity which can devise a weapon of offense is equally competent to provide a means of defense, at least such has been the experience of the past, as evidenced by the almost uniform progress in guns on one hand and armor on the other; but what defense, save that of giving an enemy the widest berth possible, and fighting at enormously long range, is likely to prove efficacious, we are at a loss to conjecture.

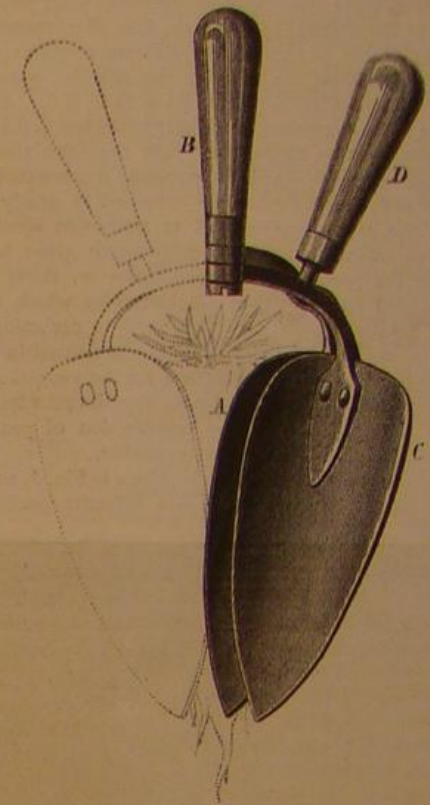


THE ERICSSON PNEUMATIC TORPEDO.

COPPEN'S IMPROVED TRANSPLANTER.

This is an ingenious arrangement of a double-bladed trowel, the object of which is to remove plants from the ground and set them in another place without destroying the soil around the roots.

The outer blade, A, has a curved shank, and a tong which enters and is secured to the handle, B. The shank of the inner blade, C, is curved to fit upon the inner side of the shank of the outside blade, and is pivoted thereto, at its extremity, by



a screw. Upon the middle part of the outer shank is formed a bend to receive the tong, which, on the inner shank, supports the handle, D.

In using the device, the blades are brought together, and thus thrust into the ground at one side of the plant, as shown in our illustration. The handles, B and D, are next operated to force one or the other of the blades around the roots, bringing the two directly opposite each other (see dotted lines). The instrument is then raised from the ground, taking the plant with it, and holding the soil undisturbed. The plant may easily be set in the desired place, the blades turned back to their former position, and the implement removed. By taking off the movable blade, the device may be converted into an ordinary garden trowel.

Patented through the Scientific American Patent Agency, October 27, 1874. For further particulars regarding sale of rights, address the inventor, Mr. George E. Coppen, P. O. Box 686, Evansville, Ind.

Electric Railway Whistles.

The French have lately introduced a system by which a stationary electric battery is made subservient to blow the whistle of an approaching locomotive, in case the road is not clear, without the engineer having to give any attention to it. Such an arrangement is, of course, exceedingly valuable at night, and especially during a fog, when signals cannot be seen at a distance. It is the reverse of the system introduced on the Hudson river rail-

road, by which every approaching locomotive sets a stationary electro-magnetic alarm bell at the depot in motion. In the French system referred to, the obstruction at the depot starts the steam whistle on every approaching locomotive when the train is still far enough away to slacken speed and stop. It has now been in uninterrupted operation on the line of the Northern Company of France for some time, and has been found practically successful in use, regularly informing the engineer whether the way is clear or not. The signal tender turns a disk and sends an electric current in the direction of the coming train to a bar placed between the rails; when the engine reaches the spot, a metal brush, placed between the wheels, sweeps the bar, the current passes to the engine, and, by means of an electro-magnet, presses upon a lever which opens the steam whistle, thus making it blow automatically. The rapidity with which the danger signal can be sent appears to be much in its favor.

THE YUCCAS.

Much might be written, and that to good purpose, on the stately effects to be obtained by the judicious planting of yuccas of different kinds in garden scenery. It is impossible to overlook their beauty, even when planted singly or in formal lines; but if arranged in bold groups and masses, they are unsurpassed as flowering and foliage plants for outdoor decoration. Their great panicles of pearly white, bell-shaped blossoms contrast so well with bright green conifers and low-growing shrubs of less distinct contour that all through the summer and autumn it is possible to form charming pictures by massing them either on the margins of shrubberies or in sheltered nooks on the lawn and pleasure grounds. These plants are simply invaluable if properly used in forming picturesque groups and clumps, instead of being, as is too often the case, dotted indiscriminately here and there on turf in unmeaning regularity. It has often been said that the hollyhock is the only decorative flowering plant of any importance to the landscape gardener. But the yuccas are even more stately, however; and they are permanent in character, being quite as ornamental in winter as in summer. They succeed nearly equally well in any soil, but a deep, rich, well drained loam is preferable; and they make finer specimens, if sheltered from rough, cold winds, than they would do if more exposed. The flowers of all the species (and these are more numerous than many imagine) closely resemble each other, being mostly of ivory-like whiteness within, the backs of the thick, wax-like segments being more or less tinted with purple. Much may be made of yuccas by associating them in well arranged masses along with other distinct and gracefully habited plants, such as the pampas grass, *arundo conspicua*, hardy bamboos, dwarf fan palms, and a score of other valuable decorative plants too seldom seen in our gardens.

Our engraving shows how a shrubbery recess may be made a charming picture by the use of yuccas alone; and it is in positions such as these that the flowers show to the best advantage. The kinds here shown are *y. filamentosa* on the left, a kind which bears rather lax but graceful spikes of flowers. The central specimen is *y. aloiolia*, a form generally met with in cool conservatories, although perfectly hardy in sheltered positions; and it is a rather curious fact that the variegated form of this plant is found to resist cold better than the normal kind. Both, however, make noble plants. The right-hand figure represents the common Adam's needle (*y. gloriosa*), one of the most robust of all the species; and associated with it is the free and vigorous *y. recurva*. These last rarely fail to flower every year.—*The Garden*.

The Diamond Drill.

The diamond drill is now extensively used in preliminary mining, to ascertain the exact location and thickness of ore or coal at given points. It is not uncommon to bore into the sides of hills or mountains for hundreds of feet with a 2½ inch diamond drill of tubular form. By this means solid cores or specimens of the borings can be had. Conglomerate rock cores, 12 feet in length, in one piece, have thus been obtained.

The Yarn Congress.

The second session of the Congress, held first at Vienna last year, to establish a uniform system of numbering yarn, has recently concluded at Brussels.

It was unanimously admitted that all textile fibers should be numbered upon one universal standard; that the metric system is gradually becoming generally employed for weights and measures, and that it is the only one that is admissible in the reform sought for by this commission; that, although it would be possible to adopt one perimeter for all classes of threads, it is advisable to take into consideration established customs, and the difficulties that would have to be overcome in introducing so great a change; and considering that there is no real necessity for fixing in an absolute manner the reel perimeters for each class of threads, and, moreover, that the perimeter of the English reel for cotton of 137 meters (1½ yards) is that which offers the best chances of bringing England to admit the metric system, it is therefore decided:

1. That the international numbering of threads shall be based on the metric system.

2. The number of the threads shall be determined by the

number of meters (meter 3.28 feet) of thread contained in a gramme, (15.43 grains).

3. The length of the skein admitted for all kinds of threads is fixed at 1,000 meters (1,100 yards), with decimal subdivisions.

4. Any system of reeling, provided that it gives 1,000 meters of thread per skein, is admissible.

5. The numbering of silk threads to be 1,000 meters as a unit of fixed length, and the decigramme (1.54 grains) as a unit of variable weight.

6. In order to provide for the commercial relations of all

stalk, about 1½ feet high, terminated by an umbel-shaped inflorescence, at the base of which are numerous scarious bracts of a greenish white color. The flowers are tubular, very fragrant, about 6 inches long, pure white, slightly greenish at the ends of the petals, which are five in number, linear in shape, reflexed and twisted, and from 3 to 4 inches long. "In the center of each flower," says W. M., an English amateur, "is a shallow cup, from which issue six long stamens. The leaves are radical, persistent, stalked, oval-elliptical in shape, and a foot or more in length; the leaf stalks are winged, and sheathing the flower stem." This very striking

plant, the habit of which is well shown in our illustration, deserves more attention than it appears to receive at present. It is easily multiplied by separation of the young bulbs, which should be taken from strong plants after they have done flowering. It may also be multiplied by means of the suckers which the plant frequently produces.

Deep Mining.

Many of the leading mining companies on the Comstock lode are now down to the depth of 2,000 feet, and a few still deeper. When mining first began on the great lode, such a depth was not thought of, or, if thought of, no one expected to see mining operations carried to such a depth as 2,000 feet in less than fifty years. Now we not only do not feel startled at hearing the great depth of 4,000 feet spoken of, but when we see preparation in actual progress, for sinking that far, we think but little of it. The Savage company, whose works we yesterday visited, have broken ground for the foundations of new machinery, which is to be sufficiently powerful to sink their main incline to a depth of 4,000 feet. This incline is already some distance below the 2,100 foot level, and is still being vigorously pushed downward. The new hoisting machine will be supplied with two 24 inch horizontal cylinders, of 4 feet stroke, and will be of over 400 horse power. The foundations of this engine are being laid about 80 feet to the westward of the present hoisting works. A building, 50x60 feet in size, will be erected over the new hoisting engine and the machinery connected therewith. The carpenters are already at work framing the timbers for this building. The steel wire rope to be used is to be 4,000

feet in length, and will weigh about 24,000 pounds. It is now being manufactured by John A. Roebling's Sons, Trenton, N. J. It will be a round rope, and the upper end will be two inches in diameter, but 2,500 feet of its length will be tapered, and the lower end will be 1½ inches in diameter. The reel on which this cable will wind and unwind will be conical, and the cable will wind about it spirally. The Ophir company contemplate the erection of similar machinery, and propose pushing their works to a like depth. The Crown Point company already have in operation machinery of much the same character as that being erected by the Savage folks, and having a cable of sufficient length to sink to the depth of 3,500 feet. The Hale & Norcross company, Consolidated Virginia company, and other leading companies at this end of the lode will erect similar powerful works, and will at once plunge down into the great unknown "depths profound," in which lie hidden the silver roots of the Comstock.—*Virginia Enterprise*.

The Imitation of Lace on Silk by Photography.

A new and beautiful application of photography has lately appeared in England, by the aid of which any lace design can be transferred to silk, so that the latter material appears to be covered with the delicate and costly fabric. The lace to be copied is secured in a frame in contact with sensitive albumenized paper, and exposed to the light until a very deep impression is obtained. This is then fixed, and the paper, washed and dried, forms a perfect negative. Another piece of paper is then sensitized with bichromate of potash and gelatin, and exposed under the negative. Inking with lithographic transfer ink follows, and the paper is placed in water and lightly rubbed with a sponge. This throws out every detail of the inked spaces, the rest remaining white or free from ink. The impression is lastly transferred to a lithographic stone, and thence printed upon the silk by the usual process.

Eight pounds of oxygen gas and one pound of hydrogen are combined in nine pounds of water.



A GROUP OF YUCCAS IN BLOSSOM.

countries, the scale of numberings for silk will be based on the variable weight of the unit of fixed length, and trials will be authorized on 500 meters (550 yards) weighing 50 milligrammes (0.772 grains).

THE HYMENOCALYX UNDULATA.

The genus *hymenocalyx* was founded by Herbert, who separated it from the genus *pancratium* of Linnaeus. The species which forms the subject of this note (*h. undulata*, or *pancratium typhillum*), is a native of Caracas, New Granada, and is one of the handsomest stove plants in cultivation. From an elongated bulb, it sends up a stout compressed scape or flower



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Spectroscopic Art in England and America.

Within the past few months, a series of independent efforts have been made in England and the United States, under the auspices of the two governments respectively, by able experimenters, to subject the spectroscopic to practical purposes in the arts, more especially in the quantitative analysis of metallic alloys.

In England, the experiments have been conducted for the Royal Mint, by J. Norman Lockyer, the distinguished astronomer and spectrum-scientist, and William Chandler Roberts, chemist of the Mint.

In this country, the experiments were conducted on behalf of the United States Mint, Philadelphia, Pa., by Alexander E. Outerbridge, Jr.

The several experimentalists have, it appears, reached widely different conclusions.

Mr. Lockyer has announced that he is satisfied that by means of the spectroscopic very minute differences in the composition of gold-copper alloys can be ascertained, but refrains from describing the process.

Mr. Outerbridge announces that a comparatively large proportion of gold may be present in an alloy, and the presence of the gold will not be indicated at all by the spectroscopic. He also concludes that, in the present state of spectroscopic science, assaying by means of spectrum analysis is, for the present, impracticable for the purpose of Mint operations.

There appears to be as great a divergence on this subject between Mr. Lockyer and Mr. Outerbridge, as there is between Professor Tyndall and Professor Draper, on the subject of the heat power of the sun's rays, or between Professor Tyndall and Professor Henry, on the subject of the propagation of sound. When the doctors disagree, who shall decide?

The experiments of Mr. Outerbridge are confirmatory of a statement, made, we believe, by Professor Young, in reference to spectroscopic observations of the sun, to the effect that because we fail to discover the lines of carbon, silicon, oxygen, etc., in the solar spectrum, we are not warranted in drawing the conclusion that these elements do not exist in the sun.

Mr. Outerbridge has made a full report of his experiments to the chief assayer of the Mint, and he also gives, in a recent number of the *Franklin Journal*, a variety of interesting facts, from which we take the following:

The beautiful parti-colored band of light, resembling a section of a miniature rainbow, resulting from the passage of a ray of white light through a prism, is familiar to every one; this simple experiment forms an appropriate introduction to the fascinating study of spectrum analysis.

Every kind of light not strictly monochromatic may, by means of the prism, be resolved into its component colors. The spectroscopic is a simple combination of prisms and lenses for the scientific examination of these different colors or spectra.

The numerous terrestrial elements, when in the state of incandescent vapor, give their own distinctive colors, which appear in the spectroscopic as lines of light arranged in definite position, whereby each element may be easily recognized.

The passage of powerful electric sparks (from an induction coil), between two terminal points of the metal to be examined, vaporizes a small portion of the metal, and this incandescent vapor transmits to the eye of the spectroscopic observer its luminous autograph, which Nature never counterfeits. Should either or both of the metallic points, or electrodes, consist of an alloy of two or more metals, the autograph of each may be clearly read.

Mr. Lockyer noticed, while studying these luminous autographs, that when he separated the metallic electrodes, causing the spark to leap a greater distance through the air, the spectral lines no longer continued to cross the entire field of vision; but certain of them broke in the middle, and, upon further increasing the distance between the electrodes, the hiatuses in the spectral lines increased proportionately, but unequally with different alloys. As the proportion of either metal of an alloy is increased, its lines lengthen, and conversely with the lines of the other metal. Upon this discovery, Mr. Lockyer based the theory of a possible method of quantitative analysis.

The spectroscopic was known to be, marvelously sensitive to the impression of these autographs, and it, therefore, appeared plain that, could such a method of analysis be reduced to a practical basis, its value would be immense in assaying metals used in coinage. For although the present modes of assaying precious metals have been brought to great perfection, yet the process is slow and tedious, requiring many chemical operations and great delicacy of manipulation; and "there is something captivating in the idea of a determination, as it were by a flash of lightning or in the twinkling of an eye, what proportion of gold or silver is present in any bar or coin." It was with the hope of reducing this beautiful theory of Mr. Lockyer to practice that these experiments were undertaken.

A powerful induction coil, reinforced by Leyden jars, in connection with a two-prism Browning spectroscopic, was employed, and it was found possible, after repeated comparisons of the spectra of different known alloys of gold and copper, to map the difference of fineness between specimens having respectively 500 and 750 parts of gold in 1,000 of the alloy, and even to recognize the variation between coin ingots 895 and 902 fine.

The spark, in passing through the air, vaporizes its constituents, namely, oxygen, nitrogen, etc.; these of course write their signatures in the spectroscopic, and it is necessary to eliminate the numerous bright air lines which thus appear in all the spectra. Some of the lines of different metals appear in close proximity, and might readily be misinterpreted. Thus a bright blue line of bismuth is almost identical in position with one of zinc. A green line of iron is nearly coincident with a bright gold line. The difficulty which presented itself in the exact comparison of these proximate lines, was overcome by using a pure metal as one electrode and another pure metal as the other electrode. The effect thereby produced was very curious. With pure gold and pure copper as the electrodes, the gold lines extend across only one half the field of the spectrum, and the copper lines extend across only the other half, the medial termini of both sets of lines being perfectly sharp and bright. By this means a double spectrum of copper and gold is obtained, or rather a section of a complete gold spectrum and a section of a complete copper spectrum are visible in immediate juxtaposition, thereby enabling a most accurate comparison of lines, which in reality are not identical in position, but which by the previous method were apparently so.

By a slight modification of the experiment, substituting pure copper as one electrode and an alloy of silver and gold as the other, the proximate lines of these three metals are presented, mapped, as it were, on a natural scale.

By using as one electrode an alloy of gold and copper of comparative fineness, and a baser alloy of the same metals as the other electrode, a result not before observed presented itself. The lines of both copper and gold crossed the entire field of vision, but in the section representing the fine alloy, the gold lines were strong and bright; while in the section representing the base alloy, the gold lines were very faint.

By now gradually increasing the distance between the electrodes, the faint gold lines of the base alloy cease to join their bright counterparts of the fine metal at the central line.

The general principle was thus satisfactorily proved, that where two alloys of different grades are subjected to this treatment, the gold lines of the baser compound are noticeably the fainter of the two; and what is more important, they may be reduced in length by separating the poles, until they disappear.

Although Mr. Cappel has shown that 0.0162 of a troy grain of gold will show a spectrum, yet a comparatively large proportion of gold may be present in an alloy, the presence of which will not be indicated at all by the spectroscopic.

In a slip composed thus: Silver, 708 parts; copper, 254 parts; gold, 38 parts: the spectra of silver and copper are alone visible.

In fact, in a base alloy of gold and copper containing from 20 to 25 per cent of gold, the gold spectrum is barely visible; while in a fine alloy of gold and copper, it was found that one per cent of the latter suffices to show the copper spectrum. Also in an alloy of nickel and copper, containing 25 per cent of nickel, its spectrum is scarcely visible. It seems evident, therefore, that the spark selects the more volatile metal as its vehicle.

If the spectroscopic fails to reveal the presence of anything less than 200 parts of gold in a base alloy, even a theorist must admit that one could scarcely expect to be able to discriminate with certainty a variation of 1-10,000th in a fine alloy.

For the foregoing reasons, the conclusion seems inevitable, that, in the state of spectroscopic science as it now exists, assaying by means of spectrum analysis is, for the present, impracticable for the purposes of Mint operations.

Although these experiments have resulted negatively from the utilitarian standpoint from which they were undertaken, it is hoped that they may prove not altogether without value in a more general point of view. The fact that quantitative proportions of composite substances may be recognized at all, even to a rough degree, cannot but be regarded as a first step. All observations bearing upon the action of the spectral lines in indicating such proportions are at least worthy of being recorded. Not the least curious of these incidental observations is the fact that, while the spectroscopic is sensitive to the minutest fraction of a grain of gold in the pure state or in solution, it fails to reveal the presence of a much larger proportion in a base alloy. Another is the fact that while the spark appears to select for its vehicle of transmission the more volatile metal in an alloy, and would thus seem to vaporize a greater quantity of the volatile than of the non-volatile component, yet in point of fact the loss of weight by such volatilization is in some instances much less in the former case than in the latter.

The rationale of these apparent paradoxes is not at present evident; but if we may judge by former experiences, in which problems even more mysterious have been resolved by study, we are warranted in anticipating that, when a large number of observations, to be made perhaps by many experimenters groping in the dark, shall be collated, the true scent may of a sudden be struck, which shall discover the desideratum of quantitative spectrum analysis.

A red hot iron passed over old putty will soften it so that it is easily removed.

Barytes Green or Manganate of Baryta.

This salt has been introduced into commerce under the names of Cassel green or Rosenstiehl's green. It has generally been prepared by calcining nitrate of baryta with oxide or peroxide of manganese, or by fusing caustic baryta with manganese and chlorate of potash. The author gives a new method for its preparation. On precipitating a green boiling solution of manganate of potash with chloride of barium, there is formed a deposit, strongly granular but not crystalline. This precipitate is of a violet color, bordering on blue. It is well washed by decantation, and then filtered. When dried, its color becomes paler as the temperature rises. At a dark red heat it is white, with a grayish blue tinge. If heated higher, with access of air, it becomes by degrees completely green, then of a fine blue, and at very elevated temperatures it is converted into a dirty brown gray. If a solution of permanganate of potash is precipitated with chloride of barium, and allowed to boil, there is slowly formed a reddish violet deposit (color of peach blossom), and the liquid retains an intense violet color. The precipitate may be washed by decantation, and filtered without decomposition. It can even be dried at 212° Fahr. without losing its color. When gradually heated, the permanganate of baryta loses its color like the manganate, but at very high temperatures it behaves differently. When its color has once been destroyed by a moderate heat, it does not become either green or blue by further heating with access of air. The whole becomes at once of a grayish brown. The finest barytes green is formed by calcining the manganate of baryta. Rosenstiehl's process—the fusion of hydrate of baryta with chlorate of potash and peroxide of manganese—yields an inferior color.—*E. Fleischer, in Chemical News.*

Carbon Cells and Plates for Galvanic Batteries.

With a sirup made of equal quantities of lump sugar and water, mix wood charcoal in powder with about a sixth part of a light powder sold by colormen, called vegetable black. The mixture should hang thickly on any mold dipped into it, and yet be sufficiently fluid to form itself into a smooth surface. The vegetable black considerably helps in this respect.

Molds of the cells required are made of stiff paper, and secured by wax or shellac. A projection should be made on the top of the mold for a connecting piece. These molds are dipped into the carbon sirup, so as to cover the outside only, and then allowed to dry. This dipping and drying is repeated until the cells are sufficiently thick. When well dried they are then buried in sand, and baked in an oven sufficiently hot to destroy the paper mold. When cleared from the sand and burnt paper, the cells are soaked for some hours in dilute hydrochloric acid, and again well dried, then soaked in sugar sirup. When dry, they are then packed with sand in an iron box, gradually raised to a white heat, and left to cool. Should some of the cells be cracked, they need not be rejected, but covered with paper or plaster and dipped in melted paraffin.

Rods or plates of carbon can be rolled or pressed out of a similar composition, but made thicker. Carbon thus made will be found to have a good metallic ring and a brilliant fracture.—*W. Symons, in Nature.*

Ingenuity of a Spider.

A correspondent writes to *Nature* that a spider constructed its web in an angle of his garden, the sides of which were attached by long threads to shrubs at the height of nearly three feet from the gravel path beneath. Being much exposed to the wind, the equinoctial gales of this autumn destroyed the web several times.

The ingenious spider now adopted a new contrivance. It secured a conical fragment of gravel, with its larger end upwards, by two cords, one attached to each of its opposite sides, to the apex of its wedge-shaped web, and left it suspended as a movable weight to be opposed to the effect of such gusts of air as had destroyed the webs previously occupying the same situation.

The spider must have descended to the gravel path for this special object, and, having attached threads to a stone suited to its purpose, must have afterwards raised this by fixing itself upon the web, and pulling the weight up to a height of more than two feet from the ground, where it hung suspended by elastic cords.

New Compound from Urine.

The substance in question, $C_4H_5N_3O_4$, has a strong resemblance to hippuric acid. It forms white columns of several millimeters in length. Freely soluble in boiling water; sparingly in cold water and spirit of wine; insoluble in absolute alcohol and ether. If heated to 250° Fahr. the crystals experience no change. If more strongly heated, they decrepitate, evolve dense white vapors of a peculiar odor, fuse, and finally burn with the odor of horn. It is neutral to test paper, does not combine with bases, but forms with acids salts which do not readily crystallize, and deliquesce on exposure to the air.—*F. Baumstark.*

ACID IN THE GASTRIC JUICE.—R. Maly finds that the pure gastric juice in dogs contains no lactic acid. The decomposition of chlorides by lactic acid cannot, therefore, be the source of the hydrochloric acid in the stomach. Lactic acid seems to play no part in the chemistry of the normal formation of acids. The source of the free hydrochloric acid in the stomach is a process of dissociation of the chlorides without the action of an acid.

[International Review.]

THE CONSTITUTION OF THE SUN.

BY PROFESSOR C. A. YOUNG.

Number I.

THE CENTRAL CORE.

Probably no subjects of scientific research have ever attracted more attention than those relating to the sun. His preëminence in our system, as the controller of all planetary motions, and the origin and mainspring of all material energy in the earth and her sister worlds, invests with supreme interest every problem concerning his nature and modes of action.

As to the sun's central core, the opinion which now generally prevails, though not without some dissent, is that it is gaseous. The reasons which almost compel this conclusion are easily stated. In the first place, knowing the sun's distance, we readily compute its diameter, which turns out to be nearly 108 times that of the earth, or in round numbers 860,000 miles.* Now, since the bulks of different spheres are proportional to the cubes of their diameters, it follows that the volume of the sun, to use the technical term, is $108 \times 108 \times 108$ times greater than that of the earth; in other words, it would require about 1,250,000 of the earth to make a globe as large in volume as the sun.

According to the best determinations, we find that the sun is about 320,000 times as heavy as the earth; and since, as we have seen, it is a million and a quarter times as bulky, it follows that its average density is less than that of the earth nearly in the proportion of one to four; and this, although we know by means of the spectroscope that conspicuous among the materials of which the sun is composed are metals, whose density, even when not under pressure and in the liquid form, far exceeds that which has been mentioned. For since the earth has a mean specific gravity of about 5.5, it follows that that of the sun is only about 1.4, while the densities of iron, titanium, manganese, chromium, copper, zinc, magnesium, etc., range from 1.75 to 9. Of the substances known to exist in the sun, only sodium and hydrogen are lighter than the sun's mean density. It is to be remembered, also, that since the force of gravity at the sun's surface is twenty-eight times as great as on the earth, the effect of the weight of the strata near the surface, in compressing and increasing the density of the central parts must be correspondingly powerful. As things stand, then, there seems to be no possibility of admitting that the substances which compose the sun are mainly in the solid or liquid state, for in that case the mean density must almost necessarily far exceed that of the earth. This conclusion is strengthened by what we know of the intensity of the heat at the solar surface, where, although exposed to the cold of outer space, we find a temperature sufficient to keep the solar atmosphere charged with the vapors of the metals we have mentioned. We can hardly doubt, therefore, that in the interior of the sun the temperature must be such as to make the existence of the metals in the solid or even the liquid state quite impossible. And yet the theory that they are in a gaseous state is not without difficulties. A few years ago it would have been urged with great plausibility that, under such a pressure as must obtain at the center of the sun, every gas would necessarily be liquefied; and it would have been impossible to meet the objection by any knowledge then in our possession. The recent researches of Andrews have, however, shown that a vapor or gas, if above a certain critical temperature, refuses to be liquefied by any pressure whatever, but, growing denser and denser under the pressure, still maintains its gaseous characteristics, which are continuous expansibility under diminishing pressure without the formation of a free surface of equilibrium, continuous expansion under increasing temperature without the attainment of a boiling point, and, in the case of a mixture of different substances, a uniform diffusion of each through the whole space occupied, according to the law of Dalton and without regard to specific gravity.

