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The Gatling Battery Gun and Cartridges.

We give in this issue a perspective view of the celebrated Gatling gun with sectional engravings of the two sorts of cartridges which have been used in it at the Government trials at Washington, Bridesburg Arsenal and at Fortress Monroe. The general appearance of the gun can be understood by an examination of the engraving: for a description we use the words of the inventor.

This gun differs essentially in mechanical construction and operation from all other fire-arms. It may be justly termed a machine gun, as it is automatic in its operation, loading and firing by mechanical agency without cessation, simply by turning a crank. The gun bears the same relation to other fire-arms that the printing press does to the pen, or that the railway carriage and the locomotive do to the stage coach and the team of horses.

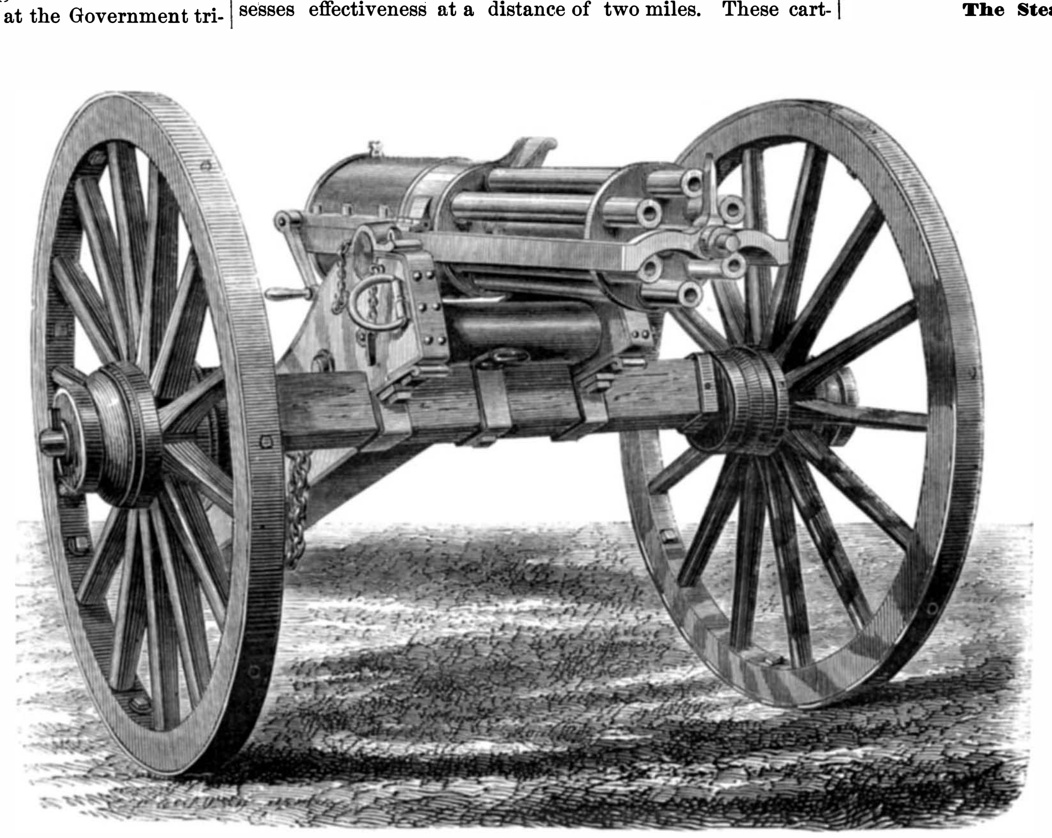
The main characteristic of the gun consists in its having a series of six barrels arranged around a common center, with a carrier and lock cylinder rigidly secured to the main shaft and rotating simultaneously. The cartridges are fed into the cavities of the carrier from boxes and are driven thence endwise into the rear ends of the barrels, then exploded and the empty shells withdrawn, all at one continuous operation without cessation. As the gun is made to revolve, all the locks and barrels are operated, loaded and fired by means of a spiral cam and a cocking ring. The barrels, inner breech and locks all revolve at the same time, while the gun is being loaded and fired, both operations being carried on simultaneously. Three cartridges at the same instant are being loaded, being at different stages of the process, while the spent cartridge shells are being removed.

Test trials of the gun were first made, by order of the Government, at the Washington Arsenal: afterwards, at the Bridesburg arsenal near Philadelphia; then again at Washington, and lastly a series of experiments at Fortress Monroe: at the last place being tested against the twenty-four-pounder flank howitzer. In the first trial, in January, 1866, at the Washington Arsenal, one of the small guns was used, carrying a ball of .58 caliber, weighing 577 grains. The gun in this trial was tested for accuracy at a target of ten feet square, at ranges of 100, 300 and 500 yards, and none of the balls missed the target. At 100 yards, the average of the balls to the center was 3·6 inches; at 300 yards, 11·3, and at 500 yards, 28·4 inches. For rapidity, twenty shots were fired in eight seconds. The penetration was eleven inches.

Col. D. H. Buell, who conducted the experiments at the Bridesburg Arsenal, reported that "the gun worked smoothly in all its parts, and the cartridges were fed and the empty cases thrown out with ease and certainty. The cartridges worked well, and no more difficulty is to be experienced with them than with any other metallic cartridges of a similar construction, if indeed, so much. I am of the opinion that about sixty shots can be fired per minute. The gun can undoubtedly be fired faster on occasions, but I think that the above average is a fair one for continuous firing. The most rapid firing I obtained was eleven shots in seven seconds.

Subsequent to the foregoing trials, three of the larger guns, carrying balls of one inch caliber and weighing half a pound each, were tested hundreds of times in the presence of Gen'ls. Grant, Hancock, Dyer, Chief of Ordnance, Delafield, Chief of Engineers, Maynadier, Hagner, and Secretary Stanton and other military and civil officers, all of whom expressed their entire satisfaction with their performances. These trials, with those afterward made at Fortress Monroe, in competition with the twenty-four-pounder howitzer, established the fact that the Gatling gun was able to put six missiles in a target where the howitzer could place one. At the distance of 1,000 yards it could put as many half-pound solid shot in the target as the howitzer could of canister at a distance of only 200 yards.

Fig. 2 shows the cartridge of the Gatling gun full size, one inch caliber, and Fig. 3 shows the cartridge for the same sized gun containing fifteen buck shot and a terminal ball—sixteen missiles. This last cartridge is intended to be used in the flank defence of fortifications, the protection of a ford, bridge, or other exposed point, or for short-range work on the field of battle against masses of infantry or charges of cavalry. The single missile is intended for long ranges, and possesses effectiveness at a distance of two miles. These cartridges have copper shells, the fulminate being in the base. The cross sections in the engraving show the arrangement of the balls in the cartridge intended for short range, and the strengthening band with the fulminate at the base. R. J. Gatling may be addressed for further information, care Colt's Armory, Hartford, Conn.



GATLING'S BATTERY GUN AND CARTRIDGES.

Fig. 2

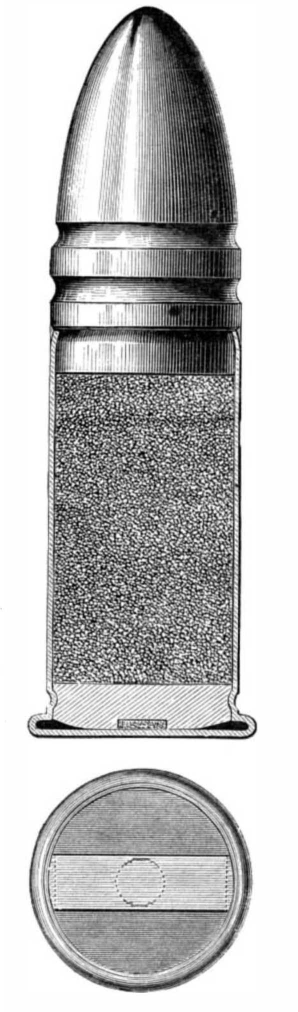
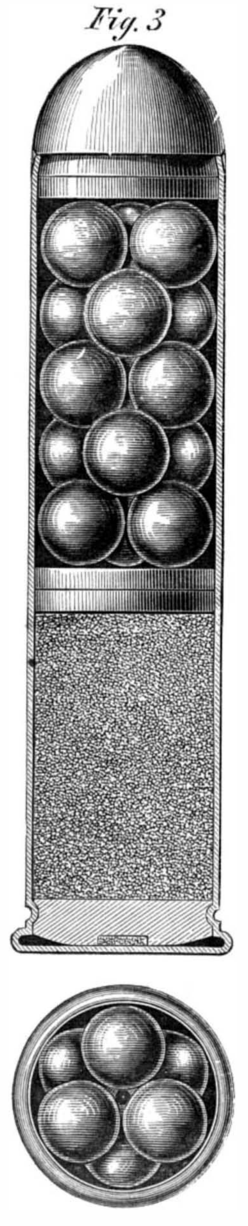


Fig. 3



The Steam Ram "Dunderberg."

Patriarch Noah, aided by superior wisdom, although a novice at the trade of ship building, constructed as his first attempt a masterpiece that in the magnitude of its proportions has never yet been excelled. Admirably adapted to the purpose for which it was designed, it would hardly be accepted now by our modern ship-wrights, as furnishing a model when speed is required. Yet, as we looked upon the *Dunderberg*, lying idly at her dock, with no other similitude could we so well compare her, as with the juvenile "Noah's Arks" of our toy shops.

Of the exterior appearance or dimensions of this vessel it is needless to repeat here the general description which has already appeared in our columns; but some of the minor details then omitted, a note of the changes made since launching, and a general survey of her internal arrangements, may interest the reader, as they interested us during a late visit.

The "thunder mountain" now awaits the reception of her ordnance, at the shipyard of her builders, the Messrs. Webb, at the foot of Sixth street, East River. Entering through a porthole, we come at once upon the main deck within the casement quarters. Descending into the depths we reach the boiler room, a gallery seventy-three feet in length. Here, arranged on either side, are the six main boilers, and the two, but little inferior in size, belonging to the donkey engines. The fire-grates, numbering sixty-four in all, are built in a double bank. Three large ventilators opening on the upper deck, serve the double purpose of supplying air, and also of furnishing a passage way for discharging the ashes. The coal bunkers, stationed between the boilers and sides of the vessel, have a total capacity of from twelve to fifteen hundred tuns. Forward of the boiler room, is placed the condenser, containing twelve thousand feet of copper tubing. The cylinders are one hundred inches diameter, with a forty-five inch stroke: the engines are of six thousand horse-power, designed by E. W. Smith, A. P. D., and built by Messrs. John Roach & Son, at the Etna Iron Works.

Returning to the main deck, we reënter the casemate or fighting deck, the scene of action in future encounters. The sides are pierced with twenty-two ports, and preparations are being made for immediately placing in position six fifteen-inch guns, each weighing with its carriage twenty-six tuns.

The captain of such a vessel is a privileged character: his attributes are king-like, his word reigns supreme over six hundred subjects: hence his apartments, located on this deck, are fitted up with princely magnificence. With less of display, still handsomely furnished, well lighted and ventilated, is the officers' ward-room, aft, directly below the bomb proof of the main deck.

The ship's company numbering so many, it may well be supposed that the preparation of food is no small undertaking, and the facilities must be on a corresponding scale. With the immense range which we noticed on this deck, designed by the late Rear Admiral Gregory, it is expected that this demand may be met and easily supplied. Outside the casemate, the extension of the main deck to the bow and stern is heavily plated so as to form a perfect bomb-proof. The rudder and propeller are protected by the extension of the sides and deck of the vessel, which completely encloses them, with the exception of several grated openings which serve as safety valves in allowing the shock from heavy seas, to escape. The skylights on this deck for the officers' ward-room below, the interior of the smoke pipe, and all other necessary openings, are protected by bomb proof gratings of heavy bars, placed across some two inches apart.

The immense telescopic smoke pipe is built in two sections, the upper one of which may be lowered previous to an engagement, but even then stands nearly fifteen feet above the spar deck. The small boats belonging to the ram are six, launches, barges and gigs. The former are small ships in themselves, capable of holding from eighty to one hundred men, together with a small howitzer each. The fighting wheel house on this deck stands seven feet high, and of a size sufficient to accommodate four or five men. Heavily plated, it has a number of narrow horizontal slits through which observations are to be taken during action. The wheel in use ordinarily, is aft upon the same deck: in heavy weather an auxiliary wheel on the main deck is employed, and still again, if any emergency should arise, the tiller may be resorted to.

We have thus hastily and with no attempt at minuteness, referred to some of the features of this vessel, which through the kindness of Mr. Mackenzie were pointed out to us. Her trial trip may at some future time furnish material for a more extended and accurate notice.

[From our Foreign Correspondent.]

ENGLISH LOCOMOTIVES.

Glasgow, Nov. 30, 1866.

MODE OF FASTENING TIRES.

To continue the account of the locomotive. There are several methods of fastening tires to the wheels, in common use, different from our usual one of rivetting directly through the tread. One very good plan is to allow the tire to project slightly over the rim of the wheel, having on one side an internal flange, slightly dove-tailed, and on the other an internal groove bored so as to come just outside of the edge of the rim of the wheel. On this side of the wheel a groove is turned in the side of the rim or at right angles to the other, and into these two grooves, L-shaped "clips" about 3 inches wide are placed at moderate intervals, and the metal of the tire forming the outside of the groove is riveted down upon them; the part that enters the tire being somewhat dovetailed. The internal flange mentioned on the other side of the tire fits against the rim on that side, and thus the tire is firmly held without injuring it by drilling holes through it. The same plan is followed for fastening the tires of the carriage wheels.

HOW STEEL TIRES ARE MADE.

Steel is taking the place of iron for tires more rapidly perhaps than for any other purpose. The manufacture of steel tires is not, as formerly, carried on by a few firms only, but is largely gone into by nearly all steel-makers, as well as by many of the locomotive works. Various methods of producing them have been tried at different times. It was thought by some that with the low Bessemer steel they could be made with a weld as in the case of iron. But a little experience proved that this method could not be relied upon, as several breakages occurred in tires apparently perfectly welded. The method now generally adopted is to hammer an ingot of a cylindrical or conical shape down to a cheese shape. It is then placed under a hammer with a conical tool, and a hole punched through the center of it. The hammering is continued until the somewhat porous metal of the original ingot becomes compact and uniform. The ring thus formed is hammered on its edge on the back of an anvil or on a mandrel to give it a bevel to facilitate the formation of the flange, after which it is ready for the rolls.

DOUBLE LOCOMOTIVE.

Notwithstanding the introduction of steel for tires and rails, the weights to be borne upon them are becoming so large that new methods of distributing the loads are being sought. Thus the tank engines of the North London and Metropolitan railway weigh 42 tons, nor are these extreme cases. To obtain an engine of even greater power and weight than these, with as great or greater ease of motion around curves, some have been built with four cylinders, being in fact similar to two engines united at the fire boxes, and it is highly probable that this form of engine will ere long be quite generally adopted in cases where great power is required. To give freedom of working around curves, the cylinders are placed on two bogies, the steam pipes being coiled so as to admit of the necessary motion between the boiler and the truck.

RAILWAY MACHINE SHOPS.

The shops belonging to the different railways surpass our own in size and outfit as far as the traffic of the lines exceeds that usual in America. Most of the principal lines build the greater number of their own locomotives. The London and North Western—the longest railway in Great Britain—has about 1,400 engines, or say one per mile of line. Their shops at Crewe are the largest locomotive works in the kingdom, and turn out annually about 120 locomotives, or more than two a week. The works of the Midland Railway at Derby, are also extensive, and supplied with an excellent stock of most useful and substantial tools. A machine tool is made to do at least twice the work here that it does with us. Thus all planing machines carry two tools and often more. Lathes have two or more rests, and a style of lathe for turning locomotive crank-shafts has seven tool-posts. There are doubtless many who will object to all this, but I confess I have great faith in the practical experience of these people, who are very careful to get the utmost out of labor. The slotting and drilling of locomotive frames is done to a number at once lying upon each other. This not only saves time but insures the shapes and holes being exactly alike. For this purpose they are laid on a bed over which are fixed three slotting machines and perhaps as many radial drills, and the top plate being laid out by template, the whole number are finished in the shortest possible time. This radial drill which is so largely used here is such an admirable tool that I wonder very much that it has not been adopted more generally with us. It consists of a stout arm swinging around an upright post or standard and carrying a drill spindle which can be run out or in to any required position, and is thus quickly brought to its work, which in heavy work is an important consideration. Besides this, being a substantial tool, it can be used for boring and work of an entirely different class from that done by the portable drills which to some extent, though inadequately, take the place of it in our shops.

HYDRAULIC CRANES.

Another important feature in shops here is the excellent cranes with which they are provided. These are generally over-head travelling cranes, worked either by hand, or more frequently by power. The merits of these are too well understood to need comment, it being no doubt only their expense that prevents their more general adoption with us. But a still better form that is now coming much into use is the hydraulic. This for simplicity, convenience and quickness, is far superior to any other kind. It dispenses at once with all gearing, ropes or chains; and when the hydraulic pump is once erected it is available for as many cranes as you may please to connect to it in any part of an establishment. There are many different forms of these, according to the work for which they are required. Some consist simply of a vertical ram forming the hydraulic piston and carrying a horizontal jib on which rests the little carriage and hook for taking hold of the weight to be lifted. This carriage moves easily when pulled, without any rack or gearing of any kind, and stands still when left to itself. As the end of the ram rests on water, the friction in swinging around is very little, and the operation of hoisting or lowering is merely the turning of a cock, which a boy is amply sufficient to manage. In others again, the piston carries a sheave at one end, through which a chain is rove, one end of which is made fast to the frame and the other passes over another sheave and terminates in a hook; though the modes on which the power may be applied are unlimited. The saving of labor and of time in the use of these cranes must soon pay for the cost of the engine and pump, which is the only extra expense that they involve. There are other forms of cranes in which all the motions are obtained by frictional gearing from a quick-running cord, which are also very convenient, though not so simple as the hydraulic. The objection that would arise in the minds of many to the use of them in our climate on account of trouble in winter from freezing, could easily be removed by using oil instead of water, the same liquid being pumped over again when discharged from the cranes.

ARRANGEMENT OF POWER AND SHAFTING.

It is a very common practice to run the shafting directly by vertical double engines placed against the wall at one end of the line, sometimes without fly-wheels. With a good governor such as Porter's or Pickering's, this gives a perfectly steady motion. Of course this saves loss of power from numbers of heavy belts, besides making each line of shafting independent of the others, so that an accident to one does not involve the stoppage of the whole. The speed of any line can thus be varied, if desired, without interference with the others. Shafting, like the rest of the equipment of the shops, is kept up in good shape, thereby not only preventing great loss of power, but doing away with the nuisance, not to say disgrace, of noisy, jarring shafting.

The best shops, such as those of Neilson & Co. at Glasgow, or Messrs. Beyer, Peacock & Co., at Manchester, are laid out entirely on the ground floor, which saves a great deal of labor in passing the work from one department to another.

WATERING ON THE RUN.

A novel arrangement that has been applied to the London and North Western Railway, is an apparatus by means of which they pick up their water while running. For this purpose a cast iron trough about 18 inches broad by say 8 inches deep and a quarter of a mile long, is laid between the rails and kept full of water. The tenders of the locomotives are provided with a sheet iron scoop, the end of which can be raised or lowered, and when this is dropped down into the water, the latter is forced up into the tank by the motion of the engine. This apparatus works best at a speed of about 30 miles per hour, and for express trains, which often run 80 miles without a stop, it is very useful, though it is also laid down on the line devoted to coal traffic, as these trains have no occasion to stop.

RAILWAY CARRIAGES.

Railway carriages and wagons are carried on two, or if long, three single axles, with elliptic springs. As there are no platforms on which a brakeman could stand, brakes are applied only to the engine and one or two vans in the train. The brake blocks are always of wood, and of course require frequent renewals, but no doubt cause less wear of the tires than would iron ones.

The problem of providing means of communication between the passengers and the guard seems to be one of extraordinary difficulty, and to require the highest powers of the intellect for its solution. Such a plan as passing a bell cord through the carriages, as with us, seems to them to be attended with numerous serious objections, such as that passengers would stop the train either out of mischief or for trifling reasons, and the person who did so could not be identified! In place of this, there are adopted on some lines, systems of signals by rockets and percussion caps, which we would think it would require special instruction to enable one to use in case of emergency. I have not seen these in use, but I should say that if I wanted to stop a train for fun, I should rather do it with a display of fireworks than by merely pulling a cord.

The carriages are coupled together so as to bring the buffers close together, which prevents jerks in starting, and steadies them while in motion. For goods, the wagons are generally open and have a tarpaulin spread over the merchandise to protect it from the weather. This is at least well adapted to the system of loading and unloading by hydraulic cranes in use at the principal stations, which do the work very quickly.

The advantages of the method of entering and leaving the carriages by the sides, as enabling one to see at a glance where a seat is to be had, and to reach it without waiting for a number of people loaded with luggage to get out of the way, are so apparent that, as we are not likely to give up our present form of cars, it is greatly to be desired that side doors should be provided in them, even though it be at the sacrifice of one or two seats. SLADE.

On Focussing.

One is constantly struck, in examining the photographs which are exposed for sale, how much bad focussing is done. When a good lens is perfectly focussed, and the resulting negative is printed upon highly albumenized paper pressed firmly against it, there results a picture with a brilliant clearness of surface which no engraving, no artist's sketch, can in the least rival. The effect is extremely beautiful. It by no means interferes with softness—it would be as reasonable to say that a landscape could have no softness with a clear atmosphere, and that the best time to view natural scenery was in foggy weather.