These essential distinctions between liquids and condensed gases are often misunderstood; but it is the more necessary to keep sight of them, as in many most important respects the mechanical properties of gaseous matter, condensed by pressure to the specific gravity of water, are identical with those of liquids; especially if at the same time intensely heated—for then, as Maxwell has shown, the viscosity, or power of resisting motions, is greatly increased; so that a mass of hydrogen at the sun's center may very possibly in its mechanical behavior much more resemble pitch than what we are familiar with as gas and vapor.

It must be noted further, and is urged as an objection by many, though we fail to appreciate its force, that if the sun's central core is gaseous, then the temperature at the sun's center must be enormous—to be reckoned in millions of degrees, perhaps millions of millions. If it were not so, even the lightest gas, as hydrogen, at the temperature of the sun's surface, would, by the inconceivable (but not incalculable) pressure, be condensed so as to be hundreds of times heavier than platinum itself. We speak somewhat vaguely, because the numerical conditions of the problem are not very

* Very few, we imagine, get from this bare statement any adequate conception of the vastness of the solar orb. Conceive the earth placed at its center so that the inner surface of the photospheric shell should be our sky; then the moon, which is distant nearly 240,000 miles, would pursue her accustomed orbit far within the bounding sphere; and indeed, if the earth had a second satellite at almost twice the moon's distance, this also would come within our ken.

accurately known, though the general correctness of the result is certain. Heat, of enormous intensity, can alone counteract this effect, and give us the small density observed. For our own part, considering what we know of the amount, constancy, and permanence of the sun's radiation, we find no difficulty in conceding any internal temperature which may be necessary to account for the facts.

[The Telegraphic Journal.]

ELECTRO-DEPOSITION OF METALS.

BY J. T. SPRAGUE.

Number I.—PREPARATION OF THE ARTICLES.

The depositing of metals in the various forms required in the arts depends upon the practical application of the theoretical principles which have been frequently explained. The processes divide themselves into two general groups: 1. Electrotyping, the forming of a mass of metal intended to have a distinct existence of its own, and requiring therefore to possess a certain amount of strength or coherence. 2. Electroplating, in which a mere film of metal is to be employed as a covering to another metal, to beautify it or to protect it from atmospheric influences.

The essential distinction between the two processes is that in electroplating the two metals are desired to be brought into absolute molecular contact, so that they shall form one body, mechanically considered; this depends entirely upon the absence of any intervening substance, that is to say, upon the absolute cleanness of the surface to be coated. Under ordinary circumstances, every surface is coated with a very strongly adhering film of air, which appears to condense among the superficial molecules, and cling, as we see liquids do, to those surfaces which they can wet. This coating of air will prevent adherence unless it is very carefully removed; most metallic surfaces form either oxides or sulphides, and of course all collect a greasy film from the air, and the first and most essential operation is the removal of all these impurities, so as to present a pure metallic surface to the new metal to be incorporated with it.

In electrotyping, on the other hand, it is necessary to ensure the presence of an intervening film, which, while not resisting ordinary contact, will prevent true chemical or molecular contact. To effect this, after the surface to be deposited on (if metallic) is properly cleaned from everything which would deface the deposit, it should be lightly rubbed over with a leather or cloth moistened with turpentine in which a little beeswax has been dissolved—a piece the size of a pea to a quarter of a pint of turpentine will suffice—to prevent adhesion without filling up fine lines, etc.

The process of cleaning varies according to the nature of the objects and the solutions they are to be used with; these processes are mechanical and chemical. In mechanical cleaning, it is desirable, if the objects will permit, to expose them first to a red heat, and then to rub and polish them thoroughly by means of suitable brushes and polishing substances. The best apparatus for the purpose consists of circular brushes mounted on a spindle, driven by machinery or by a lathe. Circular pieces of wood, faced with leather, are also useful, as also the blocks of solid emery now so much used for grinding and polishing metals. A substitute for the latter may be usefully made by soaking a leather facing with glue, and coating well with emery, turning the wheel when nearly set against a roller, so as to consolidate the surface.

Most articles, however, are more rapidly and conveniently cleaned by chemical means. The first of these is the removal of grease by boiling in a solution of caustic soda, made by boiling 2 lbs. of common washing soda and $\frac{1}{2}$ lb. quicklime in a gallon of water; after this they should be well brushed under water. The further processes will depend upon the nature of the objects.

1. Silver is washed in dilute nitric acid, then dipped for a moment in strong nitric acid, and well washed. Care must be taken that the water does not contain chlorine salts; if the ordinary supply does so, the first rinsing after acids must be made in water prepared for the purpose by removing the chlorine by adding to it a few drops of nitrate of silver, and allowing the chloride to settle.

2. Copper, brass and German silver are washed in a pickle of water 100 parts, oil of vitriol 100 parts, nitric acid (sp. gr. 1.3) 50 parts, hydrochloric acid 2 parts. Spots of verdigris should be first removed by rubbing with a piece of wood dipped in hydrochloric acid; they are then rinsed in water.

3. Britannia metal, pewter, tin, and lead cannot be well cleaned in acids, but are to be well rubbed in a fresh solution of caustic soda, and passed at once, without washing, into the depositing solution, which must be alkaline.

4. Iron and steel are soaked in water containing 1 lb. oil of vitriol to the gallon, with a little nitric and hydrochloric acids added. Cast iron requires a stronger solution, and careful rubbing with sand, &c., to remove scale and the carbon left by the acids. It is an advantage at times to connect them to a piece of zinc while cleaning. These metals should be cleaned just before placing in the depositing cell; and if they are placed in an alkaline solution, they should be rinsed and dipped in a solution of caustic soda, to remove all trace of acids.

5. Zinc may be cleaned like iron, with a dip into stronger acids before the final washing.

6. Solder requires special care, as the acids used with the objects produce upon it an insoluble coating, and an obstinate

resistance to deposit is set up at the edge of the solder. The same remark applies to soft metal edgings and mounts. These should be rubbed with a strong caustic soda solution, rinsed, and then treated as follows:—Make a weak solution of nitrate of copper by dissolving copper in dilute nitric acid; to a camel hair or other soft brush, tie three or four fine iron wires to form part of the brush; dip this in the nitrate of copper, and draw over the solder, taking care that some of the iron wires touch it; a thin adherent of copper will form, and upon this a good deposit will take place.

7. Old work for replating must have the silver and gold carefully removed; if this is not done, there is apt to be a failure of contact at the edges of the old coatings, which causes blisters and stripping under the burnisher. The best mode of stripping is with the scratch brush, etc., as described for mechanical cleaning, but chemical means may be used: Gold is dissolved by strong nitric acid, to which common salt is gradually added; it may be collected afterwards by drying and fusing with soda or potash. Silver is similarly dissolved by strong sulphuric acid and crystals of saltpeter, and recovered by diluting and precipitating with hydrochloric acid, then reducing the chloride either by fusion with carbonate of soda, or by acid and zinc cuttings. Copper can be removed from silver by boiling with dilute hydrochloric acid, and tin and lead by a hot solution of perchloride of iron.

In preparing articles for silvering and gilding, a process of amalgamation is very commonly employed, by which a very thin film of mercury is formed over the surface, which makes a perfect connection between the two metals; this is effected by a solution of one ounce of mercury in dilute nitric acid, and then diluted to one gallon; there must always be a little free nitric acid present; articles dipped in this solution take a grayish color, which on brushing under water becomes a brilliant mercury surface. They must be at once transferred to the solution for coating, without exposure to the air. In the case of iron or steel articles, a similar process may be used, but in this case it is best to add to the solution an ounce of silver also dissolved in nitric acid. It requires great care to obtain a perfect mercury surface upon iron; occasionally sodium amalgam is rubbed over iron for this purpose; the iron must be very perfectly cleaned first.

Street Cars Propelled by Springs.

The winding-up of the spring barrels, which are carried under the car, is effected by engine power, located at suitable intervals along the track, as may be convenient for the run. The stationary engine drives by belt the horizontal shaft, carried in bearings, enclosed in a metallic tube or casing, beneath the roadway, and extending across the track; close alongside whereof a covered box is sunk in the roadway, enclosing a wheel, so shaped as to connect with the winding axle of the tramway car, and thus give the requisite motion thereto. On the arrival of a car at any station, the spring barrels are quickly wound up by the engine.

It has been computed that the actual tractive force, requisite to overcome the resistance of a street car weighing gross 5 tons, is 60 lbs. on the driving wheels, corresponding to 720 lbs. on the periphery of the spring barrel; 24 lbs. and 288 lbs. respectively correspond to a gross weight of 2 tons; and in like proportions for intermediate weights. So far as previous experience goes, a spring 6 lbs. in weight, exerting a direct pressure of 105 lbs., may be taken to represent the maximum in size and power of such steel springs. Under the stimulus applied by M. Leveaux's researches, the steel manufacturers of Sheffield, by special and improved plant, annealing ovens, and appliances, have turned out springs 30 to 60 feet long, capable when duly coiled of exerting a pressure of 800 lbs. to 900 lbs., without permanent set. In France, also, steel driving bands, with great elasticity, are made, 100 yards in length, so that the question of the possibility of obtaining springs of the requisite size and power is practically solved.

M. Leveaux has had all the necessary mechanism and appliances made by a well known firm of engineers, so as to fit up a tramway car or cars for actual trial upon some of the lines of metropolitan tramways in London; for which indeed, the arrangements are now nearly complete, so that the practical working of the system will speedily receive a thorough public demonstration. We have ourselves had opportunities of seeing the potentialities of the principle, both in the model and full working size; and even in view of the sweeping change in the tramway system which is involved in its complete success and adoption, we cannot withhold the conviction that all the important practical difficulties have been effectually surmounted, reducing its practical realization to mere matters of detail. The working of the springs is entirely free from noise, perfectly smooth, easy, and effective, and completely under control, for application, cessation, and reversal.—*Iron.*

Wood Cutting by Electricity.

Professor Barnard, of Columbia College, writing to the *New York Times*, as an item of recent scientific news, says that the Abbé Moigno, in a recent number of his periodical, entitled *Les Mondes*, describes an invention which, he says, has recently been patented by Mr. George Robinson, of New York, for sawing wood by an entirely new, and what seems a sufficiently odd process. The process consists in substituting instead of the saw a platinum wire, heated white hot by means of an electric current, etc.

The original account of this invention was published in the *Scientific American*, June 22, 1872. It was patented here in May of the same year.

Machinists in the Navy.

A regulation circular has just been issued from the Navy Department, defining more clearly the qualifications requisite for the position of machinist in the navy, as well as the pay and duties. There are three ratings established, namely, machinist, boiler maker, and coppersmith. The last two are on a level, so far as pay is concerned, and promotion lies from these grades to that of machinist, when sufficient proficiency is shown. Candidates for any position must be between the ages of twenty and forty years, and must successfully pass an examination in the presence of the commanding officer of any rendezvous or recruiting station, as to qualifications. There is also a medical examination, touching physical fitness, to be undergone.

Boiler makers and coppersmiths are examined solely as to their suitability for such special ratings. A machinist must be able to read and to write with sufficient correctness to keep a steam log of his watch. He must know the names of the various parts of a marine engine; understand the uses and management of the various gages, cocks, and valves, the mode of raising steam and starting and regulating the action of the engine. He must also know how to ascertain the height and density of water in the boilers; how to check foaming, regulate the quantity of injection water, to guard against water in the cylinder, and against all dangers to the generators; understand what measures are to be taken in cases of hot journals; and, in short, know how to act upon the occurrence of any of the ordinary casualties of the engine room. In matters of repairs, the candidate is to be examined on the ordinary overhauling and repairing of machinery, the packing of the various joints and rods, grinding of valves, putting on hard and soft patches, putting in and plugging tubes, and all other work required in the management of marine engines.

The regular pay of a machinist is \$75 per month; of a boiler maker, \$40; and of a coppersmith, \$40. To this is added \$109 per year rations, and \$18 extra per President's order; so that the aggregate annual salary of a machinist is \$1,027, and of a boiler maker or coppersmith is \$607.

The relative position of men enlisted for the above grades is that of petty officer—about the same as non-commissioned officer in the army. The duties are regular watch in the engine and fire room, managing the engines and boilers (of course, under the direction of the regular engineer officers of the ship). The pay is higher for machinist than that of any other petty officer; and, when it is considered that quarters are found, the recipient having only to supply his mess and uniform (which may be done at a very moderate sum), it will be seen that every opportunity is afforded for saving.

Cruising vessels on regular squadrons are at sea for a large proportion of their time, when no chance exists for spending money. In port, a moderate amount of liberty is granted to those whose duties do not interfere with the privilege. There is an excellent system of allotment in the service, whereby a man, before he leaves home, may authorize the paymaster of the station nearest his domicile to pay, to his wife or friends, a certain proportion of his pay. This amount is then out of his control, and will be deducted from his salary by the paymaster of his vessel.

DECISIONS OF THE COURTS.

United States Circuit Court.—Southern District of New York.

PATENT REFRIGERATOR.—THE LYMAN VENTILATING AND REFRIGERATOR COMPANY vs. WILLIAM LALOR.
[Decided September 19, 1874.]

BLANCHFORD, J.:

This suit and several others are brought on reissued letters patent granted to Stephen Cutter, March 19, 1874, for an "improvement in methods of cooling and ventilating rooms." The title to this patent is vested in the plaintiff for the whole of the United States, except the eastern district of New York, and that part of the city of New York lying westerly of Broadway and Fifth avenue, and a few counties in New Jersey, the title for such excepted territory being vested in the Lyman Patent Refrigerator Company. The original letters patent were granted to Axel S. Lyman, as inventor, March 22, 1872, and were extended for seven years from March 22, 1879, and were reissued to Lyman, December 26, 1871, and were then assigned to said Cutter, and reissued to him, as above stated, March 19, 1874.

The first claim of the reissue sued on is in these words: The combination of a descending conduit or cold air flue, or either, with a reservoir for containing cooling materials, substantially in the manner and for the purposes described. This claim differs only in the addition of the words "or either" from the first claim of the reissue of 1871. The first claim of the reissue of 1871 was contained in two suits in equity, on final hearing: one before Judge Hall, in the northern district of New York, in March, 1873 (Lyman vs. Myers), and the other before Judge Benedict, in the eastern district of New York, in January, 1874 (The Lyman Patent Refrigerator Company vs. Oswald). In both of these suits it was sustained against the alleged prior invention of Thaddeus Fairbanks, in the eastern district of New York, in March, 1873, and rejected February 6, 1874, and withdrawn July 27, 1874. Long after such withdrawal, John C. Schooley obtained from Fairbanks, for the sum of five dollars, an assignment of Fairbanks' alleged invention, and an application was again made for a patent for it, and a patent was granted to Schooley, as assignee of Fairbanks, August 12, 1875. Judge Benedict, in the case against Oswald, says: The proof shows that Fairbanks abandoned his invention long prior to the issue of the patent upon it. His application for a patent, made in 1846, was rejected on the 27th of July, 1847, and he then withdrew his application. No subsequent effort to obtain a patent or preserve his invention or to put it in use appears ever to have been made by him. The patent for the invention, subsequently issued August 12, 1875, was obtained by one Schooley, as assignee of Fairbanks, who obtained an assignment of the invention from the application and abandonment of the invention by Fairbanks, the inventor.

To this it may be added that, on the present motion, nothing is shown in reference to the invention of Fairbanks, except the papers from the Patent Office and an affidavit by Schooley, showing the foregoing facts. It is not shown that, prior to the date of the original patent to Lyman, much less prior to the date of Lyman's invention, a refrigerator was actually constructed embodying what was set forth in the application of Fairbanks. The alleged invention of Fairbanks, as anticipated by Lyman, must, therefore, be laid out of made in 1846 and rejected and withdrawn in 1847, it is well settled that a not been given to the public, does not constitute an invention within the meaning of the patent laws. Evidence that such a description was made does not show, of itself, a prior invention. Such a description has not the same effect as a printed publication. It lacks the essential quality of such publication, even though deposited in the Patent Office, it is not designed for general circulation, nor is it made accessible to the public generally, being so deposited for the special purpose of being examined and passed upon by the Patent Office, and not that it may thereby become known to the public. Allusion of it, within the meaning of the statute or the law. Moreover, although the description may be so full and precise as to enable any one skilled in the art to which it appertains to construct what it describes, it does not attain the proportions or the character of a complete invention until it is embodied in a thing as the Philadelphia Fire Extinguisher Company, 6 Official Gazette of Patent Office, 31.

In answer to the present motion for injunction, various other alleged prior inventions are set up.

I have carefully considered all the matters presented in these cases, and am of opinion that the injunction asked for must be granted as to the first claim of the patent.

[John J. Allen and Edward J. Cramer, for the plaintiffs.
Edward N. Dickerson and Charles C. Bennett, Jr., for the defendants.]

United States Circuit Court, District of Maryland.

PATENT GLASS FURNACE.—FREDERICK G. SCHAU, ADMINISTRATOR OF FREDERICK SCHAU, DECEASED, vs. CHARLES J. BAKER, et al., TRADING AS BAKER, BROS. & CO.

An assignment by a bankrupt carries with it all patent rights which the insolvent owns at the time of making the assignment; but does not include his inchoate right to an extension of a patent under the law of 1880.

The plaintiff proved that his intestate, Frederick Schau, was the first and original inventor of certain new and useful improvements in the construction of glass furnaces, for which letters patent were granted to his said intestate on the 25th of April, 1854, application therefor having been made on the 7th of June, 1853. That said letters patent were extended to plaintiff, under the act of 1880, section 15, on the 23d day of April, 1868.

The improvement claimed was the making of the external and internal configuration of the breastwork of the furnace wall with re-entering portions, so as to partly embrace the pots, and, secondly, to furnish room for additional or extra teaze or ring holes, more than were to be found in the glass furnaces known and constructed at or before the date of the patent.

That the plaintiff was entitled to recover, if the jury should believe that the plaintiff's intestate was the first and original inventor of a new and useful improvement in glass furnaces, for which he received letters patent, and that said letters patent were extended to the plaintiff, the administrator of the original patentee, then deceased; and should further find that the defendants had, since the granting of said extension, and since July 1st, 1872, constructed and used a glass furnace or furnaces, substantially embracing the improvement described in said letters patent.

That in considering the question of utility in the preceding instruction, the jury are instructed that the fact of extensive use by defendants and others is evidence of such utility.

That if the jury believe that plaintiff's intestate, Frederick Schau, in 1854, applied for the benefit of the insolvent laws, and made an assignment to his permanent trustee, the plaintiff is not entitled to recover for breaches of the original patent.

The defendants also offered the following prayer, which the Court rejected: That if the jury find that the said Frederick Schau applied for the benefit of the insolvent laws of Maryland in 1854, and that William Geo. Read was duly appointed his trustee, then all the interest of said insolvent in said patent, and his right to an extension, passed to said trustee, and the plaintiff is not entitled to recover.

Verdict for plaintiff.

T. Alex. Seth and Harry E. Mann, for plaintiff.
Fred. W. Brune and Fred. J. Brown, for defendants.

Recent American and Foreign Patents.

Improved Trap and Cesspool Cover.

John Peter Schmitz, San Francisco, Cal.—The object of this invention is to provide a combined trap and cover for cesspools, to prevent foul air or odors escaping from the sewers. The frame or trap case is arranged to be on a level with the sidewalk, resting with its rim on the wall of the cesspool, its lower end sloping, and having a solid rim whereon the smooth flap, with its elastic lining, forms a tight joint when held up by a weight which is detachably connected with it.

Improved Wheel.

Henry Gwynn, Baltimore, Md.—This invention relates to certain improvements in wheels, and it consists in a socket plate cast in one piece with the shell or hub, and having triangular sections, forming sockets which are deepest and widest at the point where the spokes are introduced, in combination with an annular plate and nut, and the spokes having inclined ends and sides.

Improved Cultivator.

James M. Holladay, Twyman's Store, Spottsylvania county, Va.—This invention relates to certain improvements in cultivators, and it consists in the peculiar construction of right angular standards in combination with a metallic frame of double bars and break pins for fastening the said standards therein. It consists further in the peculiar construction of an adjustable bifurcated draft hook, and a brace on draft bar, in combination with the frame and standards.

Improved Stove.

Alexander Hamilton, Cresco, Iowa, assignor of one half his right to Aug. Beadle and Benj. Huntington, same place.—In this stove, straw, hay, or grass may be packed or compressed so as to burn slowly, and thus be profitably utilized as a fuel. Inside is a press follower adapted to be raised up to the top of the fire chamber, and receive fuel under it from a tubular feeder, and then be forced down on the fuel to press it into a dense mass. Shafts are provided for raising and lowering both the follower and the grate, and have a ratchet and pawl upon the outside of the stove to hold them at any required point.

Improved Child's Carriage.

Charles F. Lauer, Pittsburgh, Pa.—This invention consists of a front bolster for a carriage for children, having a vertical socket in the center with a coiled spring in it, contrived for affording the necessary elasticity for the easy working of the carriage, and also for allowing the necessary oscillation of the front axle for running over uneven surfaces. The sockets, together with the clips, embrace the axle and the arms for bolting the bolster to the frame pieces, and are all cast in one piece. The socket is so contrived that a single spring serves for affording the elasticity and for laterally supporting the body.

Improved Hod Elevator.

William Mullen, New York city.—This is a sliding elevator frame with top cross bar and lateral side arms, supporting, at suitable height above the lower end of the sliding side bars, longitudinal connecting bars with forked and inclined hod-supporting pieces or carriers. The last are suitably concealed along the recessed parts for bearing the collars attached to the hod shanks, and admitting the ready swinging of the hods away from or on to the elevator frame.

Improved Heating Stove.

Edward E. Gold, Brooklyn, N. Y.—This is a fireplace heater adapted for use as an ordinary stove. The fire pot is surrounded by large vertical tubes extending through the top and bottom plate for heating air. A curtain extends from the top plate nearly to the bottom plate, between the tubes and the outside plate, for causing the heat to pass from the upper part of the fire space and the heating tubes, to which it first rises, down along said tubes to the bottom before escaping from them, so as to heat the tubes and the air passing through them. Said heater also has a wide open front, with sliding illuminated doors, whereby it can be used for an open or closed fire.

Improved Glass Furnace.

Samuel Richardson, Brooklyn, N. Y.—The two compartments of a double glass melting furnace are made in a single stack by separating the ordinary furnace with a double partition, with an air space for keeping one side cool while the other is hot. There is a passage through the floor of the oven to a pit below, for receiving the glass which escapes from the pots, and a passage in the floor leading to the pit. By making the furnace double, it enables the temperature in one part to be lowered greatly for tempering the melted glass suitably for working properly, while a higher heat is maintained in the other for melting the glass, thus enabling the melting to be carried on in one part while the working of the glass is going on in the other part.

Improved Whip Socket.

Henry A. Matthews, Waterbury, Conn.—This invention consists of spring hooks, combined with the socket, and contrived to hook it to the dash-rail detachably. The said hooks are made of double springs of flat metal attached to side of the socket.

Improved Watchman's Time Check.

Theodore Hahn, Stuttgart, Germany.—This invention consists of the arrangement of a dial in connection with a disk, rotated by the action of the keys at the various stations on a ratchet wheel at the underside of the same, to produce the forward motion simultaneously with the action of the keys on the spring-marking device.

Improved Mechanical Movement.

Robert E. Brand, of Plainfield, N. J.—This is a mechanical movement by which rotary motion may be readily transmitted from the driving wheel of a machine to an upright shaft placed in position under any angle of the quadrant, for the purpose of being used in hat ironing, polishing, and similar machines.

Improved Apparatus for Loading Cars and Vessels.

George Barclay, Fayette, Mich.—In carrying the freight up an inclined plane, the forward wheels run from the machine on to a platform, while a raised or curved portion of the truck prevents the rear wheels from following. When the truck reaches the top of the incline, the rope ceases to draw it forward, and after it is discharged the rope will tip down the back end to allow the forward wheels to regain the track.

Improved Machine for Rounding Leather.

Laken D. Williams, Bethel, Ky, assignor to himself and James E. Letton, same place.—One of the two standards is made low, and to it is hinged a bar, the ends of which are bent downward nearly at right angles to meet the ends of the posts. The other end of the bar is rabbeted upon both sides to form a tenon, which enters a vertical slot formed in a higher post, where it is secured by a key. The journals of an upper roller revolve in half bearings in slots in the bent-down ends of the bar.

Improved Windlass Water Elevator.

George G. Howe and Silas L. Heywood, Faribault, Minn.—The invention consists in a chain wheel, formed with a double rim, connected by cross bars, and having alternate high and low ribs or lugs formed upon its sides, and arranged in pairs, to give a zigzag direction to the chain. There is also a double pawl, arranged with a ratchet wheel attached to the shaft that carries the chain wheel, to cause the said pawl to be shifted by the tilting buckets. To the upper edge of the buckets is attached a metallic ring cap, to prevent the mouths of the buckets from being worn by the wire, and to cause said buckets to move more readily when being tilted.

Improved Railway Car Brake.

Moses P. Kimball, Randolph, Mass.—Two sleeves work loosely upon the axle. Upon one end of the sleeves is formed a part of a friction clutch, the other part of which is attached to and revolves with the axle. By this construction, when the sleeves are moved up to the clutch, they will be revolved by friction, and will wind up chains applying both brakes.

Improved Lock Spindle.

Albert Kirks, Canton, Ohio.—This invention is a combination of a spindle having a double conical form at or about the center, and recessed laminæ of the safe door with elastic packing rings, applied to said spindle on opposite sides of the point of largest diameter. This prevents breaking open the safe by introducing gunpowder in the door.

Improved Horse Hay Rake.

Samuel G. Hurlbut, South Union, Ky.—The heads, to which the spring tines are applied, are pivoted to a rock shaft, operated by a lever mechanism, so that the tines may be raised and the hay dumped by the driver. The rock shaft is provided with guide plates, so that the heads may be thrown to either side of the shaft. A stop flange, at the rear end of each guide plate, defines the angle of greatest inclination of heads and rock shaft, while a spring pin and hand lever, operated by the driver, locks in perforations of the guide plates and secures thereby the heads and tines at any suitable angle to the rock shaft.

Improved Nut Lock.

Finis L. Bates, Carrollton, Miss.—This nut has a screw thread which does not extend through the nut, but acts as a smoother to cut the outer threads from the bolt and bind the nut.

Improved Device for Multiplying Motion.

Francois Marie Eugene Heimer, Nancy, France.—This invention consists in a means for multiplying motion by utilizing the increased velocity of a secondary rotation produced in a sliding connection moving on one side in a guide attached to an actuating axis, and on the other in a guide at right angles to the first, upon an axis placed in a different plane from the first. The sliding connection is of such construction as to keep the two guides at the same angle to each other, by means of which the two guides revolve in the same direction with the same velocity. The connection also runs a circumference, the diameter of which is the distance between the axis of the two guides, and with a velocity twice that of the said guides and actuating shaft.

Improved Heel-Polishing Machine.

Charles H. Helms, Poughkeepsie, N. Y.—Upon vibrating a bar back and forth, arms are moved over the surface of an arch, which gives the polishers a corresponding motion on the heel. The heel is raised up to the polishers, when the shoe has been affixed to the slide, by means of a foot lever. The arch and arms are heated to a high temperature, and the polishers are raised to the desired temperature by heat conductors therefrom. The heel is held rigid while receiving the polish.

Improved Rock Drill.

William Hoar, Floyd, Iowa.—The main portion of the drill is attached to the shank by means of a socket and screw. A section has a long mortise and a wing on each side, secured by a tenon, which extends half way through the mortise, and fills it in length and width. Through each of the wings are two mortises, which receive each a gib and key. The outer ends of these mortises are made angular, and the gibs are made to fit, so that they cannot work longitudinally when the keys are driven, while angular portions serve to hold the two wings together. The wings as well as the main part have each a cutting edge with right-angled lips.

Improved Ironing Machine.

George Francis Perrenet, Rockport, Tex.—The ironing board is arranged to articulate in ways, said board having one end connected by a chain to a drum, and the other end similarly connected to another drum. The chains pass over a guide plate, which keeps them from interfering with the driving shaft. These drums are mounted on a tilting frame. Stops alternately strike a lever on opposite sides, tilt the frame so as to bring first one pinion and then the other into connection with a spur wheel. The iron is connected to arms mounted on a post, so as to move up and down to some extent, and has a spring and a lever to pull it down and press it on the board, and also a cam lever, to raise it up and hold it by a button.

Improved Sewing Machine.

Chaim Groubman, Odessa, Russia.—The needle bars are connected with an actuating rock shaft by means of a wrist pin and vibrating arm, the latter having a slot in its free end in which the pin works. The object of the invention is to distribute the wear or friction incident to such connection of the needle bar and rock shaft arm over a larger surface, and to furnish a guide for the needle bar in its reciprocating movement. Two rectangular blocks are pivoted on the pin of the needle bar, one of which slides vertically in a groove of the head of the machine, and the other in the slot of the arm of the rock shaft.

Business and Personal.

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

Agricultural Implements, Farm Machinery, Seeds, Fertilizers. R. H. Allen & Co., 129 & 131 Water St., N. Y.

Wanted, Foreman—One who thoroughly understands the manufacture of Planing Mill Machinery. Address, with references, M. B. Cochran & Co., Pittsburgh, Pa.

Iron Planer Wanted—2nd hand—In good order, to plane from 3 to 5 feet. State lowest cash price, how long used, and what tools can be had with it. Address White Manufacturing Company, Bridgeport, Conn.

For Sale—One second hand Gear's Planing, Moulding, Carving, and Dovetailing Machine. M. B. Cochran & Co., Pittsburgh, Pa.

F. W. Hopkins, Wilmington, Del., makes Machines for Pulverizing Manure, &c. Satisfaction, \$100.

The manufacturer of Waterproof Leather made of Leather pulp, said to be manufactured in Massachusetts, will please send particulars and price to E. Forum, care of Todd & Co., Lock Box 56, New Orleans, La.

The Best made Match Splint Machine in the U. S. for sale at a bargain. Apply at once. H. M. Underwood, Kenosha, Wis.

"Scientific American," from September, 1846, to December, 1871, for sale. Address P. O. Box 5620, N. Y.

E. & H. H. asks for a Gas Heater or Cresset, to heat the inside of barrels while being made. Address Box 773, New York City.

Every metal worker should have a Universal Hand Planer. For Catalogue, J. E. Sutterlin Mfg. Co., Duane Street, New York.

Notice—500 Agents wanted. New articles of merit for housekeepers—used every day, or 1500 hundred times a year. G. J. Capewell, Cheshire, Conn.

John W. Hill, Mechanical Engineer, Dayton, Ohio. Drawings, opinions, and advice.

The Mystic Puzzle, or the Yankee's Dream, sent by Mail. Address, with 25 cts., F. & J. Barnes, Rockford, Ill.

Price only three dollars—The Tom Thumb Electric Telegraph. A compact working Telegraph Apparatus, for sending messages, making magnets, the electric light, giving alarms, and various other purposes. Can be put in operation by any lad. Includes battery, key, and wires. Neatly packed and sent to all parts of the world on receipt of price. F. C. Beach & Co., 263 Broadway, New York.

For full description of the most useful and amusing article in the world, for a present, address, with stamp, W. F. & J. Barnes, Rockford, Ill.

Wanted—A practical Machinist, as Superintendent in a large Manufacturing Establishment in Philadelphia. He must have had some experience in all kinds of Iron and Wood Work; be able to design work and direct men. None but a first class man need apply. Address P. O. Box 1269, Philadelphia, stating age, where last employed, reference, and expected salary.

Cast Iron Sinks, Wash Stands, Drain Pipe, and Sewer traps. Send for Price List. Bailey, Farrell & Co., Pittsburgh, Pa.

Engines and Boilers a Specialty—let class: new patterns; late patents; reduced prices. Plain and Cut-off Horizontal and Vertical Engines; Hoisting Engines; the celebrated Ames' Portable Engines; Boilers of all kinds; Climax Turbine; and the best Saw Mill in the market. Large stock always on hand. Hampson, Whitehill & Co., 28 Cortlandt St., New York. Works at Newburgh, N. Y.

Pratt's Liquid Paint Dryer and White Japan surpasses the English Patent Dryers and Brown Japan in color, quality, and price. Send for descriptive circular to A. W. Pratt & Co., 33 Fulton Street, New York.

Rue's "Little Giant" Injectors, Cheapest and Best Boiler Feeder in the market. W. L. Chase & Co., 93, 95, 97 Liberty Street, New York.

For Solid Wrought-Iron Beams, etc., see advertisement. Address Union Iron Mills, Pittsburgh, Pa., for lithograph, &c.

Many New England Manufactories have Gas Works, which light them at one fourth the cost of coal gas. For particulars, address Providence Steam and Gas Pipe Co., Providence, R. I.

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Scale in Steam Boilers—I will remove and prevent Scale in any Steam Boiler, and make no charge until the work is found satisfactory. George W. Lord, Philadelphia, Pa.

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For small size Screw Cutting Engine Lathes and Drill Lathes, address Star Tool Co., Providence, R. I.

Mechanical Expert in Patent Cases. T. D. Stetson, 23 Murray St., New York.

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All Fruit-can Tools, Ferracuts, Bridgeton, N. J.

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For Surface Planers, small size, and for Box Corner Grooving Machines, send to A. Davis, Lowell, Mass.

The "Scientific American" Office, New York, is fitted with the Miniature Electric Telegraph. By touching little buttons on the desks of the managers, signals are sent to persons in the various departments of the establishment. Cheap and effective. Splendid for shops, offices, dwellings. Works for any distance. Price \$6, with good Battery. F. C. Beach & Co., 263 Broadway, New York, Makers. Send for free illustrated Catalogue.

For best Presses, Dies, and Fruit Can Tools, Bliss & Williams, cor. of Plymouth and Jay, Brooklyn, N. Y.

Eames Patent Molding Machines, for Metal Castings. Saves fully one third in cost of labor of molding, and secures better work than the ordinary method. For Circulars, address P. & F. Corbin, New Britain, Conn.

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Peck's Patent Drop Press. For circulars, address Milo, Peck & Co., New Haven, Conn.

Small Tools and Gear Wheels for Models. List free. Goodnow & Wightman, 25 Cornhill, Boston, Mass.

Danbury, Wilkes Co., Ga.—Makers of Small Agricultural Engines will please send me Price List and Descriptive Circular. D. B. Cade, Jr.

Magic Lanterns and Stereopticons, all sizes and prices. Views illustrating every subject for Parlor Entertainment and Public Exhibitions—a profitable business for a man of small capital. Catalogues free. McAllister, Man'g Optical, 43 Nassau St., New York.

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Salamander Felt—Leading manufacturers pronounce Salamander Felt the only indestructible and best non-conducting covering for all heated surfaces. A. G. Mills, Manager, 23 Dey St., New York.

Steel Lathe Dogs, 14 sizes, and 7 sizes of Steel Clamps. The Best and Cheapest. Send for Circular and Price List to Phila. Hydraulic Works, Evelyn St., Phila.

Saw Ye the Saw?—\$1,000 Gold for Sawmill to do same work with no more power Expended. L. B. Cox & Co., 197 Water St., N. Y.

Electric Bells for Dwellings, Hotels, &c.—Most reliable and cheapest Hotel Annunciator. Cheap telegraph outfit for learners. Instruments for Private Lines, Gas Lighting Apparatus, etc. J. H. Heslin, Sec., Cleveland, O.

Portable Engines, new and rebuilt 2d hand, a specialty. Engines, Boilers, Pumps, and Machinist's Tools. I. H. Shearman, 45 Cortlandt St., New York.

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Best Philadelphia Oak Belting & Monitor stitched. C. W. Army, Manufacturer, 33 & 35 Cherry St., Philadelphia, Pa. Send for new circular.

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For First Class Steam Boilers, address Lambertville Iron Works, Lambertville, N. J.

Wanted for All Steam Boilers—A great economizer for Fuel. Send for Circular. George E. Parker, Man'g of Light Machine Work and Brass Founder, 117 & 119 Mulberry St., Newark, N. J.

Diamond Carbon, of all sizes and shapes, for drilling rock, sawing stone, and turning emery wheels, also Glaziers' Diamonds. J. Dickinson, 64 Nassau St., N. Y.



(1) C. C. asks: Is there any way to render silicate of soda insoluble, so as to resist the action of rain water? A. There is no known method for this.

(2) C. L. W. asks: What will neutralize the effect of nitric acid upon clothing? A. Aqua ammonia, if promptly applied.

Will two electro-magnets (the two unlike poles being opposite) attract each other with more force than one electro-magnet will attract a piece of iron with? A. No, if the other conditions are the same.

(3) C. D. asks: How am I to proceed to electroplate in iron? A. Use the protosulphate or neutral chloride of iron, with an iron electrode.

(4) T. B. C. asks: 1. Has a steam boiler ever been constructed so as to be heated by electricity? A. No. 2. My idea is to have coils of platinum wire traversing the boiler and attached to batteries of sufficient power to generate the heat. Is this practicable? Can sufficient heat be generated? A. Your idea is totally impracticable.

(5) W. M. asks: Can you tell me why the English telegraphs are run on the open circuit and the American on the closed circuit, and which is the most economical? A. The original telegraph in England was the Cooke and Wheatstone's needle telegraph, which was worked by reversals of the poles and necessitated the use of the open circuit, with batteries at each station. When the Morse came into use, they still adhered to the open circuit feature. In this country, the open circuit plan has been used quite extensively, and is still employed to work the duplex and quadruplex systems. The open circuit plan is the most economical.

(6) W. E. W. asks: How can I become a good practical architect? A. The best way is to serve a regular novitiate in the office of an architect of good standing, in which you will become acquainted with the requirements of the profession, and have access to his library.

(7) M. B. asks: 1. What would be the width of the torrid zone if the axis of the earth were inclined 30° instead of 23½°? A. Sixty degrees. The sun's greatest declination is 23° 27' 22", and is diminishing 1/4 second annually. 2. We are situated at about 40° north latitude. As the sun never gets farther north than the Tropic of Cancer, why is it that the sun appears to rise north of us in the summer? A. At the summer solstice, in latitude 40°, the ecliptic meets the N. E. by E. horizon.

(8) C. H. A. asks: 1. How is the sphericity of the earth proved by the appearance of clouds on the horizon? A. Lines of true level are curved, and differ from straight sight lines of apparent level one eighth of an inch in a sight of one eighth of a mile. 2. How can it be shown by canal level? A. The dip of the horizon at sea when the height of the eye is three feet is 1' 42"; when the eye is elevated 17 feet, it is 4' 3".

(9) B. D. R. asks: 1. How many times does the strongest magnifying glass now known magnify? A. 100,000 diameters. 2. Could such a glass be used as ordinary eye glasses or spectacles? A. You can wear a pair of magnifying spectacles of about 3 inches focus. The microscope brings the object nearer to the eye than ten inches, its normal focal distance. A pin hole in a card, or a larger aperture holding a drop of Canada balsam, or a spherule melted from glass thread, illustrates this.

(10) H. M. asks: When the air is perfectly dry and clear, is sound propagated farther than when moisture exists in the air? A. Yes.

(11) A. B. asks: 1. Is there any difference in the kind of electricity obtained from an electric

shocking machine, operated by a battery, and one composed of magnets which are turned by a crank? A. None. 2. Do they use a common glass plate or cylinder electrical machine for medical purposes? A. No. 3. Is a galvanic battery without any machine for shocking ever employed? I never could feel anything by simply using a battery. A. Yes; in some hospitals it is exclusively used. A battery of 100 Daniell's cells is employed. You would have got a shock if you had used a battery of a sufficient number of cells. 3. How is it that I feel a shock when I put the wires on the shocking machine, but not when I simply hold the wires from the battery without connecting with the machine? A. Because the passing of the current of low tension through the primary coil induces electricity of high tension in the secondary coil, from which you obtain the shock.

(12) S. E. S. asks: If I start from the equator and travel in a northeasterly direction, shall I finally arrive at the point from which I started? I think that if I kept any course except due east or west, I should finally reach one of the poles. A. You are right. In shaping a course, the middle latitude between two places is used to look for the difference of longitude, departure, course, and distance in the tables.

Where is the Puerto River? A. In New Mexico. It flows into the Rio Grande.

(13) E. W. asks: If I make a mark, at 1 o'clock by a correct watch, on a floor, where the shadow of the corner of a house falls, shall I have a standard to keep the watch correct by? A. The sun is right April 15, June 14, September 1, and December 24. Make a noon mark in the meridian and apply the equation of time from the Nautical Almanac.

(14) C. D. asks: How is asphalt pavement made? A. It is composed of broken stones, sand, and gravel, cemented together by tar, pitch, or bitumen.

How much pressure per inch is it safe to use in a boiler of two feet diameter, and 1-16 inch thick? A. About 25 lbs.

(15) B. F. asks: What is the highest temperature at which water will readily condense steam? A. At any temperature less than that of the steam, if enough water be circulated through the condenser.

(16) S. H. D. says: If you put a thermometer in an open vessel of water heated to the boiling point, it will indicate 212°. If it is in a boiler or other closed vessel, will it indicate more than 212°, provided you have heating surface enough, as in a boiler furnace? A. It can be made to give much higher indications, if the water is confined so that it can be converted into steam of greater pressure than that of the atmosphere.

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

D. W. D.—It is impure brown sesquioxide of iron.—E. M. M.—Your specimen is graphite.—J. N.—It is iron pyrites.—M. S. W.—It is sulphure of zinc, traversed by a thin seam of pyrites.—C. L.—It is gypsum.—J. W.—It is clay, with a small percentage of oxide of iron. It would make an inferior paint.

—V. W. S.—It is a very difficult thing to answer such questions as yours, when a piece of something looking like dirt and of hardly the size of a three cent piece is sent. A piece of reasonable size should be sent, with some suitable explanations. The present so-called specimen is black and green sealing wax, mixed up with nitrate of baryta.—A reader sends two specimens, in an unlabeled paste-board box. No. 1 is a silvery looking mineral, in fan-like needles, with a greasy feeling like soapstone. It is pyrophyllite, so called because when heated it swells out to many times its original bulk, forming small leaves. It is a silicate of alumina containing water. No. 2 is quartz sand mixed up with pebbles of brown oxide of iron. Some of the latter, of a cubical shape, have arisen from the alteration of the yellow sulphide of iron to the brown oxide.

J. A. C. says, in reference to an article on spontaneous combustion in hay: Some persons distribute salt plentifully throughout their hay when they pack it away, in order to make it more palatable to the stock. Cannot the salt be also suggested as a preventive of spontaneous combustion?—S. W. asks: Is the wood of the *bois d'arc* or Osage orange tree ever used in ornamental work?—T. McI. asks: Are there any wire swing bridges?—H. R. E. asks: How are dies, for making type, cut?—G. E. asks: How do pocketbook makers make the creases in the leather of pocket books and what kind of tool is used?

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

On Ventilation. By C. A. W.
On Hydraulic Brakes. By W. M. H.
On the Phylloxera. By L. W. G.
On Dynamite. By H. C. R.
On Life Insurance. By H. F. R.
On a Hole through the Earth. By B. C.
On a Flying Machine. By L. M.
On the SCIENTIFIC AMERICAN. By E. G. F.
On Sun Spots and Comets. By J. W. F.
On Strange Forces in Nature. By G. W. R.
On Lacing Belts. By J. W. S.
On Cribbing in Horses. By B.
On Tempering Steel Tools. By T. D. L.
On a Cut Worm. By A. G. C.
On Phosphor Bronze. By J. A. B.

Also enquiries and answers from the following:
W. P. F.—C. E. M.—H. M. H.—S. D. G. N.—B.—H. H. F.—L. L. B.—G. E. W.—C. J. R.—W. H. H.

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 the three cylinder engine be obtained? Whose is the best book-binding machine? Where can bookbinders' finishing tools be bought?" 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

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SCHEDULE OF PATENT FEES.

On each caveat.	\$10
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On application for Design (14 years).	\$30

CANADIAN PATENTS.

LIST OF PATENTS GRANTED IN CANADA,
NOVEMBER 18 to 25, 1874.

4,071.—S. H. Finch, New York City, U. S. Improvement in railroad switches, called "Finch's Railroad Switch." Nov. 19, 1874.	156,989
4,072.—E. Beard, Chicago, Ill., U. S. Improvement on a machine for nailing boxes, called "Beard's American Box Nailer." Nov. 19, 1874.	156,989
4,073.—R. M. Evans, Buffalo, Erie county, N. Y., U. S. Improvements on the consecutive number printer, called "Evans' Number Printer." Nov. 19, 1874.	156,989
4,074.—J. F. Collins and J. W. Cumming, Montreal, P. Q. Improvements in the process of separating animal from vegetable matter, called "Collins' Patent Process for Separation of Animal from Vegetable Matter." Nov. 19, 1874.	156,989
4,075.—E. T. Ducharme, Montreal, P. Q. Improvements on automatic oil cans, called "Ducharme's Automatic Oil Can." Nov. 19, 1874.	156,989
4,076.—F. Proudfoot, Toronto, Ont. Improvements on stovepipe drums, called "Proudfoot's Heating Drum." Nov. 19, 1874.	156,989
4,077.—C. P. Chisholm, Oakville, Halton county, Ont. Useful plant box, called "Chisholm's Improved Plant Box." Nov. 19, 1874.	156,989
4,078.—S. P. Littlefield, Lynn, Mass., U. S. Useful way meter for railway carriages, called "Littlefield's Railway Carriage Meter." Nov. 20, 1874.	156,989
4,079.—E. Leonard, London, Ont. Improvements in stills and on process of distilling petroleum and other fluids, called "Leonard's Perpetual Still." Nov. 30, 1874.	156,989
4,080.—G. S. Bruce, Cincinnati, O., U. S. A coal box, called "Bruce's Improved Coal Vase or Box." Nov. 30, 1874.	156,989
4,081.—R. T. Booth, Trumansburgh, Tompkins county, N. Y., U. S. Improvements on automatic gas light extinguishers, called "Booth's Automatic Gas Light Extinguisher." Nov. 30, 1874.	156,989
4,082.—A. Eames, Bridgeport, Fairfield county, Conn., U. S. Improvements on machines for molding patterns, called "Eames' Molding Machine." Nov. 30, 1874.	156,989
4,083.—L. Prentice, Montreal, P. Q. Improvements on cigar molds, called "The Dominion Cigar Mold." Nov. 30, 1874.	156,989
4,084.—J. Higginbotham, Toronto, Ont. Improvements on a machine for washing, called "The Eclipse Washing Machine." Nov. 30, 1874.	156,989
4,085.—N. W. Simons, Ashtabula, Ashtabula county, O., U. S. Improvements on harness holdbacks, called "Simons' Improved Harness Holdback." Nov. 25, 1874.	156,989
4,086.—E. Horton, Hartford, Hartford county, Conn., U. S. Improvements on machines for reaping and binding grain, called "Horton's Reaper and Binder." Nov. 25, 1874.	156,989

Advertisements.

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[NEW SERIES.]

NEW YORK, DECEMBER 26, 1874.

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RAILWAY BRIDGE, NEAR YORK, ENGLAND.

We publish herewith a view of a fine railway swing bridge, erected over the river Ouse, near York, England, by the North Eastern Railway. We are indebted to *Engineering* for the illustration of the structure, which consists of three openings, namely, one fixed span of 107 feet over all, and a double swing span of 176 feet over all, leaving a clear opening for vessels of about 62 feet, the river being navigable for small craft some distance above the bridge.

The swing portion of the bridge is supported on a pier of cast iron situated on the north bank of the river, this pier being composed of one central column 7 feet in diameter, containing a hydraulic accumulator, and eight supporting columns each 4 feet in diameter carrying the roller frame and path. The weight of cast iron in the pier, exclusive of the foundation cylinders, is about 280 tons.

The swing portion is formed of two main girders, 176 feet in length and 14 feet in depth between flanges over the swivel pier, where they are connected together at the top by cross girders, carrying a platform, from which is regulated the working of the bridge. The flooring is composed of 23 transoms, 26 feet long and 1 foot 8 inches in depth, which, over the pier, are covered by $\frac{3}{4}$ inch plating, the rest of the floor being formed of bars 8 inches by $\frac{5}{8}$ inch, with openings of 1 inch.

The girders and flooring of the fixed span are of the same form as those of the swing portion. The total weight of wrought iron in both swing and fixed spans collectively is 401 tons.

The swing portion is moved by means of hydraulic machinery giving motion to a pinion geared into a circular rack.

The superstructure of the bridge was designed by Mr. J. E. Harrison, and erected by Messrs. Pease, Hutchinson & Co., of Darlington, the hydraulic machinery being devised and applied by Sir William Armstrong & Co., of Newcastle on Tyne.

California's Growing Industries.

A correspondent of the *New York Times*, writing from California, states that the mining interests continue prosperous, and most of the leading mines are doing well, taking out a good quality of ore, and paying dividends. Many of the lesser ones, however, continue to levy assessments (Irish dividends); but that must necessarily be the case where no working capital is set aside for the purpose of carrying on the work of development. "It takes a mind to work a mine" is amply illustrated; but it is the history of nearly all the present dividend-paying mines. They all had to travel the old beaten tract, and occasionally relapse into their former condition. It is expecting a good deal of a mine to continue paying for an endless period of time, when we consider the fearful drain upon it to produce daily from 100 to 500 tons of ore. It cannot be expected, you know. Take the Crown Point and Belcher, for instance. These two mines have produced, on an average, five hundred tons daily for several years. A ton of ore is six cubic feet, and a hundred tons makes a big hole. They have taken out forty-six millions of dollars in the last four years, and are now down in the bowels of the earth some sixteen hundred feet. If anything were wanted to prove the theory that the center of the earth is a mass of seething molten matter, the intense heat in the lower levels of some of our deep mines would be conclusive evidence. In the lower galleries of the Ophir, for instance, before the recent air shafts were completed, the heat was so intense that the shifts of men had to be changed every two hours. (When I say "shifts," I speak in mining parlance.) Occasionally they got a gush of hot water that made things lively for them. After all the fuss about the great value of our agricultural products being superior to the mining interests, the grain production has only exceeded that of mining some four millions. In the earlier days we never dreamed that California would prove an agricultural country, and we relied only upon mining; but the two interests together are pretty good. It would be difficult to name a country, with

the same population, producing its equal in value—ninety-six millions in four years, that we have a record of, to say nothing of the large aggregate of the Chinese product, and that of individuals, of which we have no record, at least four millions more—say one hundred millions in total, or an average of two millions a month, and constantly increasing. California is not such a bad country after all. Wait about five years, and you will see its product doubled. Another evidence of our prosperity is the constantly increasing manufactures. We shall soon be able to supply nearly everything we require, thereby retaining in the country the money that we have heretofore sent abroad. Conspicuous among the recent enterprises, I can mention the establishing of jute bag factories, more woolen mills, and a watch manufactory. The Cornell Watch Company, of Chicago, has been transferred to this place, and will soon be in operation—the advantages being an even temperature and Chinese labor. The Chinese are probably the most intelligent and skillful people for any such purpose that can be found; quick to learn, always reliable in their work, doing a thing always alike, never striking for higher wages, never going on a spree, quiet and tractable; and they are particularly skillful where nice manipulation is required. The Watch Company will employ about 150 men, and the advantages of cheap labor will be manifest over Eastern labor in these particulars, to say nothing of the difference in price. The company were paying on an average \$3.25 per day, while they will be able to obtain better operatives here at \$1.25—a saving of \$2 per day, less the difference between gold and currency—not much, either, when we take into consideration that their receipts will be in coin. The company will find a large outlet for their cheap watches in China and Japan, the natives of those countries being much addicted to purchasing timepieces. Every Chinaman purchases a watch. They want to know about what time they may expect to be pelted with brickbats and mud balls by the enterprising young Americans, who are inculcated at an early age in this entertaining sport.



RAILWAY BRIDGE NEAR YORK, ENGLAND

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our subscribers have prepaid, expires. In order that
our readers may experience no stoppage in the receipt of the
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the paper to print at the commencement of a new volume,
we hope our friends will signify their intention to continue
the paper by early remittances.

The plan of discontinuing the paper when the time expires
for which it is prepaid, we think preferable to the course,
adopted by many publishers, of continuing their paper indef-
initely and collecting afterwards. The latter course is too
much like having a bill presented for a suit of clothes after
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ANOTHER NEEDED AMENDMENT OF THE PATENT LAW.

By the present law, the grantee of any interest in a patent
has ninety days within which to file his conveyance for record.
If he complies with that rule, his rights are determined by the
date of his deed. This furnishes abundant and unnecessary
opportunity for fraud, and often imposes great hardships on
innocent and careful purchasers.

He who after full examination finds the title of a patent
complete and unencumbered often feels safe in paying his
money therefor, and in making extensive arrangements for
the manufacture thereof. Ninety days thereafter

he may learn that an assignment one day older than his has
just been filed in the Office, and has rendered his title worth-
less. This ought not so to be.

In some of the States of the Union, the registry laws relative
to the conveyance of real estate have had a like provision, but
experience has shown the inexpediency of such a rule. Pri-
ority of right is now generally given to the purchaser who
first files his deed for record. This is a wise regulation; for
if some one must suffer wrong, good policy as well as justice
dictates that it should be the negligent rather than the vigi-
lant. Is not this an equally sound maxim as applied to the
sale of a patent?

At all events, the ninety days now allowed to the purchaser
of a patent is much too great. No great mischief would
result from allowing such a purchaser hardly time enough to
send his deed to the Patent Office. If he failed to do this, his
rights should be postponed to those of any other bona fide
purchaser whose deed was first on record. A rule of vigilance
similar to that which is observed in order to charge the in-
dorse of a protested promissory note might best protect the
just rights of both purchasers, and would furnish little room
for injury of the kind above referred to.

But there is a still more crying evil of a similar character.
A license under our present law need not be recorded at all.
A bona fide purchaser, who has waited ninety days before pay-
ing the purchase money or doing any other irrevocable act,
may afterwards find, to his dismay, that there are licenses in
existence, running the entire lifetime of his patent and cov-
ering the whole scope of his conveyance, which is thus ren-
dered wholly valueless. Opportunities for successful wrong
are here presented, for which there is no excuse. They are
unworthy of the intelligence of the age and country. The
hand of reform should be applied here without delay.

GOVERNMENT MONOPOLY OF THE TELEGRAPH LINES.

The argument of Mr. G. P. Lowery, before the Congres-
sional Committee, in opposition to the Hubbard Postal Tele-
graph bill, contains much forcible reasoning. Whether or
not Congress has the right to make telegraphic intercom-
munication a government monopoly is clearly a constitu-
tional question, based upon the interpretation of the sections
which confer upon the national legislature the power to
establish post offices and post roads, and to regulate com-
merce. The advocates of the scheme hold that, under these
provisions, Congress has the necessary power, and urge that
the telegraph must be regarded in similar light as the mails;
if the government has the right to monopolize the dissemina-
tion of information through the carriage of missives in the
latter case, it has the same right through the transmission of
signals in the former. The opponents of the bill, including
all the present private telegraphic corporations, deny the
above premises, and draw a wide margin of difference between
the establishment of the post offices and roads and that of
the telegraph. They maintain that the post office is simply
the medium through which the government tenders itself to
carry parcels of a limited weight for a limited price, and this
entirely regardless as to the contents of the parcels, whether
the same be a means of transferring ideas from one person to
another, or a mere mass of material substance. The tele-
graph, on the other hand, is *per se* a medium for transmitting
information, and nothing else.