Doubtless much imperfect focussing depends upon the defective surface upon which the picture is often focussed. I have yet to see a good piece of ground glass made in this country, and I have known photographers to remove the ground glass from the camera and laboriously work it over themselves, in the hope of getting it into such a condition as would enable them to see some of the fine detail upon it. Such care is exceedingly well bestowed; but all have not the necessary familiarity with the mechanical operations of grinding and smoothing. Besides, it is annoying to have to devote so much time and trouble to preparing a plate which may at any time be broken.

In a previous article devoted to this subject, I proposed several new methods of producing a surface upon glass, with a grain so exceedingly fine as to make it capable of receiving very exact detail. One of these methods consisted in applying a layer of *starch* upon the plate, which in drying leaves a thin, opalescent pellicle.

With time, the films showed a strong tendency to flake off and leave the plate in spots. These spots continually widened, until, in one plate which I had constantly in use, the whole of one end of the film split off from the glass.

To avoid these difficulties only one way suggested itself—to prepare a varnish which should itself have the necessary opalescence.

I take a good negative varnish made with alcohol, and saturate it thoroughly with tartaric acid. It does not dissolve a great deal, and to get a sufficient quantity into solution, the acid must be finely pulverised, added in considerable excess, and the vial well shaken at intervals for several days. It may then be allowed to settle for a day or two, when the clear liquid is to be poured off.

It is to be applied precisely in the same way as in varnishing a negative: that is, the plate to be gently warmed before and after the application of the varnish.

I cannot of course affirm that all negative varnishes will answer equally well for this purpose, even if made with alcohol, though there seems no reason to the contrary. That which I used was an old varnish made after Hardwich's receipt of lac, sandarac, and alcohol.

The grain of the film obtained in this way is so fine that the smallest print may be read through it with ease, even when the other side of the glass is placed next to it; at the same time it is not too transparent. It thus reconciles the two points to combine which is the grand difficulty in making a focussing film; for there is no difficulty in obtaining a film of fine grain in many ways. But this quality is accompanied with a transparency which renders the image on the ground glass too dark and indistinct. When it is attempted to focus on such a film, only the strong contrasts of the picture can be seen—a dead branch standing out against a sky, or something similar; but the film which I here describe renders every part of the picture plain and distinct, and the purest details can be watched as the camera draws out and in to find the focus.

I think it may perhaps give a better idea of the quality of such a film as this, if I describe what it is capable of accomplishing in the way of clearness.

I placed a book before the camera, of clear, but not unusually large type, and at such a distance that the image on the focussing plate was diminished to *one hundredth* of superficial size as compared with the original. On this image, with the aid of a single lens of moderate power, the loops of the letter "o," wherever it occurred could be made out. Now this could not be done on ground glass, at least not on any that I have seen, even with a much more powerful lens: for if the grain of the film be not sufficiently fine to receive and show the fine detail, no magnifying can bring it out. A comparison which I made between this film and a glass plate which I had roughened with hydrofluoric acid gas, was three to one in favor of the former in point of visible detail. M. CAREY LEA.

Hints on Spectacles.

Dr. W. Ackland, a surgeon of some note in London, makes the following suggestions:—

"The natural decay of vision occurs usually from thirty to fifty years of age, varying according to habits and employment of the individual. Sometime during this interval the refractive powers of the crystalline humors of the eye slightly alter their condition, while the crystalline lens and cornea change their form, so that a difficulty of distinct vision is felt. The eye loses a portion of its power of seeing at varying distances, or its power of adjustment, and near objects are no longer as easily seen as in youth. Reading small print by candle light is difficult, as the book requires to be held at a greater distance from the eye than formerly, and a more powerful light is needed, and even then the letters appear misty, and to run on into the others, or seem double. And still further, in order to see more easily, the light is often placed between the book and the eye, and fatigue is soon felt, even with moderate reading.

"When these symptoms show the eye to have altered its primitive form, spectacles are absolutely needed. Nature is calling for aid, and must have assistance; and if such is longer withheld, the eye is needlessly taxed, and the change, which at first was slight, proceeds more rapidly, until a permanent injury is produced.

There is a common notion that the use of spectacles should be put off as long as possible, but such is a great mistake, leading often to impaired vision for life, and is even more injurious than too early employment.

"Timely assistance relieves the eye, and diminishes the tendency to flattening, whereas, should the use of spectacles be longer postponed, the eye changes rapidly; and when the optician is at last consulted, it is found that a deeper focus spectacle must be used than usual for the first pair, and even these suit but a short time, and have to be again exchanged for those of still deeper power; and these changes become a matter of necessity which, unless judiciously checked, continues during life.

"It must not be forgotten that, when first using spectacles, they are not required during daylight, but only for reading, etc., by artificial light; and it may be from six months to two years from the time of first adopting them ere they will be required for day use.

SHORT RULES FOR THE PRESERVATION OF SIGHT.

"It is of the highest importance that near and distant objects should be equally examined, so that the eye may preserve its fullest power of adjustment: this should be done by the unaided eye alone, where it is possible, but the short sighted should always use spectacles, as the power to see at different distances becomes paralysed, and different spectacles for near and distant objects will be required.

"Spectacles should only be worn to compensate for any deficiency or excess of refractive power of the eye, and this deficiency or excess should be most carefully ascertained by the use of the optometer, in order to guide us as to the requisite focus.

"Use the softest washleather to wipe your spectacles, and if the lenses become scratched, have them exchanged at once.

"Single eye-glasses are injurious, as all the work has to be done with one eye, and then a prolonged use is always followed by the focal length of the eye differing in each."

PATENT LAW---AN INTERESTING QUESTION.

Does the validity of a patent depend upon the success or utility of the apparatus patented? It would seem at first sight, that this question could hardly come up in a practical shape; the utility of an article being the only ground upon which a prosecution for infringement would ever be brought or contested. But a case is now before the Supreme Court on appeal from the Circuit Court for the district of Connecticut, which hinges on precisely this question. Two patents cooperating to the same purpose having been revived and reissued together by Act of Congress, it is claimed that the whole reissue is invalid, from the original invalidity of the prior of the two patents; and this alleged invalidity is founded on the admitted worthlessness of the first machinery, until improved by that subsequently patented. Here is a chain of three links: the first patent depends for validity upon the ability of the device to accomplish its purpose; the second patent depends for its availability upon the validity of the first; the Act of Congress extending both, rests for its effect, on the validity of both; and the whole concatenation falls to the ground, by the failure of the primary machinery. The opinion of the District Court, invalidating the claim, implies rather than expresses the point that the second patent was a dependency of the first and must stand or fall with it; for it has been decided repeatedly that an act may be valid in part and void in another part, so that the reissue of a valid patent would not be invalidated by being coupled with the reissue of a worthless patent.

The case is that of the Union Manufacturing Company *vs.* John D. Lounsbury, *et. al.*, for infringement of a patent relating to the manufacture of felt cloth. The original patent was issued to John Arnold, in 1829. The second patent was issued to Arnold and George G. Bishop, in 1836, and describes a process without which the former machinery never was or could be utilized, viz., "depositing the weft in separate sheets, edge to edge, upon the continuous sheet of warp." The court held that as Arnold's machine of 1829 could not effect its purpose, it was no invention in a practical or legal sense. His intention or conception, as it stood at that time, unrealized in practice, could not be legally patented. The complainants, on the other hand, hold that Arnold's machinery, not his unexecuted conception, was patented and protected as his property, such as it was, irrespective of its worth or worthlessness.

It has been held in a case of stolen railroad tickets, as well as in many others, that a thing is property only to the extent of its practical value as it stands, and that hence a thing of no value cannot be recovered for as property, whatever private estimation the claimant may set upon it. Arnold's machine would have been property to the extent of its value in wood and iron, but not as a mode of accomplishing what it could not accomplish. Two nicer questions, however, arise here. First, did not the machine contribute to the accomplishment of the end proposed, and in such case, is it to be adjudged an absolute nullity in property, because it stopped short of completely effecting its purpose? Second, granting that the device has no property value, to be recovered from a trespasser, may not even the most worthless article be defended as a possession, against such as would wrest it from the possessor? If this were the truth and the whole truth of the case, then the injunction asked would seem to be just, where an action for damages would fail.

The counsel in this case are R. Rowley, C. M. Keller, and B. R. Curtis for defendants, and E. W. Stoughton for appellees.

Editorial Summary.

SANITARY EDUCATION.—Dr. Jenner, in his remarks on Nov. 12th, at the opening session of the London Epidemiological Society, of which he is President, advocated the introduction of sanitary science as a regular part of a liberal education. We would go further, and urge its adoption as an element of common-school education, in its simpler laws and principles, and in its philosophy as an essential of professional education, equally with chemistry, for example. Dr. Jenner's arguments are abundantly forcible for our conclusion. The difficulty in the present state of general education, of spreading practical sanitary knowledge, and of inducing men to act so as not to destroy themselves and their neighbors, is all but insuperable. Constant and indefatigable iteration, on the part of the few; line upon line, precept upon precept, example on example, warning on warning; offer the only hope of gradually awakening and instructing the present generation with regard to the common laws of health and disease. The next generation might be and should be better indoctrinated. Meanwhile, every press and every public instructor, of whatever kind, should give prominence to the daily lessons of experience and science on this all-important subject.

A CURIOUS EFFECT.—Gernez has lately found that many substances which after being fused still retain their liquid form until their temperature has been considerably lowered, are nevertheless instantly solidified while their temperature at the same time rises again to the melting point, either by contact with a particle of the same substance, or of another which has touched it, or by friction of two solid bodies within the fused mass. Phosphorus and sulphur are examples, either of which will instantly commence to crystallize at the point of contact with a particle of their own kind, or with glass which has been touched with the same, or with two bits of glass shaken together, within the melted substance; the crystallization spreading rapidly throughout the mass.

MOUNT HOOD, Oregon, is reported 17,600 feet in hight, the loftiest peak in the United States, and a volcano. Prof. Alphonso Wood, of this city, who measured the altitudes by observing the boiling point of water, found the summit of the Cascade Range and foot of Mount Hood proper, at an elevation of 4,400 feet; limit of forest trees, 9,000 feet; highest limit of vegetation, 11,000 feet. On the flanks of the mountain are glaciers, and on the north side a precipice of a vertical mile of bare columnar rock. The crater is of great extent, with an original depression estimated not less than 1,000 feet deep, and an open abyss vomiting sulphurous smoke, on the west side. The area of the mountain summit is crescent-shaped, half a mile long, and from three to fifty feet wide.

BESIDES "the thousand natural shocks that flesh is heir to," smokers are liable to peculiar attacks upon the senses of sight and hearing and the faculties of will and memory. Paralysis of the optic nerve, and torpor, coldness, and hissing noises in the ear, promonitory of paralysis of the auditory nerve, are the forms in which nicotine attacks these two organs. Medical observers have often remarked the failure of memory, and also a general characteristic of irresolution or indecision in habitual smokers. Exceptions are abundant, but this pathological characteristic of the drug is undisputed.

A MASS of iron weighing 1000 pounds at the equator would weigh 1005 lbs. at the poles, and but 500 lbs. at a distance of 2,000 miles below or 1650 miles above the earth's surface, and only 160 lbs. on the moon. On the planet Jupiter, however, its weight would be increased to 2,600 lbs., while if placed on the sun, it would gain 27,000 pounds.

TO TEST the quality of wool, take a lock from the sheep's back and place it on an inch. If the spirals count from thirty to thirty-three in the space of an inch, it equals the finest Electoral or Saxony wool grown. The diminution in number of folds to the inch shows the inferiority.

FOR testing gold or silver, slightly wet the metal and rub gently with lunar caustic. If genuine gold or silver the mark will be faint; but if an inferior metal it will be quite black.

A JAPANESE-ENGLISH dictionary has been completed by Dr. Hepburn, of the Presbyterian Board of Missions, and is to be published at the risk of an American merchant at Yokohama.

IRISH-AMERICAN whiskey, according to the Revenue Commission, may be made by the following delightful receipt: 40 gallons of whiskey, 30 gallons of water, 5 gallons tincture of Guinea pepper, 1 quart tincture of killitory (or killaliberal), 2 ounces acetic ether, 1½ gallons strong tea. To improve the flavor, add 3 ounces pulverized charcoal, and 4 ounces ground rice to the gallon, and let it stand for a week, stirring daily. Mix in any nasty receptacle convenient, in any subterranean den which the revenue officers are least likely to penetrate.

THE chief manufactories of beet sugar in Germany are at Stassfurt. Three or four of them employ from five hundred up to a thousand operatives, turning out as high as a million pounds of sugar to the hundred laborers. The price of the refined sugar is ten cents a pound at the factory, and the price of beets is ten cents a hundred pounds in the fields.

AN attempt is to be made in France to transmit messages to considerable distances by accoustic tubes.

A NEW process in coining has been invented by a melter in the Philadelphia mint, by which it is expected the Govern ment will save a quarter of one per cent, or $2,500 in every $1,000,000 on all its future coinage. The process will remain a secret in the possession of the Government—if possible.

DEODORIZATION OF VULCANIZED RUBBER.—The offensive sulphurous smell of india-rubber goods, is a serious drawback upon their otherwise great convenience. Mr. Stephen Bourne, an Englishman, has patented a process for removing this odor by treating the fabrics in a heated chamber with charcoal, and in preference, animal charcoal, as more rapid in its effect. The operation may be conducted simultaneously with the vulcanizing, the apparatus required being very simple.

MINNESOTA is accumulating a magnificent school fund which promises, if well administered, to make that State a good one to be born in. The sales of school lands ha e already realized $1,326,893. The drawback upon this good luck is that, as with large fortunes generally, the people will recline upon it, and will feel unwilling to tax themselves, or to look vigilantly after that which costs them nothing.

THE Senate Committee on Foreign Relations has now before it the memorial of the New York Chamber of Commerce asking that our idle navy be allowed to survey the bed of the Atlantic from the United States to France and Southern Europe, with a view to a telegraph which our foreign "relations" cannot control in peace or monopolize in war.

FIVE minutes from New York to Ireland, is now announced as the average time occupied by messages through the cable.

HENRY KEEP, lately elected President of the New York Central Railroad Company, came to Rochester thirty years ago, a penniless boy of seventeen, and was glad to get employment with a cooper at seven dollars a month. He began his financial career soon after, by buying up city shinplasters at a discount, during the panic of 1837, and lending them for short terms without interest but returnable in good money. He is now one of the most powerful railroad men in the country, and sits in the seat of Dean Richmond.

THE chief mechanic in the Imperial Turkish mint is an American, who has been employed there thirty years. The office during the past year seems to have been one more of honor than of pecuniary gain, as owing to the depressed condition of the country's finances, he has not received any portion of his salary.

A LUMBERING firm in Skowhegan, Me., is said to own 400,000 acres of land, equal to six or eight large townships, on the Kennebec River. Their force is 800 men and 380 animals, and their winter product twenty-five million feet of logs.

"THE work of a thousand men for four years" is the inscription placed prominently on the new bridge over the Susquehanna at Havre de Grace.

MR. JAMES HOWARD, the well-known implement maker of Bedford, England, lately delivered a lecture before the London Farmers' Club on "Things in America." Mr. Howard had been profoundly impressed with the happiness, prosperity, energy, intelligence, and self-government of the American people, during a recent tour in the United States. He wonders that so many people are willing to remain in the Old World, without a chance to rise, with hardly a chance to exist. If the United States were crowded as England is, the population would be nearly a thousand millions. In reply, however, to the question whether he thought large and opulent English farmers would do well to send out their sons to America, he remarked that one of the first memoranda which he made in his diary after seeing the United States was, that *it was no use to send a fool to America. Rem tetigit acu*: or, in proverbial Saxon, Mr. Howard hits the nail on the head.

A CHINESE newspaper is about to be started in San Francisco for the large and increasing population of that race on the Pacific coast. Type and compositors have been procured from China, but the enterprising proprietor is a Yankee—we guess. This, while inquiry is moved in Congress by a California representative, with a view to measures for checking the vicious immigration.

ELEVEN cotton mills are now running successfully in South Carolina, having 996 looms and 27,200 spindles. The Kalmia Mills are the largest, having 600 looms and 10,000 spindles.

Sub-marine Pneumatic Passenger Tubes.

A friend who has recently visited the pneumatic passenger tube in process of construction in the bed of the Thames, reports the work rapidly approaching a successful completion. The simplicity and undoubted feasibility of this mode of transit, has already, we are told, prompted the organization of a company of heavy capitalists for the purpose of laying tubes from New York to Brooklyn and Jersey City, and from the lower to the upper end of the Island, under the North and East Rivers. Wilder predictions have been uttered—and fulfilled—than that some of the men who assisted at the laying of the Atlantic cable, may live to see the tubular sub-marine railway in operation alongside of it. Who knows?

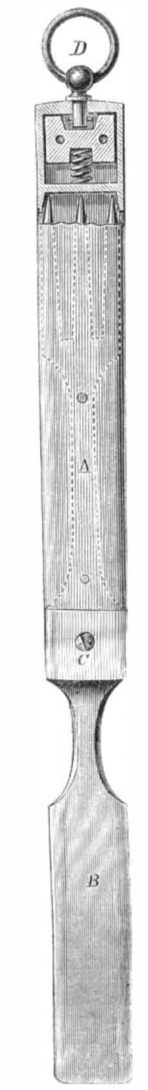
The Paris Exhibition Agency.

Messrs. Blanchard & McKean, whose advertisement appears on the back page of the present issue, are alive Americans. They propose to attend personally to the proper exhibition and sale of articles sent to the Paris Exhibition. The arrangement is not merely a temporary one, but they propose to remain in Paris and continue their agency. They have had considerable experience in such matters, and their services will be valuable to our readers.

IN consequence of the complete change in the SCIENTIFIC AMERICAN, and the occurrence of Christmas, we were delayed two days in getting the first number to press. Hereafter we hope to bring it out on the usual day of publication.

SUINE'S CULINARY INSTRUMENT.

The engraving represents an implement designed to subserve two or more purposes in culinary operations. It can be used as a lifting or steadying fork, or as a spatula or slice for lifting and turning fish, cakes, meats, omelets, etc. It is represented partially in section, and consists of a long handle, A, open at the side edges like a razor handle, the two sides being connected at the ends. The fork, shown by the dotted lines, and the blade, B, are of steel, in one piece, pivoted in the handle at C, so that it can be turned in either direction. At the upper end of the handle is a sliding plug sheath, shown in section, to which is attached a ring, D. By pulling on the ring the tension of the spiral spring is overcome, the sheath receded, and the blade or fork released, when the instrument can be transformed into a fork or slicer at will. The blade has rounding edges, the point being thin and square across.



It was patented through the Scientific American Patent Agency, Dec. 18, 1866, by P. L. Suine, Shirleysburgh, Pa., who will answer all letters of inquiry.

Central Fire of the Earth.

Our London cotemporary, the *Engineer*, discusses at great length the evidence of "fervent heat" with which the elements beneath the crust of our globe are melted, and transfers a wondrous scientific tale which has been running through the French press with solemn gravity. Some of our readers will perceive that, like the beetle's ball, the story has gained in size by being rolled across the Atlantic.

The story, as copied into the *Engineer*, runs thus: "Not far from the Falls of Niagara was a glacier, belonging to a company who realized enormous profits by the sale of the ice in the western cities during the summer months. A few days later than the Aspinwall explosion, an aurora borealis of magnificent proportions was observed wheeling its shafts several nights in succession in the northern sky, causing two lightning conductors on the top of the glacier (!) to emit long electrical flames of a bluish color. In the meantime a boiling noise was heard inside the glacier, accompanied with a disengagement of gas and occasional loud detonations. A captain of militia ventured to enter an opening in the ice with a light, when the glacier burst with an explosion that shook the whole country. Happily nobody was killed except the unfortunate captain, of whom not a trace could be found. The glacier contained 16,000 tuns of ice, and after the explosion there was a fall of lukewarm water over a space of 500 yards in diameter. The theory of the cause of the explosion is that the two lightning conductors on the glacier acted under the influence of the electricity as the two poles of a voltaic battery, and decomposed the ice into a mixture of oxygen and hydrogen gases, which of course exploded with resistless power on the introduction of a light."

FERRY ACROSS THE ENGLISH CHANNEL.

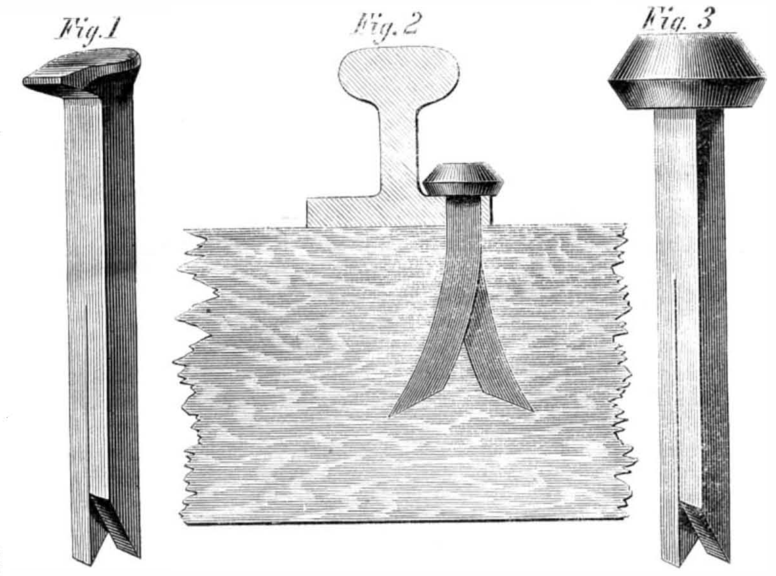
The proposition for a railroad ferry across the channel that divides England from the continent is by no means new, and it is not improbable that before many years it will have become an accomplished fact. Indeed, it is a matter of some surprise that this enterprise has not before this been ultimated into a reality. Of all the projects suggested, the tunnels of masonry, of iron, the sub-aqueous bridge, and the artificial islands, etc., that of the monster ferry appears to be the most practicable and feasible.