Mr. Lowery elaborates these views with much ingenuity
and cogency in his argument. He points out that the post
office is an agency, the original design or motive of which
was, doubtless, to favor the transmission of intelligence,
public or private, between the people: its function is the
carrying of packages which may contain information. Be-
cause this possibility exists, and Congress controls the means
of conveyance, therefore it is urged by the advocates of the
plan that Congress should control another medium which
conveys nothing, but merely transmits information as such—
a clearly illogical sequence.

To borrow Mr. Lowery's illustration: Suppose A and B are
talking together a couple of feet apart. A crosses the street,
and the conversation is still maintained by raising the voices;
or one person may go to the garret and the other to the cellar
of a house, and yet converse through a speaking tube. They
may separate by a wider interval and talk by pre-arranged
signals made with their arms; or lastly, they may place an
interval of a thousand miles between them, and still continue
their remarks by the aid of the telegraphic wire. A's mind
meets that of B just as instantly through the telegraphic
signals as through the medium of oral words. In the one
case a conducting wire, through which a current passes, is
the means; in the other, sound-conducting air, through which
certain vibrations are transmitted, serves the same purpose.
The extension of the telegraph, then, from between A and B
to between every individual in the United States and every-
where else, virtually places all the people within the sound of
each other's voices. If such were literally possible, then—if
the government has the right to control batteries and wires
in the one case—it has equally power to control the vocal
cords and air in the other: in other words, to prevent people
talking to each other save on the payment of tax—a *reductio
ad absurdum* too palpable to need further demonstration. Of
course the power once in the hands of any government to
control interchange of information between the people con-
verts that government into a despotism very different from
that contemplated by the Constitution. That instrument,
however, is a rigid one; and as it distinctly says "establish
post offices and post roads" and "regulate commerce," and
does not say anything about controlling information (however
transmitted), it may be taken as reasonably certain that no judi-
cial interpretation would discover in the plain provisions above
quoted the degree of elasticity necessary to extend them to an

authorization to Congress to assume the ownership of the
telegraph lines.

There are many, however, who would be willing to yield a
point of right, if the expediency of the change were great.
That is, if, by suppressing the private corporations and plac-
ing the telegraph under government control, the whole
country would be manifestly benefited, not many would be
found to oppose any legal means, if such could be reached,
for accomplishing the object. But here again we are met by
an array of considerations and facts which demonstrate the
project to be plainly inexpedient. The latest reports of
European government telegraphs show clearly that, instead
of being a source of revenue to the countries where the system
has been adopted, they are a source of expense. Statistics
for 1873 show for the German Empire a deficit of \$661,727.
France has a very slight surplus; but taking the aggregate
receipts of seven countries—Germany, Hungary, Belgium,
Denmark, France, Holland, and Switzerland—the expendi-
tures are found to have exceeded them by \$1,075,510. As
for England, the *London Railway News*, of late date, admits
a deficiency of \$5,000 a week, and this increasing.

In adverting to this subject before, we pointed out that a
comparison of the British tariff with our own, taking into
consideration the enormous distances between points in this
country, shows in the end that our rates could gain little in
cheapness supposing our government to run the telegraph at
once as efficiently as that of England now does. Again, the
English post office carries letters for a penny, and makes five
million dollars a year; ours charges three cents, and, accord-
ing to Postmaster Jewell's report, there is a deficit of eight
million dollars. The Postmaster General may well assert
his intention to try and make the receipts and expenditures of
the Department bear some proper relation to each other; and
we may justly doubt even the accomplishment of this task
for some time to come. It is absurd, however, to suppose
that, beside this, a postal telegraph could be made into a paying
enterprise, and not an additional burden on the taxpayers.
There are other objections to the postal telegraph which we
have not space here to detail. A government censorship of
news is not to be desired in these days of high party feeling;
nor is the saddling of the country with an immense host of
new officials an inviting prospect—particularly when appoint-
ments will probably, as is the case now in other political
positions, be governed by every other consideration save that
of fitness for the work. The imposition of another tax is
also objectionable. The telegraph is not employed by a great
mass of the population. As it is now, it costs this class no-
thing; as it would be, they would be obliged to contribute to its
support.

Postmaster Jewell's report, to all appearances, gives the
postal telegraph scheme its practical quietus for this session;
but as the project is nevertheless likely to be brought up and
discussed, it is, perhaps, well that the public should under-
stand wherein it fails both in law and in expediency. If the
government chooses to erect or acquire telegraph lines for its
own use and benefit, it certainly has the right to do so; but
that it should compel the people to employ only those lines,
by legislating the great telegraphic corporations out of exis-
tence and securing to itself the monopoly, we decidedly dis-
believe.

THE TRANSIT OF VENUS.

Cable despatches from three of the American expeditions
for the observation of the transit of Venus, respectively
stationed in Japan, Siberia, and Tasmania, and from the
British parties in India, China, and Egypt, announce the re-
sults thus far obtained. Professor E. Hall, telegraphing
from Vladivostok, reports that, as the planet advanced and
touched the sun's limb, the moment was signaled with ac-
curacy; but owing to the drifting of haze and clouds between,
it was impossible to obtain good photographs of the contacts.
After Venus had crept half way across the sun's disk, how-
ever, thirteen good negatives were secured, so that it will be
possible to map the planet's track on the photographic image
of the sun after the observers return home. Professor David-
son, at Nagasaki, was also troubled with cloudy weather.
The first contact could not be recorded, but the time of the
second one was obtained excellently. A large number of ac-
curate measurements were secured, however, and sixty clear
photographs. The astronomers of this party were remarkably
fortunate, as almost immediately after the occurrence of the
phenomenon the sky became thickly clouded.

Messages from the British parties to the Astronomer Royal
state that at Thebes, Egypt, numerous fine photographs were
taken; and at Cairo and Suez, the closing stages of the transit
were viewed under favorable auspices. The reports from
Shanghai, China, are discouraging, and announce complete
failure of all attempts, owing to the cloudy weather. The
Indian observations seem to have been the most successful,
upwards of one hundred negatives of the planet's position on
the sun's disk being secured. The details of the micrometric
measurements and of the instants of contact, it is also stated,
were obtained with precision.

Professor Harkness, from Hobart Town, Tasmania, announ-
ces bad weather, but good results, in the shape of one hundred
and thirteen photographs.

Altogether the reports are encouraging, and point to gener-
ally fair success. The despatches of Professors Harkness and
Hall are the most important, owing to their stations being
far north and far south of the Equator, and hence giving the
most trustworthy data.

In this connection we notice a letter, from Mr. Lewis M.
Rutherford, to the *Times*, in which he recommends the use of
a short telescope and enlargement of the image by the inter-
vention of an enlarging lens between the objective and the
plate on which the photograph of the sun is taken, in lieu of

a long telescope, some forty feet in length. Mr. Rutherford's great success in solar photography, as well as in the photographic record of the positions and aspect of other heavenly bodies, entitle his opinions to the highest consideration; and since his suggestion to the above effect has not been adopted by our observers, the details of the results obtained by using long telescopes will be looked for with interest. If there be any error or difficulties due to the latter cause, it would be a matter of grave public regret that Mr. Rutherford's advice had not been heeded.

Professor C. S. Lyman, of the Sheffield Scientific School, has published an interesting communication detailing telescopic observations of Venus, made from the observatory of the above institution just before the period of transit. When the planet arrived at a distance of only half the sun's diameter from the sun's limb, its appearance became no longer that of a crescent but of an entire ring of light, beautifully delicate, and brightest on the side toward the sun. It is only when the conjunction occurs very near the node that the planet can approach near enough to the sun to have the horizontal refraction of the planet's atmosphere, on the side opposite to the sun as seen from the earth, deflect the solar rays so as to bring them to the observer.

It is to be hoped that other astronomers have watched this interesting phenomenon: for beside its beauty and novelty, it affords, with proper measurements, the means of determining the refractive power of Venus' atmosphere, which would appear to be about one sixth greater than that of the earth.

THE PATENT OFFICE CLERKS.

We are informed by a Washington newspaper that the Commissioner of Patents is proposing to have the force in his office increased without increasing its expenses, by diminishing the pay of some of the old employees sufficiently to provide salaries for the new ones. We hope this statement is untrue. That the present rate of compensation in the Patent Office is not too great is proved by the fact that it is insufficient to secure the desired permanency in official station therein. When a clerk has acquired the experience and skill that qualify him for the effectual discharge of his duties, he soon finds some more lucrative employment elsewhere. These situations are thus often regarded as stepping stones to the real business of life, and are vacated as soon as the incumbents have fitted themselves for usefulness therein. This state of things will grow worse the more the rate of compensation is diminished. As the higher grades of these clerkships require the highest order of talent and skill, they should be made the object of ultimate ambition and desire to those holding subordinate positions. These should not, therefore, be induced to seek more inviting situations elsewhere, in consequence of inadequacy of compensation here.

If, therefore, a larger number of employees is needed, let them be employed and fully paid; if they are not needed, they ought not to be employed at any price. It is a false economy to fix the scale of official salaries so low that they will not command proper qualifications in their incumbents, and it is almost an equal mistake to cumber the rooms and halls of the Patent Office with those whose services are not needed. Let all be diligently employed and fully paid.

If we are not misinformed, there are already nearly or quite five hundred persons now on duty in the Patent Office. With proper regulations, and under a well arranged system of labor, we believe that this number is fully sufficient for all the business that will be brought before the Office for many years to come. The funds of the Patent Office have been contributed by the inventors of the world, and should be devoted to their benefit. It is due to them that this fund should not be wasted or needlessly expended. If it is now more than sufficient to meet the annual expenses of the Office, a diminution of the office fees would be a proper corrective; but it ought never to be squandered on a multitude of officials who are willing to serve on half pay.

EZRA CORNELL.

Just as the reports of the astronomers scattered over the remotest portions of the globe, telling of the observations of a great natural phenomenon, are flashing over the wires, the sad intelligence reaches us of the death of the man to whom, next to Morse, the world is indebted for the introduction of that grandest of modern inventions, the electric telegraph. The immediate associate and co-worker with the inventor, his firm adherent through all the dark hours preceding the triumphant success of the derided project, the name of Ezra Cornell will pass to posterity as indissolubly linked to the telegraph as to the noble university which remains a monument to his benevolence and philanthropy.

Mr. Cornell was born at Westchester Landing, New York, on January 11, 1807. His youth was spent working at the potter's trade with his father, but little opportunity being afforded him to acquire more than the rudiments of a common school education. On attaining his majority and for fifteen years thereafter, he was at times a workman in machine shops and at times engaged in agriculture, earning but a slender income. In 1843, he became acquainted with Morse, and at once deeply interested himself in the plans of that inventor. At that period Morse was seeking a practicable way of laying his wires through underground pipes, and called in Cornell's aid to assist him. Cornell soon invented a machine for accomplishing the work, which was successfully used until it was decided to abandon the underground system in favor of the poles. It is related that this decision was not arrived at until two thirds of the Congressional appropriation, for constructing the experimental line between Baltimore and Washington, had been expended, and it was evident that the balance could not complete the undertaking. Morse

then called Cornell aside, and told him that operations must be stopped, but in such a manner that the public would not suppose that they had failed. Cornell at once grasped the handles of his machine and started the eight mules by which it was drawn ahead at a lively pace. By an adroit turn of the wrist when unobserved, he ran his plow point against a rock, wrecking the apparatus, thus demolishing the only means by which the pipe laying could be continued. Subsequent experimenting resulted in the success of the wire elevated on poles, as is well known, but the labors of the inventor and of his faithful friend to raise funds to extend their projects were none the less unremitting. So hard-pushed were they at one time that they opened a show of their instruments in a store on Broadway, asking a small admission fee; but the public failed to appreciate the chimerical scheme, and the revenue of the partners was very small. Cornell was almost penniless, entirely so at one period, as he afterwards stated that the lucky finding of a shilling in the street prevented his going dinnerless.

With the general recognition of the magnitude and importance of the invention, Mr. Cornell began to reap the returns for his zeal in its behalf. He was employed in the construction of many telegraph lines, through which means, together with the increase in value of the shares of stock which he owned in the Western Union line, he speedily amassed a large fortune.

The early part of his life is a lesson of frugality and perseverance; his closing days furnish a shining example of liberality and benevolence. He struggled until he attained wealth; but riches once gained, he abnegated self, and devoted them to the welfare of mankind. His first public act of philanthropy was the endowment of a public library in Ithaca, New York, on which he expended some fifty thousand dollars. Then followed the magnificent gift, first of \$500,000, then of two hundred acres of land with the necessary buildings, and finally smaller donations amounting to \$11,000, to found Cornell University, one of the few great educational institutions which aim to teach men to keep themselves, to send out skilled mechanics, graduates capable of earning their bread at once by their own work, not mere book-worms, as ignorant of the world as of how to make it support them.

Mr. Cornell for many years took an active part in politics, filling with honor several State legislative offices. He was also President of the State Agricultural Society, and was largely interested in many railroad, banking, and manufacturing companies. His fatal illness, which terminated on the 9th of December, was induced by overwork in business affairs.

WILL DO IT AFTER A FUNERAL.

It is now considered settled by the most eminent medical authorities that a large percentage of the sickness which prevails in cities, like New York, is due to the backing up of foul gases through sewer pipes into the apartments of dwellings. Against these dreadful odors, the pipe traps commonly used offer but little protection.

There is a very sure and simple remedy, which at a slight cost might be applied in every house in New York; but which, we are sorry to say, is rarely put into use until after there has been a funeral in the family. In the case of the Deaf and Dumb Asylum, in this city, it required several funerals before the parties could be induced to look to the sewers connected with the establishment.

The remedy we allude to is the connection of the house sewer pipes with the kitchen chimney, so that all gases that back up from the sewers will be carried up chimney and not into the house.

We have repeatedly called attention to the excellence of this remedy, have given engravings illustrative of the method of application, have cited instances of its application in other countries, have urged our architects to take special care in drawing up the specifications of new buildings to provide for these escape pipes. We now renew these reminders. Furthermore, we would respectfully ask the eminent and accomplished scientific gentleman who presides over the Board of Health in this city, whether, in his opinion, the introduction of escape pipes as suggested is not a desirable thing to accomplish, regarded from a sanitary point of view? If it is, are there any weighty reasons why the Board should not issue an order forthwith, requiring all landlords to put the pipes in? The Board, we believe, does not lack authority in the matter. It has only to speak the word, and it will be done.

THE LATEST POLAR EXPEDITION.

Dr. Augustus Petermann, the celebrated German geographer, has recently addressed a letter, on the subject of past explorations of the arctic regions, to the British Royal Geographical Society, which is of timely interest in view of the present fitting out of another English expedition to that unknown quarter of the globe. Dr. Petermann believes, from the results already arrived at, that with appropriate steam vessels, making use of the extensive experience gained, the central area will be penetrated as far as the North Pole or at any other points. He also states that the disputed question as to the proper route is clearly settled in favor of passage through Smith's Sound.

Through the individual labors of Dr. Petermann, continued since 1865, seven small expeditions have been sent out. The details of the explorations conducted have not been made public; but generally, from the interior of Greenland, in 30° W. longitude to 59° E. east of Spitzbergen, a width of about ninety degrees of longitude has been surveyed. Besides this, it is now known that the Norwegians, in frail fishing smacks, have circumnavigated Nova Zembla, and have proved that the Kara and Siberian seas are for five months in the year

open. The most important information, however, communicated in Dr. Petermann's letter, lies in the extracts from reports by Captain Gray, of Peterhead. From observations made in 1868, this navigator concluded that no difficulty would be found in carrying a vessel to the Pole by taking the ice at about the latitude of 75° (where generally exists a deep bight), sometimes running in a northwest direction upwards of 100 miles toward Shannon Island, thence following the continent of Greenland as long as it is found to sound in the desired direction, and afterward pushing northwards through the loose fields of ice which will be encountered. Captain Gray penetrated northward again during the past summer as far as 79° 45'. At that latitude, in August, the ice was broken up, whereas "down to 77," he states, "the floes were lying whole in the sea, clearly showing that the ice in 80° must have been broken up, by a swell from the north; beyond the pack to the north (which I could see over), there was a dark water sky, reaching north until lost in the distance, without a particle of ice to be seen in it."

If two thoroughly equipped steamers be despatched, one up the west coast of Greenland, by way of Smith Sound, and the other up the east coast of the same continent, there is not much question but that one or the other would ultimately reach this open water near the pole, the existence of which so many have credited. It has been the misfortune of late arctic expeditions that all have been projected on too small a scale; and although they have performed excellent service as pioneers, they lacked the completeness in organization and equipments necessary for the endurance of so long and arduous a voyage.

The preparations for the British expeditions, we understand, are already under way, and the command has been given to Captain George S. Nares, late of the Challenger. We may conclude, therefore, that the long-sought problem of reaching the pole is at length to be met by all the resources of engineering skill and scientific knowledge, in presence of which the solution cannot be far distant.

CHEAP FREIGHTS.

The American Cheap Transportation Association recently met at Richmond, Va., under the presidency of the Hon. Josiah Quincy, of Boston, Mass. Mr. F. B. Thurber read a report on railroads, in which he pointed out various abuses incident to the general management of lines in this country. Among these he mentioned watering stock, fast freight lines run by concerns outside the companies, the present practice, sleeping, and express car systems, and the fact of employees being pecuniarily interested in the use of certain materials and patents. The conclusions were that the most effectual and permanent remedy for the evils is competition, and that the most effective competition will be found in railroads when they are owned by the people. The improvement of water courses and the construction of small canals to connect large bodies of water is also necessary. An exclusive freight road, it is believed, from the grain-growing sections of the West to the seaboard, would demonstrate how cheap freight can be carried by rail; and as soon as this is ascertained, public opinion would soon compel existing roads to abolish the abuses which are absorbing the revenues of the present system.

It strikes us that any candid reader who peruses the columns of the daily journals and endeavors to master the intricacies of the strategic movements of the Pacific roads against the trunk lines, the Baltimore and Ohio against the New York Central, the Pacific Mail muddle, and the question of the Saratoga agreement, will arrive at no other conclusion but that there is plenty of competition, though the chances of cheaper freights are by no means so generally apparent. The recent completion of the Baltimore and Ohio direct road to Chicago is, it is said, destined to have considerable significance, in that negotiations are pending between its managers and those of the Erie line for a joint use, by the latter, of a portion of the former route, which would render Erie independent of Lake Shore. It appears, however, that, in spite of the pronounced benefits to be gained by the Baltimore and Ohio completion, the published rates of the New York Central are far less already than those of the first mentioned road. Mr. Vanderbilt's table of local freight tariffs, compared with that of the Baltimore road, shows rates averaging in the neighborhood of 40 per cent less for similar distances. For example: From South Branch to Baltimore, 163 miles, is charged 62 cents; from Schenectady to New York, 161 miles, the winter tariff is 50 and the summer 30 cents, all first class. Flour, per barrel, from Parkersburgh to Baltimore is \$1.30, 383 miles; from Buffalo to New York, 440 miles, 50 and 70 cents.

The Central besides gives special rates to any one. A like comparison to the above shows that the tariffs on that road are actually less than those asked by the Grangers on the Illinois lines. Finally the comparison of the business done by the New York Central for the past year, as compared with 1873, exhibits an increase of 46,800 tons in tonnage, and a decrease of \$397,972.59 in earnings on freight. This looks more like practical cheap transportation than any project before the public, while it disposes of the charges of illiberality on the part of the Vanderbilt management. Mr. Thurber, in the address to which we refer in our initial paragraph, goes into facts, figures, and an elaborate argument to prove that the New York Central ought to and must charge a much higher rate of freight, because it invests its earnings and issues stock representing the same, instead of using the earnings to improve the road and carrying the balance over as surplus, after the fashion of the Baltimore and Ohio. It is unfortunate for Mr. Thurber that actual figures demonstrate exactly the reverse of his theoretic conclusions.

Eelskins dried and cut in strips make very strong bals lacings.

THE UNDERGROUND RAILWAY, NEW YORK CITY.

NUMBER VI.

Continued from page 387.

Division number two of the work commences at 79th street, ends at 102d street, and is under the charge of Mr. Sverre Lee, C.E. In this division is embraced a specimen of almost every description of construction upon the road. From 79th street to a point 27 feet 7½ inches south of the south side of 80th street, a distance of about 173 feet, is a piece of beam

with rubble masonry 3 feet 6 inches in thickness, and on the inside of each of the side tunnels with brickwork 1 foot 4 inches thick, thus giving to each abutment a thickness, inclusive of linings, of 15 feet 6 inches. Through each of these inner abutments are cut two man holes, 7 feet in width and 75 feet apart.

The roofs of the tunnels are semi-circular arches: that of the central arch with a rise of 12 feet 6 inches and a span of 25 feet, and that of each of the side tunnels with a span of 16 feet and rise of 8 feet, each with a uniform thickness of 2 feet. The ventilation is by means of cylindrical shafts, in

the three tunnels. At the end of these tunnels begins the large tapering tunnel. It consists of a brick segmental arch with a span of 68 feet in the clear, and rise of 15 feet 8 inches at the south end, and thence tapering off to a span of 50 feet in the clear and rise of 12 feet 9 inches at its north end, 165 feet further north. The springing lines of the arch are 12 feet above railroad grade, and start from the solid ledge wherever possible. Throughout its entire length, it is lined up to springing line with rubble masonry 5 feet thick. Wherever it springs from the ledge, the skewbacks consist of two courses, and abut against the ledge, hammered off to receive them.

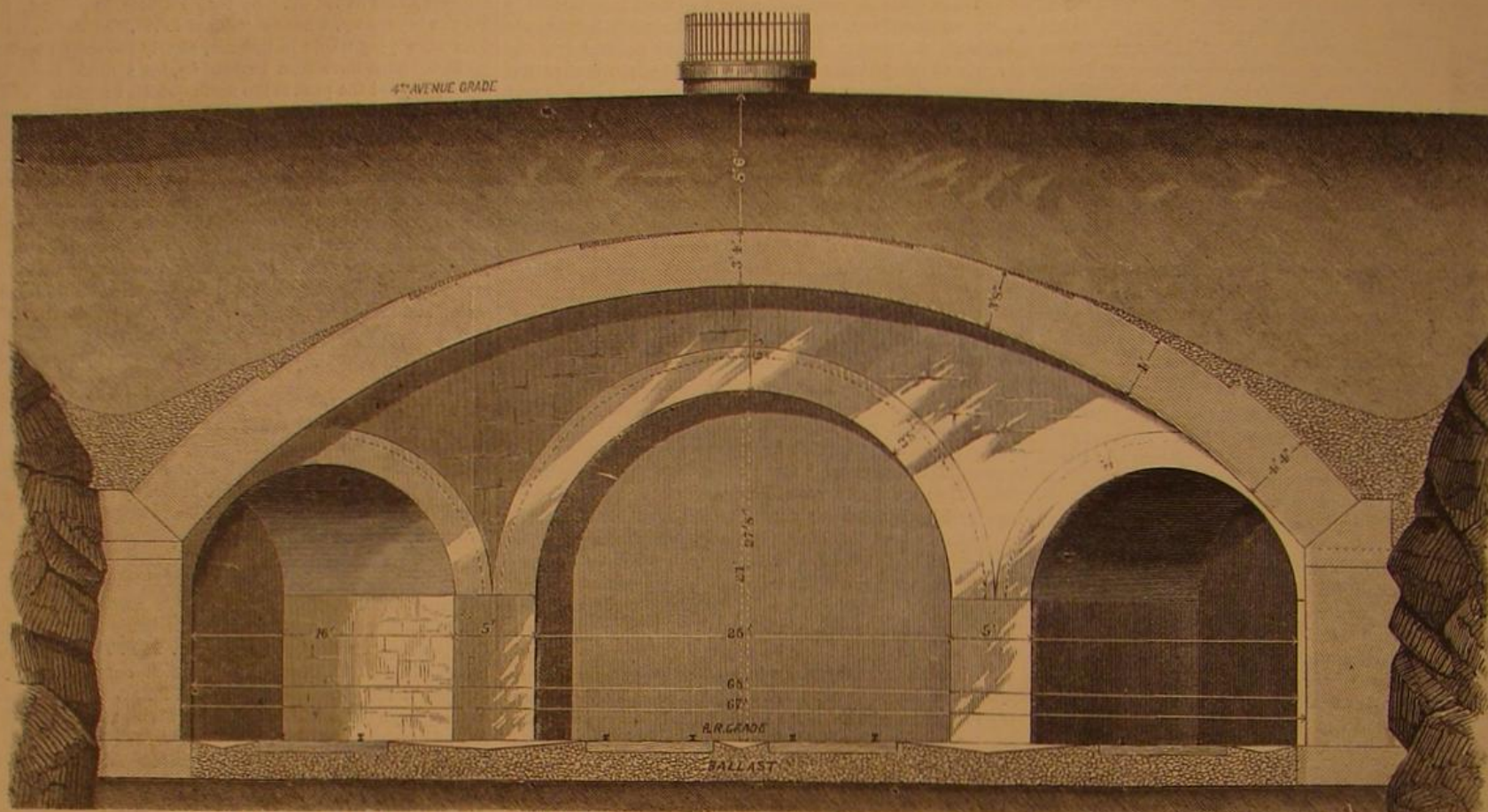


Fig. 15.—THE UNDERGROUND RAILWAY IN NEW YORK.—THE GREAT ARCH NEAR 95th STREET.

tunneling; from this latter point to 92d street extends a section of brick tunneling, 3,237½ feet in length; from 92d street to the north side of 94th street is the rock tunnel, 550 feet in length; from the north side of 94th street to a point 31 feet 6 inches north of the north side of 95th street is the partly rock and partly brick tunnel, 287½ feet long; from this latter point to the north side of 96th street is the tunnel known as the large tapering tunnel, whose length is 250 feet; from 96th street to the north side of 98th street, there occurs an open cut, 537½ feet in length; and finally from this point commences the stone viaduct.

We have in previous impressions described in detail sections of the beam and brick tunnel and open cut, and shall not, therefore, repeat the description in connection with similar work on this section, but merely point out in what respects, if in any, these tunnels differ from the one already described. The beam tunnel at the south end of the division is precisely similar to that on the first division. In the beam tunnel, however, which extends from south of 80th street to 92d street, several noticeable changes have been made. Thus from 80th to the center of 85th street, the roof of the large central tunnel is changed from a semi-circular to an elliptical arch, with a rise of 8 feet 10 inches, as is shown in Fig. 12, page 371. The reason for this change will be apparent by a glance at the profile of the road on page 308, which shows the difference of grades to be too small to admit of an arch of 12 feet 6 inches rise. Again, from the center of 85th street to the south side of 88th street, six rubble masonry abutments are built, so that each of the three arches rests upon two separate abutments of its own; the space between the two inside abutments, east and west (that is, between the abutment of the central arch and the inner abutment of the side arch), is filled in with dry rubble masonry up to the springing lines, and the spandrels above the springing lines with rubble cement masonry. The central arch is also elliptical. From 88th to 92d street, the tunnel is the same as that from 80th street to the center of 85th street. Omitting, for the present, the description of the rock tunnel from 92d to 94th street, we will take up that of the partly rock and partly brick tunnels.

These tunnels begin at the north side of 94th street, where the rock was not of sufficient strength and depth to allow of a rock tunnel, and consist of three brick arches supported upon four abutments of rock formed by three parallel cuttings through the rock. The two outside abutments are chipped off smooth, and lined with 16 inches of brick, carried up to the springing lines, which are 8 feet 6 inches above grade. The two inner abutments are composed of rock, carried up above the springing lines, of an average thickness of 10 feet 8 inches, and lined on the inside of the central tunnel

general character the same as those already described, but only 6 feet in diameter in the clear, and of a depth depending on the difference of grades.

From a point 101 feet 10 inches north of the end of the rock tunnel, the two side tunnels begin to curve in gradually toward the central tunnel, which they intersect 191 feet further north. The radius of this curve is, for the center of the tracks in each of the side tunnels, 1432.7 feet, and for the center of the tunnels themselves, 1773.7 feet. From the point where this curvature starts, the inner and outer abutments are lined, each of them, with rubble masonry 3 feet thick, coursed; the courses being not less than 16 inches, and the

The thickness of the arch varies at the springing line and at the crown, and these dimensions again vary with the span. Thus at the south end where the span is 68 feet and rise 15 feet 8 inches, the thickness of the arch is 4 feet 4 inches at the springing lines; a little further up the arch, it is 4 feet; still further up, 3 feet 8 inches, and at the crown, 3 feet 4 inches, thus losing 1 foot in thickness from springing line to crown. At the north end, where the span is 50 feet and the rise 12 feet 9 inches, the arch is 3 feet 4 inches in thickness at the springing line and 2 feet 4 inches at the crown. It will be observed that the arch also loses 1 foot in thickness at the skewbacks between the two ends. This is of course

accomplished by a series of three offsets of 4 inches each, passing around the arch, all of which occur at the ventilating shafts. For instance, between the south end and the first ventilator, the arch at the crown is 3 feet 4 inches; from the first to the second ventilator, 3 feet; from second to third 2 feet 8 inches, and from the third to the end of the tunnel, 2 feet 4 inches. The details of this tapering tunnel will perhaps be best understood by a glance at Fig. 15, which represents a cross section of the tapering tunnel taken at the junction of the two side tunnels with the central tunnel, and shows the three tunnels in question, as also the segmental arch with its varying thickness. It will be remembered that the tunnel preceding the tapering tunnel has a total height from railroad grade to the crown of the arch of 21 feet, and that this tapering tunnel has a total height in the clear of 27 feet 2 inches. The manner of joining these two tunnels is illustrated in Fig. 16. The roof of the central tunnel, which has elsewhere a thickness of 2 feet, is increased to 2 feet 8 inches for a distance of 5 feet around the face, and on the back of the arch at this point is built a rubble retaining wall, 7 feet 4 inches high, 3 feet at the bottom by 1 foot at the top, which is on a level with the back of the tapering tunnel. The back of the retaining wall is lined with concrete. The joining at the face of the two small tunnels is made in a precisely analogous way.

As this arch is one of unusual span, we shall take occasion in our next article to describe the centering on which it was turned.

Immense Photographs.

Photographs have been made of the new Opera House, Paris, 4 feet 3 inches in length, and 3 feet 4 inches in height. They were obtained in one single piece, by well known processes, and with the aid of a large and specially constructed camera. All the lines of the pictures are of remarkable excellence, the moldings, the busts, the medallions, and even the minutest details being reproduced with rare perfection. The attempt is being made to secure pictures even larger than this.

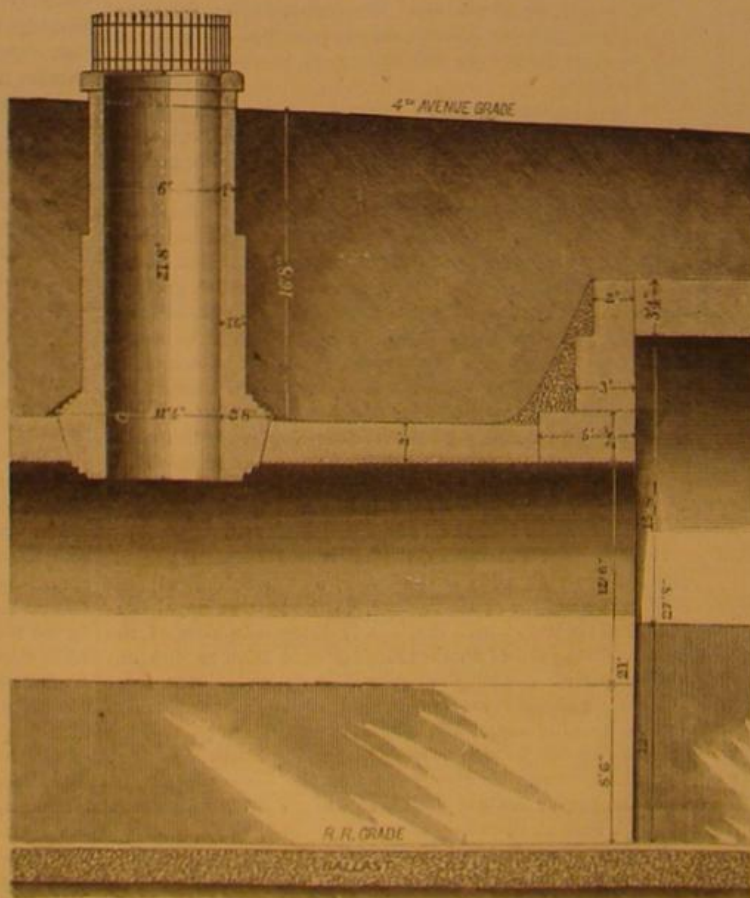


Fig. 16.—THE UNDERGROUND RAILWAY IN NEW YORK.—JUNCTION OF THE TUNNELS NEAR 95th STREET.

joints cut to lay ¼ inch. Owing to the curving of the side tunnels, the inner abutments are made somewhat wedge-shaped, tapering off from a thickness of 15 feet 6 inches at the point of curvature to one of 5 feet at the intersection of

A NEW NAIL.

This is a new form of nail, the peculiar features in which are its screw, shank, and the head concave underneath and provided with teeth. In using it, a hole is first bored in the wood as for an ordinary screw; the nail is then driven in by a hammer, when the teeth about the head will readily catch



in the surface of the adjacent wood. The nail thus secured can neither be turned nor withdrawn without destroying in whole or in part the fibers of the wood.

The invention will doubtless be of advantage in fastening packing cases for shipping, as, in addition to forming a strong connection, its removal, in case of any tampering with the contents, can be at once evidenced by the condition of the box.

Patented March 17, 1874, by Mr. Joseph Lowensohn, of Berlin, Prussia.

CONCEPTION OF THE TELEGRAPH.

(From advance sheets of the Life of S. F. B. Morse, by S. I. Prime.)

The packet ship *Sully*, Captain Pell, sailed from Havre on the 1st day of October, 1832, for New York. Among the cabin passengers were the Hon. William C. Rives, of Virginia, returning with his family from Paris, where he had been as Minister of the United States; Mr. J. F. Fisher, of Philadelphia; Dr. Charles T. Jackson, of Boston; Mr. S. F. B. Morse, of New York; Mrs. T. Palmer, Miss E. Palmer, Mr. C. Palmer, Mr. F. Palmer, Mr. W. Palmer, Mr. J. Haslett, Charleston, S. C.; Mr. Lewis Rogers, Virginia; Mr. W. Post, New York; Mr. Constable, of Boston; Mons. de la Cande, Mons. J. P. Chazel, Charleston; Mr. A. Scheidler, Frankfort, Germany; Mr. and Mrs. Burgy, and others.

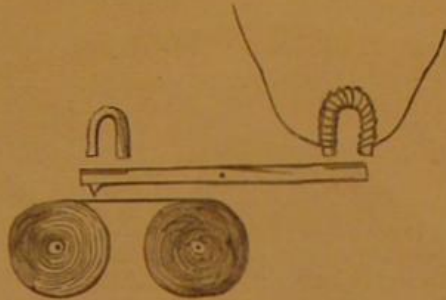
In the early part of the voyage, conversation at the dinner table turned upon the recent discoveries in electro-magnetism, and the experiments of Ampère with the electro-magnet. Dr. Jackson spoke of the length of wire in the coil of a magnet, and the question was asked, by some one of the company, "if the velocity of electricity was retarded by the length of the wire?" Dr. Jackson replied that electricity passes instantaneously over any known length of wire. He referred to experiments made by Dr. Franklin with several miles of wire in circuit, to ascertain the velocity of electricity, the result being that he could observe no difference of time between the touch at one extremity and the spark at the other. At this point Mr. Morse interposed the remark: "If the presence of electricity can be made visible in any part of the circuit, I see no reason why intelligence may not be transmitted instantaneously by electricity." The conversation went on. But the one new idea had taken complete possession of the mind of Mr. Morse. It was as sudden and pervading as if he had received at that moment an electric shock. He withdrew from the table and went on deck. He was in mid-ocean, *undique calum, undique pontus*. As the lightning cometh out of the East and shineth unto the West, so swift and far was the instrument to work that was taking shape in his creative mind.

The purpose instantly formed absorbed his mind, and to its perfection his life from that moment was devoted. He was the man to do the work. His mind was eminently inventive and mechanical. In his early youth and riper manhood, he had sought out many inventions. His name had long been enrolled among inventors in the Patent Office of the United States. Patience, perseverance, and faith were hereditary traits of his character. He was now forty-one years old.

Of all the great inventions that have made their authors immortal, and conferred enduring benefit upon mankind, no

tence, in which his earlier and later pencilings are preserved. As he sat upon the deck after the conversation at dinner, he drew from his pocket one of these books, and began to make marks to represent letters and figures to be produced by the agency of electricity at a distance from the place of action. First, he arranged ten dots and lines so as to represent figures referring to words. Next, he drew the wires in tubes. Then came the magnets, and by and by cog rules, to be used in regulating the power. In the course of a few days his book presented several pages of the first marks ever made in the invention of the Telegraph. [All of these drawings and marks are given in facsimile in the volume.]

He wrought incessantly that day, and sleep forsook him in his berth that night. His mind was on fire. In a few days he submitted these rough drafts to Mr. Rives, who suggested various difficulties. But Mr. Morse was ready with a solution. Mr. Fisher states that Mr. Morse illustrated to him his signs for letters, to be indicated by a quick succession of strokes or shocks of the galvanic current, to be carried along upon a single wire. After several sleepless nights, while his mind was in labor with the subject, he announced it at the breakfast table, and explained the process by which he



FACSIMILE OF THE ORIGINAL SKETCH, MADE BY MORSE, OF THE ELECTRIC TELEGRAPH—TAKEN FROM HIS NOTE BOOK.

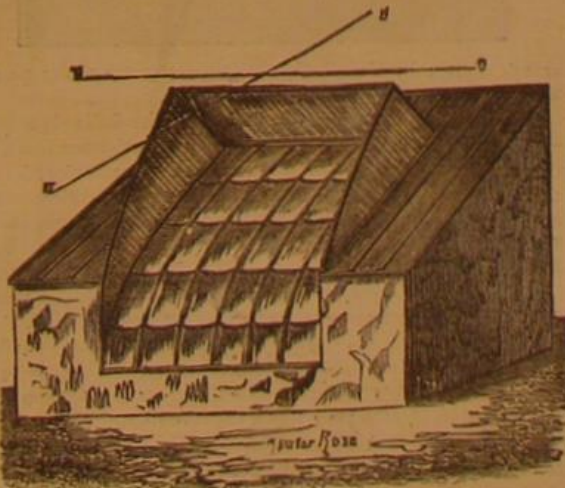
proposed to accomplish it. He then exhibited the drawing of the instrument, by which he would do the work, and so completely had he mastered all the details that five years afterward, when a model of this instrument was constructed, it was instantly recognized by Captain Pell and others, as the one he had devised and drawn in his sketch book, and exhibited to his fellow passengers on the ship.

Captain Pell says: "Before the vessel was in port, Mr. Morse addressed me in these words: 'Well, captain, should you hear of the telegraph, one of these days, as the wonder of the world, remember the discovery was made on board the good ship *Sully*.'"

Thus it appears from his own records, and the recollections of the captain and passengers, gentlemen of the highest respectability and intelligence, that on shipboard Mr. Morse had actually drawn out and recorded a system of signs, composed of a combination of dots and spaces, to indicate letters, figures, and words, and a mode of applying the electric or galvanic current so as to make these signs permanent upon paper, to be passed along in the instrument which he had invented. The invention was accomplished and announced ere the inventor set foot on his native shore.

FRENCH PHOTO SKYLIGHTS.

"In France they do not have as much sunshine as we; therefore," says Mr. Wilson, in the *Philadelphia Photographer*, "the construction of the skylight has had even more attention there than we give it. Every device is employed for securing a proper light, and a proper quantity of it, and for avoiding anything that may obstruct it. We all know how many skylights are obscured by an accumulation of dirt and dust and rain on the outside. I have known of several cases where photographers have complained that their lights continued to work slower and slower, when, had they looked upon the outside, the guilty cause would have been very apparent. But, in a measure, to avoid that labor, the French use the plan made plain by the figure annexed. It is not without several advantages.



FRENCH PHOTO SKYLIGHT.

"It is similar to the ordinary construction, differing, however, in form. The sash is curved. The advantage of this arrangement is alluded to above, and to do away with the beam which absorbs the freest and is most active part of the light, since it strikes the sash at precisely an angle of 45°. The other part of the roof may be sloping both ways, the proportions of the *attelier* and the glass sash remaining as

ordinarily. At each end of the glass *attelier* a space may be set off of about ten feet in length on the whole width of the room, to be used as a laboratory and dressing room. The room will thus have a total length of eighteen meters, or about twenty-three feet.

For the portrait photographer who is sometimes obliged to accommodate the sitter who cannot come to his *attelier*, the



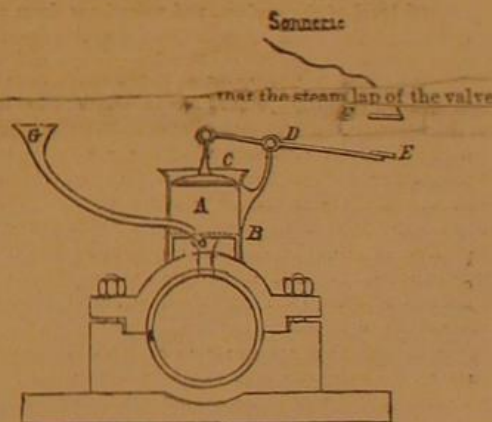
FRENCH PHOTO TENT.

annexed engraving of a tent, forming a posing room, will be found useful. The front faces the north in northern latitudes, and is turned, on the contrary, to the south in southern latitudes. Use a gray blue cloth background, which is about six feet wide by seven feet high. In travelling, it is rolled around the supporting pole; the top and the sides, forming curtains, are made of thin stuff, and held by rings to the rods of the framework, which are taken apart with great ease, to be packed into a very small compass.

In this portable *attelier*, excellent portraits may be obtained, and the time of posing is one half less than in a glass house. The professional photographer and the amateur will be henceforth able to work with advantage in the open air, and obtain very fine negatives of portraits and landscapes, with a baggage relatively light and easy of transportation.

A Hot Bearing Alarm.

This device, the diagram of which we extract from the



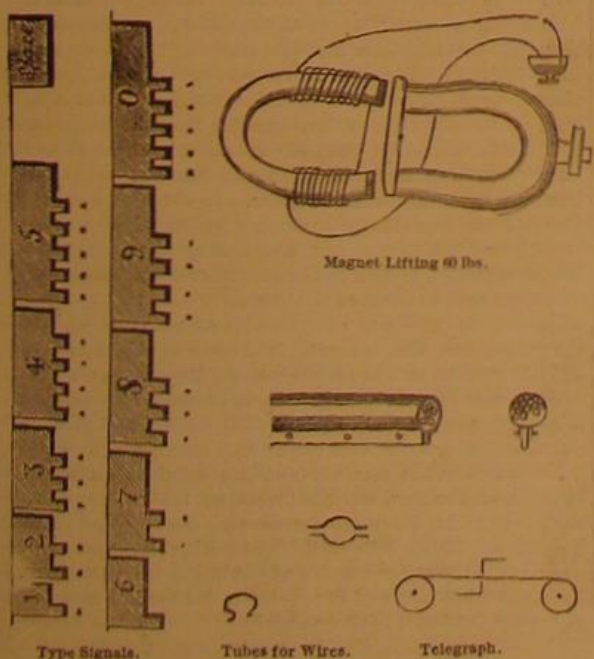
Revue Industrielle, consists in a cylindrical box, A, provided with a perforated bottom, B, and placed directly over the journal. The box is filled with a prepared grease which melts at a certain temperature, to which it must be raised by the shaft becoming hot. As the compound liquefies and escapes through the perforations, a disk, C, which rests thereon, descends, thereby tilting the lever, D, and so making contact between the plates, E and F. The latter are connected by an electric circuit with a bell which sounds when the current is established. The pipe, G, serves for the ordinary lubrication of the journal. It is suggested that this device might be profitably used upon journals not readily accessible.

The Shipping of the World.

The *Repertoire Generale della Marina* for 1874-75, recently published, gives some interesting statistics respecting the number of sailing ships belonging to the different nations in the world, with their tonnage. It may be remarked, however, that the following only relate to seagoing ships, vessels for inland navigation not being included:

Nationality.	No. of ships.	Tonnage.
British.....	20,538	5,383,763
American.....	6,869	2,181,659
Norwegian.....	4,464	1,349,138
Italian.....	4,343	1,227,816
French.....	3,780	736,326
German.....	3,483	832,789
Spanish.....	2,674	509,767
Greek.....	2,063	406,937
Swedish.....	1,905	360,368
Russian.....	1,428	330,350
Dutch.....	1,418	385,801
Danish.....	1,339	173,480
Austrian.....	955	327,742
Portuguese.....	410	92,808
Turkish.....	277	43,360
South American.....	219	89,761
Central American.....	188	46,580
Belgian.....	51	17,158
Asiatic.....	35	13,527
Total.....	56,289	14,523,680

The same publication gives the total tonnage of the steamships of all nations to be 5,244,888, of which 3,015,773 tons belong to England.



ORIGINAL SKETCHES FROM MORSE'S NOTE-BOOK.

one was so completely grasped at its inception as this. His little note or scratch book was always at hand, in which he made sketches of objects which met his eye, or of images formed in his mind. Scores of these books are now in exis-

(International Review.)
THE CONSTITUTION OF THE SUN.

BY PROFESSOR C. A. YOUNG.

Number II.

THE PHOTOSPHERE.

As to the nature of the photosphere, or visible surface of the sun, all the observable phenomena, with hardly an exception, concur in representing it as a sheet of luminous cloud: its peculiar granulated structure, the swift mobility of its constituent filaments, and the remarkable appearances, presented by the spots and faculae, are all consistent with this idea and readily explained by it. And if, as is most likely, according to what has been said, the main body of the sun is in fact a huge globe of mingled vapors and gases at such a temperature that even the enormous force of solar gravity can only reduce them to a density a little greater than that of water, it is perfectly easy to account for the existence of such a cloud sheet: it is simply a necessary consequence of the cooling of these vapors at the outer surface of the globe, where they come in contact with the cold of space. Under such circumstances condensation must result, for just the same reasons and in the same manner as that which produces the water and snow clouds of our own atmosphere: minute drops or flakes must be formed, not of water and ice indeed, but of the materials which we know to exist upon the sun, and must descend in fiery rain and hail into the central depths to be again reëvaporated. And as the descending matter is continually replaced by fresh supplies from below, there must result a vertical circulation of ascending streams and jets of vapor contesting the supremacy with down-pouring cataracts and sheets of the products of condensation; and in consequence the upper surface of the cloud layer must be in a state of continual and intense disturbance, as observation directly shows.

For it is found that the solar surface, when examined with a powerful telescope, is by no means uniformly bright, but mottled with a peculiar texture which has been very variously described, but may well enough be accounted for by supposing it to be formed of columnar clouds, floating vertically in the atmosphere of vapors out of which they are formed. Here and there the surface is marked by brilliant streaks known as the faculae, most conspicuous near the edge of the sun's disk, which on account of the absorption of the solar atmosphere is much less brilliant than the center. They are simply photospheric clouds, whose summits rise above the general level of the surface, and sometimes form visible projections on the limb. But the most singular objects, and the most interesting, are the spots, whose origin and phenomena

they are dark blotches of exceeding irregular form, and consist essentially of two parts, a central "umbra," as it is called, surrounded by a lighter fringe known as the "penumbra." The umbra contains usually one or more rounded spots much darker than the rest, and known as "nuclei;" even the darkest nucleus, however, is dark only by contrast with the intenser light around; for when, by means of a peculiar eyepiece, invented by Mr. Dawes, who first discovered these nuclei, we examine the umbra, excluding all light from the surrounding regions, it is found that even the darkest points are far too bright for the unprotected eye; and by the help of Professor Langley's polarizing eyepiece the color is seen to be a purple tint, closely matching that portion of the spectrum near the fixed line, H.

That the spots are hollows, having a depth varying in different cases from two to ten thousand miles, may be considered as an established fact, admitted now almost without dissent. The spectrum of the umbra of a spot is found to differ from that of the neighboring portions of the solar surface, first, in a general darkening of the whole; second, in a widening and deepening of many of the dark lines, with, on the other hand, a thinning and sometimes even an actual reversal of others; and third, in the presence of certain dark bands, sharply terminated on one edge, but shading gradually on the other. Now all these phenomena are just what might be expected in a cavity filled to a great depth by the nearly transparent gases which elsewhere form a thin layer over the sun's surface.

Spectroscopic observations on the chromosphere also show that around the spot there is an unusual and violent up-rush of hydrogen and other materials from the central depths.

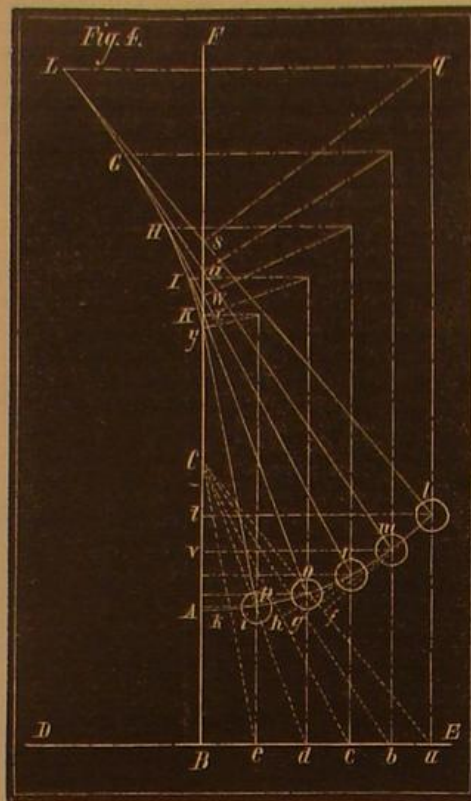
There is a well marked periodicity in the frequency and violence of our magnetic storms and their accompanying auroras, which exactly corresponds to that of the solar spots.

PENDULUM GOVERNORS.

Number II.

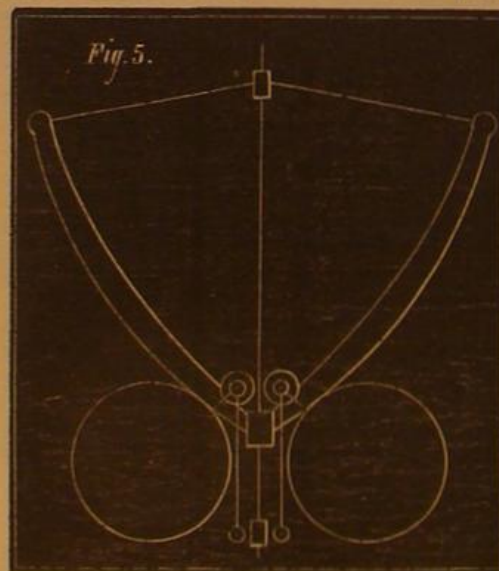
A governor in which the height of the balls is always the same, whatever their position, is said to be isochronous. In such a governor, the balls can only maintain the middle position, corresponding to the ordinary load on the engine, when the latter is at its proper speed, any change of speed causing the governor to act upon the regulator in such a manner as to correct the variation at once, if sufficiently powerful. In order to fulfil this condition, the centers of the balls, as they change their positions, must describe arcs of parabolas, as illustrated in Fig. 4, the curve, $l m n o p A$, being a parabola. It will be seen that, as the ball changes its position, so does the point at which the center of the ball rod cuts the center of the spindle, so that the vertical heights from center of ball to these points are always the same. In this form of parabolic governor, the end of the governor rod is made of flexible steel, and is hung to the end of a curved check, $L G H I K$, which is called the evolute of the parabola. The con-

struction of the parabola and its evolute are shown in Fig. 4. The weight of balls, length of arms, and resistance to be overcome are first ascertained; and from these, the height of the balls can be calculated when the engine is at speed. Then draw two lines, $B F$, $D E$, at right angles to each other.



Make $B C$ equal to the calculated heights. From C , draw any number of lines, $C e$, $C d$, etc., to $D E$, and, at each point of intersection, erect a perpendicular to $D E$. From the middle point, k , of $C e$, draw a perpendicular to $C e$; the point, p , in which it meets the perpendicular through e , is one point of the parabola. Bisect each of the other lines, $C d$, $C c$, etc., by perpendiculars, and the points in which these perpendiculars cut the perpendiculars drawn through d , c , etc., will be other points of the parabola. From each point so determined, as from l , draw a line, as $l s$, parallel to the line drawn through C , to determine the given point. From each point, as s , in which this line cuts $B F$, erect a perpendicular, as $s q$, and from the point in which it cuts the perpendicular, as q , through the given point of the parabola, draw a line, as $L q$, parallel to $D E$, till it meets the line, as $l s$, first drawn. In this way, points L , G , H , I , K , of the evolute of the parabola, are determined.

Another manner of making the balls move in parabolic



arcs is shown in Fig. 5, the balls sliding up along parabolic guides, as they change their position.

It has been shown that the weight of the balls does not affect their position, if the governor has no resistance to overcome beyond the weight of its own parts. In practice, however, a governor acts upon the controlling mechanism, and should have its balls proportioned so as to exert the requisite force. The necessary weight is thus calculated: Measure the distance of the point of suspension of each ball from its center. If there is a sliding weight, measure also the distance from its center to each point from which it is suspended. Ascertain the resistance of the controlling mechanism in pounds, and measure the length of the connections by which the governor overcomes this resistance, from their points of suspension to their points of attachment with the controlling mechanism.

1. Multiply each weight or resistance by the length of its connection, and divide by the length of the ball rod; add these quantities together, and divide them by 2.

2. Assume the greatest speed of governor that will occur under variation of load on the engine, subtract the proper speed of governor from this number, and divide by proper speed.

3. Divide the quantity obtained by the first part of the rule by the second quantity. The result will be the weight of the two governor balls.

This rule is somewhat complex, and it may be simplified by applying it to an example.

The ball rods of a governor are each 12 inches in length; there is a weight of 30 pounds connected to the spindle by a lever 9 inches in length; the resistance of the controlling mechanism is 20 pounds, and the rods connecting this mechanism with the governor are each 14 inches long. The governor is connected with the engine so as to make 300 revolutions per minute when the engine is at speed, and the greatest number of revolutions per minute under variations of speed is to be 350. What is the proper weight for each ball?