Engineering strongly recommends this plan, whether the boats employed are to carry a railway train with its passengers or not. It says: "It is a question of judgment how far we may go on increasing the size of our Channel steamboats. As a mere matter of construction we could make them of almost any size, even so that their length should form a respectable proportion of the whole distance between England and France. Our plans must be governed, however, by the probable traffic, and here, again, we are left to conjecture what increase of communication would follow a nearly total prevention of sea-sickness. We know that many of our ablest engineers, Mr. Hawkshaw among them, count so largely upon this increase as to believe that a tunnel, were it to cost ten or even fifteen millions, would eventually become a profitable undertaking. Yet even were the tunnel made, and supposing no apprehensions to exist as to its perfect security, it is not every one that would prefer a ride of twenty-five miles under the sea when he could cross over it in nearly the same time."

Engineering proposes boats 800 feet long with a beam of one-fifth or 160 feet, driven by four pairs of engines, each of 600 horse-power, working collectively to 12,000 indicated horse-power, and driving four wheels, the two pairs 300 feet apart. We believe with *Engineering* that boats so constructed and propelled would almost annihilate the proverbial miseries of the Channel passage; and, as it is a subject in which Americans have some interest, we sincerely hope the matter will be pushed forward by our enterprising cousins. Not unfrequently we hear the complaint that the passage from England to France is productive of more discomfort than a voyage across the Atlantic.

Improved Split Spikes.

Railroad spikes, as ordinarily constructed, are very liable to become loose by the jarring and trembling of the rails, also by contraction and expansion. The annexed engraving illustrates a split spike of a new construction, and one well calculated to retain its place in the sleeper until more than usual power is exerted to draw it out. The body and head of the spike are of the usual style. The body is split, as will be noticed by reference to the illustration, centrally and longitudinally, for about half of its length, and the ends of each prong are beveled on alternate sides, as shown clearly in Figs. 1 and 3. It will therefore be perceived that when the spike is driven into the sleeper the two prongs will diverge or turn outward, in a direction parallel with the plane of the split in the spike, as shown in Fig. 2; the chisel edges cut the way for each prong, and the bevel throws them outward. It is not necessary to previously bore a hole for the spike, as it can be driven with the same facility as a common solid spike.



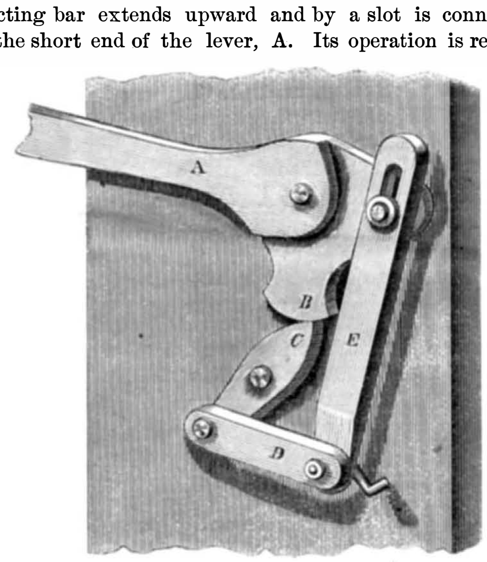
KIRKUP'S PATENT SPLIT SPIKE.

The power necessary to be exerted upon the spike to draw it is about three times that required for drawing an ordinary spike. The spike, when drawn, may, by a slight blow of the hammer, be fitted for use again.

This invention was patented in the United States, Jan. 2, 1866, and it has also been patented in Europe and other countries. For further information address H. A. R. Moën, at No. 71 Broadway, New York City.

A NEW LEVER MOVEMENT.

The accompanying engraving exhibits the plan of a new method of applying the action of a lever to the production of a rotary motion by means of a crank. The lever, A, has a double cam face, B, which engages with the lever, C, that by a connection, D, is attached to the crank. From the crank a connecting bar extends upward and by a slot is connected with the short end of the lever, A. Its operation is readily understood. By raising the lever, A, the point of C slides over the face of B and falls by the weight of the bar, E, beyond the radius, where the front of B takes it and reverses its motion; the bar, E, gradually rising until near the vertical center, when the reciprocating movement of A completes the turn.



As the arrangement is made in the engraving—taken from a simple wood model—gravitation has much to do with its operation, but modifications could undoubtedly be made by which it could operate in any position. The inventor thinks this movement could be readily and usefully applied to the propulsion of hand cars on railroads and for the connections between marine engines and screws. He claims that the power exerted is by this plan applied directly to the crank. Practical mechanics can readily judge of the advantages or merits of this combination of levers and cam. It is the invention of Henry Maas, Homestead, Iowa.

The Teeth.

According to a paper by Dr. Latimer, in the *Dental Cosmos*, a deciduous set of twenty teeth—viz: eight incisors, or cutting teeth, four cuspids, or pointed teeth, and eight molars or grinders—are given to each human being, usually during the two and a half years succeeding the first six months of life. When the jaws are sufficiently grown, and the time approaches for the deciduous set to be replaced by strong and permanent teeth, they lose their roots by absorption, become loose, and work out, one by one. The first four molars, one on each side of each jaw, are usually replaced first, at about five or six years of age. Next them, at 12 to 14 years, appear a second quaternion of molars; and at 17 to 21, a third and entirely new set, making in all twelve. Meanwhile, the new incisors come on, from six to nine, the central ones first, and the cuspids follow, from nine to twelve.

Teeth, nails and hair originate from the skin, and the four in general bear a common family likeness The teeth being in great part composed of phosphate of lime, which is abundantly diffused among vegetable substances by nature, a natural diet nourishes them with their special ingredients. An artificial diet, if not shaped by science as well as the arts, *starves* the teeth by superfining the food of its mineral elements. Wheat deprived of its russet shell by fine bolting, contains little or no strong mineral food for the bony system; but instead of this, we substitute mineral poisons in the bread, which attack the enfeebled teeth with disastrous success.

Microscopic photography has lately been made a valuable auxiliary to the study of the structure and internal economy of the teeth. Very striking exhibitions of the secrets of nature are thus fixed upon paper, and will doubtless become more and more popular in the future. Magnifying glasses of considerable power are also adapted to the use of dentists in examining the teeth and in working out their excavations, fillings and finishings to perfection.

[For the Scientific American.]

SNOW MELTED BY FRICTION--DANGEROUS PAPER.

BY PROFESSOR CHARLES A. SEELEY.

MELTING SNOW BY FRICTION.

Latterly, there is no good sleighing on Broadway. The pleasure sleighs avoid Broadway and seek the avenues, or go beyond the limits of the city. The huge stage-sleighs, drawn by six to twelve horses, and carrying a hundred frolicking passengers, which used to be the most exhilarating incident of the winter on Broadway, now belong to the past. And yet as much snow as ever falls in the winter, and it is never carted away as in some other cities. Lately, the snow, instead of being looked upon as a source of comfort and good humor on Broadway, is pronounced to be a very serious nuisance.

People account for the change by telling us that the great and increasing traffic on Broadway cuts up the snow, and thus spoils it for sleighing. This reason, although good enough for a short one, is not sufficiently specific and comprehensive for the philosopher, or the readers of this paper. It seems to have in view only such evident circumstances as evenness in depth and compactness. I invite attention to a single fact which very few of those who are satisfied with the cutting-up theory have taken into account.

The snow on Broadway does not last so long as in other streets: it actually melts faster there. I have observed that the melting goes on most rapidly in the middle of the street; practically, there is a streak of warmth up and down. Some of the merchants have found out this warm streak, for I have seen men employed pitching the snow into it, that is, under the horses' feet in the carriage path. Wherever this was done, the snow was cleared off the premises very promptly. If the practice were generally adopted from Bowling green to Union square, it would very much diminish the peril of navigating Broadway in winter; shoveling the snow where it will melt, is much better than salting it, as was once the custom here.

But why does the snow melt more rapidly in the carriage way? Is it really warmer there, and why?

There are two reasons which are pertinent to the case, and which perhaps sufficiently explain it. First: The friction in the snow produced by the trampling of horses and the passage of vehicles. Friction always produces heat. Two pieces of ice may be melted by rubbing them together: water which is much agitated is prevented from freezing, and water in a bottle may be boiled by shaking it, provided that the heat produced by the friction be retained in it. I know that a little friction does not produce much heat, that a pound of water requires an expenditure of 772 foot pounds of force to warm it one degree, and that to melt a pound of snow demands 140 times as much. Yet, on the other hand, when we calculate the thousands of tons of horse, man, stage, cart, express wagon, and merchandize, incessantly crushing and stirring up the snow on Broadway, we must conclude that here is a force adequate for a notable result. *Causa aequat effectum.* Second: Absorption of the sun-heat. The sunlight is absorbed and disappears on dark-colored surfaces, and carries all the heat with it: white surfaces reject both. The pure white snow is very slow to melt, because it refuses to take in the heat. Sprinkle ink or lampblack on the snow, and it will melt when the air is below zero, if the bright sunbeams fall on it. The case is plain: the white snow of the side of the street, when thrown in the roadway, becomes inked over with dirt, and now is eager for the sun heat.

There are other causes which might be discussed, such as the warmth of animals, the better exposure to the sun of the middle of the street, etc., but they are insignificant compared to the two above named.

DANGEROUS PAPER.

There is a great difference in the combustibility of common paper. Enameled card paper, on account of its compact body and the presence of mineral matter, white lead or barytes, is quite disinclined to burn: in fact, some kinds are practically fire-proof. White writing and printing paper can seldom be lighted by a spark, and when ignited by a flame, it requires dexterity to keep it burning. On the other hand, there is a common reddish-yellow paper which, in some circumstances, is as dangerous as gunpowder. It takes fire by the smallest spark, and burns like tinder: when once lighted, if left alone, it is sure to be consumed completely. All the yellow and buff paper which I have tested, out of which envelopes are made, partakes more or less of the same character. I have no doubt that such paper has been the occasion of some of the fires in this city which have been otherwise explained, such as the fires in paper warehouses and offices of professional men. A spark of fire, or the stump of a lighted cigar, falling in a waste basket containing yellow envelopes with other kinds of paper, would have a good chance of setting the whole on fire.

NATURE'S TERRACULTOR.

The common earthworm or angleworm is a veritable dirt-eater. It takes no other food than the earth by which it is surrounded, and the prevailing notion, that it feeds on roots and seeds and is harmful to the garden, is an error. The worm is a tidy animal; after he has extracted out of the earth he has devoured whatever is nutritious to him—namely, the adhering organic matter and water—he bores a passage to the surface of the ground and discharges the refuse. The "worm-castings," or excreta, may be observed during the summer in every garden. Thus the worm is constantly employed in transporting the fine soil from the depths of his subterranean burrowing-places. What a single worm can do in this way in his life-time may be insignificant, but the aggregate work of all the worms is something which may employ the engineer and geologist to determine. We must remember that this work has been the habit of worms for ages, and we know that a still more insignificant creature, the coral polyp, has constructed many large islands in the sea and a considerable part of the continents.

When the fine soil is brought to the surface, the coarser particles, gravel and stones, sink down and may be covered up. In one case, Mr. Darwin, the author of the Darwinian theory, found that the fine soil over a large area was brought up at the rate of over an inch in depth in five years.

The earthworm is Nature's terraculter. He breaks up the soil, buries the stones, and brings the fertile earth where the husbandman needs it. There is no agricultural machine which can compete with the worm in the neatness and perfection of his work. Those who know these facts will never again despise our humble friend.

MUELLER'S STOVE HANDLES.

One of the greatest annoyances of daily life is certainly the heated handles or knobs of stove and furnace doors, the dampers and the cover lifters, when left on the stove, often raising blisters and the temper of the person so unlucky as to touch them. This great annoyance has been overcome by a simple, strong, and neat contrivance, by means of which the door or damper can be opened or shut without burning the fingers—certainly a great desideratum. This invention also does away with holders and other protectors for the hands, so liable to be mislaid. This handle is not only useful but ornamental.

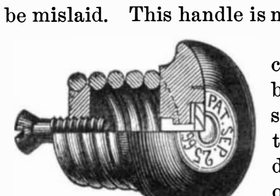


Fig. 1. shows one of the forms covered by the patent, which can be applied to old as well as new stoves. It consists of a heat-radiating coil, fastened at one end by a disk and screw to the door, the other end being riveted to a wooden handle. The same contrivance is applicable to the rod of the well-known Self-Regulating Parlor Stoves, and in different forms and sizes to all wood and to almost all coal stoves.

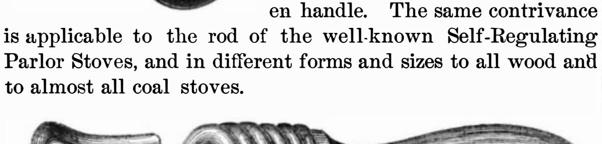


Fig. 2 shows a lifter for covers, made on the same principle, which can be easily fitted to any size or form of groove.

This invention was patented September 25, 1866, by J. U. Mueller, and its practicability having been fully tested, a company has been formed for the manufacture of the different sizes and varieties of handles.

For further particulars address Mueller & Hannimann, No. 207 Groghan street, Detroit, Mich.

SUB-CALIBER SHOT.—The enormous friction of an elongated cylindrical shot, in passing through the gun, detracts materially from the range and effect of the missile. To remedy this loss of power, a recent improvement reduces the diameter of the shot so as to be easy in the caliber of the gun, while a tight rifled disk is placed behind it to receive and communicate the full force of the explosion. The disk drops in the wake of the shot, and therefore cannot well be used in field firing, over the heads of troops. Bourne, the eminent English engineer, writes decidedly in favor of the improvement.

FARADAY asserts that the products of combustion from an ordinary grate fire during twelve hours, will render 42,000 gallons of air unfit for supporting life.

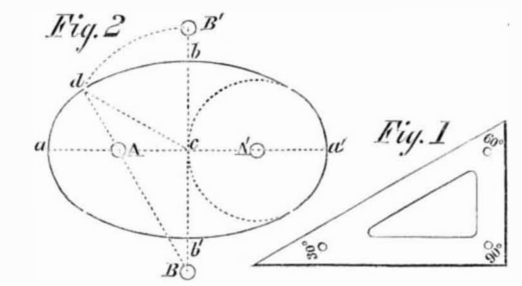
Correspondence.

The Editors are not responsible for the opinions expressed by their correspondents.

NEW RULE FOR ISOMETRICAL PROJECTIONS.

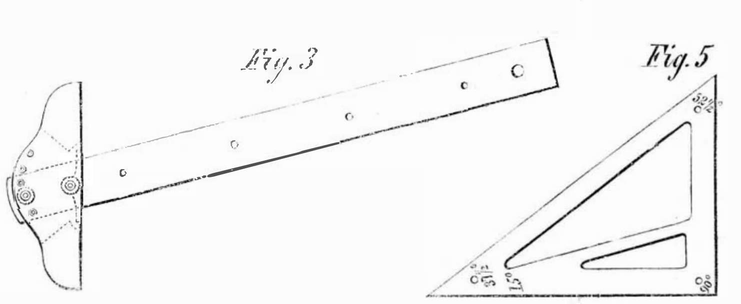
In this kind of perspective, the effect of distance on apparent size is disregarded and an equal measure or scale applied to every part of the drawing.

The distorted appearance when brought too close to the eye of the observer, disappears on more distant inspection; experience teaching him that the "vanishing" element is practically eliminated by distance, as for example, when a house is viewed from a lofty hill-top or a small object such as a work box is looked at from the opposite side of a room;



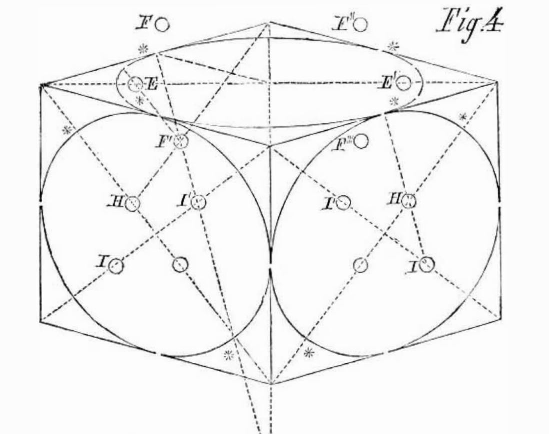
so that to make this class of representations appear correct, they have but to be sufficiently removed from the observer. Indeed the so-called "true" or "vanishing" perspective as actually practised is less correct, preserving as it does the parallelism of all vertical lines, although of course subject to the same law of convergence, as may be plainly seen in any photograph of street buildings.

In isometric projection, as commonly practised, the top and two nearest sides of any rectangular object are presented at an equal angle to the visual line; so that by use of a common T square and a triangle of 30° and 90°—see Fig. 1—almost every right line in a machine or implement can be laid down to a given scale and measurements taken therefrom with the same facility, as from a simple plan or elevation.



But the representations of circles, being of course ~~so many~~ ellipses of various sizes though mostly of one shape, was comparatively tedious, and the writer devised a plan now generally adopted, of which Fig. 2 is an illustration, whereby all ellipses in one of the three principal planes could be struck with a tolerable approximation to truth, by circular arcs *a a'*, *b b'*, described from four centers A A' B B', the actual radius being laid off on the semi-conjugate *d c*.

But a more effective and pleasing projection for most objects is obtained by use of two angles of 15° and 37½° (see Fig. 5), the horizontal ellipses being struck approximatively from six centers, to wit E, E,' F, F', F'', F''', G and a center G',



not shown, and the vertical ellipses from four centers H H' I I' (see Fig. 4), in which the 15° and 37½° angles are shown respectively by equal and unequal dots. The arcs marked * are all of equal radius.

The T square (see Fig. 3) may be so constructed as to dispense with the triangles. GEO. H. KNIGHT.

Cincinnati, Dec. 4th, 1866.

THE COMPASS---LOCAL ATTRACTION.

[For the Scientific American.]

In the October number of the *London Quarterly Review* there is an elaborate article on the mariner's compass, alluding to no less than thirty-eight publications covering a period from 1779 to 1865. Among the well-recognized names in England are Flanders, Barlow, Airy, Ross, Sabine, Scoresby, Smith, Walker, Evans, Fitzroy, and others. This is, at least, proof positive that this all-important subject has not been neglected by the *savants* of Europe. Let us inquire what has been the practical result of their researches. In carefully perusing the fifteen close pages of the *Quarterly*, what does the practical seaman find? An elaborate review of all the theories of distinguished men, showing pretty plainly that the causes of the deviation of the compass, in iron ships especially, are very well understood: that is to say, it is known that when a ship's head is to the east or west, the north point of the card is drawn one way in north latitude, and another way in south latitude; that when the ship heads nearly north or south, the deviation is less than in the cases just named; that a ship corrected for local attraction at Liverpool may go across the Atlantic with tolerable safety, by help of a table of errors and a mechanical arrangement by which the helmsman can steer the right course; it not being pretended by any of the experts in compass correction that it can be made to tell the truth on all courses without a table of errors varying from one-fourth to one point, more or less. Neither is it pretended, so far as we know, that any iron ship corrected in Great Britain for considerable errors arising from local attraction, can be safely navigated by means of such corrections in the other hemisphere.

It is well known that there is induced magnetism, sub-permanent and permanent magnetism, vertical and horizontal induction; and that soft well-hammered iron differs essentially in its intensity or magnetic effect from cast iron: it is also well known that every piece of iron in a ship has its north and its south pole; that is to say, one end will attract and the other repel the points of the needle; and it is generally understood that these poles, or properties of attraction and repulsion, are reversed on going into another hemisphere, unless, by manipulation individually—by hammering—they be changed while in the same hemisphere.

It is well known that many iron and steel vessels corrected in England get safely out of the channel and find their compasses very much out of the way on approaching the West Indies, and in the run to Brazil; and it is a well-known fact that vessels corrected in the Mersey have been found many points in error on getting into the St. Lawrence.

It is also well known that a ship built with her head in a certain direction may retain her original magnetism in a great degree on being launched and put into a different position; while another vessel built with her head in another direction may undergo a great change on being launched. It is, or ought to be, well known that no two ships can be treated precisely alike, even if they be built on the same blocks and of precisely similar dimensions. One of them may have, by a singular and improbable coincidence, all the north or south poles of her beams one way, and the other ship may have her beams in the opposite direction. One may have a single soft iron stanchion in such a position relatively to the locality of the standard compass that the needle will be moved to the ~~left, while a stanchion similar~~ to the eye, in the other ship, will move the needle directly opposite.

It is generally understood that the heeling and even the pitching of an iron ship in a rough sea will affect the compass not simply by the oscillation of the ship, but because the magnetic lines are temporarily changed thereby. It is also understood that a corrected ship, if laid up in certain places and in certain positions will prove to be more in error, or nearer correct, when put into commission again.

All these matters, and many more, pertinent to the subject, are fully and skillfully discussed in the October *Quarterly*. The diseases to which iron ships are subject always, as well as the less severe ones of wooden steamers and sailing ships with wire rigging, metallic boats, etc., seem to be pretty well understood—but where are the remedies? The writer has been familiar with ships and shipping for about half a century: twenty years ago he had never heard of local attraction, but soon after, he came near losing two wooden steamers from this cause. Since the more general introduction of iron into the construction of ships, in the shape of plates, rigging, steering gear and machinery, errors of compasses arising from this insidious agent have attracted much attention, by reason mostly of the great losses of life and property that have resulted therefrom. How many valuable ships have been lost on the coasts of North America? How many in the West Indies? Could the truth be known, all or nearly all have been lost for want of correct compasses—or rather, for want of correction in the ships themselves: for it is a misnomer to speak of correcting the compass, when treating of local attraction; though to speak the whole truth, many compasses are sadly in want of correcting. Scoresby tells us in his narrative of his voyage in the *Royal Charter* to Australia, that no corrections made in the Northern hemisphere can be depended on in the Southern, and that the only safe or tolerably safe expedient is to place a compass aloft out of the reach of the local attraction of the ship.

Having thus alluded to the amount of thought expended by the *savants* of Europe on the disease called local attraction, and to the paucity of remedies therefor, let us recite some of our experiences during the last twenty years. The iron tow-boat *R. B. Forbes*, belonging to certain of the underwriters of Boston, ran for some time corrected by a gentleman of New York. His method did not prove to be reliable. Her captain, Griffith Morris, an uneducated seaman who had scarcely heard of Barlow, Scoresby, and Airy, turned his attention to the study of local attraction, and after several years of anxious experiments, he mastered the enemy. The tow-boat under his command never went much further than New York, but she went there often in thick weather, over the intricate shoals, and always went safe, towing valuable ships with poor compasses. Her compasses were situated in her wheel house, over the forward ends of her boilers, and not very far from her very large smoke stack. No table of errors was necessary; the compasses were correct on all courses. This boat continued to run under Capt Morris's command more than fifteen years. No boat ever rolled and pitched more, and few ever encountered so much hammering; yet up to the day when she was sold to the United States Government, her compasses were entirely reliable, as can be attested by every underwriter and almost every prominent merchant in Boston.

Next came an iron schooner called the *Mahlon Betts*, belonging to and built at Wilmington, Del. She found her way to Boston by following other sailing vessels through Vineyard Sound: her compasses—in the binnacle very far aft, and not very far from an iron steering wheel revolving a very sensitive shaft—being literally useless. In swinging the vessel, they would jump from S. S. W. to W. S. W. or something like it, and would do nothing else. Morris corrected her, leaving the binnacle where it was. She had no table of errors, and ran as far as Trinidad, and was reported for a number of years perfectly correct on all courses.

Then Morris came to be appreciated by many steamship masters and owners, and from that day he has been recognized, in this section of the country, at least, as master of the art of counteracting local attraction—not only in this hemisphere but all over the world where ordinary commerce spreads her wings.

For the writer, he corrected four iron vessels. The yacht *Edith* was one; a vessel where a compass seemed to be only an incumbrance. She was used as a yacht two years hereabouts, where the writer had abundant opportunity to test the correctness of her adjustment. No table of errors was needed: the compass was correct on all courses. She went, in 1858, to the La Plata, and the writer joined her there. Both he and the captain found no error in the compass, going out or while navigating the waters in the vicinity of the La Plata. She was sold as a pilot boat, and never was heard of as in error in her compass.

The iron brigantine *Nankin*, built for the China trade by the writer, was found to have an error on some points of more than 90°: in fact, her compass was totally unreliable. Capt. Morris adjusted her, so that she went to the La Plata in 1858, without any appreciable error in any of her courses! Thence to China, back to England, again to China; and for a year or two longer she was navigated, until lost by an accident to her bow ports, without any discoverable error!

The iron steamer *Argentina* also went to the La Plata, and met with no deviation of her compass. No table of errors was found to be necessary. The fourth iron vessel was the propeller *Pembroke*, belonging to the writer and others. She went to China under the command of an intelligent captain, who never reported any difficulty in navigating her on account of errors in her compasses. The United States frigate *Merrimac*, the frigate *Minnesota*, the *Hartford*, the *Colorado*, and the *Wachusett*, were also corrected by Capt. Morris, and proved to be correct after many months' trial in northern and southern hemispheres. The steamers running between Fall River and New York, and many others whose names we do not recollect, have been similarly corrected, and so far as we know, not a single case of error has been reported.

The question naturally arises—why does not Capt. Morris put himself in the hands of reliable, disinterested, and liberal-minded men of science, who will vouch to the world that he understands correcting local attraction so that no table of errors is necessary as a guide to the navigator? The answer is plain. Capt. Morris understands the mysteries of local attraction, and accomplishes its correction both in north and south latitude, while the scientific men of Europe and America have not even pretended that they can do it, so that the compass shall be positively correct on all courses, for all purposes of navigation in both hemispheres.

Capt. Morris cannot explain his method in the language of the *savants* of Europe or America, and he feels that his secret is safer while kept to himself: a pardonable feeling, when it is considered that he supports himself and family on the earnings arising from his peculiar method. R. B. FORBES.

Boston, Mass.

Stereochromy, or Monumental Painting.

MESSRS. EDITORS:—As in this country we are rather poor in monumental paintings, I give you herewith a description of the new mode of imparting pictures to walls. I shall, however, confine myself to a general outline of the method by which Echter and Kaulbach, the celebrated artists of Munich, have executed four large pictures in the new museum at Berlin, which are generally acknowledged to be unequalled in the line of monumental painting.

Stereochromy (from *stereos*, solid, and *chroma*, color), differs from any other mode of mural painting by the binding material applied therein. This is soluble glass. Colors are in fact silicified with it, and therefore pictures executed after this mode are distinguished by great durability and power of resisting atmospheric influences which so easily destroy common frescoes.

In regard to the *modus operandi* the following may serve as an illustration. The wall to be painted is first coated with a layer of ordinary lime mortar, its object being to equalize any unevenness of the surface. In preparing the cement, lime must be sparingly employed, so as to render it rather poor than otherwise. The sand, which may be either quartz or calcareous, must be of even grain and well washed beforehand. In this and in all the following operations rain water must be used.

The plaster thus prepared must be well dried and be exposed to the air for several days, so as to become entirely carbonated, as the soluble glass afterward employed would be immediately decomposed by caustic lime. Professor Fuchs, the inventor of stereochromy, recommends moistening the wall with a solution of carbonate of ammonia, so as to accelerate the saturation of the lime. When dry, it is washed several times with a moderately diluted solution of double water glass—*vide* page 371 of this journal—allowing it to dry each time.

The ground being thus prepared, the upper layer may be added soon after. This also consists of lime cement one tenth of an inch thick. The sand employed must be of a grain not exceeding a certain size, and fine powder must be rejected. It is best, therefore, to pass it through a sieve. A rough grain is rather advantageous, and, as Kaulbach says, it ought to feel like a rasp. For a picture to be viewed at a long distance, a less fine grain is required than for a picture to be viewed at a short distance.

This coat being dry, it is moistened with a solution of one part of phosphoric acid in six parts of water, the object being to remove the thin layer formed of carbonate of lime, which would prevent the absorption of the soluble glass subsequently spread over it. The soluble glass here referred to must be the double water glass, clarified with liquor silicum. It is diluted with an equal bulk of water, and the operation has to be repeated twice. Too much water glass prevents the ground from taking the colors.

The ground being thus completed, the painting may be at once proceeded with, although some delay increases the capacity of absorption. The colors to be used—see page 371 of this journal—have to be ground with pure water, and the wall has to be frequently but carefully sprinkled with water, in order to displace the air from the pores, and thus insure the adhesion of the colors.

Nothing now remains to be done, but to fix the colors properly with a solution of soluble glass. They, adhering but slightly, do not admit of being wet with a brush. It is therefore necessary to sprinkle the solution upon the painting in a fine shower or mist, and this is done by a syringe made for the purpose. The operation of alternate sprinkling and drying is continued till the colors adhere so firmly that by rubbing them with the finger they are not disturbed.

Very fine in appearance are the stereochromic paintings at the world-renowned picture gallery at Munich. When we saw them some time ago they were as fresh as if they had been completed the day before, although exposed to snow and rain for many years.

Philadelphia. ADOLPHUS OTT.

On Steam.

SIMPLE CALCULATION OF THE AMOUNT OF POWER DEVELOPED BY STEAM.

MESSRS. EDITORS:—You stated, page 367, Vol. XV., that the mechanical force developed by the change of one cubic inch of water into 1700 cubic inches of steam is nearly one tun. This is correct, provided we add, lifted up one foot high.

The statement of a given weight alone, say a pound or a tun, represents only a certain quantity of matter, and nothing else: it cannot convey to our mind the idea of force: but the statement of a certain weight moved through a certain space against gravitation, represents a certain force, as it conveys to our mind the idea of an obstacle to overcome.

We can easily deduce this power of steam from the rate of expansion of water when changed into steam, and from the pressure of the atmosphere, which counteracts this expansion. Suppose we have a tube of one square inch internal section, and 1,700 inches long, closed at one end; suppose further we have in this tube near the closed end one cubic inch of water, and by means of heat change this water into steam; one cubic inch of water produces one cubic foot of steam at the common atmospheric pressure: one cubic inch of water is transformed, therefore, into 1,700 cubic inches of steam, and the steam developed will fill the whole tube, expelling the air. As, however, we also know that the air exerts a pressure of fifteen lbs. to the square inch, the steam will have to counteract this pressure when expelling the air, in the same way as if it had to move a piston against a pressure of fifteen lbs. through a space of 1,700 inches. The power developed by the steam is thus able to move fifteen lbs. for the space of 1,700 inches or one hundred and forty feet, or, which is the same, one hundred and fifty pounds fourteen feet, or fourteen times one hundred and fifty pounds one foot: that is, we overcome the pressure of nearly one tun, through a space of one foot.

SIMPLE CALCULATION OF THE AMOUNT OF HORSE-POWER OBTAINED BY STEAM.

The statement of a given weight combined with a given space through which it moves against gravitation, gives us the value of a force, but to compare this force with the labor performed by men or animals, we want the statement of a third condition, namely that of time. A man cannot possibly lift a tun weight one foot high in one second, whatever machinery he may devise for it, but in one minute he may accomplish that task easily, by a proper lifting apparatus; or by sub-dividing his load, if practicable, into thirty parts of seventy lbs. each, and lifting every two seconds one part on a step one foot high, in one minute he will have raised the whole tun one foot. He may even lift two tuns weight in this way in one minute by lifting every second seventy lbs. one foot high, or what is easier, lifting the 4,200 lbs. by proper machinery, so slowly that after the lapse of one minute it has been raised one foot. Almost daily we see illustrations of this operation, and as the number last given is about the maximum labor a man can perform, it has been adopted as the power of a man. As a horse is about as strong as eight men, it has been adopted that the horse-power is represented by the lifting of eight times 4,200 or nearly 33,000 pounds, one foot high in one minute.

As we found above that the transformation of one inch of water into steam, can lift one tun one foot high, so in order to lift 33,000 pounds or about sixteen tuns one foot high, we must evaporate sixteen cubic inches, that is, a little over nine ounces, of water (or produce sixteen cubic feet of steam), and when we do this every minute, we obtain one horse-power.

SIMPLE CALCULATION OF THE AMOUNT OF COAL REQUIRED TO PRODUCE A CERTAIN AMOUNT OF HORSE-POWER.

As it has been found by elaborate experiments that it takes one pound of anthracite coal to evaporate in a proper furnace and boiler nine pounds of water, or one ounce of coal for nine ounces of water, to produce one horse-power we must evaporate nine ounces of water, and to do this we shall have to burn one ounce of coal per minute, that is four pounds per hour, or about forty or fifty lbs. per day, and a steam engine will consume a tun of coal in forty or fifty days for every horse-power it developes. This theoretical economical amount is, however, never reached on a small scale; and an engine is considered better in proportion as its consumption of coal comes nearer to this statement. Usually the consumption is double this, namely eight lbs. per horse-power, per hour, but some of the modern improved engines and boilers come wonderfully close to the four lbs. per hour.

HEATING SURFACE, GRATE AREA, AND STEAM ROOM.

Experience has taught also, some interesting facts in relation to the amount of grate necessary and of boiler surface exposed to the heat, required to develop a given amount of steam in a given time, and consequently required for a certain amount of horse-power. Evidently there must exist a direct relation between them, but this relation is so modified by the kind of boiler, engine, cut-off, expansion, condensation, etc. that it would lead us into too many details to enumerate the quantities adapted for different circumstances.

We will only state that it varies from eight to eighteen feet of heating surface of boiler, and grate surface from one quarter to one-half square foot per horse-power. Steam room (that is the space in the boiler above the water) has been adopted from four to eight cubic feet per horse-power: however, these numbers are considerably diminished in locomotive engines, and lately very much modified in boilers and furnaces constructed on new and entirely different principles.

P. H. VANDER WEYDE, M. D.

Spontaneous Combustion.

MESSRS. EDITORS:—I am prompted to write a word of caution to the readers of your valuable paper, especially to those using and dealing in oils. Never permit cotton rags or waste, saturated with oil, about you; as they will often ignite of themselves and do great damage. To prove the danger: last summer, in the furniture rooms of Fargher, Sanford & Co., of this place, a finisher had been filling the grain of some walnut furniture with linseed oil, whiting, and umber, using cotton rags which he closely packed in one corner of the room when he had finished his work. These rags were found only two hours afterward on fire, and on being removed, were soon in a blaze. Had this occurred in the night, it would have been charged upon an incendiary. Many fires occur through neglect, and can often be traced to oiled rags.

WM. FARGHER, Jr.

Laporte, Ind., Dec., 1866.

[A physician in this city who had been in the habit of saving pieces of thrown-off linen garments, to be used in dressing wounds and bruises and putrefying sores, took a handful of them one day from a drawer where the pieces were kept, and vigorously applying them to his boots, put them back where they belonged. In a few minutes afterward he saw smoke issuing from the drawer, and upon opening it found the rags in a blaze. Had he left his office before discovering the smoke, the building might have been destroyed.

Not long since, a lot of rags used in an up-town hotel for polishing brass and silver were thrown in a heap in one corner of a room, and not long afterward they were discovered to be on fire. Had this occurred in the night, most likely the hotel would have been destroyed. These facts are worthy of attentive consideration.—EDS.

Small Motor Wanted.

MESSRS. EDITORS:—There is an increasing want of a cheap, simple and effective local motor, for use in hotels and every considerable establishment provided with a hydrant. A motor that will start with any force exceeding five pounds to the square inch and be regulated in intensity or suspended at will by the mere turn of a faucet. Numerous operators with light machinery, such as printers, tailors, opticians, cutlers, etc., only require a few practical illustrations to be unanimous in its favor. As for glass workers, jewelers, dentists, etc., they are getting tired of blowing their brains out over the blow-pipe. Such an instrumentality could obviously be made to perform the principal drudgery of the wash-room, the laundry, the kitchen and the scullery, besides running the sawing machine and making the family organ and melodeon vocal. GEO. H. KNIGHT.

Core-Making for Founderies.

MESSRS. EDITORS:—Allow me through the medium of your valuable paper to impart a useful item of knowledge to those interested in the foundery business I find the skimmings of sorghum—which are worthless to persons making sorghum molasses—very useful for making cores for casting. They are much cheaper, stronger, and less liable to "blow," than any cores made with flour. Use partly sharp sand, molding sand, and saw dust. Skimmings should be reboiled, but will answer without. Having had years of experience in the foundery business, I recommend it to all founderymen as a useful discovery. C. KRATZ.

Evansville, Ind., Dec. 1866.

Pen Palsy---Arsenic in Ink.

MESSRS. EDITORS: I inclose a slip cut from a newspaper. Please say whether the French copying ink (I write this with it) does contain arsenic, and if so, in what combination or chemical form.

This talk about "pen palsy" has always seemed to me ridiculous, whether charged to steel pens (as was done a few years ago), or to an ink, unless the same really contains arsenic. Overwork of the brain, with use of stimulants, is enough to account for it in all cases that I have heard of.

SAMUEL WILLARD, M.D.

Springfield, Ill., December 17, 1866.

[The following is the newspaper article:

A private letter from Washington mentions the serious illness of a literary gentleman of that city, his disease being pronounced to be "pen palsy." The affection derives its name from the fact that it is attributed to the use of the popular French copying ink, which contains arsenic. Both his hands and feet are badly swollen, and his health is so precarious that his physicians have prescribed abstinence from labor, and especially from the further use of the copying ink. The case should serve as a warning to those who use the fluid which has proved so disastrous in its effects.

The ink is of a dark purple color, and probably contains an aniline dye. Arsenic is used for some of the aniline preparations, and this fact perhaps accounts for the report that there is arsenic in the ink. It has not been convenient for us to test the ink for arsenic, but we do not believe that it would be found in it to any harmful extent.—EDS.

Old Stannard's Last Shot.

A young man of Milton, Wisconsin, who was familiarly known to his comrades as "Old Stannard," was a messmate of mine in that famous and once terrible regiment of sharpshooters commanded by Col. Berdan. He was well known as a "crack shot" at home, and soon established a like reputation in the army. After doing some hard service on the Peninsula with McClellan, we were recalled to help Pope out of his dilemma on the Rappahannock, and joined his forces just before that bloody second Bull Run battle in which occurred the incident of which I write.

In the afternoon of the last and hardest day's fight, the rebels posted a detachment of riflemen in the tops of some pine trees that formed a narrow belt along a portion of a field, a little in advance of our main line. As these men were fine marksmen, their elevated position enabled them to pour upon us a fire too galling to be borne with patience, and it was soon decided they must be dislodged. Our regiment was selected for the "glory." We got the order, and at them we went, "double quick." To cross the intervening open field was a task soon accomplished, though we lost a few men by their hurried discharge. When we had gained the woods, the odds were all on our side, for it was easy to shelter ourselves from the fire of any particular one, though in so doing we exposed ourselves to an unseen enemy; and, all things considered, we did some tall jumping and dodging in the first few minutes.

As usual, Stannard and I had kept together, and were peering anxiously into the thick bushy treetops about us, when suddenly came a shot from a tree directly in our rear, which we had passed carelessly by. Stannard gave a start with something very like a yelp, and held up his foot, saying—

"See there, George."

I looked, and sure enough his shoe was in tatters, and his toes badly mutilated—one entirely gone. I told him to start for the rear; but he was looking into the tree from which the shot had come. Soon he saw his enemy and pointed him out to me in the very top. The "Johnny" sat astride a limb busily engaged in loading, unconscious of the terrible death so near. Stannard raised his rifle. I watched the man—it seemed hours before the flash.

At length it came, and with an awful yell the man threw up his arms and fell backward, striking the limbs, and whirling over and over in his descent, until he reached the earth, falling upon his head and shoulders with a heavy "thud." We went to him, and when Stannard found him to be quite dead, he limped off to the rear, with his gun for a crutch, and a self-satisfied smile on his face, thinking how well he had avenged his hurt.

Poor Stannard, it was his last shot, for he was never able to march again.—*Waverly Magazine.*

["Old Stannard," or properly, Mr. A. C. Stannard, of Milton, Wis., is an old subscriber to the SCIENTIFIC AMERICAN, and withal an inventor. He is now engaged in business, we believe, but will never recover from the injury received on that fatal day of Bull Run.—EDS.

Photographic Mosaics.

This is an annual record of photographic progress, edited by M. Carey Lea, M.D., and Edward L. Wilson, editor of the Philadelphia *Photographer*. The volume before us, for 1867, is brim-full of valuable information, hints, formulas, and essays, concerning the wonderful art, and the improvements therein realized during the year now just closed. As a sensitizer of thought, and a developer of ideas, the Photographic Mosaics are very valuable. To say the least, each book is worth its weight in nitrate of silver and chloride of gold.

Chemical.

We lately attended a brilliant chemical lecture by Professor Doremus, before the medical class and a large number of invited guests, at the Lecture Room of the Bellevue Hospital in this city—subject "Carbonic Acid." The peculiar qualities of this remarkable substance were illustrated by a variety of wonderful experiments. The acid was represented as a gas, a liquid, and a solid. To obtain the liquid the gas was subjected to a pressure of 600 lbs. to the square inch. On being liberated from this compression, it evaporates with exceeding rapidity, and its temperature is thereby so reduced that it assumes the solid form of snow.

Carbonic snow evaporates comparatively slowly. Among the experiments with the snow was the freezing of mercury, which, poured into a trough and covered with the snow and ether, soon congealed. A long bar of mercury was the result, which was vigorously hammered upon the anvil, and exhibited the usual qualities of other metals under the same treatment.

Dr. Doremus' lectures are always in the highest degree instructive and valuable.

Coloradian Experience in Stamp Mills.