1. Multiplying the weight on the spindle of 30 pounds by 9 and dividing by 12, we obtain 22.5 pounds as the equivalent weight, if its connection were of the same length as those of the balls. Similarly, the equivalent resistance of the controlling mechanism is 15 multiplied by 14 and divided by 12, or 2.5 pounds. The sum of these weights is 25 pounds; and dividing by 2, we obtain 12.5.

2. The difference between the greatest number of revolutions of the governor per minute and the proper number is 50, and this, divided by 300, is 0.167, nearly.

3. Dividing 12.5 by 0.167, we obtain 74.85+ pounds, so that the weight of each ball should be about 37.5 pounds.

It will be evident, from what has preceded, that a pendulum governor which is very sensitive cannot be very powerful, nor one which is very powerful be very sensitive; and that, in order to obtain great power, it will be necessary to use very heavy balls. Our readers have, doubtless, observed that those governors which give the best satisfaction are arranged with a view to sensitiveness, the controlling mechanism being actuated by the application of a very slight force. It is probable that governors of any design will be subject to similar conditions, since a great resistance in general requires considerable force to overcome it.

We have been at great pains to simplify the rules contained in this article, and we think our readers, by applying them to a few examples, will readily understand them. The principles stated are of interest and value to all who are engaged in the construction of governors.

Correspondence.

The Patent Office Tea Set.

To the Editor of the Scientific American:

In answer to your inquiry as to what has been done in reference to the illegal presentation to Commissioner Leggett, I would say that it was stated on good authority that the Assistant Secretary submitted the question to the Attorney General for his opinion, and that it was finally concluded to drop the matter, and do nothing about it.

That it was a plain, open violation of the law is clear, and is admitted by the more honest of those who participated in it. The leading ones—those who headed the subscription and gave the most, some of whom are soon to come before the Senate for confirmation—fearing the effect of their illegal act, now seek to evade it by denying that they gave anything. The ground on which they do this is that, although they subscribed, they did not pay their subscriptions until after the 1st of November, which was some time after the plate was purchased and presented. Possibly, in order to avoid the effect, they may not have paid it yet; but that the present Commissioner headed the list with \$50, and the Assistant Commissioner followed with \$25, or more, is not denied, and cannot be, truthfully. This, to say the least, is a most cowardly and mean attempt to crawl out and leave blame to fall on the subordinates, nearly all of whom subscribed under compulsion: merely to retain the goodwill of those in authority, or to come in, and thereby to retain their places or secure promotion.

Again, they urge that they did not violate the law, because the subscription, although made early in October, was dated November 1, so as to have it appear that it took place after the Commissioner was out of office. This only makes the matter worse, because it shows on its face a knowledge of the law, and a deliberate attempt to evade its plain provisions.

Again: they urge that it was at best but a technical violation, because, although legally Leggett's resignation did not take effect until the 1st of November, still practically he was already out of office. The trouble with this is that it is not true, for not only did he remain until after the presentation (October 19, I think it was), but the Office records show that he acted as Commissioner and made decisions after that—at least so I am informed and believe. It has also been stated that this matter of the presentation originated with the lady employees. This is not true, and it is all the more unmanly for these parties to seek to shift the responsibility from their own shoulders to those of the women. A certain woman did originate, or at least carry out, the plan of presenting the cane; but the tea set presentation originated with, and was carried out by, the male employees. A certain examiner, who hoped and expected to be made Assistant Commissioner, was the main mover in the matter, and personally circulated the subscription paper.

Not only was the whole proceeding a palpable and wilful violation of the law, but they were so told at the time, by some who refused to subscribe, for that among other reasons. The whole matter, both in the transaction itself and in the neglect to enforce the penalty of the law by the Secretary, is but a fair illustration of the contempt for the law manifested of late by the Patent Office officials.

JAMES.

GREAT BRITAIN has formally accepted the invitation of the United States to contribute to the Centennial.

THERE is no mode so effectual to impress ideas on the mind as that of experiment aided by reflection.

PRACTICAL MECHANISM.

NUMBER XIV.

BY JOSHUA ROSE.

In the experiment referred to in our last, the valve had (in the first instance, when it had no lap) one sixteenth inch of lead so as to give that amount of exhaust opening when the piston was at the end of the stroke. In the second instance, however, when the valve had $\frac{1}{8}$ of steam lap added to it, it was set so as to have not more than $\frac{1}{16}$ of lead, the author being convinced that, when a valve has sufficient lap to give a moderately free exhaust, there is more to be lost by back pressure from excessive lead than to be gained by the small amount of assistance it lends towards making the exhaust more free. If a valve has no lap at all, it may with advantage be given an amount of lead that would otherwise be decidedly detrimental. It would appear that, in the early days of steam engineering, one of the advantages due to adding lap to the valve (a free exhaust) was largely attributed to the lead of the valve, since sufficient lap to cut off the steam supply when the piston has traveled three quarters or even more of its stroke will give a sufficiently free exhaust, even supposing that the valve has no lead at all.

Referring again to the advantage in economy due to using (or, as it is commonly called, working) the steam expansively, it is self-evident that, if we have steam at a gage pressure of 50 lbs. per inch, (that is, above the pressure of the atmosphere) and permit its escape at any pressure above that of the atmosphere, we shall not have extracted from it all the power it contains, because it may be used at the initial pressure of 50 lbs. per inch during a certain portion of the stroke, and, by then being permitted to expand itself before being exhausted, may be employed to perform duty as steam of 49, 48, 47, etc. lbs. per inch, and so on down to that point at which the indicating needle or hand of the steam gage will stand at zero, denoting that there is no longer any pressure in the steam. This last, however, is not actually the case, since the pressures marked on the gage are in each case 15 lbs. per inch less than the actual pressure of the steam when the needle stands at that point, which 15 lbs. serves in a high pressure engine to overcome the atmospheric pressure: which, in consequence of the exhaust port being open to the atmosphere, acts upon the exhaust side of the piston as back pressure, and therefore has to be overcome by an equal pressure of steam on the opposite side of the piston; so that, when a high pressure engine uses its steam expansively, so that it exhausts at the gage pressure of zero, it has extracted from the steam all the useful effect possible in such an engine, but at the same time not all the useful effect or power which the steam contains, as will be hereafter explained. This leads us naturally to another consideration, which is that, if steam be used expansively in a high pressure engine to an excessive extent, the result is an actual loss of power, because, if the steam on the one side of the piston is at a pressure less than the atmospheric pressure on the other, the latter acts of course as a retarding force to the advancing piston.

The steam passages between the valve seat and the cylinder bore, and the clearance between the piston (when it is at the end of its stroke) and the cylinder cover, are spaces which have each to be filled, during each revolution of the engine, with live steam; and if the engine is not worked expansively, this live steam escapes without giving any of its power to the engine, and is lost, except in so far as it was necessary to fill those spaces. If, however, the engine is worked expansively, the expansive force of such live steam is extracted from it and applied as useful effect upon the piston, the result being an appreciable gain in the economy of steam, especially in those engines which, by reason of having the valve seat in the center of the cylinder, have very long steam passages, not merely because of the length of such passages, but also because in such cases the steam port serves alternately as the exhaust port, and has therefore to be made of larger proportions than it would need to be if employed as a steam port only, since an exhaust port always requires to have a larger area than a steam port. Hence the content of such passages, together with the clearance before referred to, bears a large proportion to the whole contents of the cylinder; and to extract power from the steam contained in them, by utilizing its expansive force, is a considerable gain to the engine.

From what has been already said, it will be perceived that a high pressure engine, to work to the greatest possible advantage and economy, should work its steam expansively to such a degree that it will be exhausted at zero of the pressure gage, or in other words at a pressure of 15 lbs. per inch, that being equal to the pressure of the atmosphere on the exhaust side of the piston. The point in the stroke at which it may be necessary to cut off the supply of steam to the cylinder, in order to effect such an amount of expansion, will vary according to the pressure of the initial steam and the length of the stroke of the engine, and must hence be determined according to those conditions.

An approximate calculation, as to what extent the steam in a cylinder is working expansively and its pressure at the termination of each inch of piston stroke, may be made by making the whole distance the piston has moved (under both live and expansive steam) the denominator and the distance it has moved under expansive steam the numerator of a fraction, and then multiplying the initial pressure by the numerator and dividing by the denominator of the fraction; then subtract the quotient from the initial pressure, the last product being the pressure of the steam. Thus: Supposing the initial pressure of the steam admitted to a cylinder to be 60 lbs. per square inch, the length of the piston stroke to be 20 inches, and the supply of steam to the cylinder to be cut off by the valve when the piston has traveled 5 inches of its stroke, what pres-

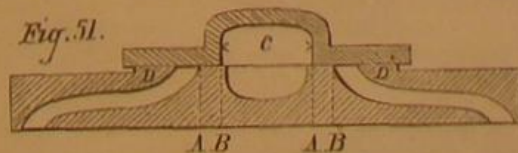
sure of steam will there be in the cylinder when the piston is at the end of the tenth and twentieth inches of its stroke, respectively: Here the tenth inch of stroke—whole distance moved by the piston = 10, distance moved by the piston under expansive steam = 5, hence the fraction $\frac{5}{10}$; then the initial pressure $60 \times 5 = 300 \div 10 = 30$; then $60 - 30 = 30$ = the lbs. pressure on the piston when it had arrived at the end of the tenth inch of its stroke.

Again: Whole distance moved by piston = 20 inches, distance moved by the piston under expansive steam 15 inches, hence the fraction $\frac{15}{20}$; then the initial pressure of the steam $60 \times 15 = 900 \div 20 = 45$; then initial pressure $60 - 45 = 15$ = the pressure of the steam in pounds per inch at the end of the twentieth inch of the stroke or piston movement.

By making such a calculation for every inch of the piston movement and setting the figures in a column and adding them together, and dividing their sum total by the number of inches in the stroke, we arrive at a tolerably accurate estimate of the average pressure of the steam upon the piston throughout the stroke.

A review of the above calculations discloses that, as before stated, the pressure of the steam has decreased in precise ratio to the increase of the space it occupied, that is to say, when the piston was at the end of its fifth inch of stroke (the steam supply being cut off) there was five inches of the length of the cylinder filled with steam at a pressure of 60 lbs. per inch; and when the piston was at the tenth inch of its stroke and the steam had expanded so as to occupy ten inches of the length of the cylinder, the pressure was reduced to 30 lbs. per inch; and the same rule applies to the twentieth inch of stroke, for the steam then occupied four times the space it did as live steam, and had therefore fallen to one fourth of its original or initial pressure. It is to be noted, however, that while such a calculation is absolutely correct as applied to any one definite point of the stroke (making no allowance for the steam in passages and clearance) it is not entirely correct in its results if we take a number of such points to obtain therefrom the actual average pressure of steam throughout the stroke, for the following reason: Suppose we calculate (by the given rule) the pressure of the steam per inch upon the piston when it had concluded its sixth inch of stroke. Here the whole distance moved by piston = 6 inches, distance moved under expansion = 1 inch, therefore the fraction is $\frac{1}{6}$; then the initial pressure = $60 \times 1 = 60 \div 6 = 10$, then again initial pressure $60 - 10 = 50$ = pressure of steam per inch upon the piston at the termination of its sixth inch of movement. Now while 50 lbs. per inch accurately represents the pressure of steam upon the piston at the termination of its sixth inch of movement, it in no wise represents the average pressure of steam per inch during the whole inch of movement, because the piston commenced that inch of its movement or stroke under 60 lbs. pressure of steam per inch, and not until it had concluded that inch of movement was the pressure reduced to 50 lbs. per inch. Nor will it avail us to take the mean between the two, that is 55 lbs. per inch, as the average pressure for that inch of movement; because, so long as we calculate the pressure at every inch of the stroke, we shall have the same discrepancy between the pressure at the beginning and at the end of the inch of movement, whether it be at the fifth, sixth, or seventh inch, or at $5\frac{1}{2}$, $6\frac{1}{2}$, or $7\frac{1}{2}$ inches of the stroke. To get a more nearly correct result, we must take a greater number of points in the stroke such as every half or quarter inch of the piston movement; the more points taken, the more nearly correct will be the result obtained. It is, however, generally considered as sufficiently correct for practical purposes to take as many points as there are inches in the piston stroke.

With a common slide valve, it is not practicable to cut off the steam supply to the cylinder sufficiently early in the stroke to effect so large a degree of expansion; because, in the first place, it would require the valve to have an excessive amount of steam lap, and the exhaust would take place too early in the stroke, thus causing the piston to travel a large proportion of the latter part of the stroke without having any pressure of steam behind it; and because in the second place, when there is the large amount of steam lap on the valve necessary to cut off earlier in the stroke than at two thirds (that is, carrying full steam two thirds of the stroke) the admission, expansion, and exhaust of the steam to, in, and from the cylinder becomes very irregular in the forward as compared to the backward stroke of the engine, which irregularity will be shown and treated upon in connection with the piston movement, steam supply, etc. To obviate the defect (above referred to) of a too early exhaust, the valve may have lap added to its exhaust side, that is to say, the exhaust port of the valve may be made narrower than the width between the two nearest together edges of the steam ports of the cylinder face, as shown in Fig. 51, C being the exhaust



port of the valve and from A to B being the lap on the exhaust side. Such lap is, however, only possible when there is a good deal of lap on the steam side of the valve.

The amount of exhaust lap is at all times to be governed by the speed at which the engine is to run. A fast running engine, cutting off its steam supply at about one half stroke (which is the extreme limit of expansion permissible with a slide valve), may have exhaust lap to half the amount of the steam lap; a slow running engine may have exhaust lap to nearly three quarters of the amount of the steam lap. The reason of the difference is that, as the

exhaust lap retains the steam in the cylinder longer, it, to that extent, cramps the exhaust; and as a quick running engine requires a more free exhaust than a slow running one, the latter may have its exhaust more covered by the exhaust lap when the piston is at the end of its stroke.

The objection to a valve having clearance is the open communication permitted between the steam and exhaust ports, which, though it exists for only a comparatively insignificant space of time, is a radical defect, especially when it is borne in mind that, as we have already shown, a slide valve should always have steam lap, and therefore will always have a proportionate amount of exhaust opening, in addition to that given to it by the lead of the valve. Clearance, then, is an expedient which should never be resorted to, it being a blunder applied merely to remedy a blunder. Clearance to a valve having much lap on its steam side is altogether inadmissible, since it is not requisite to give a more free exhaust, while it assists in letting the exhaust steam escape earlier in the stroke; and by this means, it adds to a defect inherent in slide valves having much steam lap, which is a too early exhaust.

A slide valve is sometimes given what is called clearance, that is to say, it is made wider in its exhaust port than are the two nearest together edges of the steam ports, so that (referring to Fig. 51) the port, C, of the valve would overlap the steam ports to the amount of the clearance, giving to them both an open communication with the port, C, and therefore with each other during the instant of time at which the valve is in the center of its travel. Clearance on the exhaust side of a valve is therefore the very opposite of lap on the exhaust side of a valve. The object of clearance is to give the valve a more free exhaust, and it is therefore only resorted to in cases where, the valve having little or no steam lap, the exhaust steam cannot freely escape.

Common slide valves, however, work to better advantage when the lap is so proportioned as to cut off the steam at from two thirds to three quarters of the stroke than at any other point, because of the comparatively long stroke of the valve (and hence large eccentric) necessary when much steam lap is brought into requisition, and because of the large amount of friction between the valve and cylinder faces in consequence of the pressure of the steam on the back of the valve. There are of course many devices for balancing such valves and some for reducing the pressure to a minimum, but none have as yet appeared whose benefits have proved such as to cause their general adoption for locomotives or small stationary engines, to which the application of the common slide valve is now almost universally confined.

To reduce the friction to a minimum, that part of the cylinder face upon which the face of the slide valve works may be raised above the general face upon which the steam chest beds, as is shown in Fig. 51, so that the steam lap of the valve may have the steam on the under as well as the outer side, and be to that extent relieved of the outer pressure. In such case, the width of the projecting faces (marked D in Fig. 51) should not be any wider than is the bridge (of the cylinder face) between the steam and exhaust ports; otherwise the wear of the face of the bridge will be the greatest and the valve seat of the cylinder face will wear hollow, the valve springing (to fit such face) from the steam pressure on its back. Especially is this the case where a high pressure of steam is employed. It is not uncommon to cut away these faces, leaving them full only around the edges of the ports, which cutting is performed by a slotting drill.

It is advantageous to make the steam ports long and narrow rather than short and wide, so that, when the valve commences to open, whether it be on the steam or exhaust side, a small amount of opening will present a comparatively large area for the ingress or egress, as the case may be, of the steam; hence the supply and exhaust of the steam to the cylinder will be larger in proportion to the valve movement, and therefore more instantaneous. A long port will of course entail a broader valve surface, and hence increased pressure of the valve to its seat; but this is compensated for by the decrease in the stroke of the valve (and hence in the diameter and stroke of the eccentric) permissible with the long port.

The rule sometimes given by which to calculate the required area of a steam port is, say, for a fast running engine: One eighth the area of the piston is the proper area of the steam port; the employment of such a rule, however, gives a result bearing no definite relation to the piston speed, and leaves a wide margin of difference, since either 300 or 600 feet of piston travel per minute is a fast running engine; whereas the amount of steam required to pass through the port for the one speed (supposing both pistons to be of equal diameter) is double that required for the other; while if the port area is larger than necessary, it causes a serious loss of steam; whereas if it is too small, it withdraws the steam and fails to supply steam at full pressure to the cylinder. The following rule, given by Mr. Bourne, appears to meet the exigencies of the case, by giving the port an area proportionate to the quantity of steam required to pass through it. The rule is: Multiply the area of the cylinder in square inches by the speed of the piston in feet per minute, and divide the product by 4,000; the quotient is the area of each steam port in square inches.

EVERY subscriber of the SCIENTIFIC AMERICAN ought to be an agent for the increase of its circulation. Whoever reads the paper can aid in this matter very materially by recommending it to his neighbors. In the absence of agents, we appeal to our friends to lend us a hand. Let us have a "subscription bee," such as we remember in our early days, when all turned out, with oxen, horses, plows, and shovels, to do up some good work with dispatch.

TRYING-UP AND FOUR-CUTTER PLANING AND MOLDING MACHINE.

We illustrate herewith a new wood planing and molding machine introduced by Messrs. Wm. Furness & Co., of Liverpool, Eng., for the combined purposes of dimension planing, or trying-up, and planing on all four sides timber of any length, and up to a given width and thickness. The machine is shown adapted for trying-up or planing perfectly level and out of wind a piece or pieces of timber up to 20 feet long, 20 inches wide, and 16 inches thick. This is done in the ordinary way by revolving horizontal cutters, driven by two bands, one on each side of the machine, the table with the timber traveling under the cutters at the desired rates of feed, a quick return motion being provided for bringing back the table. The novel part of the machine consists in the feed works, which are here shown to be behind the table. These feed works are formed of four calender rollers powerfully geared, between which works the bottom cutter head driven from a countershaft fixed to the framing of the machine. The side cutter heads are in advance of the second pair of feed rollers, and are also part of the feed works. One side cutter head is a fixture, and the other is worked in or out on slides by means of a screw. It will thus be seen that the feed works comprise the feed rollers and necessary driving gear, bottom and side cutter heads, and pressure rollers, etc. The whole is carried by four grooved friction rollers, running on two turned rods supported by the framework of the machine and a bracket at the back.

When it is desired to use the feed works for tonguing and grooving, molding, or planing all four sides of the timber at once (says *The Engineer*, from which we select the engraving), the table of the machine is run forward till the end is almost under the top cutter head, when the feed works can be easily drawn across the framework of the machine. It fixes itself in V slides; and the bands for bottom and side cutter heads having been placed on their respective pulleys—which are fixed on the ends of the spindles, so that no lacing or fastening is required—the machine is ready for work. It will work any size of timber up to 4 inches thick and 12 inches wide. By the removal of the side cutter heads, which is a very simple operation, surfacing or panel planing can be done by the top cutter head alone up to 20 inches wide. A very important feature of the machine is the rapidity with which the feed works can be removed when the machine is required for trying-up purposes, about five minutes being required. A great advantage, and worthy of attention, in this combination of two efficient machines is that they only occupy the same space as one machine, and only require one pulley upon the shaft of the mill to drive them.

NEW MECHANICAL CONSTRUCTION FOR COMPOUND TOOLS.

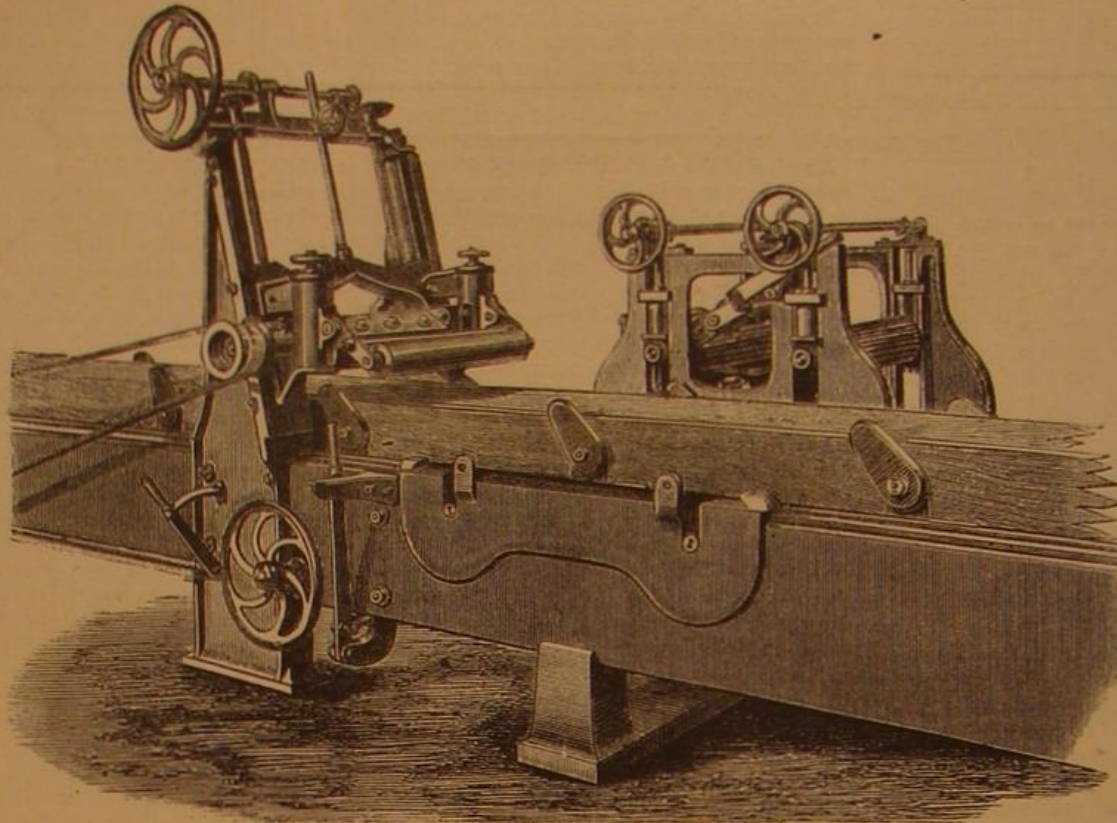
We have lately had brought to our notice an entirely novel construction for scissors, pliers, shears, and other tools of similar nature, which is an invention of considerable utility and merit, and which will doubtless commend itself as a valuable addition to the kit of every mechanic. In using implements with pivoted jaws, a large percentage of the power is wasted in useless strain on the pivot. In the present device, the pivot is abolished, and the jaws are so arranged as to be forced together by a powerful cam lever. To add to the utility of the tool, these jaws are made interchangeable, so that a single stock may answer for saw gummers, pliers, shears, saw set, pincers, and a multiplicity of other implements.

Referring to the engraving, Fig. 1, A is the stock, B B' the handles, C C' the operating jaws, and D, a spring for opening the latter. The stock is recessed to form two side pieces, between which the shanks of the jaws are pivoted at c and d. The upper jaw, C', Fig. 4, has a long shank which is recessed near its head to receive the cam, B', which is formed on the handle, B'. The end of the shank of the under jaw, C, which is pivoted, as stated, at c, impinges against the shank of the upper jaw. The cam lever handle, B', is pivoted at a.

When the handle, B', is brought toward the stock handle, the cam on the former presses against the shank of the upper jaw. From this last, motion is communicated to the under jaw, so that each is made to approach the other. By reversing the handle, B', a more powerful leverage may be brought to bear on the jaws. The cutting edges are thus forced together square and true, not overlapping so as to tear the material apart, as is frequently the case in pivoted cutting tools. There is therefore less strain on the jaws, and

they are consequently more durable. A recess is provided through the jaw, C, through which bolts or wires to be cut may extend, so that a bar of any length may be divided squarely at any desired point. Each jaw is tempered separately, thereby giving to both an improved temper, unattainable in the ordinarily constructed implement. Finally, the jaws are easily adjustable, so that in case of injury they may be readily removed and others substituted, or, as above stated, tools for a different purpose may be inserted.

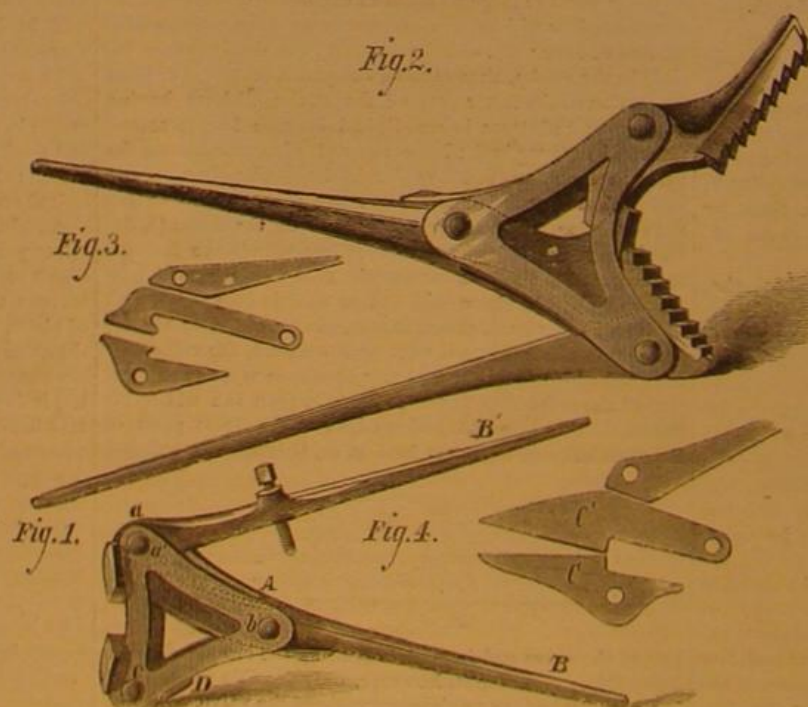
We are informed that, since the date of the patent of the invention, by Peter Broadbooks, of Batavia, N. Y., November 18, 1873, important adaptations of the system have been made, so as to render it suitable for the tools of over fifty



TRYING-UP AND FOUR-CUTTER PLANING AND MOLDING MACHINE.

classes of mechanics, including, among others, tongs, presses, bolt cutters, pruning shears, punches, pipe wrenches, and horse shoe nail clinchers. The construction of the implement last mentioned is shown in Fig. 2. The arrangement of parts is the same as in Fig. 1, except that the jaws are shaped differently and are provided with serrated faces. The jaw operated by the cam lever goes under the hoof, and the angle of the latter enters the curved portion between the jaws. The corrugated face of the upper jaw, therefore, takes against the incline of the hoof, and, as it is rubbed down the same by forcing the handles together, the corrugations catch against and clinch the nails. This is done quickly and without injury to the hoof, thus saving to the animal a large amount of the suffering often caused by the usual mode of clinching.