In the course of an article on stamps, the Black Hawk *Mining Journal* ,Nov. 13th, says:—Mr. Belden is to-day employing four different stamp mills, counting a section of the Black Hawk Company's new mill as one. Of these four mills, the old Empire mill, which is like our first crop of stamp mills —havingnarrow and close batteries and 450 lb. stamps dropping thirty times a minute—is doing by far the best. It is a well known fact that the old Briggs mill which had 450 lb. stamps dropping thirty times a minute, never ran a day without making money, whereas the new mill with 880 lb. stamps dropping twenty-two times a minute, is idle to-day because it won't make any money. When the Smith & Parmelee Company built their mill which is a heavy stamper, they employed both their own and the Briggs mill, and Ben Smith declared that it would pay him to let his mill stand idle and give the Briggs mill $75 a cord to crush his ore. Mr. Bertola says that thirty years experience in quartz milling has taught him that Colorado has made the biggest mistake in the world in investing so largely in heavy, slow-moving stamps. He says, never make a stamp weighing more than 350 lbs. When they first began to mine in California they made their stamps weigh nearly a tun. In a few years they came down to a thousand pounds. Later they have fallen another 100 per cent., and the business of quartz mining improves in proportion. They are just adopting a quartz crusher, combining, like Gardner's, a grinding and crushing motion, which, with the aid of one man, daily crushes to the fineness of peas or rice, sufficient rock to supply 40 stamps; thus performing more than half the work of the stamps, saving half their wear and tear, consequently much of the cost of crushing the rock. The machine is called "Brodie's Quartz Crusher." It is probably not superior to Blake's, Gardner's, or Dodge's, many of which are already in Colorado, and some of them in use. It would seem that the advantage of using these machines is not generally understood. By crushing the rock to a uniform size, it enables the stamps in the batteries to always fall on an even surface, and thus operate with more uniform effect in crushing, and it saves the breaking of shoes and dies, by leaving no large pieces of hard rock for the stamps to fall on unevenly. In the account of the Victoria works, which make a profit on $2-rock, published by us lately, we find that "the quartz is supplied to the batteries by a self-feeding apparatus, requiring the attention of one man only to sixty stamps." Why cannot we profit by these full-set examples of our neighbors? Here, it is a man's work to feed a section, or twenty stamps. Again, the simplest means for amalgamating are the favorites both in Australia and California. Quicksilver is bestowed in a thousand ingenious little hiding places, over which the crushed ores must pass. Blankets are the stand-by, however, and their use seems to result in complete success. Indeed, it is hard to conceive how gold can be carried over from ten to fifty feet length of blanketing by the sluggish current of water usually run from the stamps. In Australia, where they make the poorest rock pay, the battery screens have 120 holes to the inch, and the ore from the batteries passes over twenty-four feet length of blanketing. We go to the trouble of publishing and re-publishing these things, in the hope that some of our mill-men, or all of them, will act on the suggestions, which are eminently practical. Except in the matter of heavy stamps, the improvements we speak of would cause no detention or expense. And let nobody ever again have a stamp made weighing more than 450 pounds. There n't a mill-man of any experience in the Territory, who is not already convinced that light stamps, dropping faster, will do a great deal better work than such as we now universally have. Make the batteries so that there should be absolutely no space below the face of the dies, break the ore as fine as peas with a quartz crusher, of some kind, there are enough of them, and then lay down blankets to catch the gold. With this for treatment, and an average mine, systematically opened by shafts and galleries, so as to always have paying ground in sight; with a mine pump and power to run it and hoist ore; with no sinecure offices to be filled at big salaries; with a careful manager, who is honest and energetic, and knows the value of money, all of which, in most cases, are easily attainable; and, finally, with a railroad to the base of the mountains, conferring a thousand benefits it is needless to specify, the cost of quartz mining and milling in Colorado, may be reduced from $15 to at most $10, if not $5, per ton.

[From reading the foregoing it is quite evident that improvements in quartz crushing are still much needed.—EDS.

Gas Lighting by Electricity.

One of the most persevering inventors of the present times is Mr. Samuel Gardiner, of this city, whose various improvements connected with the use of electricity for gas lighting have been duly chronicled in our pages. When the dome of the Capitol at Washington began to rise, it became a serious problem how to light the immense concave. Mr Gardiner was the only man who proved able and willing to undertake the solution of the question, and after several years of constant labor, his efforts have been crowned with complete success.

We copy the following interesting description from the report of the official committee appointed to examine the condition of the work, Messrs. Shaffner, Pike, and Knight:

The gas pipe connections consist of circles of burners at 45, 80, and 165 feet from the floor of the rotunda, and are furnished with 300, 325, and 425 burners respectively. In addition to these, a cluster of 90 burners is placed in the tholus at a hight of 264 feet from the floor, and being 60 feet above the crown of the dome is, of course, invisible from the interior, but is a beautiful object viewed from the Capitol grounds, and visible at a distance of many miles.

The flow of gas at each tier, and in the tholus, is equalized by a regulator, and governed by a stop-cock, the latter being opened and closed by electro-magnetic engines in their immediate vicinity, worked from the battery, the central brain of the apparatus from which ramifies the nervous fluid which vitalizes the motive agents and the illuminating coil of each of the 1,130 burners.

The battery occupies an elliptical room 45 by 36 feet, and consists of 200 glass jars of a depth and diameter of about 13 inches, containing two zinc plates 9 by 10 inches, weighing 6 pounds each, and an interposed carbon plate, all supported by suitable insulators in the acid bath. It is disposed on benches in concentric series in the room, and arranged in sections of 20 jars each, to be brought into service as required.

The connections consist of five miles of No. 10 copper wire, doubly wrapped with linen yarn, and, when necessary, encased in India-rubber tubing: this is securely laid in protecting pipes or through passages drilled through the walls, the return circuit from the engines and the burners being made through the gas pipes.

The burners used have an indestructible lava tip, which acts as an insulator, and each is provided with an insulated coil of platinum wire, placed on one side of the orifice, so as not to interfere with the free exit of the gas, which is lighted by exposure to the red-hot metal when the electric connection is made.

The tiers of burners are divided into sections of from 30 to 50 burners, each section having independent connection with the instrument, so that a tier being divided into ten sections, it is lighted by a corresponding number of pulsations following the flow of the gas, which is turned on by the electro-magnetic engine belonging to, and in the vicinity of the tier. The manipulation which by successive pulsations operates the engines, makes the series of illuminating connections, and registers the work, is performed in a passage-way leading north from the floor of the rotunda, and perhaps 50 feet from the battery.

The electro-magnetic engines consist of a double helix, with a sliding armature, on which is a latch which operates a ratchet wheel on the axis of the stop-cock. The operator, by a succession of electric connections, works the armature piston, and turns the plug of the stop-cock such a fraction of a revolution as is represented by a number of teeth on the ratchet wheel.

The handsomely engraved dial-plate, of silver, has keys, eleven in number, and with a corresponding number of vernices.

The primary electric connection with the battery is made by a stud in the central key, which, by rotation, is made to bring such a portion of the battery into play as may be required, a vernice indicating the extent of battery connection which takes place in successive sections of 20 jars.

The surrounding keys, ten in number, are equally divided between the duties of turning on the gas and lighting the same at the five levels for which the dial-plate and keys are adapted. But four of these are yet arranged, consisting of the tiers at the elevation of 45, 80, and 165 feet, respectively, and the tholus at 264 feet.

The fifth may be used for a proposed tier at the spring of the dome, or a circle to illuminate the picture, as you may desire.

Each gas-key has a dark and a light segment on its disc, which are exhibited at an opening in the dial-plate, in correspondence with the closed and open position of the stop-cock, which governs the flow of gas at the tier represented by the said key.

Each lighting key has a pointer, which indicates on its vernice the extent to which the electric connection has been made in the sections of the tier to which it belongs.

The apparent column of light in the tholus, erived from 90 burners, with reflectors and prisms, was designed by Mr. Gardiner, and has a beautiful effect.

The prospective cost of maintenance, so far as it consists in the waste of materials used in the 200-jar battery, may amount to 600 pounds of zinc, 80 pounds of mercury, and 50 gallons of sulphuric acid, per annum.

So far as appears to us, the apparatus requires but proper ordinary care and attention to maintain it in effective condition, and the lighting of the burners can be more effectively and economically accomplished by the use of this apparatus than by any other appliance that has come under our notice.

The workmanship of the dial and appurtenances, and the electro-magnetic engines, is substantial and elegant, and deservedly attracts great attention from expert and intelligent casual visitors, from whom the effect of the manipulation of the keys elicits murmurs of applause.

Many doubts as to the ultimate success of the enterprise have arisen in the minds of persons quite familiar with the science, when the great amount and proximity of the metal in the iron dome was considered, and on account of other difficulties incident to the scale of the apparatus and connections, but these are happily set at rest, and the appropriateness of the exhibition of American enterprise in the national Capitol has given zest to the congratulations tendered to the inventor and contractor, Mr. Gardiner.

We have to report, in conclusion, that the work has been well done; its efficiency and practical performance leave nothing to be desired; its permanency may well be admitted from the solid and honest character of the work; and the economy with which it performs its duty is beyond dispute.

Mr. Gardiner's improvements are applicable to the turning on, lighting and turning off gas for street lamps, public buildings, and private dwellings. We understand that he is now engaged in developing a project for the lighting of gas in theaters, saloons and dwellings, in this city, with an arrangement for an electric reservoir, so that when connection is made with a wire passing through the street, the burners in the connected building will be lighted or shut off at the will of the occupants, by merely pressing a key. This is an extensive enterprise.

TALBOT, RUST & Co., have lately built an ice house at Rockport, Me., costing $6,000, in which they expect to pack ten thousand tuns of ice this winter.

Recent American and Foreign Patents.

Under this heading we shall publish weekly notes of some of the more prominent home and foreign patents.

HAME FASTENING.—W. J. Alexander, Manchester, Delaware.—This device is for fastening the hames upon the collar, and consists of two portions attached to the respective hames; one slipping into the other, and fastening therein by the engagement of a spring catch, with recesses in the socket. The catch piece is detached from the socket by a peculiar motion, and the whole is metallic, and intended to prevent the fastening from being gnawed and destroyed, as is frequently the case with mule harness.

A NOVEL PATENT.—Frederick Maunder, of Barnstaple, England, has recently taken out a patent in that country for an invention to prevent the recurrence of periods of excessive speculation and panic. We hope Mr. Maunder will come this way with his invention. He would find here many places where its application would be of immense importance.

Inventions Patented in England by Americans.

[Condensed from the "Journal of the Commissioners of Patents."]

PROVISIONAL PROTECTION FOR SIX MONTHS.

2,806.—MACHINERY FOR SPINNING, DOUBLING AND TWISTING WOOL AND OTHER FIBROUS MATERIALS.—Charles B. Hoard, Watertown, N. Y. Oct. 30, 1866.

2,899.—CHUCK FOR HOLDING DRILLS AND OTHER TOOLS.—Albert Beach, Newark, N. J. Nov. 7, 1866.

2,903.—REAPING MACHINES.—William Schuckers, New York City. Nov. 7, 1866.

2,923.—POCKET KNIFE.—William Sausser, Hannibal, Mo., Nov. 9, 1866.

2,943.—MANUFACTURE OF CHAINS, AND MACHINERY EMPLOYED THEREIN.—Joseph Copley, Jr., Alleghany, Pa., Nov. 10, 1866.

3,026.—CARRIAGE WHEEL.—Ellis J. Morton, Cambridge, Mass. Nov. 19, 1866.

3,054.—VOLUTE SPRING.—John Freeland and Daniel Ward, both of New York City. Noy. 21, 1866.

3,058.—MACHINERY FOR MANUFACTURING SPIKES AND RIVETS.—John O. Reilley and Alexander Wiley, both of Baltimore, Md. Nov. 21, 1866.

3,059.—MODE OF AND MEANS FOR ATTACHING CASTERS TO THE STANDS OF SEWING MACHINES.—Myron Perry, New York City, Nov. 21, 1866.

3,070.—MACHINERY OR APPARATUS FOR OPENING AND CLEANING FIBROUS MATERIALS.—Charles G. Sargent, Graniteville, Mass. Nov. 22, 1866.

3,065.—MACHINERY FOR DRILLING ROCKS.—Charles Burleigh, Fitchburg, Mass., Nov. 22, 1866.

3,098.—LOOMS FOR MANUFACTURING PILE FABRICS, PART OF WHICH IMPROVEMENTS ARE APPLICABLE TO THE MANUFACTURE OF OTHER FABRICS.—William G. Hartley, Saxonville, Mass. Nov. 24, 1866.

3,106.—PROCESS FOR EXTRACTING OIL AND PARAFFINE FROM BITUMINOUS SUBSTANCES.—S. Lloyd Wiegand, Philadelphia, Pa. Nov. 26, 1866.

3,186.—MOWING AND REAPING MACHINES, PARTLY APPLICABLE TO CARRIAGES AND OTHER WHEELED VEHICLES.—John G. Perry, South Kingston, R. I. Dec. 4, 1866.

Improved Apparatus for Wheelwrights.

Wheelwrights and carriage makers are gradually rejecting the old system of hand work and bringing machinery into their business. In large manufactories this has been done for years, but even in country concerns, and where the amount of custom is limited, it is found to be profitable to use machinery where muscle has heretofore been employed. The machinery represented in the engravings is just what is needed to enable these small manufacturers to compete with those whose patronage and facilities are very superior; and for them, even, this device may be found advantageous.

Fig. 1 represents a machine for sawing spokes to length and tenoning them The full details of the machine could not be represented in a perspective view, but may be understood by the description. The hub being mortised, and the spokes driven in, the skeleton wheel is secured to a movable sliding table on the frame, A, by a hook bolt secured by the lever nut, B. By means of the treadle, C, and a pinion on the shaft, D, engaging with a rack under the sliding carriage, the spokes are brought in rotation under the circular saw on the arbor, E, and are sawed off to equal lengths; the upright frame, F, carrying the saw and its attendant machinery, is capable of being swung diagonally with the main frame, being secured in the desired position by the screw wrench, G. This is to allow the spokes as they are sawed to swing on their common centers without coming in contact with the face of the saw.

Fig. 1.

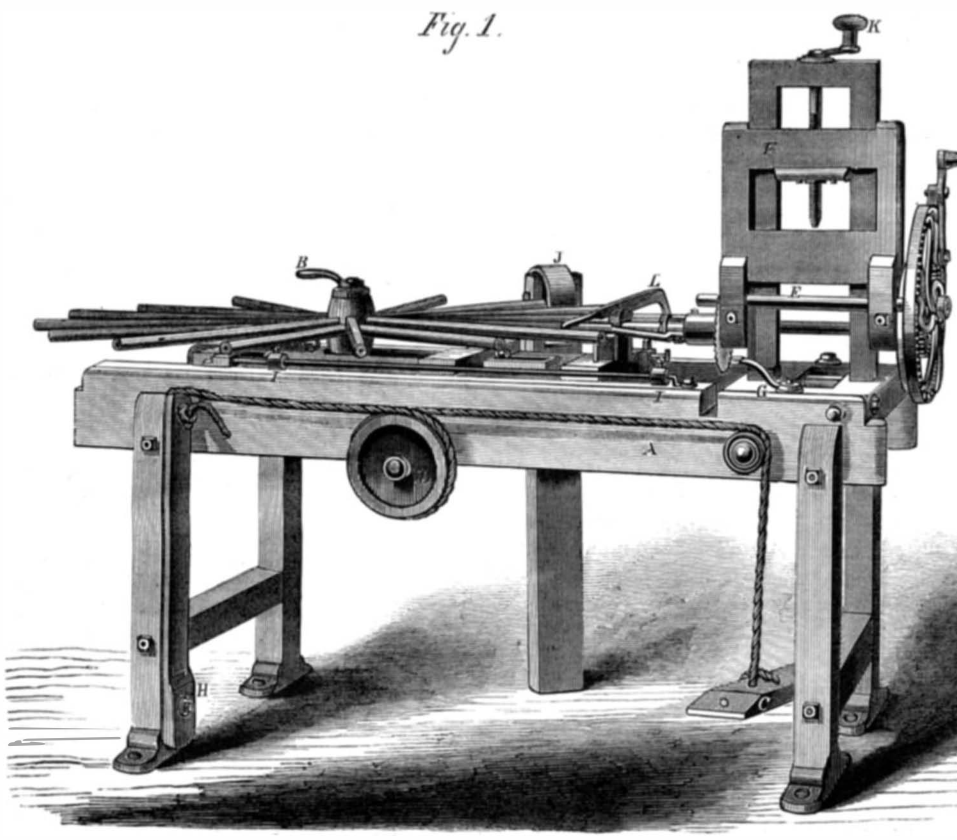


Fig. 2.

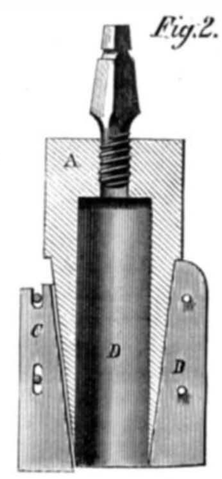
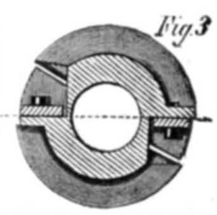


Fig. 3



LEFEBER'S SPOKE TENONING MACHINE.

The spokes being sawed to length, the hollow auger seen in Figs. 2 and 3, which is secured in the end of the saw mandrel, is lowered to position, the movable carriage being allowed to recede by the weight, H, and the checks, I, on the longitudinal rod, are secured to a point which shall allow the sliding carriage to move just far enough forward to make a tenon of the proper length on each spoke. The pulley, J, is attached to an adjustable frame, which is hinged at one end, and when not in use is swung back against the frame, A. This pulley is designed to carry a belt of sand paper or other polishing material, to be driven by a pulley on a shaft occupying the place of the arbor, E, in the engraving.

The carriage, F, can be raised or lowered by the screw, K, to accommodate the action of the saw or the hollow arbor. The frame, F, can be readily removed, and another substituted carrying two saws, which, by means of a curved and rabbeted carriage placed in front of the sliding table, will bring a felloe to the upright frame, sawing the ends to length, boring the mortises, and, by a rotary planing head, dressing the felloe to size. The lever, L, secures the spokes near their outer ends to a rest, and is held in place by a swing lever acting as a button.

Fig. 2 is an axial section of the hollow auger. A is the stock, B one of the radial wings for receiving the flange of the cutter, C. The space, D, is the hollow for the reception of the tenon after it is formed. Fig. 3 shows a cross section of the auger. The bits of this auger are made so as to secure the greatest strength with the smallest amount of material. They are adjustable by means of set screws, so that the cut may be regulated at will.

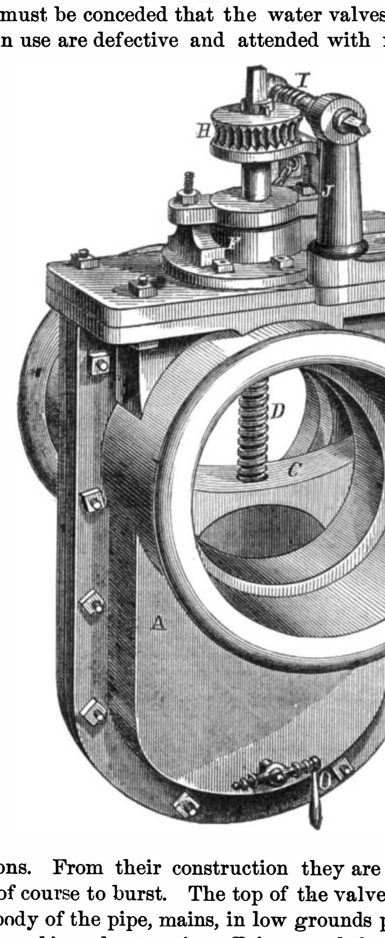
The machine may be driven either by hand, as seen in the engravings, or by power, and is easily and readily adapted to the tenoning of spokes, dressing and mortising of felloes, or to the uses of an ordinary drill and boring machine. It is the subject of two patents, obtained through the Scientific American Patent Agency, dated Sept. 4 and Oct. 2, 1866. For further facts and particulars address James Lefeber, Cambridge City, Ind.

CHEMICAL INGREDIENTS OF CELESTIAL LIGHT.

Among all the wonders of science, none is more beautiful than the detection of the atmospheres and mineral elements of celestial bodies, by the analysis of their light. If the vapor of any particular substance is present in a flame, it imparts to the prismatic spectrum of that flame certain characteristic lines of brightness in certain invariable positions. Then, if light from another source be passed through that flame, the spectrum of the transmitted ray will lose color, intercepted as it were, just where the characteristic bright lines of the other spectrum occur, and dark lines will be seen in their place. Such dark lines, taking the places of bright lines characteristic of a variety of known mineral elements, are always to be observed in the spectrum of solar light; whence it is inferred that solar light has passed through an atmosphere containing vapor of such minerals. As it has been settled that our atmosphere does not contain vapors of solid bodies, the deduction is made that these elements must be present in the atmosphere of the sun, and therefore in its mass. The same observations are made, with the same conclusions, upon the stars. Modern philosophers have determined the exact influence of the earth's atmosphere upon the solar and stellar spectra, by experimenting upon the more nearly vertical rays, which pass through the least distance of the earth's vapors, in comparison with the level rays which pass through most of those vapors. M. Jansen, a Belgian philosopher, has proved that the dark band observed in the solar spectrum, when the rays are level to the horizon, consists of a multitude of fine lines, which are always present, but diminish in number and intensity as the ray passes through a less expanse of vapor; and at any hour, the higher the dew-point, the more distinct and numerous are these same dark lines. By this means the influence of foreign atmospheres is accurately discriminated from that of our own, and the cause of the latter is shown to be the moisture or other contents of terrestrial vapor; which again suggests a means of measuring the moisture of the air in regions otherwise inaccessible, and of determining whether watery vapor exists in the atmosphere of the heavenly bodies. The terrestrial dark lines thus discriminated, are found to be ten times more numerous in the red and yellow of the spectrum, and their intermediate tints, than those produced by the mineral vapors of the sun's atmosphere; while in the remainder of the spectrum, the latter class of negative lines greatly predominate. This coincides with the common fact, that red, orange and yellow colors are displayed when the terrestrial vapors are most deeply shown in the horizontal rays of the sun; thereby abstracting much of those colors from the spectrum, and leaving dark lines in their place.

KEARNEY'S WATER VALVE FOR WATER SUPPLY PIPES, GAS COMPANIES, STEAM ENGINES, ETC.

It must be conceded that the water valves or gates at present in use are defective and attended with many serious objections. From their construction they are liable to freeze, and of course to burst. The top of the valve projecting above the body of the pipe, mains, in low grounds particularly, must be dipped in order to gain sufficient earth for protection of the screw and pavement. The seats of the valve being exposed, foreign substances drift into them and prevent the effectual closing of the valve. The opening or shutting a heavy valve is attended with great labor, and when done by inexperienced employees, the pipes often burst from the too sudden and rapid pressure of the water.



The inventor and patentee of the valve illustrated herewith is a *working* engineer in one of the principal steam water-supply works in this country, and from practical experience thinks he has accomplished the work of producing a very perfect valve. The following letters will fully explain its construction: A, casing of valve; B, flanges of supply pipe; C, valve; D, screw; F, stuffing box; J, pillars supporting worm; H, gear; I, worm; O, cock. The advantages claimed are as follows. From its construction all liability to freezing is avoided. No possibility of foreign substances of any nature preventing the valve closing, and the straight line of the pipe is not discontinued. When the valve is in a state of rest there is no wearing of the screw and nut, to which suspended valves, from the lateral motion of valves by the current, are subject.

The cock, O, is intended to draw off or blow out any fine foreign substances which may collect at the bottom of the valve casing, when the valve has been closed any length of time. The upper corners of the valve being square, the valve is guided fairly over the face of the seats, thus preventing fouling and shearing, as in the ordinary form of valve. In first starting or lowering the valve in order to open it, the screw, D, is turned by applying power to worm, I, the latter being thrown in gear by worm wheel, and by this means the valve may be started with facility whatever the pressure of the water in the supply pipe may be, and after the valve is partially lowered and opened, the power may be applied directly to the screw, D, which will, of course, move it with greater speed, the worm, I, being previously thrown out from worm wheel; thus the labor of opening and shutting the valve under great pressure is materially reduced by the combined power, and the danger of bursting the pipes by the too sudden pressure of the water is avoided. Small valves under light pressure do not require the combination, and any other compound gearing can be used. This valve is also well adapted for gas companies, as the screw is nearly on a level with the pipe. We are pleased to learn that the water valve is already in use.

This valve was patented through the Scientific American Patent Agency, Sept. 11, 1866. For further information address the patentee, Wm. Kearney, Belleville, N. J., or Robt. B. Carter, of Griffith & Co., sole agent, No. 24 Cliff street, New York City, where a perfect valve can be seen.

The Meteoric Shower in Turkey.

A correspondent of the *N. Y. Tribune*, writing from Constantinople, alludes to a most beautiful display of meteors observed there on the morning of November 13th and 14th. On the first morning he noticed about 4,000 per hour, the actual number that fell being, of course, much larger. On the 14th, the sky was obscured with clouds, until nearly sunrise; but the display of meteors, between two and three o'clock, was undoubtedly some 10,000 an hour. On both occasions they were of all sizes and colors. Many of them lit up the heavens like a flash of lightning; and in several instances they left trails of light behind them from 5° to 20° in length, which remained some five minutes. Not a few persons were alarmed at this rare and startling phenomenon, believing that the stars were falling from heaven. A great fire occurred in the midst of the display, on one night, and the writer surmises that it might have been originated by a falling meteor.

The grand shower, in this country, of 1833, it may be remembered, was preceded by a display in Europe, of great beauty, the year before; a chance, therefore, seems to exist, that we may yet have an opportunity of witnessing this sublime species of celestial pyrotechnics during the fall of 1867.

A Neat Skate.

Specimens of the McCormick's patent skates have been shown to us which are intended for the Paris Exposition. They are of great beauty, being highly finished, plated, and ornamented with engraving. But the most notable feature in these skates is their lightness and perfect workmanship. The top which attaches to the sole is of sheet steel, recessed at the heel, by "striking up," in the most perfect manner. The corners are turned sharp, and the metal is as smooth and even as though cast in a mold. The patentee informs us he is unable to fill the orders as rapidly as they come in. The skates appear to be perfection both in material and workmanship. The agents are Clark, Wilson & Co., Beekman street, New York City.

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VOL. XVI., No. 2....[NEW SERIES.] ....*Twenty-first Year.*

NEW YORK, SATURDAY, JANUARY 12, 1867.

Contents :

(Illustrated articles are marked with an asterisk.)

ADVERTISERS.

The value of the SCIENTIFIC AMERICAN as an advertising medium cannot be over-estimated. Its circulation is ten times greater than that of any similar journal now published. It goes into all the States and territories, and is read in all the principal libraries and reading rooms of the world. We invite the attention of those who wish to make their business known to the liberal terms offered in our advertising columns. A business man wants something more than to see his advertisement in a printed newspaper. He wants circulation. If it is worth 25 cts. per line to advertise in a paper of three thousand circulation, it is worth $2.50 per line to advertise in one of thirty thousand. The value of an advertisement depends chiefly upon the circulation that is given to it.

REFORMS IN THE PATENT OFFICE.

In our last number we called the attention of Congress to the condition of the Patent Office, and urged upon that body the importance of appointing a committee to enquire what further legislation is necessary, to provide for the present wants and future expansion of that department. We hope some member of Congress will take hold of this urgent matter, and move a committee.

Pending such inquiry, we wish to offer a few additional suggestions. An immediate relief can be given to the Office by the prompt removal of the Agricultural Bureau. A temporary building might be constructed for its use and convenience in the inchoate Geographical and Agricultural Park on Rock Creek. What more graceful or appropriate suggestion could be made? The usefulness of the Bureau could be much strengthened by such change. Commissioner Newton and his able staff could spend much time in that rural spot in experimenting upon vegetables and plants. He would be able to see how the seeds of the common egg-plant are made to produce the prince's feather—a change which we were astonished to witness in our garden the last season, the product of a few seeds kindly supplied to us from the Patent Office.

Another thing, still more important; the Patent Office, instead of being a mere dependency of the Interior Department, ought to be an independent bureau. The Commissioner should have full control of its details and its appointments. The Patent Office is no place for mere office hunters, but it always will be subject to this baleful influence so long as the Commissioner is held subordinate to the Secretary of the Interior, who cannot resist the clamor of his supporters for situations at his disposal. Whenever vacancies occur in the Patent Office, the Secretary—with the best intentions—is liable to repeat the error of appointing men to positions, who might be more profitably employed in pulling stumps and hoeing corn. An Examiner in the Patent Office should bring to its duties a mind well instructed in physics and mechanics. Unless he possesses these qualifications as a basis, he can never render such service as the law contemplates. The salaries now paid are beggarly. There are old and faithful Examiners in the Patent Office who are barely able to support themselves and their families on the pay they now get. This is a disgrace to the Government, and ought no longer to be tolerated. Valuable talent cannot be permanently secured unless the salaries are raised. We don't wonder that so many changes occur in the Office: the wonder is that there are no more.

The Government is building a new office for the Secretary of State, and a new War office is also to be built. This is all right: the old buildings were unfit. Now let us have a new building for the Department of the Interior, and another step will have been taken in the right direction.

FERTILITY OF AMERICAN GENIUS.

Archæologists recognize in the pre-historic times, the three periods known as the stone, the bronze, and the iron ages. During the reign of barbarism, the weapons, utensils and ornaments of the nations, were few and carved in the roughest manner from wood or stone by every individual, as occasion demanded. Working in metal was the first great step in civilization, and naturally with limited resources the easily fused alloys would be employed prior to the introduction of iron working.

The wants of the patriarchs were few, and of the simplest character. Ingenuity received no impetus for putting itself in action, comforts were of the most primitive character and luxuries there were none. Descending to comparative modern times, history shows that even the use of chimneys for fire places, was unknown in England till the time of Richard II. and as late as the Elizabethan age, such a simple contrivance was regarded as a luxury only to be enjoyed by the wealthy.

The list of patent claims granted during the past six months, and published in the volume of the SCIENTIFIC AMERICAN just completed, may be considered as an index of this age of progress, and on examination it may reveal some facts of interest. A comparison with similar records of previous years, shows that certain contrivances are either in great demand or open a wide range for the ingenuity of inventors. As instances of this class it appears that cultivators, plows, churns, and washing machines have been made the subjects of sixty-three, fifty-two, fifty, and forty-eight patents respectively. Agricultural and farming implements furnish a fruitful field for the ingenious, for we note patents issued for thirty-three varieties of harvesters, twenty-four hay forks, twenty horse rakes, twenty-five corn planters, twelve potato diggers, nine reapers; fences of forty-seven patterns, and forty-three gates, twenty-two beshives and an equal number of brick machines, bridles, and coloring matter for butter; the pumps number thirty-two, and evaporators fifteen.

In the household line we have seven different castors, twenty-eight broom heads, and eleven bottle stoppers, eighteen bed bottoms, and fifteen patent springs, baking pans, baskets, buttons, and apple parers; eight wringers, seven sprinklers and clothes dryers; pea sheller and fruit cans, stoves and sadirons; fourteen lamps, and twenty lanterns. Such a primitive contrivance as an umbrella seems hardly worthy of improvement, yet five successful inventors undoubtedly deem themselves fortunate in having obtained as many patents.

Property is defended and the curious are excluded by means of twenty-five locks and padlocks, while nine new burglar-alarms are warranted to detect and expose the intruder.

Contributions to the musical world are briefly enumerated: an improved cornet, banjo, piano, and harmonium, besides a musical attachment for bird cages.

For traveling, carriages and carriage fixtures have received twenty-five patents. For railroads we notice car brakes to the number of sixteen, twice that number of new car couplings, and the danger incident to such traveling is dispensed with by safety switches, car trucks and bridges. Should accident befall the traveler in spite of these precautions, the injured man may make use of one of the many artificial arms, legs, hands, eyes or teeth. "Patent medicines" of twenty varieties, are sure to find a ready sale.

Labor-saving machines have been opposed on the ground that by their introduction former workmen must be thrown out of employment. The fallacy of this reasoning is shown by the friends of progress, in a reference to the kindred branches of industry created thereby, and no better illustration of this truth can be found than is shown in the case of the sewing machine. In the past six months, nineteen machines proper have been patented, in addition to twenty-eight new attachments, connected with and dependent for success upon the use of the machine, and demanding in their manufacture, the services of a large body of additional hands.

Many items of interest might be further enumerated, but the result would be such a heterogeneous collection as to rival the far-famed inventory of goods displayed as a sign at a country store, which, informing the public in a poetic strain of the commodities to be disposed of, closed with "Gimlets Godly books and Groceries for sale here."

CASE HARDENING OF IRON.

This simple process, so useful to the mechanic, is not always understood even by workmen of considerable experience.

The effect of case hardening is to convert the surface of iron to steel. It is, in fact, a process of cementation, differing mainly from the manufacture of true steel in the different lengths of time employed. True case hardening is effected by packing the article to be hardened in a box with ground or broken bones, particles of horns, raw hide, and even tanned leather. The box should be of cast iron, of any convenient form, large enough to receive the article to be case-hardened and to admit of surrounding it with the material used. It ought really to be covered and luted air-tight, although tolerably good results may be obtained if it is left open. The box with its contents is placed in a furnace, the fire of which should surround it. The fuel may be anthracite or coke, but preferably charcoal. The longer the heat is kept up, the deeper will be the action of the cementing materials. Ede says that in half an hour after the box and its contents are thoroughly heated, the coating of steel or case-hardening will be scarcely the thickness of a sixpence; in an hour double that, etc.

But this process is lengthy and not always convenient. Frequently all the mechanic requires is a thin coating of indurated metal on the outside of the article, which will not be subject to ordinary abrasion or the action of a file. For this purpose prussiate of potash is largely employed and has become an article of commercial importance. It is a ferrocyanide of potassium, and is made from animal matters containing nitrogen, as blood, hoofs, hides, woolen rags, hair, leather, and animal offal, charred in retorts and then fused with potash. The mass is then drawn, cooled, filtered, and dried for crystallization. The result is a crystallized yellow mass. This is pulverized for use.

In case hardening with prussiate of potash, the article of wrought or cast iron is heated in a furnace or forge to a light red, the powdered prussiate then sifted on, when it fluxes, and the article may be immediately removed and plunged into cold water. Reheating it is of no benefit, but really a detriment. One application of the prussiate is sufficient.

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SCIENTIFIC (PAID) COMMISSIONS—Professor Louis Agassiz, Cambridge, Massachusetts; James H. Bower, Chicago, Illinois: Henry d'Aligny, Superior City, Wisconsin; William Slade, Cleveland, Ohio; Henry Fuiling, Portland, Oregon; John P. Kennedy, Baltimore, Maryland; Samuel B. Ruggles, New York; J. Lawrence Smith, Nashville, Tennessee; J. P. Lesley, Philadelphia, Pennsylvania; W. A. P. Barnard, New York.

HONORARY COMMISSIONS—A. T. Stewart, J. H. Alexander, J. R. Freeze, R. G. Peterson, Charles B. Norton, John W. Ginnis, Iowa, W. J. Valentine, J. Hervey Jones, William A. Adams, Frank Leslie, Dr. Thomas W. Evans, J. G. Usher, J. P. Reynolds, S. H. Wales, John G. Butler, John C. Wilstead, P. T. Barnum, A. Shaffer.

At the French Exhibition of 1855, the number of United States Commissioners in attendance nearly equaled the number of contributions from the States. One of the Commissioners spent most of his time in dealing out samples of Delpit's black snuff, of which he was an excellent judge, another superintended the sweeping and dusting out, the others dined out around and performed the duties of bowing and scraping to French dignitaries. In these respects they were found fully up to the standard of other nations. At the approaching Exhibition in the spring of 1867, the display of American Commissioners promises well. Barnum will probably establish an "American Museum," deliver lectures on temperance (the water in Paris is horrid,) and show off the go-ahead characteristics of the "universal Yankee nation." Stewart has money enough to open a first class hotel, or a mammoth dry goods store. Agassiz can lecture on fish and South America. Frank Leslie can publish the *Illustrated News*. Ruggles can devote himself to the metric system, Kennedy can furnish reminiscences of the American navy in other days, while Dr. Evans can operate on the teeth. Taken, as a whole, the American Commission is made up of all the elements necessary to exhibit almost any phase of our national character. England, Austria, Russia and Prussia, propose to send two or three Commissioners only, but what they fall behind us in the volume of personal display, will be made up in the greater number of articles on exhibition.

CANADIAN PATENT LAWS.

We have requests from four different parties, residents of Canada, asking us to urge their authorities to change the Canadian patent system. The shoe pinches just here, that these parties have applied for patents in the United States and have been compelled to pay in advance a patent fee of $500, simply for the reason that the patent laws of Canada discriminate against the citizens of the United States to such an extent as to wholly prevent them from obtaining patents in those provinces. They very naturally dislike to pay this fee, and especially with no prospect of getting a cent in return if their claims are refused. Now we freely confess that this is a very awkward thing, but the remedy is simple. Whenever the Legislature of Canada enacts a law that will permit our citizens to take out patents there upon the same footing as resident subjects, that moment Canadian inventors can come here and get out patents on the same terms as citizens. The remedy is in their own hands and at their own option. We therefore urge our correspondents to turn their attention to the proper authorities and demand a remedy. The present Canadian patent system is a legalized bid for thieving upon the genius of our people. There is neither justice nor comity in it, and we shall be glad to chronicle the introduction of a patent code more in accordance with the spirit of the times. The same remarks apply equally to Nova Scotia. The system there is exclusive to residents, and belongs to the age of Queen Bess.

TUNNELING on railroads is being pushed to an extreme. Even where a *detour* would avoid a bore, engineers seem to have a peculiar gratification in piercing the earth. Apart from the pride of a great work completed, is it not possible that the fascination of delving after the mysterious and unknown may be a clue to the present rage for tunneling? We tunnel under lakes for water, through mountains for roads intended to save time and distance, and even propose to unite countries, severed by seas, with tunnels. This age may be called the age of the earth-borers.

COLORING AND DYEING IVORY.

In reply to the inquiry of E. P. W., in our issue of Dec. 8th, we have received four communications which we condense. Mr. Joseph Hirsch recommends a process similar to that he furnished us, which was published in our number of Dec. 8th, relative to the dyeing of horn; which he informs us was the invention of Gustav Mann, of Stuttgard. If the method employed in dyeing horn is applied to ivory, it is necessary to thrust the ivory directly from the hot bath into cold water, to prevent the production of fissures. He gives the following recipes for dyeing ivory:—

BLACK.—The ivory is boiled about ten minutes in a solution of logwood and then placed in a solution of green vitriol; to be repeated until the desired depth of shade is secured. Another plan is to immerse the ivory in a solution of nitrate of silver exposed to light. This to be repeated, if the first attempt is not satisfactory.

BLUE.—The ivory to be placed in a diluted solution of sulphate of indigo for a few moments, and dried with blotting paper.

YELLOW.—Immerse the ivory in a diluted solution of nitromuriate of tin for a few minutes, and then for an hour or less place it in a filtered hot solution of fustic; or immerse the ivory a quarter of an hour in a solution of sugar of lead, then in a solution of chromate of potash for half an hour; or the ivory may be steeped first for twenty-four hours in the chromate of potash and then boiled in a solution of acetate of lead. Another method for yellow is to boil the ivory a short time in diluted nitric acid.

ORANGE.—As in yellow, first recipe, except to the fustic add Brazil wood to deepen the color.

RED.—Boil the ivory a few minutes in a mixture of cochineal and vinegar; or immerse it in a diluted solution of nitromuriate of tin, then boil it for half an hour in a decoction of Brazil wood or cochineal.

SCARLET.—Same as the last, except the addition of fustic.

CHERRY RED.—Same as the last, with the addition of immersing the ivory, after being dyed, in a diluted solution of potash

VIOLET.—Dye red and afterward blue; or place the ivory in a highly-diluted solution of tin and boil in the logwood bath

PURPLE.—As in the last, and place it in water containing a little nitric acid.

GREEN.—Dye yellow and then blue; or immerse for half an hour in a solution of chromate of potash (concentrated), and expose to the sunlight.

Aniline dyes yield a very satisfactory result, being bright and clear.

Another correspondent quotes the following from Dr. Winkler, in Bottger's *Polytechnic Notices*:—

YELLOW.—Dissolve one-fourth of an ounce of picric acid in half an ounce of boiling water. Dilute one eighth of an ounce of strong sulphuric acid with one fourth of an ounce of hot water by pouring the acid gradually into the water. Insert the ivory in the acidulated water, turn it around repeatedly in order to admit the acid to all parts, remove the ivory from the fluid and dry it. Then insert the dried ivory in the boiling solution of the picric acid, turn it also around and leave it in the solution until all parts appear of a uniform yellow color. Then remove it from the solution of picric acid, dry and polish the ivory with soap water and finely levigated chalk. After the polishing the ivory possesses a permanent dark-lemon yellow color.

BLUE.—Insert the ivory for fifteen to twenty minutes in diluted muriatic acid (half an ounce of acid for one pound of water, having the taste of a good vinegar), and from this acidulated water transfer the ivory into a more or less concentrated solution of indigo-carmine (soluble indigo) and keep it in that solution until the ivory has assumed a uniform blue color; then dry and polish.

GREEN.—Insert the blue-dyed ivory in a solution of picric acid as prescribed for the yellow color.

Mr. Henry Connett, of Madison, Ind., sends the following, which he has heard pronounced good, although never having personally tried them:—

Ivory may be dyed or stained black by a solution of brass and a decoction of logwood; green, by a solution of verdigris; red, by being boiled with Brazil wood and lime water.

TO SOFTEN IVORY.—Soak for three or four days in a mixture of three ounces of spirit of nitre and 15 ounces of spring water, when it will be soft enough to obey the fingers. To color it in this state, dissolve the proper pigment in spirit of wine, then plunge in your ivory and leave until sufficiently tinged, then give it the proper form. To harden it, wrap in a sheet of white paper and cover with dry, decrepitated common salt, and leave for twenty-four hours. To whiten ivory that has turned brown, slack some lime in water, decant, and boil your ivory in this till white.

A correspondent from Northboro', Mass.:

BLACK.—Let the ivory be laid for five or six hours in a diluted solution of neutral nitrate of pure silver, with access of light, and it will assume a black cast. Ivory may be dyed blue by being laid or immersed in a diluted solution of sulphate of indigo, partly saturated with potash. Green is given by dipping blued ivory for a few moments in a solution of nitromuriate of tin, and then in a hot decoction of fustic.

RED DYE may be given by treating the ivory first with the tin mordant and then plunging it in a bath of Brazil wood.

TO MAKE IT FLEXIBLE.—This may be done by immersing in a pure solution of phosphoric acid of sp. gr. 1·13 and leaving it there till soft. It hardens on exposure to the air, but will resume its pliancy when put in hot water.

We may add that ivory is commonly silvered by immersing it for a few minutes in a solution of nitrate of silver and then placing it in clean water exposed to the sun's rays; or, better, after immersion in the nitrate expose it to the fumes of phosphorated hydrogen.

THE PARIS INTERNATIONAL EXHIBITION.