We have tested various sizes of pliers constructed after the plan described, and find that they cut nails and spikes with great facility, one little instrument, no larger than a conductor's punch, biting off shingle nails as easily as if they were pins. The device is excellently suited for saw gummers.



BROADBOOKS' COMPOUND TOOL.

The adaptation of the invention as a hand vise is shown in Fig. 3, and as a shears, in Fig. 4.

Further particulars and descriptive circulars may be obtained by addressing Messrs. S. P. Allen & Co., care of Pollock, Weaver & Co., 17 West Main street, Rochester, N. Y.]

New Discoveries in the Mammoth Cave.

Professor F. W. Putnam, of the Peabody Academy of Sciences, Salem, Mass., has recently explored the Mammoth Cave in Kentucky, and has visited several caverns never before entered. His investigations have resulted in finding colored fish without eyes, thus exploding the theory hitherto held that all eyeless fish are colorless. White fish with eyes, and crayfish both with and without those organs, were obtained, presenting many new features of great interest to naturalists. Skeletons of human beings, mounds, and a large variety of valuable archaeological relics were found in the new chambers.

Cheap Telegraphy.

President Orton's report of the affairs of the Western Union Telegraph Company is not calculated to inspire much hope in those who believe that the government can run the lines at cheaper rates to the public. On the 1st of January, 1873, a reduction of more than fifty per cent was made in the maximum tariff between the most remote points on the company's lines. This, though occasioning a temporary loss of revenue, has resulted, during the last few months, in a large increase. The reduction was from \$7.50 and \$5 to \$2.50. President Orton now adds that, owing to Messrs. Edison's and Prescott's quadruplex apparatus, which is, at the present time, working successfully between Chicago and New York, and by which two messages are sent in the same direction and two more in the opposite direction simultaneously on a single wire, he believes it practicable before long to cut rates down still lower, and ultimately to establish but four rates for day messages, namely, twenty-five, fifty, seventy-five cents, and one dollar, with half charges (except for the lowest) for night

Decline of City Trades' Unions.

The repeated strikes, and the suffering caused thereby to the workmen participating, are at last beginning to open the eyes of the latter to the evils of trade union rule. It appears that the unions in this city since 1873, taken as a whole, have lost fully one fifth of their members—aggregating 9,000 men. As a rule, these people have found employment, and doubtless now perceive the advantage of steady work, even at lower wages, over starving in idleness in the hope of getting ultimately a few dollars more. Some societies have suffered in a remarkable degree, notably the painters and coopers, which have lost respectively fifty and forty per cent of their members. The building trades show a decline of twenty-five per cent; the shoemakers, twenty per cent, and the cigar makers, thirty per cent. The horseshoers, tailors, hatters and longshoremen maintain their strength, though the numbers of the latter bid fair to be much depleted through the recent difficulties with the shipowners.

The Highest Lake in the United States.

Dr. Harkness has discovered, in Plumas county, California, a body of water, probably the most elevated in the United States, the barometer registering a height of 7,330 feet above the sea level.

The lake is of triangular shape, having its longest diameter about one mile and three quarters in length. The water during last August was intensely cold and of a deep blue color. The outlet is into Warner Valley, over a declivity of some 2,000 feet. The California Academy of Sciences has named the lake, after its discoverer, Lake Harkness.

Ignorance and Crime.

We doubt if more striking evidence of the necessity of compulsory education laws and the provision of means for their rigid enforcement could be found than appears in a suggestive fact in the pages of a recent report of the National Prison Association. This volume, which is filled with copious statistics of prisons and convicts in this country, deals incidentally with the causes of crime, making its deductions from the various prison reports of the mental and social condition of the incarcerated. Ignorance is proved to be the worst evil with which a community must struggle. Forty-eight per cent of all the convicts in the United States can neither read nor write, and only one per cent of the aggregate have acquired a superior education. We trust that the enforcement of the compulsory laws already enacted in some of the States, will soon justify the wisdom that prompted them, and lead to an improvement in the average education of the lower classes.

IRON-FRAMED THRASHING MACHINES.

We illustrate herewith an iron-framed thrashing machine, the manufacture of which has been made a specialty by Messrs. Marshall, Sons & Co., of Gainsborough, England, who have turned out, according to *Engineering*, a large number of these machines. Fig. 1 is a side elevation, which shows the framing, stiffened around the edges, and at intervals in the length by plates. It also shows the arrangement of the pulleys for driving the drum, shakers, fan, etc. The other view is of a longitudinal section through the center of the machine, and shows clearly the arrangement of drum, shakers, shoes, barley awners, and fan. The engravings explain the arrangement of the machine thoroughly, and we

and use more metal in the construction of frames for thrashing and similar machines.

[The Telegraphic Journal.]

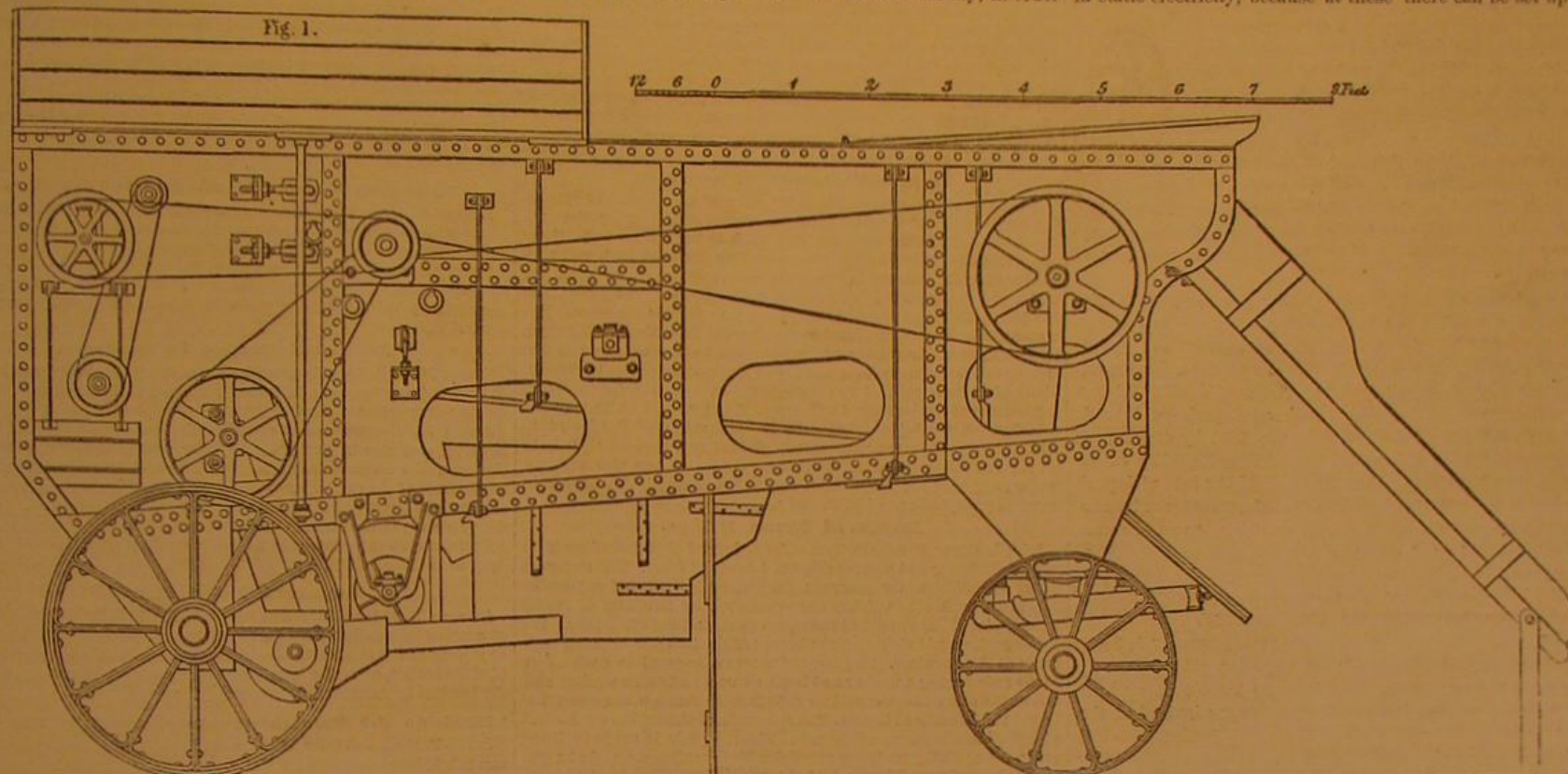
ELECTRO-DEPOSITION OF METALS.

BY J. T. SPRAGUE.

[Concluded from page 393.]

The connecting wires should be secured to the objects while under water, unless, which is much better, they can be soldered on before cleaning; it is usually better to have two or three wires to an object, so as to diminish the resistance, and to shift the points of contact occasionally, in order

obtained. If the surface is very large in proportion to the current, the deposit will form in separate crystalline granules, chiefly on the edges and corners, and a deposit formed under these circumstances will develop into a series of nodules capable of easy separation from each other. If the surface is small compared to the current, the deposit will be of a brown color, and have no coherence; this state, also, will begin to show itself first at edges and corners; there the deposit may be quite friable, while a good metal is forming at the middle of the plate. The principles of liquid conduction account for these effects by showing that the current acts in a higher degree at points and edges, just as charge does in static electricity, because at these there can be set up the



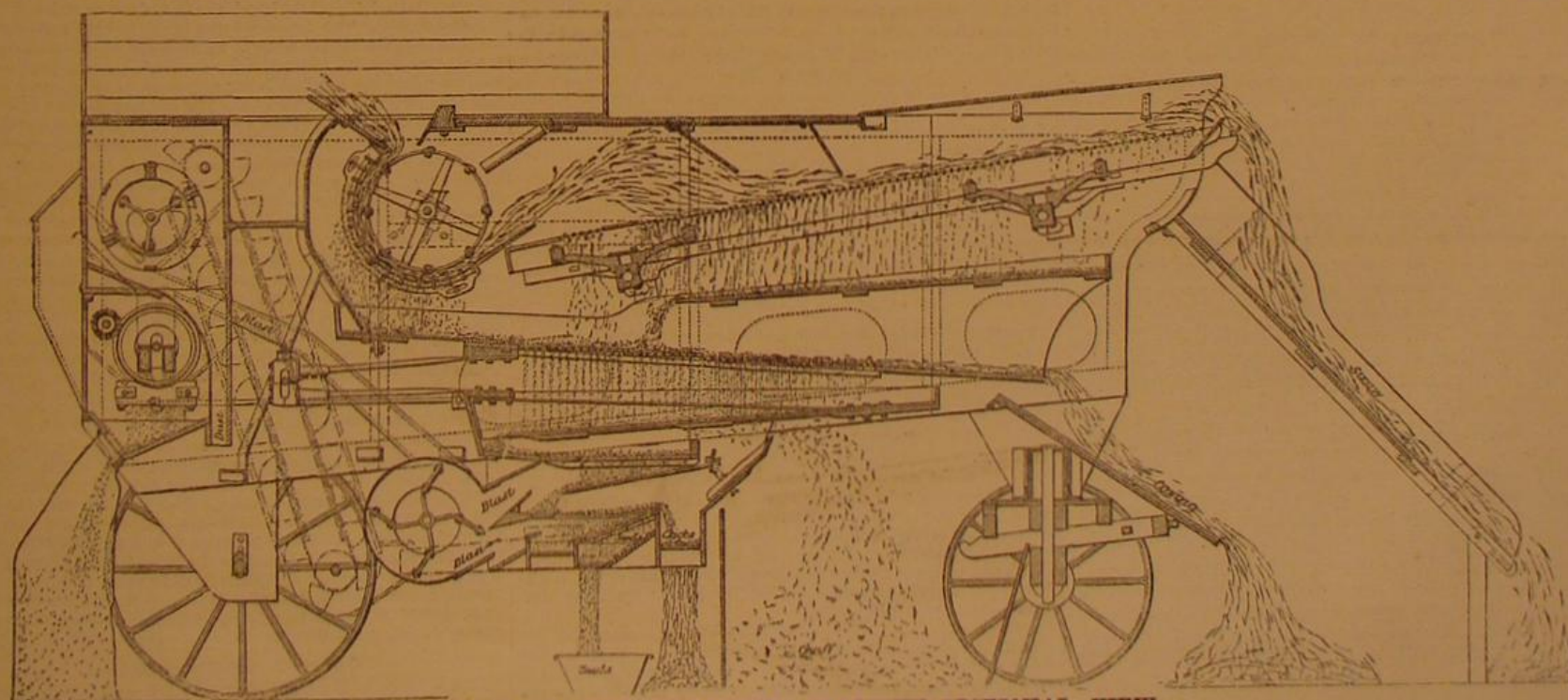
MARSHALL & CO'S IRON-FRAMED THRASHING MACHINE.

need not, therefore, attempt any detailed description, but confine ourselves to the special features of this machine, other than the iron framework mentioned above. The drum spindle is of steel, and the rings placed upon it are slotted out, as shown in our second engraving, to receive a number of iron bars, to which the beater plates are attached, this arrangement being found preferable to introducing wood beneath the beaters. The concave at the back of the drum is

to avoid furrows upon the face; it is better also to make the actual contact by short pieces of fine wire attached to a larger conductor not in contact with the object. The general principle to be kept in view is to make the resistance of these connecting arrangements as small as possible, and yet to avoid anything which shall interfere with the contact of the liquid and its free circulation over every part of the surface to be coated.

most numerous lines of polarisation towards the opposing surface. We learn, in fact, that there are two sets of conditions to be attended to.

The first point is the strength of solution. If we pass a strong current in a weak solution we get the brown powder; if, without altering any other condition, we add saturated solution of the metal, the deposit may become good. In every solution there are several different ions present at the elec-



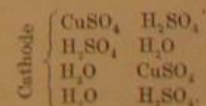
IRON-FRAMED THRASHING MACHINE SECTIONAL VIEW.

entirely of wrought iron. The shakers consist of four boxes, the straw platforms being arranged as shown. They are actuated by two crankshafts, one at each end, connected with the shakers by brackets. The cranks are provided with long bearings, and a collar at each end, over which the top bearing block overlaps, to keep out the dirt. The reciprocating dressing shoes are hung on spring rods, as shown, and are worked by a crankshaft similar to those for the shakers. The whole of the blast employed in the machine is taken from one fan, shown in the second engraving, one part being taken under the riddle of the main dressing shoe, and the other thrown upwards to act on the corn as it passes from the cleaner to the screen. The elevators are entirely within the machine, and lift the grain from the reservoir. We may add that a thrashing machine of this type was exhibited by Messrs. Marshall & Co., at Vienna. And we would also state that manufacturers of agricultural machines in this country would do well to take the hint from the English builders

According to the conditions we set up will be the nature of the metal deposited: that is to say, its molecular condition as to cohesion, etc., will depend upon the relations of force to which the deposit is exposed. Color also depends, in great degree, upon the molecular condition of the surface; for instance, gold in very thin films has a greenish tint, owing to the light reflected through it; in a very finely divided state, as when chemically precipitated, it is a dark brown; in its ordinary condition, also, the presence of very small quantities of copper and silver greatly modifies the color. To secure deposits of good quality and appearance, therefore, it is desirable to ascertain those relations of energy which set up the conditions upon which good deposit depends.

If we pass a strong current into a weak solution of copper, the metal deposited will be pulverulent; if, by means of resistances and varying battery power, we pass a fixed current into a solution, but effect the deposit upon a surface of gradually diminished area, a series of instructive results will be

trodes; thus, in the case in point, with a weak solution, only a small part of the cathode can have copper turned towards it; by far the greater portion of its surface must be in contact with the hydrogen of the water or acid; the conditions are, in fact.



Now, if the current (or quantity) is larger than the Cu is equivalent to, of course H_2 is set free, and this will reduce a neighboring atom of copper, but not in contact with the electrode; that is to say, the deposit will consist of detached molecules, and most likely of a compound of copper and hydrogen. This would not occur if the current also were weak, because a weak current means a low tension at the electrode, and hydrogen can be set free only when a certain tension has been reached, sufficient to supply the requisite specific

energy; besides, the slow current would be able to find sufficient copper in even a very dilute solution.

It is obvious, therefore, that solutions should be sufficiently supplied with metal for all likely requirements, and the stronger they are the more rapidly they are to be worked.

The other point to be studied is the relation of the current to the solution and to the work, and this the most important, because it is under control and is constantly varying with different objects. We have seen that there is a point so near balance that the extra strength of current concentrated on the edges destroys the coherence of the deposit. Now, if we arrange several vessels in series, all alike except in the difference in the area of the cathode in each, and connect them to a battery, we can produce such a condition of things that, by the same current and from the same solution, and with the same size of anode, we shall obtain every gradation of deposit, from brown loose powder to single hard crystals. Here, then, we find a relation between the quantity, or current, and the area over which it is distributed—a relation which is rarely pointed out with the definiteness required, for this is the fundamental condition of good working. Of course this is practically known, or there could be no success in depositing, but the principle can only be understood by a distinct conception of measurement and of the molecular relations of electricity.

This relation we may examine under the name of density of current, for which also we require a unit; this is conveniently furnished by the chemie unit of current and square inch of surface. We must therefore ascertain, by experiment, for any given solution, the range of density of current which gives good work. Such an experiment is made by using a cathode of a fixed area, so that by varying the battery power we can examine the different quality of deposit produced. Having thus ascertained the rate of deposit adapted to the solution, the density of current can be controlled by similar means in actual working, so as to secure the conditions of good working and the rate and quality of deposit we desire.

CHEERFUL FOR ADVERTISERS.

The Special Edition of the SCIENTIFIC AMERICAN is being printed and mailed as fast as it can be gotten off. Orders for advertising in that edition have been so large that we have been induced to make it twenty-four pages instead of sixteen.

We hope soon to be compelled by advertisers to make every regular issue of our journal of the same size.

Those who have advertisements in the Special will be gratified to know that we shall print of our first edition—now on the press—ONE HUNDRED AND FORTY-FIVE THOUSAND copies, and it is expected that the demand will be so great that a second edition of from 25,000 to 50,000 will be required.

NEWS AGENTS will be supplied with the Special Edition by the American News Company at the same price as the regular issue; and, in ordering, they should be careful to state *Special Edition*.

DECISIONS OF THE COURTS.

United States Circuit Court.—Northern District of Ohio.

CLOVER REED MACHINE PATENT.—JOHN C. BIRDSELL vs. A. McDONALD et al. JOHN C. BIRDSELL vs. THE ASHLAND MACHINE COMPANY et al.

(April term, 1874.)

SWANEE, J.:

These are suits in equity founded upon certain patents issued to the complainant, touching machinery for getting out clover seed. Except in one particular, hereinafter mentioned, the bills in both cases contain the same allegations.

The parties agree as to the state of the art down to the period of the alleged inventions of the complainant.

Before that time clover heads were detached from the stems, preparatory to hulling, by the tramping of horses, by thrashing with flails, by cutting with cradles (the two first fingers being covered with canvas and the heads cut off near the place of their attachment to the stems), by removing the heads in the field by an instrument known as a stripper, and, after mowing, by ordinary thrashing machines. The heads were also sometimes detached by a machine designed especially for that purpose. Hulling out the seed was a distinct process. This was usually done by a machine used for that purpose alone. Machines for thrashing and those for hulling were frequently worked at the same time side by side.

The complainant's bill against McDonald and others is founded upon two patents, reissue No. 1,268, and the original patent, No. 85,399. The bill charges the defendants in that case with infringing all the claims, three in number, of the reissue, and the third claim of the original patent.

A patentee cannot be charged with having abandoned his invention because his solicitors, without his knowledge, neglected to file his application in the Patent Office, for more than two years after it had been sworn to, and was in all respects complete.

An invention will not be held forfeited because it was used for experimental purposes, in good faith, more than two years before applying for a patent. The objection is not one to be regarded with favor; but, if clearly established, it is fatal.

It is presumed, from the decision of the Commissioner of Patents, in granting a reissue, that it embraces the same invention as the original patent; and the contrary can be shown only by a comparison of the papers in the two cases.

A reissued patent can only be impeached for fraud by a bill in equity brought for the purpose by the Government.

A combination is legitimate when all the elements cooperate in producing a result, and are necessary to it, though their several functions are not performed simultaneously; if performed in immediate succession, it is sufficient.

If an alleged invention proves superior to what has been known before, it is evidence in favor of its novelty.

A clover machine with two hulling cylinders does not affect the validity of a subsequent patent for a machine for one cylinder for thrashing and another for hulling.

Machines which have been abandoned after being experimented upon do not preclude a subsequent patent for a successful machine, however closely they resemble each other.

[S. B. Fisher, for complainant.

George Wiley and George Elin, for defendants.]

Recent American and Foreign Patents.

Improved Sash Balance.

Newton J. Snaggs, Talladega, Ala.—By suitable construction a cord is pressed and clamped against the side bar of the sash by the downward movement of the block into the cavity of a plate. The block is raised to release the cord by means of a knob, the stem of which passes in through a vertical slot in the angle of the plate, and is screwed into the block.

Improved Running Gear for Wagons.

William H. Simmons, Memphis, Tenn.—This invention consists in connecting the reach to the front running gear by means of a tube through which the king bolt passes. The tube is secured to the axle independently, and thus relieves the king bolt of strain.

Improved Holding Jack for Wagon Bodies.

William R. Crane, Stony Creek, Mich.—This invention consists of a couple of rests for the support of a wagon body, mounted on a horizontal support, one being jointed and the other attached to it. Said support is mounted on the top of a standard, in which it is capable of turning on its axis. The standard turns on its axis, so that the box may be turned and shifted about, and presented and held in various positions for the convenience of the workmen in dressing, finishing, and painting it.

Improved Adjustable Dead Pulley.

Augustus Newell and Asa B. Cook, of Erie, Pa.; said Newell assignor to said Cook.—The loose pulley is entirely supported by the box, there being a space left around the shaft. The two arms of the double hanger are held against the sides of the box by means of a bolt, which passes through the lower extremity of the said arms. The double cam of the shifting lever, as it moves the loose pulley in and out, presses the rim of said pulley against the rim of the fast pulley, thereby causing sufficient friction between the pulleys to impart motion to the loose pulley, said motion being requisite to facilitate the shifting of the belt. A completion of the movement of the lever withdraws the pulley from contact with the other pulley, and leaves it at rest. The opposite movement of the lever applies the friction as before, shifts the belt to the loose pulley, and allows it and the belt to come to a rest.

Improved Rotary Evaporator.

Adrien Quera, Marlborough, N. Y.—The tubular arms of a revolving carrier support heating pipes, which are arranged parallel with the shaft, so that the water will flow back to the hollow hub. They are arranged also in clusters, by connecting them at each end to a hollow ring. Partitions in the hubs and hollow axle prevent the water of condensation from running back into the lower portions of the hubs; they also separate the steam on entering the pipes. The water will in this arrangement escape directly from the heating pipes by gravity, and thus offer no obstruction to the entrance of the steam; but it will not escape until the pipes rise above the horizontal plane of the axis, so that the partitions will keep it from falling to the bottom of the hubs, and will cause it to flow out at the escape side through the hollow shaft. By the separation of the hub into which the steam enters, the steam is divided and applied equally to all parts of the evaporator. The steam enters at one side, and the water escapes at the other. This apparatus is applicable to use in vacuum pans, both as a heater and agitator.

Improved Truss Bridge.

John L. Miner, Brenham, Tex.—The object of this invention is to provide a strong and cheap bridge of improved form. The stringers which are bolted to the pier caps are formed by bolting two parallel beams to each other. They are connected by two sets of zigzag braces, placed the one set at the upper part, and the other set at the lower part, of said stringers, the braces of the two sets crossing each other at their centers. The two stringers are secured to each other by tie rods having a washer and head at one end and a washer and nut at the other end, the said tie rods passing through the space between the two sets of braces. The side walls of the bridge are formed of wall plates, braces, and tie rods. The cap plate is made in three parts, the central part being parallel with the stringers, and at a distance above them of fifteen feet or more. The end parts of the cap plates are inclined, and extend to the ends of and are bolted to the said stringers. The tie rods are vertical, pass through the stringers and through the cap plates, near the upper ends of the braces, and have washers and heads upon their lower ends, and washers and nuts upon their upper ends. The girders are attached to the stringers, and, in connection with the joists, support the planks that form the road bed.

Improved Illuminating Roof Plate.

William L. Smith, Jr., P. O. Box 81, Brooklyn, N. Y.—This illuminating tile is made of malleable metal, so as to make it lighter and less liable to break than when made of cast iron. Holes are formed in a metal sheet with collars in it of a size to suit the glass. Another sheet is added, in which holes are made of a size to prevent the glass from falling through, thus forming seats for the glass to rest upon. The holes in the two sheets are punched, so as to correspond with each other in position, and the two sheets are fastened together.

Improved Hoe.

William Moore Faunt Le Roy, Fredericksburg, Va.—This invention consists in making the handle adjustable with regard to the blade to suit the various purposes for which hoes of various kinds, as well as shovels, are used.

Improved Wagon Jack.

Frank Judson, Des Arc, Ark.—For operating the jack, a lever is raised as far as it will allow, and a catch is placed as far out on the rack of the lever as possible. The lever is then pressed downward to raise the center post. A pin is placed through the lowest visible hole above the upper part of the standard for sustaining the weight thereon, and the operation of raising the center post is then repeated until the wagon or other object to be hoisted is at the required height.

Cutting Block Holder for Leather Workers.

Elias P. Newton and Hiram A. Titus, Gloversville, N. Y.—This cutting block holder has adjustable ends provided with pendent extensions and connected by screw rods at top and bottom to provide for longitudinal adjustment.

Improved Weighing Scales.

Henry M. Weaver, Mansfield, O.—These weighing scales may be so adjusted that the net weight of any article placed on the platform may be directly read off at the dial plate. By the position of the weights, a portion of the same is thrown above a horizontal line drawn to connect the pivoted points or edges of swinging bars, so that, by rising above the line, it proportionally loses its power as a counter weight, and causes a pointer to describe equal distances, on a dial plate, when equally increased weights are placed upon the platform.

Improved Gate.

Jonathan Moore, Jr., Brooklyn, N. Y., assignor to himself and Lorenzo D. Longhi, same place.—The bottom portion of the gate is made in two parts, one being a door to which the other part is a frame. A button on the under side of the frame swings under the door and holds it up. The gate can be opened for cleaning it out without the aid of a lever, the button being readily turned by the fire hook, shovel, or any instrument. The hinges are protected from the ashes and cinders.

Improved Horse Detacher.

Anatole Ehret, Telegraph City, Cal.—The traces have loops by which they are hitched to hinged bolts at the ends of the singletrees. A spring catch is thrown by a spring in front of the hinged bolt, to hold the bolt in position for confining the trace. The spring catches are connected with sway bars by chains. When a lever is pushed outward, the effect is to draw back the spring catches, which detaches the traces from the singletrees.

Improved Soldering Machine.

William D. Brooks, Baltimore, Md.—This invention relates to that class of soldering machines which inject a flame upon can joints, so as to melt the solder and allow it to be uniformly disseminated along the seam, whether it be in soldering the cap, top, or side seam. The invention consists in providing, on a burner end or gas outlet of the compound blowpipe, a continuous slot or opening, so that all parts of the seam may simultaneously receive the same quantum of heat and its due proportion of solder, a perfect and reliable joint being thus always formed.

Improved Gate Hinge.

Stephen G. Peabody, Champaign, Ill., assignor to himself and Lyman D. Chaddon, same place.—This is a hinge for gates, heavy doors, etc., so constructed as to prevent water from entering about the pintle, and also self-closing. Concentric cups are formed upon the adjacent ends of the parts of the hinge. In one cup is placed a coiled spring, which causes the hinge to close itself when released.

Improved Apparatus for Making Extracts.

Julius Robert, Gross Selowitz, Austria, assignor to Otto Krutz and R. Sieg, New Orleans, La.—This is an improved arrangement of extractors in a single battery, together with conducting and connecting pipes and heaters, for making extracts of juice from plants, by the process of diffusion, as described in the patent granted to the same inventor, October 30, 1866. The plants are first cut into thin slices and placed in extractors, together with water, and allowed to stand for a short time, when the juice is replaced by other juices of less strength than the remaining juice in the cells of the plants, and so on, until all the juice is extracted. The thick juice is drawn off to the factory, for the subsequent treatment; while the thin juices are passed through the heaters for being warmed, to be used for other diffusions, until made thick enough to be conducted away. By suitable arrangement of pipes and connections, the operation is carried on continuously and in succession in all the different stages without interference of one with another.

Improved Guide Wheel for Car Trucks.

Nathan M. Hale, Cleburne, Texas.—This invention consists in supporting horizontal wheels that run under the flanges of a central T rail on springs, the elasticity of which allows the wheels to rise and pass any obstacle without stopping the car or injuring the track. This allows the wheels to be fastened to the cow catcher, and renders unnecessary the elevation of the main rails to an equality with the central one.

Improved Double Cultivator.

James M. Holladay, Twyman's Store, Va.—This invention relates to certain improvements in double cultivators. It consists in the peculiar construction of devices for adjusting the tongue or pole from the rear for the purpose of adapting the implement to hillside cultivation, and also in the peculiar construction and arrangement of the parts of a traction frame, so jointed and attached to the carriage as to admit of the cultivator proper being lifted from the ground and suspended about the axle for the purpose of transportation. It consists, further, in the manner of pivoting the traction frames so as to adjust the cultivator laterally to the irregularities of the row, and to deep or shallow cultivation.

Improved Paint Brush.

Etienne X. Thiercelin, Shark River, N. J.—This invention consists of a tapering handle with metallic socket, connected by guide strips or prongs of the same with the top and side part of the outer bristle binding socket, after the handle has been carried centrally through the bristles to strengthen it and make it more durable.

Machine for Smoothing and Cornering Panels.

Jacob P. Beck and John H. Weaver, Lock Haven, Pa., assignors of one third their right to A. N. Raub, same place.—This is an improved machine for smoothing and cornering panels, so that the sandpapering of the raised part at one side thereof may be obtained, at the same time with the broad level portion at the other side, by mechanical means in place of by hand work. There are vertically rotating heads, with detachably inserted pads, covered with sand paper for smoothing both sides of the panel, and adjustable detachable bits for cornering the same. The revolving heads work on separate mandrels, one being laterally adjustable to the thickness of the panel, and the other being capable of vertical adjustment on an arc-shaped guide support.

Improved Machine for Driving Brush Handles.

John Ames, Jr., Lansingburgh, N. Y.—In this machine devices are provided for driving all the brush handles of the same lot to exactly the same point. The ferrule of the brush is held and supported while the handle is being driven. By means of weighted cords a tube is forced up through the brush head. Within the tube is placed a rod, the upper end of which is pointed so as to open a way for the said tube through the brush head. The rod is supported in the tube by a coiled spring. The tube and rod moves upward through the brush head, and strikes against a stop. This leaves the upper end of the cavity of the tube empty to receive the point of the brush handle, the other end of which rests against the lower end of the driver. The driver is then forced downward by operating a hand wheel, which forces the brush handle through the brush head. As the point of the brush handle passes down through the brush head and through the tube, it is received in the concave upper end of a short tube, through which the other tube passes, and all the parts are carried down together by the continued descent of the handle. By suitable arrangement, when the brush has been removed and another brush head arranged in the thimble, a slight pressure with the operator's foot upon the end of a bent lever will release the tube, and allow it and the pointed rod to be forced up through the brush head by the weights.

Improved Knob Spindle Fastener.

Eugene F. Lincoln, Boston, Mass., assignor to himself and John C. Hancock, same place.—This invention consists of a little slide bolt inside of the rose plate, to lock the knob spindle by sliding into a notch in the edge of a disk on the spindle. The said slide has a pawl with a handle pivoted to it, so as to drop into the slot of the escutcheon plate, through which it projects, to lock the bolt when shoved forward. There is also a spring for throwing it back when the pawl is pulled out of the slot to release the slide bolt. The object is to provide a simple inside lock for fastening the door of water and other closets, sleeping rooms, etc., temporarily, without having to change the key from one side of the door to the other.

Improved Seedlings Puller.

John S. Swaney, Marengo, Iowa.—As the machine is drawn forward, the jaws are opened to allow the plants to pass between them, and to grasp the said plants and draw their roots from the ground. As the jaws are again opened by the opener, the plants will drop into a concavity formed in the frame, whence they are taken by an attendant and bound. As the plants pass up at the rear side of a wheel, they are struck by a horizontal rod which has a rapid up and down movement. By this device all the soil is knocked off the roots of the plants before they are dropped into the receiver.

Improved Machine for Rubbing Oil Cloths.

Charles Rommel and William H. Crane, Elizabeth, N. J., assignors to themselves and Wisner H. Townsend.—This invention consists of a reciprocating rubber, to which simultaneous revolving motion is imparted by its connection with a shaft with cranks arranged in opposite direction. The rubber frame supports the pumicestone blocks on a sliding interior frame, which is hung to a roller with handle, to be readily raised with the pumicestones, for admitting the cloth below the same.

Improved Car Axle Box Support.

Charles Billmeyer, York, Pa.—This invention relates to that class of trucks which are intended for narrow gauge roads, and which are let down, as respects the axle boxes and the load, so as to prevent the center of gravity, on a tilt, from passing outside the rails and thus overturning the cars.

Business and Personal.

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

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Address W. H. Rishel, Danville, Pa., Agent for the Sale of Patents.

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John W. Hill, Mechanical Engineer, Dayton, Ohio. Drawings, opinions, and advice.

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H. K. will find a recipe for cement for grindstones on p. 251, vol. 31.—J. H. B. will find a recipe for hard cement on p. 9, vol. 37, and a description of porcelain on p. 3, vol. 30.—F. W. D. will find an explanation of the shirt polish mystery on p. 233, vol. 31.—F. H. M. will find a recipe for a silver plating solution on p. 299, vol. 31.—J. E. will find that a process of tempering mill picks is detailed on p. 232, vol. 31.—G. R. L. C. will find directions for mounting chromos on p. 91, vol. 31.—C. H. F. will find directions for preserving iron from rust on p. 229, vol. 31; for painting brick walls on p. 345, vol. 31.—W. H. M. can clean chamol skins by the process detailed on p. 91, vol. 31.—W. H. K. will find a description of the cultivation of the castor bean on p. 335, vol. 31.

(1) J. S. S. says: I contend that if two casks are put on an equal level, and a one inch pipe is fastened airtight in the head of one end, and a 12 inch pipe similarly in the other, each pipe being 50 feet high and filled with water, the pressure will be as much in one disk as the other. Is this so? A. The pressure on equal and similar areas in the two casks will be the same.

(2) J. C. asks: Can you tell what to put on al bumenized paper to remove the gloss, so that water colors can remain on the surface? A. Try gentle steaming.

(3) G. V. says: I intend to pump water for irrigation. I have to carry the water 600 feet in an open tank or trough, the amount of water to be pumped being 1,000 gallons per minute. I can afford to give it a fall of 3 inches in the whole. What should be the dimensions of the trunk? A. Give the trunk from 1 1/2 to 2 times the cross section of the discharge pipe of the pump. 2. Would pine lumber 1 inch thick be heavy enough? A. Yes.

(4) D. J. T. asks: 1. What percentage of boiler pressure is the mean effective pressure on piston in an ordinary slide valve engine with throttle valve wide open? A. From 75 to 80 per cent. 2. I have been running for eighteen months an engine with 10x16 inches cylinder, and I notice that some of the bolts that hold the face plate to steam chest, also to cylinder head and piston head cap, are being cut away as if by acid; some of them are reduced to about one half their original size. The part affected is that which passes through the steam chest plate, the piston head cap, and the cylinder head. It is not rust, for the parts have been kept perfectly well lubricated. Can you tell me the cause and a remedy? A. Probably caused by water carried over with the steam, in which case the use of dry steam will be a preventive.

How can I make a first class Babbitt metal? A. You will have to experiment to get the metal right. See p. 364, vol. 29.

(5) E. P. asks: What process is used in casting steel or iron into ingots, so as to prevent blow holes on the outer surface? The process I have used is casting through a sprue into bottom of mold, causing metal to flow upward. This process is not satisfactory, and I wish to know how it can be remedied. A. Make your mold with a long neck, into which the air may rise and leave the blowholes in the top part of the casting, which is to be cut off.

(6) J. A. T. asks: I desire to construct a reflector telescope. 1. Can ground specula be procured in this country, 4 1/2 or 6 1/2 inches in diameter? A. Yes. 2. What would be the probable cost of a 4 1/2 or 6 1/2 inch speculum? A. For silvered glass mirrors, parabolized, \$40 for each square decimeter (4 inches) of surface. The focus is six times the diameter, and the highest power equals twice the aperture expressed in millimeters (fifty per inch). 3. Could you give me a full explanation of the construction of small sized reflectors? A. The English have devoted much talent and money to the construction of reflectors without adequate results. The diagonal plane of the Newtonian obstructs the best part of the mirror, and its supports add diffraction wings to the image of a star. Still the silvered mirror costs but one fifth, and its power is nearly five sixths, of that of the achromatic of like aperture.

(7) C. asks: Does a fence over a hill contain exactly as many pickets as a fence on level ground, between the same points, the pickets being the same distance apart? A. Yes.

(8) M. asks: What do opticians mean by immersion lenses? A. An immersion lens is a microscopic objective which has its front and back combinations so adjusted that a film of water, joining the front surface and the thin glass cover of the object, completes the correction for spherical aberration, which correction depends in a dry objective upon the thickness of the front lens. Objectives of 1-1/2 inch and shorter focus are made to work either dry or with immersion by a screw collar adjustment.

(9) Z. T. K. asks: What is the horse power of an undershot or current water wheel 30 feet in diameter, of 15 feet face and 3 feet deep, running in a current which moves 3 miles an hour? A. Multiply 0.884 times the square of the velocity of the water in feet per second, and divide by 55,420. As to your other query, see article on friction of water in pipes, p. 45, vol. 29.

(10) T. C. W. says: I melted 1 lb. resin and 1 lb. pitch together, in an iron vessel; then, while hot, I poured the contents of the vessel into a wooden mold, in the shape of a brick. But I found

after the mixture got cold and hard, that I could not get it out of the mold; it adhered to the wood. Please to tell me how to construct a mold so that the substance will readily come out when cold and not adhere to the mold. A. Try coating the mold with paraffin.

(11) M. H. P. says: We use in our kerosene lamps a powder which prevents breaking of chimneys. It is said to destroy the naphtha. Can you inform me of any ingredients that will answer the above purpose? A. You do not state the mode of applying the powder in question. If you will send us a sample of the powder and a description of the mode of application, we will endeavor to answer your question.

Is there a cement for mending cracks in iron pots? A. Try glycerin and litharge.

(12) E. C. H. asks: What ingredient in soap is it that, when coming in contact with the eyes or an abrasion of the skin, causes it to smart? A. The alkali it contains. 2. Can there be manufactured an effective article of soap that will not cause such pain? A. No.

Which would be the most serviceable application for ordinary New Jersey yellow pine weather boarding, lime, whitewash, or coal tar, and which would be the coolest in hot weather? A. The whitewash.

(13) S. H. T. asks: What is the mode of etching engravings, etc., on glass? A. See our answer to P. M., No. 4, p. 228, vol. 31. The printing ink protects the glass with which it is in contact from the corroding action of the acid. Mr. Napier, the patentee, prefers to have the glass ground, enameled or veneered beforehand, when the objects stand out in relief. If the veneer or enamel is colored, of course the picture remains colored, while the body of the glass is white. This also answers J. G. G.

(14) J. H. asks: How much more power, if any, will be required to turn a wheel one foot in diameter four times around than to turn a wheel 4 feet in diameter once round in the same time? A. Multiply the resistance by the distance through which it is overcome in each case, which will give you measures of the power exerted in turning the two wheels.

(15) J. C. D. says: I wish to run my sewing machine by water power, and propose the following plan: A water wheel 15 inches in diameter, inclosed in a watertight case, to be adjusted under the table of the machine, with a tank, resting 20 feet above the floor and 30 feet on a horizontal line. The tank to hold about 200 gallons, with a pipe leading to the wheel 1 1/2 inches in diameter. The jet from this pipe to be 1/4 inch in diameter, and strike the water wheel at about 45° below the line of the shaft; a discharge pipe to be adjusted at the bottom of the wheel case. Will this run the machine for ordinary domestic sewing? A. This plan will doubtless answer well.

(16) W. H. G. asks: If a loaded ship, afloat, were elevated one half the number of feet which it draws, would it capsize? A. Generally it would; but the load might be so disposed that the ship would remain upright.

(17) A. M. asks: By what process are raisins manufactured? Can the grapes grown in this part of the world be used for this purpose? B. The grapes are dried, either in the sun or in ovens. We do not think it likely that raisins made from the grapes of this country would compare very favorably with those that are imported. We cannot refer you to any work especially devoted to this subject.

(18) J. N. & S. say: We want to drive a shaft at a right angle to our line shaft, and wish to know if we can do it with friction pulleys. The speed of line shaft is 300 per minute. Of what material and how should the pulleys be constructed? A. You can do it with friction pulleys, made of cast iron, if you have sufficient surface.

(19) M. F. D. asks: 1. How shall I make a dry rose madder suitable for painting on wax for flowers? A. Inclose 2 ozs. troy of the finest Dutch madder in a bag of fine and strong calico, large enough to hold three or four times as much. Put it into a marble or porcelain mortar, and pour on to it a pint of clear soft cold water. Press the bag in every direction, and pound and rub it about with the pestle, as much as can be done without tearing it, and when the water is loaded with color pour it off. Repeat the process until the water comes off but slightly tinged, for which about 5 pints will be sufficient. Heat all the liquor in an earthen vessel till it is near boiling, and then pour it into a large basin, into which place 1 oz. of pulverized alum; stir the mixture for a short time, and while stirring pour in gently about 1 1/2 ozs. of a saturated solution of subcarbonate of potash; let it stand till cold, to settle; pour off the clear yellow liquor, add to the precipitate a quart of boiling water, stirring it well; and when cold separate by filtration the lake, which should weigh 1/4 an oz. Fresh madder root is superior to the dry. 2. How shall I make cadmium yellow for the same purpose? A. Cadmium yellow (sulphide of cadmium) is a compound of sulphur and cadmium. It is obtained by precipitation from a salt of cadmium by a current of sulphuretted hydrogen gas, or by an alkaline carbonate.

(20) J. N. P. says: The copper mines in the mountains of East Tennessee are second to very few in the country. I recently observed a precipitating process which interested me very much. Two shafts have been sunk to a depth of fifty or sixty feet, and a stream of so-called "copper water" has been struck. Pumps are inserted, and this water is pumped into a very long trough, running nearly level. Into this trough is put a lot of old scrap iron. Every twenty or thirty feet along the trough are pits, about two feet deep, into which the precipitated copper is swept. It is then shoveled out and is ready for the refinery. 1. Of what does this water consist? What is the proper name of it? A. A solution of sulphate of copper in water, and probably proceeds from the oxidation of copper

pyrites (sulphide of copper). This solution is commonly called blue vitriol. 2. If the residue is the copper precipitated from the water, what becomes of the iron? A. The iron takes the place of the copper in solution. 3. What is the proper name of the water after the copper is taken out? A. The solution of sulphate of iron is called green vitriol.

In certain parts of the country adjacent to the mines, there prevails among the cattle a disease which the natives call milk sickness; they say the cattle never have it unless they have been feeding in dark caves or places in the mountains where the sun seldom shines. To what is it attributable? A. Probably to some poisonous substance contained in the water, which could be determined by an analysis.

(21) W. S. B. asks: 1. Has science ever given a decided answer as to the cause of the Gulf Stream? A. It is due to the flow of the heated waters of the torrid zone towards the poles, the direction of the flow being influenced by the earth's rotation and the forms of the continents. 2. How swiftly does it flow, and how wide is its current? A. The maximum velocity of the Gulf Stream is five miles an hour, and the average less than one and a half.

(22) J. W. asks: 1. Does lead contain sulphuric vapors and oxygen vapors? A. No. 2. When lead melts, does it expand and force the vapors off? A. No. 3. When the lead is cooling, does it re-absorb these vapors from the air? A. No.

1. Is there such a thing as malleable glass? A. No. 2. Fluorhydric acid corrodes glass. Is the glass converted into a vapor or into silicic acid? A. It attacks the silicic acid in the glass, combining with it to form hydrofluosilicic acid. 3. Can the glass be obtained by evaporating the fluorhydric acid? A. No.

Do potassium and magnesium combine together? A. No.

If four grains of arsenic and two grains of potassium were combined together, would the combination be green? A. No.

(23) P. E. V., of Paris, France, asks: 1. Will you please give more precise details for preparing the waterproof paper described on p. 146, vol. 31? I have tried the process, but failed. A. A concentrated solution of borax in warm water should be made, to which is added the shellac in a fine powder. The paper, after saturation in the solution, may be pressed between rubber rollers and dried. 2. What is aqueous solution of shellac in borax? A. Shellac is the purified resin which exudes from the branches of several trees in tropical climates, and in particular from the *Acacia indica*, *Acacia religiosa*, and *Rhamnus Jujuba*. It is soluble in an aqueous solution of borax, by which it may be distinguished from most common resins.

(24) C. B. F. asks: What is the thickness of the earth's outer crust? A. Nothing is definitely known as to this. Some philosophers fix 60 miles as the thickness of the earth's crust, and others imagine it to be 125.

Should cream be allowed to sour before churning? A. No.

1. Is silver better than brass or German silver for a cornet? A. There is some difference of opinion on this subject, but the general belief is that there is no particular advantage in employing silver. 2. What is German silver composed of? A. Copper, zinc, and nickel.

Is gold the heaviest metal? A. No.

Is the centennial tower progressing? A. You should apply to the projectors for information. We have heard nothing of it, late.

(25) C. E. W. asks: What is the rule for finding the mean of the thermometer when part of the observation are above and a part below zero? A. Add all the negative readings together, and subtract the sum from the sum of the positive readings. Divide the difference by the whole number of readings.

(26) S. K. H. asks: What is oxygenized oil, used for testing olive oil? A. Several oils have the property of absorbing oxygen under certain conditions, among which is boiled linseed oil. This latter may be possibly the oil in question; but no mention can be found, in scientific works, of any oil specifically named oxygenized.

(27) R. S. asks: What is the gas or smell proceeding from newly baked bread? My dwelling is connected with a bake house, and the smell from a large quantity is penetrating, and very disagreeable. Is it unhealthy? A. The smell is due to the escape of the gases and volatile compounds generated from the breadstuff during the process of fermentation, and expelled by the heat. We know of no case where it has proved unwholesome to a marked degree.

How can I determine whether water is poisoned by passing through lead pipe? A. Render the water acid with dilute oil of vitriol, and add sulphuretted hydrogen to it. A black coloration indicates the presence of lead.

When plaster of Paris has been used to fasten the parts of a lamp together, what will soften it so that the parts can be separated? A. Dilute muriatic acid.

(28) N. E. L. says, in reply to Y. M., who has trouble in sucking water with his pump at 20 revolutions: I am using a small engine, and I was told I could not suck water from a well about 20 feet deep with 3/4 inch pipe. I put in the pipe; and near the pump in the suction pipe, I put a T joint with about 1 foot of 3/4 pipe, with the end soldered up. This serves as a water or air chamber. I have no trouble in running 20 revolutions per minute. J. M. should put in an air chamber about five times the capacity of his pump. A T joint and a piece of pipe may do, but an air chamber, with the water drawn from the bottom and the supply pipe coming in a few inches above, so that, while it is pumping, it will not prevent a steady flow of water into the chamber, will be better. The pump now has to start the water in the whole length of the supply pipe; and in fact, the pump will form a vacuum before the momentum of the water is overcome. With an air chamber, it has only the water from the pump to the air chamber to start,

and the water flows into the air chamber in a steady stream. J. M. may not be able to run at 200, but I think he can go over that. I think the supply pipe is large enough. I hope J. M. will tell through your paper how he succeeds. A. Your hints are practical, and will be of great value to some readers. The air chamber in the supply pipe, however, is not the universal panacea for sulky pumps that you seem to consider it. Still, no one who puts in such an air chamber will have cause to regret it.

(29) E. L. F. says, in reply to F. S. M. & Co.'s query as to sesquioxide of manganese: The sesquioxide of manganese is found in its anhydrous state as braunite, and in an hydrated state as manganite. It may be obtained by passing chlorine through manganous carbonate, placed in water, and afterwards applying diluted nitric acid to remove the excess of the carbonate.

(30) E. L. F. says, in reply to W. H. R., who asked how to make the muriatic salts of nickel: Pure nickel has a great similarity to iron, both in its external appearance and its combinations, and is regarded as a tetrad, although it forms but one chloride, in which it is bivalent. Nickel chloride (NiCl_2) may be prepared by dissolving the oxide or carbonate of nickel in hydrochloric acid. By a simple process, the nickel carbonate may be prepared from the crude *specimens*. Any good work on chemistry explains the method.

COMMUNICATIONS RECEIVED.

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

On Vegetable Fibers. By J. W.
On Hydrocarbons on Iron and Steel. By L. P.
On Solids Floating on Liquids. By A. R.
On Popular Dental Science. By C. S. S.
On a Flying Machine. By C. H. C.
On Boiler Explosions. By R. H.
On Oyster Culture. By J. O. C.
On Suet Butter. By J. L.
On a New Projectile. By W. L. A.

Also enquiries and answers from the following:

J. G. G.—S. W. R.—E. W. H.—G. A. P.—X. Y. Z.—
L. N. K.—W. J. R.—J. W. D.—W. D. D.—F. R. D.—
M. L. W.

HINTS TO CORRESPONDENTS.

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

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

Hundreds of enquiries analogous to the following are sent: "Who erects wire tramways? Who buys broken window glass? Who builds engines and boilers for small boats? Where can spectroscopic apparatus be bought? Who sells photographic chemicals that can be relied on for quick work?" 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.]

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November 24, 1874.

AND EACH BEARING THAT DATE.

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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:

31,448.—FELLY MACHINE.—C. H. Denison.....	Feb. 3.
31,445.—LINE KILN.—R. Donaldson.....	Feb. 3.
31,503.—COAL BREAKER.—R. A. Wilder.....	Feb. 3.
31,535.—WEIGHING APPARATUS.—A. B. Davis.....	Feb. 10.
31,534.—SCALE BEAM.—A. B. Davis.....	Feb. 10.
31,566.—DRYING TUNNELS.—F. H. Smith.....	Feb. 10.
31,579.—CORN PLASTER.—F. B. Preston.....	Feb. 10.

EXTENSIONS GRANTED.

30,033.—FIRE ESCAPE.—E. B. Lather.....	
30,051.—HARVESTER.—S. W. Tyler.....	
30,065.—SEED DRILL.—H. Moore.....	
30,091.—CASTING PLOWSHARES.—F. F. Smith.....	
30,091.—PLOW.—F. F. Smith.....	
30,719.—PAPER FOLDER.—C. Chambers, Jr.....	
30,745.—CULTIVATOR.—N. Messenger.....	

DISCLAIMERS FILED.

102,462.—COOK STOVE.—J. B. Wilkinson, Troy, N. Y.....	
155,534.—DRESS PROTECTOR.—H. M. Macdonald, Lowell, Ms.....	

DESIGNS PATENTED.

7,855 to 7,858.—CARPETS.—R. Allan, Yonkers, N. Y.....	
7,859 to 7,862.—CUTLERY.—J. D. Fry, New Britain, Conn.....	
7,863.—COOKING STOVE.—G. G. Richmond, Providence, R. I.....	
7,864.—BOTTLE.—S. C. Upham, Philadelphia, Pa.....	
7,865 to 7,869.—SILVER WARE.—G. Wilkinson, Providence, R. I.....	
7,870.—WINDOW SCREEN.—G. Shattuck, Waukegan, Ill.....	
7,871.—INKSTAND COVER.—H. C. Wilcox, W. Meriden, Ct.....	
7,872.—MONUMENT.—H. C. Borgner, Lebanon, Pa.....	
7,873.—ORGAN CASE.—G. E. Carhart et al., Washington, D. C.....	
7,874 to 7,876.—CARPETS.—F. W. Green, Orange, N. J.....	
7,877 to 7,881.—CARPETS.—H. Horan, East Orange, N. J.....	
7,885.—PARLOR HEATER.—A. T. Jones, Stamford, Conn.....	
7,886.—HOT CLOSET RANGE.—A. T. Jones, Stamford, Conn.....	
7,887.—CARPET.—L. G. Malkin, New York city.....	
7,888.—WRITING PAPER.—C. D. Myers et al., N. Y. city.....	
7,889.—CARPET.—H. Nordmann, New York city.....	
7,890 & 7,891.—BUTTONS.—H. E. Bostwick, New Milford, Ct.....	
7,892 to 7,901.—EMBROIDERY.—E. Crisand, New Haven, Ct.....	
7,902.—FORK HANDLE.—C. Osborne, N. Attleborough, Ms.....	
7,903.—STATUETTE.—T. J. Palpoint, Providence, R. I.....	
7,904.—OILCLOTH.—C. T. & V. E. Meyer, Bergen, N. J.....	

TRADE MARKS REGISTERED.

2,672.—CHEWING TOBACCO.—Allan et al., Cincinnati, O.....	
2,673.—STOVE POLISH.—H. A. Barlett & Co., Phila., Pa.....	
2,674.—STOVE POLISH.—B. F. Brown & Co., Boston, Ms.....	
2,675.—GLOVES.—Harris Bros., New York city.....	
2,676.—SHIRTINGS.—Naumkeag Steam Co., Salem, Mass.....	
2,677.—COOK STOVE, ETC.—G. G. Richmond, Providence, R. I.....	
2,678.—HEALING SALVE.—Stapleton & Co., Springfield, Ms.....	
2,679.—MEDICINE.—G. Stiel, Cincinnati, O.....	
2,680.—PERFUMERY, ETC.—J. & E. Atkinson, London, Eng.....	
2,681 & 2,682.—CORSETS.—L. Coleman & Co., Boston, Mass.....	
2,683.—CORSET.—Ottensheimer & Co., New York city.....	
2,684.—SOAP.—Reed & Co., Pittsburgh, Pa.....	
2,685 to 2,688.—SALT.—Union Pacific Salt Co., S. F. Cal.....	
2,689.—TOBACCO.—Frishmuth & Co., Philadelphia, Pa.....	
2,690.—PILB REMEDY.—C. Mayne, New York city.....	
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2,695 to 2,697.—WOOLEN GOODS.—Wash Mills, Lawrence, Ms.....	
2,698.—GROCERIES.—N. W. Burchell, Washington, D. C.....	

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 filing a Disclaimer.....	\$10
On an application for Design (3½ years).....	\$10
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On application for Design (14 years).....	\$30



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