The extension of space granted to agricultural processes and machinery in the experimental grounds on the Isle de Billancourt, will have the effect of adding considerably to the display of American improvements which had been excluded from the limited space in the Champ de Mars. These must, however, pay their own expenses—the small appropriation by Congress having been already exhausted—and their applications must be made in due form to the Commissioner General at the Palace of Industry, by the 15th of January. Two vessels have been employed by the United States Agent, Mr. J. C. Derby, to convey the goods of American exhibitors already accepted, free of charge, from this port to the Exhibition and back. The second of these, the *Mercury*, is now loading at Pier No. 6, North River.

The whole exhibition is arranged in the ten following classes or groups:—

1. Works of art.
2. Materials and their applications in the liberal arts.
3. Furniture and other objects used in dwellings.
4. Garments, tissues for clothing and other articles of wearing apparel.
5. Products, wrought and unwrought, of extractive industries.
6. Instruments and processes of common arts.
7. Food, fresh or preserved, in various stages of preparation.
8. Animals and specimens of agricultural establishment.
9. Live products and specimens of horticultural establishments.
10. Objects exhibited with a special view to the amelioration of the moral and physical condition of the population.

These are subdivided into ninety-five classes, most of which it would be of no interest here to particularize. Some of the more important or novel features intended, may strike the eye as we glance over the departments in their order, and serve to illustrate whatever is characteristic in the grand design of the French Government. It is gratifying to learn from the assurances of the Agent, that our own country is to be fairly represented in all classes; the space, 42,000 feet within the palace, having been entirely taken up, after rejecting many superfluous or inferior articles.

Group number one will afford such a view of American achievement in the fine arts, as has never before been presented, even in this country. Thanks to the exertions of a self-organized committee of influential connoisseurs, a large collection of the very best works of American art, from private and public galleries as well as studios, will grace this truly great department of the exhibition. The peculiar expenses of shipping and insuring these costly and delicate treasures will be paid by private liberality.

Group number two, nearly allied to the fine arts, includes, under class 10, instruments of music, in which it is needless to say that our country will in certain respects make an imposing demonstration. In photography (class 9) our artists will hardly be behind, and will certainly not be backward. In the medical art (class 11), if humanity in its noblest development is to be the standard, our Sanitary department, organized by Dr. Thomas W. Evans of Paris, with special reference to the operations of the American Sanitary and Christian Commissions during the late war, will exhibit America in the van of real progress. We are glad to learn that a special section of the Exposition has been devoted to this object, outside of the space allotted to the United States. Among the articles shown will be large, elegant and costly models of Dr. Harris's hospital car, and Perot's and Autenreith's medicine wagons, four of the best ambulances from actual service, an ambulance kitchen, a hospital tent completely furnished with Sanitary Commission stores, and the identical Christian Commission coffee wagon which was in use in the field at the time of Lee's surrender. Dr. Evans will have deserved the gratitude of the represented world for this noble movement, on which he is said to have expended $25,000 or $30,000 out of his own pocket.

In the third and fourth groups, we hear of nothing remarkable from America, except the suggestion that our grand deputation of fifty red aborigines, with their native attire, weapons, paint, wigwams, domestic arts and utensils, and mode of life, will be a unique though primitive illustration of the subjects of "furniture" and "garments." This remarkable feature of the Exposition has been provided by the agency of the Commissioner for Minnesota, Dakota and Idaho, at the suggestion of the Imperial Commissioners themselves. The fifty Indians will embark with their "traps" about the 10th of March. They will probably fall under class 92, group 10, "Specimens of costume."

In the fifth group, class 40, products of mines; class 41, products of the forest; class 42, products of hunting and fishing and collections of natural growth; and class 43, agricultural products not food—no country can on the whole present so varied and important an exhibition as our own. The mammoth trees as well as the mines of the Pacific coast will be represented.

The sixth group has been overwhelmed with American contributions, with which, as a whole, no other country can vie. The whole infinite variety of our useful inventions it was im possible, of course, to accommodate. A selection of the better class had to be made, and we must hope it was judiciously and yet liberally done. A very large amount, unavoidably left out of the palace, will find accommodation as above stated on the island.

The seventh group will include some of the most original, interesting and "refreshing" items of the exhibition. Every country and grade of civilization will be represented, as far as possible, in its materials and styles of preparing and taking food. A genuine Japanese coffee house, with Japanese girls as attendants, is on its way; and specimens of the eating and drinking of New England, New York, and the West, with every other race and nation—not merely to be looked at—will invite the hungry and thirsty and curious millions (for so they are reckoned) of strangers from all lands.

We pass to the tenth, and to our mind the grandest, group of the exhibition. In this department the world will not deny that we have much to show for the benefit and instruction of mankind. In devices and arrangements for the improvement of the condition of the laboring classes, and for the better organization of labor, it must be confessed that England and France are ahead of us. The obvious reason of this is, that our operatives are so well off in their independence, that it is difficult to induce them to combine, except for higher wages. For the same reason there is comparatively little pressure upon the other classes to organize beneficent movements for them, or to offer them an interest in the produce of their labor, as has been done so nobly and successfully by a few English and French employers. Hosea Biglow's

> ——true American idee,
> To make a man a man, and let him be,

is the principle upon which our social economy has proceeded so far. The first part of it—to make a man a man—which is certainly better than everything else that can be done for a man, we have carried further than any other people in history, and the exhibition will give our fellow-nations some hints, at least, of our process. Our public schools are to be represented (chiefly through Massachusetts liberality), in models of our best school houses, and representations of our most approved apparatus and modes of instruction, school books, results of education, and educational laws. Incidentally, not as a matter of display, the free, simple, Bible religion, which nourishes the root of all our national happiness and grandeur, will be illustrated by an evangelical chapel, in which the great Parisian gala day, which we revere as the Christian Sabbath, will be sacredly observed, in strange contrast, to Frenchmen, with the restless gayety which seems happiness to them. The daily union prayer meeting is also to be maintained there, for the devout of all races and sects who hold one common spiritual Head.

Every sort of religion and manners have free and equal welcome, and as an offset to the above, Spain will exhibit a national characteristic—six bull fights—for which a Spanish company are making preparations on a gorgeous scale. Comment is unnecessary; yet the condition of Spain will afford it, in the almost entire absence of contributions to the welfare and honor of humanity from a nation once the foremost in civilization and grandeur.

The prizes amount to 800,000 francs, in sums of money or medals of gold and silver. Each nation is represented on the grand international jury of six hundred, according to the space allotted to it in the exhibition. This jury is divided into sixty-eight sub-juries on classes, which are to work simultaneously, from the opening of the exhibition on April 1, and finish their awards before the 14th of May, except with regard to certain specified classes. The largest prizes are ten of 100,000 francs each, and one grand prize of the same amount, to persons, establishments or localities where by special institutions harmony and well-being, material, moral and intellectual, have been promoted among those who carry on the same labors. A special jury will determine these awards. In art, there are 139 prizes, from 400 to 2,000 francs each. In agricultural and industrial products, 250,000 francs will be distributed in gold, silver and bronze medals; the gold worth 1,000 francs each, and the others of the same character except the material only. Many other topics of interest present themselves; but we reserve them for maturer attention as they shall come up in the actual progress of the exhibition.

THE OCEAN YACHT RACE.

On the 11th of December, at 1 P. M., three pleasure yachts started from Sandy Hook for the Isle of Wight, in a friendly trial of speed and good seamanship. The *Henrietta* arrived at Cowes, Isle of Wight, at 5 minutes to 6 on the evening of the 25th; the *Fleetwing*, 8 hours and 15 minutes, and the *Vesta*, 9 hours and forty-five minutes, after. Considering the tonnage of the vessels, the season of the year selected, and the prevalence of gales during the passage, the time made was remarkable. The owner of each vessel staked $30,000 on the result.

The *Henrietta* is a fore-and-aft schooner of 205 tuns, 108 feet long, 23 feet beam, and 10 feet depth of hold. She is a keel boat, and was built in 1862, by Henry Steers, of Greenpoint, L. I., from a model by Wm. Tooker, of New York. She carried a crew of 27 men. Her owner, Mr. J. G. Bennett, Jr., son of the editor of the New York *Herald*, sailed in her.

The *Fleetwing* has a capacity of 212 tons, is 106 feet long, 24 feet beam, and has 10 feet depth of hold. She is also a keel boat. Her builder is Joseph Van Deusen, and she is not quite one year old. Her owner is Mr. George A. Osgood. Her crew consisted of 21 men.

The *Vesta* is a center-board boat, built last spring, by Mr. Carll. She is 108 feet long on deck, and carried a crew of 24 men. She is owned by P. Lorillard, of this city.

The interest of this race does not end with its termination and the transfer of the money staked on the result. There is something behind all this to make it noteworthy. The daring and skill displayed in crossing the stormiest ocean on the globe, at the most inclement season; the confidence in the skill of man to thwart the fury of the elements; and, above all, the triumph of mechanical genius and good workmanship, guided by scientific knowledge, evidenced in the build of these tiny craft, are facts in which every man and mechanic must feel a pride. Again, as one of the results, the cordial and generous manner in which these facts were recognized and the crews welcomed, by our brethren of the "sea-girt isle," are additional elements in our satisfaction. Only one occurrence casts a shadow on our gratification—the sad accident of the loss of four men from the *Fleetwing.*

PRACTICAL EDUCATION FOR MECHANICS.

Some months ago we advocated briefly the advantages of theoretical knowledge for mechanics, quoting one notable instance in support of our position. We wish now to allude as briefly to another department of the mechanic's education—the practical. This, it may be said, is obtained during the apprenticeship and in the practice of his business. True; but some of it might be obtained before he enters upon his apprenticeship, and more during the period of his noviciate than s commonly the case. There are few schoolboys who do not evince the bent of their tastes before reaching the first stages of manhood, and it is saddening to notice sometimes how the years of schooling have been little better than wasted by attention to branches of study which were not only distasteful to the pupil, but could be of little or no value to him in his after progress. To be sure, there are elementary studies which are necessary for all. Whatever may be the youth's after station, he should be drilled in the rudiments of general knowledge. But it is possible to partially prepare the future mechanic for his business by instruction more or less practical, and to familiarize him with the results as well as the principles of mechanical art. The structure, strength, useful properties and management of materials; the differences between the metals; the varying qualities of wood; the uses of the simpler tools and machines; the principles of mechanical movements and natural forces; the application of the rules of arithmetic to measurements and mechanical calculations, and illustrations of all these by reference to familiar objects, can be taught the boy with but little effort.

Thus practically informed, he will enter the workshop prepared to appreciate its object and fitted to unravel its mysteries. We shall have fewer of human machines and more of intelligent mechanics, who can do a good job and also understand the philosophy of the means and materials employed and used.

In the shop the apprentice should be shown the object of a manipulation, as well as taught how to perform it. He should be directed to see and understand the connection of a drawing with the pattern, and of that with the parts and whole of the completed structure. If a good job is given him to perform, a little explanation as to its object and uses would often assist him in its completion, and give him an interest in his work impossible otherwise to be awakened. His judgment and discretion would thus be developed and he be improved, to his employer's benefit and his own advancement.

We cannot subscribe to the opinion of the engine driver in Dickens's "Mugby Junction" that fitters make the worst drivers because they understand too much of the internal structure and workings of the locomotive. In mechanics, ignorance is neither bliss nor benefit. Knowledge here is power. An educated judgment is better than the skillful hands of the mere human machine. The operator of any machine should have a thorough knowledge of all its parts, even though he may not be able to repair or replace them when injured or lost; and this statement applies to the driver of a locomotive as well as to the manager of any other machine, the "Mugby Junction" engineer to the contrary notwithstanding. Even where operatives are employed to attend to machines almost self-acting and requiring only to be fed with material, as in manufactories, a general knowledge of their structure as well as operation is desirable; for it would sometimes prevent accident to the machine or imperfection in its results. Such knowledge is not all that is required to make a good practical mechanic, but is not to be despised because it is somewhat superficial.

The willing learner, working in any business, or following any vocation, can always find subjects enough to employ all his capabilities. If, after a process which was expected to yield a certain result, he finds his expectations unrealized, as not unfrequently occurs, instead of leaving the matter uninvestigated and unsettled, there should be considered an opportunity presented for gaining additions to his stock of useful, practical knowledge. Many valuable discoveries have been made when the manipulator of experiments was in search of something entirely different; and he must be a dullard, in deed, who could honestly proceed with an investigation into the secrets of nature without deriving benefit from the work.

RAILROAD ITEMS.

A road locomotive is now in constant use in the neighborhood of Zurich, and is remarkable for the ease with which it ascends considerable inclines, drawing after it carriages containing as many as forty passengers. It is said to be easily guided, its speed regulated with great facility, and may be quickly stopped.

The introduction of horse railroads into London, has met with but little success. In Hamburg they are considered a great public benefit, and a line four miles long between that city and Wandsbeck, a market town in Holland, has carried during the three months since it was opened to the public, no less than 330,000 passengers, giving an average of 3,700 francs per day.

A project is now in contemplation for laying city railroad tracks through the principal streets of Dublin. The scheme has received official sanction and approval.

The railway bridge across the Mississippi River at Quincy, Ill., will be a first class iron structure about 4,000 feet in length, on stone piers and on foundations of the most substantial character. It is to be built by a union of the interests of the Toledo, Wabash and Western, the Hannibal and St. Joseph, the Chicago, Burlington and Quincy, and the Michigan Central, Railway Companies.

The rights of the traveling public, according to judicial decisions, are governed by the following rules, which have been adopted by the courts. All railroad tickets are good until used: the condition "good for this day only" being of no value. No person has a right to monopolize more seats than he has paid for, and any article left in the seat while the owner is temporarily absent, entitles him to his seat on his return. Passengers are bound to observe decorum in the cars, and are obliged to comply with all reasonable demands to show their tickets. Conductors are not obliged to make change, if applicants for tickets do not offer the exact amount of their fare. A loss of a ticket necessitates the purchase of another, or ejection from the car, and the latter penalty is lawful for standing on the platform, or otherwise violating the rules of the company.

The Directors of the Company organized about a year ago for the construction of a railroad from Oswego, N. Y., to Jersey City, have been actively engaged in pushing forward the project, and claim that the prospect for the ultimate construction of the road is now flattering. The main reliance of the friends of the new line, is in securing town subscriptions or the pledge of town bonds.

The Southern Railroad of Chili, is now completed as far as Curico, connecting the latter place with the capital, a distance of 120 miles.

The Iowa extension of the Chicago and Northwest Road, is now completed to Woodbine, on the western boundary of the State, 450 miles from Chicago, and thirty-nine miles from Omaha, on the Missouri River, the initial point of the Union Pacific Railway. It is confidently expected that the track will be laid into Council Bluffs, Mo., before another month. From the terminus at the North Platte station, 290 miles west from Omaha, a day and night mule team freight line, connects with Denver, Colorado territory.

The proposed railroad from Millerton, N. Y to Sheffield, Mass., will when completed open a new through route from New York via Pittsfield to Montreal

The average cost of constructing a railroad in England, is three times as much as in this country.

There are thirteen railways in Canada, with 2,148 miles of road open for traffic. The total value with equipments is $1,300,000.

The traffic across Egypt is enormous. Immense quantities of manufactured goods for India are continually passing over the Suez line, and the return of cotton from Bombay by this route, is in like proportion. There has been a late reduction of twenty-five per cent, on the rate of carriage of goods sent by slow trains.

The city of New York supports eleven horse railroads, having a total length equivalent in single track to 170 miles.

The roads and equipments are valued at $16,000,000. The gross earnings of ten companies for the year ending in September last, were over $4,000,000: the net profits for the same time amounted to $800,000.

Seventeen international railway lines branch off from Paris, of which nine go to Belgium, one to Luxemburg, one to Rhenish Prussia, one to Rhenish Bavaria, one to Baden, three to Switzerland, and one to Italy.

On the London, Chatham and Dover Railroad, England, three trains are run into London between the hours of four and six, every morning, for the convenience of those at work in the city, but who reside out of town. Commutation tickets on the road, for stations not more than five or six miles out, entitling the holder to two passages each day, cost but one shilling or twenty-four cents per week. On the Metropolitan Road, on which early trains are also run, no weekly tickets are issued, but the fare is the same by the single trip, two cents.

The indebtedness of Southern railroads for rolling stock and locomotives bought since the war, is estimated at $7,000,000, of which the Nashville and Chattanooga road owes $1,300,000.

GLEANINGS FROM THE POLYTECHNIC ASSOCIATION.

Reported for the Scientific American.

The regular meeting of this branch of the American Institute, was held on Thursday evening, December 20th. Prof. Tillman presented the following items of scientific interest:

PERSISTENCE OF RAYS.

An experiment by Abbe Laborde, seems to show that waves in the sunbeam of higher velocity, producing the perception of blue, make a stronger impression than waves of lower velocity. When a disk of metal, having slits in its circumference, so as to admit and intercept the solar beam, is caused to rotate with a high velocity, the ray of light, when received on a plate of ground glass, is tinged with blue, green, rose, white, green, blue, in this order. After the second blue, the image is white at all higher velocities of rotation.

REMAINS OF A GIGANTIC DINOSAUR.

At the Academy of Natural Sciences, Philadelphia, Prof. E. D. Cope exhibited some fossil remains found about two miles south of Barnesboro' N. J., just under the stratum of green sand, and about twenty feet from the surfa e. The bones were those of a gigantic Dinosaur, an extinct tribe of reptiles of great size, and approaching in many characteristics the mammals. In length, this creature equalled the Megalosaurus (measuring seventy feet), and must have been one of the most formidable of the rapacious terrestrial vertebrates.

NITROGEN FROM MANURES.

J. B. Lawes, F. R. S., and Dr. J. H. Gilbert, F. R. S., experimenting with wheat grown for twenty years on the same land, both with and without manure, found that much of the nitrogen supplied by the manure was not recovered in the increase of crop. A considerable part of this loss is retained in the soil, yet a larger amount is as yet unaccounted for. Field results show that there was an increase of but one or two bushels in the crops, due to the accumulated residue of nitrogen in the soil, notwithstanding its amount was much greater than if freshly applied every year, to the soil otherwise in the same condition.

TREATMENT OF SEA-WEED.

By Stamford's process of destructive distillation, the sea-tangle is collected, dried, placed in a closed iron retort, and subjected to a low red heat. After carbonization, the stems contain about forty per cent of salts, consisting of chloride of potassium, sulphate of potash, iodine, bromine, and iodide and bromide of potassium. The products of distillation saved are chloride of ammonium, tar and pitch; from the tar, oils acetone, naphtha, and illuminating gas.

THE SOURCES OF ANIMAL FAT.

A large proportion of the fat of the herbivora, fattened for human food, must be derived from other substances than fat in the food. When such animals are fed on the most appropriate fattening food, much of the stored-up fat must be produced from carbo-hydrates. The nitrogenous constituents of food may also serve as a source of fat, in defect of a liberal supply of the non-nitrogenous ones.

GRAVITATION.

By invitation, Dr. Van der Weyde again appeared before the Society, making some interesting remarks on the origin and creation of the world, pointing out the action of gravitation in forming regular bodies from matter previously existing in a highly rarified condition, and dispersed through space unequally, both as regards quantity and quality. This force of gravity alone sufficiently explains the creation of the whole planetary system; the cause of the light and heat undoubtedly once given out by every planet; the revolution of the planets on their axes, and around the sun; the higher velocities of the inner planets; in short, all the results observed in the admirable system of worlds. As heat is the result of this same force, then all life and motion is merely gravitation in disguise.

TEMPERATURE AND VITALITY.

The cooling down of these masses has been gradual, and modified by their distance from larger bodies communicating heat by radiation. The smaller interior planets, Venus and Mercury, still have a temperature much above that of the earth. As vitality can only exist at a temperature ranging from 100° to 40° Fahrenheit, Prof. Loomis has suggested the hypothesis, that organic life on the planets Uranus, Saturn, and the asteroids, has long since passed away; that on Jupiter, its existence is doubtful; that Mars and the earth are now populated; and Venus and Mercury have yet to cool for some millions of years before being adapted for organic life.

THE CRUST OF THE EARTH.

For every thirty or forty feet of descent toward the center of the earth, it has been observed that the temperature is raised one degree. It has thus been accepted as a foregone conclusion that this increase goes on in the same ratio for all depths, till, after a few miles, every thing is in a melted condition. A comparison with the diameter of the earth, 8,000 miles, seems to show a very thin crust. But no guaranty exists that this increase in temperature goes on according to this law. Hopkins, in England, has calculated, from the precession of the equinoxes, that the earth's crust can not be less than 300 to 1,000 miles in thickness. But we may suppose that masses of melted matter may be distributed through this crust, and give still cause for volcanic eruptions when reached by water penetrating through the surface of the ground.

The great extent of country over which an earthquake is felt, is an argument in favor of a thick crust; and, again, it has been calculated that a crust of at least 400 miles thickness, is required to support the computed weight of the vast Hi nalaya system of mountains; for if the slight thickness commonly supposed were indeed the case, a depression of the surface would follow, and this would show itself by elevating the bed of the Indian ocean.

The Zoetrope.

This is the name of a mechanical toy, constructed on philosophical principles, and capable of affording amusement to the old as well as the young. It is an exemplification of the science of optics, and is a valuable aid in illustrating this department of natural philosophy. It consists simply of a rotating drum open at the top, in which, around its inner periphery, are placed strips of paper having figures of men, animals, etc., in varying positions. By turning the cylinder, the images are seen through slits in its upper side, giving the effect of action to the figures. For instance, a porpoise is represented in perhaps a dozen different positions. The turning of the drum brings into view, in rapid succession, the varying positions of the fish until they blend into a perfect image full of motion and operating to produce the natural action of the animal. It is manufactured by Milton Bradley & Co., Springfield, Mass.

Scrap Iron for Heavy Forgings.

On page 357 of our last volume we published some important information in regard to the quality of iron used in heavy forging, indicating its unfitness for such purposes. A correspondent, writing from Detroit, says: "I find your article on 'Scrap Iron for Heavy Forgings' is causing steamboat and steamship owners to look into the material shafts etc, are made of, pretty carefully." Undoubtedly; and if manufacturers would generally heed the instruction imparted through the SCIENTIFIC AMERICAN, it would be vastly to their benefit.

HOW PEOPLE LIVE IN PARIS.

The interest now felt by Americans in all that relates to Paris, is greatly hightened by the fact that thousands of our citizens propose to visit that wonderful city next year. "Irenæus," (Dr. Prime, Editor of the *Observer*, now on a tour through Europe), presents the following graphic picture of "Cafe life in Paris," which we feel sure will interest our readers. We know, says he, very little of this kind of life in American cities. The less we know of it, in our experience, the better. But it has some advantages, and these make it the great feature of social existence in this unique and wonderful Paris.

You would get some idea of it, if Broadway were lined on both sides with open saloons on the ground floor, from Union Square to the City Hall, and these were all brilliantly illuminated every evening with gas lights, and elegantly furnished and tastefully adorned, with mirrors, pictures and flowers, and were filled with people, and the sidewalks lined with little tables and chairs crowded with men and women, eating, drinking, talking, laughing, and apparently all enjoying themselves as if it were some great feast day they were celebrating, instead of the usual every-day mode of life to which they were all accustomed. If the cost of living in our large cities continues to advance, as it has advanced within a few years past, we shall come to something like it, in spite of our greater fondness for the exclusive mode of living, which we, in common with our cousins of England, so much prefer. To see how and why it is that the French eat and drink away from home so much, living at a coffee-room,—a cafe, so called, —instead of in their own houses, we must begin at the beginning. And the first idea is that they do not eat in their own houses because they do not have any houses of their own. When you walk up and down Fifth Avenue, or the splendid streets adjacent, you know that in each one of those magnificent mansions, the entire length of the street, only one family resides. And you must come down a long way in the scale of social life, before you find genteel families, unless they are relations or near friends, sharing a dwelling between them. We associate the very name of tenant house with the poor. There are many of them in our cities, but we know very well that they are designed only for those who earn a moderate income by hard labor. And the accommodations are according to the necessities of the tenant. In vain have we long endeavored to induce capitalists to attempt something better for the poor, and to try the experiment of providing a higher class of buildings for the genteel, who would pay more for fitting apartments, in desirable quarters of the town.

Here in Paris, there are rich families who live in a house by themselves, a grand hotel or mansion, for the word hotel was by the English used for an inn, which it does not necessarily mean. But there are also thousands of rich families, who live in splendid style, on one floor only, of a house built for the use of more families than there are stories in it. It is hard for those who are not familiar with this mode of living, to believe that the most genteel, wealthy, aristocratic and cultivated families may be found on the fourth or fifth floor of the dwelling in which five, six or seven families and more are occupying rooms above or below them. A common flight of stairs leads up to the door of each household. A doorkeeper at the foot, in her little room, knits or sews all day, and answers every call that is made, and will save you the trouble of mounting, by telling you if any family is at home or not. In each set of rooms there is a complete domestic establishment, from parlor to kitchen, and the occupants have every needful convenience for managing their own household affairs within themselves, if they prefer to eat at home. And as a general thing they do take breakfast at home, if any where. I say, if anywhere, for the meal which we call breakfast has hardly a place in a Frenchman's day. Twice at the close of the Sabbath service, at one o'clock, P. M., I have been invited home to breakfast (!) by my kind friends in Paris. Shortly after rising, they had taken a cup of coffee, perhaps, and now in the middle of the day they would have a meal answering to our breakfast or lunch, which is usually provided in their own rooms. At six or afterwards, it is customary to take dinner at a restaurant or dining saloon, of which there are so many, in such parts of the town, and at such prices, that no one may be at a loss to find one convenient and agreeable. Many of these places combine the cafe and the restaurant, having private apartments where families or parties may be with themselves only, and quite as secluded as if they were at home. Some of these establishments have a continental reputation, and I might say *American* also, for our countrymen have the faculty of soon finding where the best things are to be had, and of getting them too. The cafe institution in Paris was started in 1697 by an Armenian (not an American) and has been growing in favor and use from that day to this. The word *restaurant*, has this origin. In 1765, a cook in Paris put over the door of his eating-house this profane parody of Holy Scripture: "Venite ad me, omnes qui *stomacho* laborant, et ego RESTAURABO vos." There are now about 3,000 in Paris. It is not unlikely that the larger part of the population of this splendid city, including the higher and lower classes, depend on the restaurant for their dinners. And by occupying a floor, or suit of apartments, in a large house that is also the home of many other families, they live according to their means, and are as genteel as if they had a house of their own.

How much does it cost to live in Paris? Why, there is no city in the world where money slips away faster than it does here, but there is no need of spending as much for mere "board and lodgings" as in New York or any other American city. I am assured by a resident here, who has made himself perfectly familiar with the ways and means of Paris, that there are many *gentlemen*, officers under Government, literary men, titled men, and men who move in the very highest circles, attending the most aristocrat parties, and being on the best footing with the best society, whose entire income is not $500 a year! On this they dress well, pay their rent and buy their food, and often lay up money besides! How can they do it? To get an answer, you must take the facts into account which I have just mentioned. By going up in the world, to the highest floor of one of the many dwellings built for tenants, you may get a furnished room for a franc (twenty cents) a day, and even less. In fact, many of the fine houses on fashionable streets have upper stories where the poorest of the poor hire lodgings for a few cents per night. But I am speaking only of the respectable class of people with very limited incomes. In the middle of the forenoon, or as I have often seen them, at twelve noon and even afterwards, they take their breakfast, consisting of bread and coffee or common wine. This breakfast may be had at a decent restaurant for five cents, or sous, and it will be as much as a man requires. All over Paris there are restaurants where a full dinner is furnished for 40, or 35, or even 30 cents. For this sum you get a dish of soup, two dishes of meat, bread, a dessert and wine. One man who was once a butcher, has established several restaurants, in various parts of the city, and is prosecuting the experiment of feeding the greatest possible number at the least cost and a fair profit. He now entertains ten thousand every day, and at some of his tables a good dinner may be had for less than twenty cents. I have not yet dined at any of these cheap establishments, but as soon as my courage and appetite are equal to the undertaking, I am going through a system of economical dietetics, and will make an honest report of the result. And even if we allow our friend with an income of $500 a year to indulge in the luxury of a room at two francs, a dinner at two francs and breakfast at one franc, he is spending only a dollar a day, and has plenty left to dress like a prince: that is, to dress as a gentleman should. These figures are higher than were given to me, as the cost of living on a little in Paris, and, indeed, I am afraid to put it as low as it was put to me. When Pat wrote home that he had meat three times a week in America, his employer asked him if he didn't have it three times a day. "Yis, yur honor, but don't you think I want to be belaved?" I want my story to be *belaved*, and therefore keep it *within* the limits of the truth.

And if the family do not wish to resort to a restaurant for dinner, they employ a *traiteur*, or petty restaurateur, to send them a certain number of dishes at a certain hour of the day, and this arrangement makes it more economical than to provide the same dishes at home. This is creeping into practice in New York, and will become common after a while. Dinner being over, instead of sitting at their wine, as gentlemen are apt to do at home, they throng the cafes on the Boulevards and the brilliant squares of Paris, and, with their coffee or ices, or a "little glass of liquor," pass an hour or two, or three, or more, as the case may be. This custom imparts to Paris an aspect, in the evening, entirely unique. As we walk the gayest streets at any hour from dusk to midnight, and how much later I do not know, the sidewalks are lined with men and women, few of the latter compared with the number of men, enjoying themselves as if the *business* of the day were over, and now they would yield themselves to utter *abandon* and social enjoyment. It is really curious to see, as we often do, grey-headed and venerable men, who look as if they might be heads of families and heads of the Corporation, solid, respectable, grave, and good, mingled among a crowd of jolly *bon vivants*, yet all engaged in sipping their drinks, and chatting, without noise or drunkenness, and quietly retiring when they are through. On the Champs Elysees and in other parts of the town it is common to connect a concert of music with the cafe, but those are quite distinct institutions from the Boulevard saloon where Paris spends its evening when it is not at the theater or opera.

I ought to add that these establishments are graded in style, price, respectability and company. Even the best books on Paris will tell you where the company is *not* select, and that is a sufficient indication to the "lover of pleasure" to resort to the cafe that affords the free-and-easiest entertainment. Nor is there anything in the manner of any of them that forbids the "strange woman" to enter at any time, take her seat where she pleases, and with those who gather about her to eat, drink and be merry. As the night wears on, in some of the most frequented of these brilliant halls, the revelry grows madder and wilder, and Paris probably becomes as drunk as London or New York. Vice is not so public and disgusting here as in those cities. But social morals are looser, and must be so where the home tie is so slender, and society is built on a basis that does not require *domestic* life for its pleasure or its security. I would not like to see cafe life becoming a part of our social system in the dear land that rejoices more than any other in the strength and beauty of its homes. But it would be well if we, in America, could live and let live on a scale of expenditure five times lower than society now demands, and could learn that there is higher good, and sublimer enjoyment, than is found in spending money for what we eat and drink and wear.

Variations of Climate.

We know little of the weather anterior to "the memory of the oldest inhabitant," except what may be inferred from geological traces, and incidental notices bearing on the subject which have casually floated down to us. But enough is known in these ways to decide that the climate of particular regions has undergone great changes since the creation, and even within the historical period. There is evidence of a marked amelioration of climate both in North America and Europe, since the discovery of the western continent. While the spread of agriculture and civilization undoubtedly has its effect in this direction, there are also astronomical changes constantly in progress, which control, slowly but irresistibly, the climatic conditions of the earth. The elliptical form of the earth's orbit brings us about three millions of miles, or nearly three per cent, nearer to the sun, at about the season of "January thaw." This is the case at present, but a regular change is going on in the proportions of the ellipse marked by the earth's annual revolution, which would in process of time so much flatten and elongate it, as to increase the difference between the greatest and least radius to as much as fourteen millions of miles. At the same time, the month of January is gradually rotating from the nearest to the remotest and coldest position. At the suggestion of Sir Charles Lyell, a calculation was undertaken some time ago by Mr. Stone, chief assistant at the Royal Observatory, England, to determine the period of the extreme difference. The calculation was too vast to be completed at the time; but it was carried far enough to show that 210,000 years before A. D. 1800, the difference amounted to as much as ten and a half millions of miles. Again, there is a small but constant change going on in the direction of the axis of the earth, which runs through all its variations in about 26,000 years: so that the position of a given latitude, relatively to the sun, would vary from the aspect or exposure of minimum warmth to that of maximum warmth, in about 13,000 years. The importance of these points of contact between astronomical and geological researches, can not fail to be developed by the devotees of science.

THE COTTON MANUFACTURE.

It would be a work of supererogation to descant on the value and uses of cotton. Its use is now universal and its value as widely understood. Politically, cotton may be no longer king, but economically it still reigns without a rival, and is in no danger from a usurper. It is cultivated in this country as an annual, the seed being sown by hand in March or April in rows. The only cultivation required is hoeing, or running a cultivator plow between the rows to keep the soil moist and open. The yield is from 320 to 750 pounds per acre, according to climate, season, soil, and degree of cultivation. The varieties cultivated here are two, the "green seed" or "short staple," and the "Sea Island" or "long staple."

Cotton was unknown to the Egyptians, as is proved by an examination of the wrappings of mummies, which show only the round, smooth fiber of flax, and not the angular and spiral fiber of cotton. Herodotus, about 450 B. C., mentions a tree in India which produced fleeces fairer than those of flocks, which the Indians manufactured into cloth. After that time its mention is not unfrequent.

The cotton itself is a fibrous mass enveloping the seed, in a receptacle, which, like that of the poppy, holds it with the seed until near maturity. It then parts, disclosing the delicate, white, fibrous substance, like a ball or globe of newly deposited snow. The appearance of a field of cotton at this stage is a sight once seen never to be forgotten. The field of brilliant green looks as though a sudden snow storm had fallen from the summer clouds and deposited upon each shrub balls of the fleeciest frozen vapor. But in each one of these globes of snowy fleece is a quantity of seeds, not merely lying in their protecting covering, but adhering strongly to it. The tenacious hold of these seeds was the reason that the cultivation of cotton, previous to the invention and introduction of the cotton gin, was not very remunerative. Before that machine was used, the seeds were picked from the floss by hand, and one pound per day was about all that good cleaners could average.

In 1793, Eli Whitney of New Haven, Conn., but a native of Massachusetts, invented the gin that still bears his name. By it over three hundred pounds of short staple cotton could be separated from the seeds by the same labor and in the same time which before scarcely sufficed for one pound. From this time, the cultivation of cotton assumed an importance it had not before known, and it gradually became one of the chief staples of commerce and an important agent in the material progress of the nations.

The inventions of Arkwright and Hargreaves in 1764, by which power was applied to the working of cotton and improvements made in the machinery, gave an impetus to the manufacture which Whitney's invention further developed. For years after Arkwright had successfully put in operation his improvements, England possessed almost the entire monopoly of the manufacture. The first machines for carding and spinning made in this country, were built by two brothers, Robert and Alexander Barr, who were employed by Hon. Hugh Orr, of East Bridgewater, Mass., to build them, in 1786. They were bought by the Legislature, but left in the care of Mr. Orr, who was allowed to use them as a compensation for his trouble in explaining them to those who desired to build others. In 1790, Samuel Slater, who had been employed by Arkwright, built the first machinery on the Arkwright model ever used in the United States, and ran it in Pawtucket, R. I., by water power. In 1793, the "Slater Mill" was built at that place, and is still standing and used as a manufactory.

There are a number of varieties of cotton, but only two possess distinctive peculiarities sufficient to entitle them to especial remark. The ordinary cotton known as the "green seed" is generally cultivated in this country, and latterly in India, Egypt and other portions of Africa. That known to commerce as the Sea Island, and Nankin, is a very long-stapled cotton peculiarly valuable for this reason. Unlike the short staple, the fibers of this have a yellowish tinge, and are remarkable for their length and silkiness, and the strength and tenacity of the fabrics spun or woven from them. This variety is cultivated on the low islands on our Southern Atlantic coast. The ordinary gin tends to break these long fibers and thus injure the value of the material.

The Whitney gin acts upon this principle: A series of disks armed with teeth, either of wire or cut out of the material like those of a saw, revolve through the interstices of a wire sieve too fine to allow the passage of the seeds. These teeth catch the fibers of the cotton, as it fed upon the sieve, and pull them through, leaving the seeds behind. For the long staple cotton this machine is not well fitted, and a different gin is used for separating the fiber from the seeds. The method is simple. The cotton is fed between yielding rollers, in front of which a rapidly vibrating arm plays vertically, knocking the seeds out while the cotton is drawn through. It has been tested on the ordinary cotton also, with beneficial results. Separated from the seeds, the cotton is pressed into bales for convenience of transportation, and sent to the factory.

The first machine to which the material is subjected is technically termed the "devil" or the "willow." It is a cone-shaped cylinder, suspended horizontally, and armed on its outer surface with stout steel pegs, or teeth, placed circumferentially. This cone is surrounded with a case, the inside of which conforms to the exterior of the cone, and is similarly armed with pegs. Those on the cone pass between the rows of those on the inside of the case. The cone is driven with great rapidity, and the cotton, direct from the bale, is fed into the small end through a hopper on the upper portion of the case. The centrifugal motion, caused by the revolutions of the cone, throws the cotton around its circumference and discharges it at the largest end, torn into a light, fleecy substance, very unlike its condition in the bale.

In this form it is fed into a "picker.' Placed in carefully measured quantities on an endless apron, it passes between fluted steel rollers, when a "beater" of two steel arms on a rapidly revolving shaft, breaks it down and beats it into fine fleecy masses. These fall on cylindrical sieves of wire, by the rotation of which they are carried in an even web, like the cotton battings sold at the stores as wadding for garments, to another series of rollers and beaters, until this process has been repeated three times—on the same machine, and constituting one operation—when the "lap", or web of cotton passes between heavy iron rollers and is wound on a core of wood furnished with journals at the ends. The main object of these preparatory processes is to thoroughly clean the cotton. It has not as yet been either carded or spun. Those unacquainted with the manufacture of this material suppose that carding is the first process and that it is immediately succeeded by spinning. On the contrary, there are various stages to be reached before the carded cotton is ready to be spun into thread or yarn.

These preliminary processes, although apparently crude, are very important. The cotton is full of dust and dirt, gathered from the time of the first formation of the boll up to the period of its arrival at the factory. All this must be removed, and the bottom of the willowing machine is a net of strong wires through which the dirt finds its way, while the rotating sieves of the "picker" allow large quantities to escape. The rooms where this work is done are consequently dirty and unwholesome. The amount of cotton fed into the picker at once, and the degree of evenness with which it is spread upon the endless apron, affect the condition and value of the material through every after process up to the finished yarn or cloth.

DISINFECTANTS---A VALUABLE REPORT.

Dr. Letheby, Health Officer of the city of London, has recently made the following report :—

The several disinfectants which I have largely tested are the following:—

1. Chlorine gas.
2. Chloride of lime.
3. Carbolate of lime.
4. Carbolic acid.
5. Chloride of zinc (Sir William Burnett's fluid).
6. Chloride of iron.
7. Permanganate of potash (Condy's liquid).
8. Animal charcoal.

Each of these disinfectants has its own particular value, and may be used on certain occasions in preference to any of the others : thus

1. *Chlorine gas*, being a very diffusive body, is best suited for the disinfection of places which cannot easily be reached by other disinfectants. I have used it largely for the disinfection of the vaults of churches, where the atmosphere has been so charged with offensive and dangerous organic vapors, let loose from the contents of the decaying coffins, that the workmen could not enter the vaults with safety. In this manner all the vaults of the city churches have been disinfected, and the contents of them put in order and covered with fresh mold. I have found also that chlorine is best suited for the disinfection of rooms where, as is the case with the poor generally, the occupant cannot be removed for a thorough cleansing; and I have employed it with great advantage in places where persons have been sick with fever, scarlet fever, small-pox, and cholera. The process which I adopt is the following :—About a teaspoonful of the black oxide of manganese is put into a teacup, and there is poured over it, little by little, as occasion requires, about half a teacupful of strong muriatic acid (spirit of salt). In this manner the chlorine is gradually evolved, and the action is increased, when necesary, by stirring the mixture, or by putting the teacup upon a hot brick. As chlorine is heavier than atmospheric air, it is best diffused through the room by putting the mixture upon a high shelf. The quantity of chlorine thus diffused should never be sufficient to cause irritation to the lungs of those who occupy the room, and yet it should be sufficient to be distinctly recognizable by its odor. If it be properly managed, the chlorine may be thus diffused through the atmosphere of the room, even during its occupation by the sick.

2. *Chloride of lime* has been very largely used in the city during the recent epidemic of cholera. The inspectors have sprinkled it upon the floors of the houses occupied by the poor, and have scattered it about the cellars and yards. In some cases it has been used with water for washing the paint work and the floors of rooms. Altogether indeed, with an average staff of 45 men, we have used rather more than seven tons of chloride of lime in this manner in disinfecting every week about 2000 of the worst class of houses in the city, and the results have been most satisfactory.

3. *Carbolate of lime*, which is a mixture or rather a chemical compound of carbolic acid and lime, has been used in many cases where the smell of chloride of lime or its bleaching action has been objected to. It has been used by dusting it by means of a dredger over the floors of rooms and cellars ; but as the disinfecting power of this substance is destroyed by chloride of lime, it is of great importance that they should not be used together. The carbolate of lime which we have employed contains 20 per cent of carbolic acid : it is essential that this should be its minimum strength, or its power is not sufficiently efficacious. The strength of it may be ascertained by treating 100 grains of it with sufficient muriatic acid, diluted with its own bulk of water, to dissolve the lime, when the carbolic acid is set free, and floats upon the liquid ; this, when collected, should weigh 20 grains at least. The advantage of carbolate of lime is its continuous action ; for the carbonic acid of the air slowly lets loose the carbolic acid, which diffuses itself throngh the atmosphere in sufficient quantity to act as a disinfectant, and it does not destroy the color of clothing.

4. *Carbolic acid* has been used as the sole agent of disinfection for privies, drains and sinks, and for the sewers and the public roads. In the former case it has been used in its concentrated state by pouring it at ouce into the privy or drain, but in the latter case it has been diluted with about 2000 times its bulk of water and sprinkled by means of the water carts upon the public way. In this manner about 1000 gallons of carbolic acid have been used in the city thoroughfares ; and the acid getting into sewers, we have observed that the usual decomposition of sewage has been arrested, and instead of a putrefactive change with the evolution of very offensive gases, the sewers have been charged to a slight extent with carbonic acid and marsh gas. As there are many coal-tar acids now sold for carbolic acid, it is of importance that the adulteration should be recognized. This may be done by observing the strength of the soda solution which will dissolve the tar acid. All the inferior acids are insoluble in a weak solution of caustic soda.

5. *Chloride of zinc* (Sir William Burnett's fluid, or, as it is sometimes called, Drew's disinfectant), is well suited for the disinfection of the discharges from sick persons, but it is hardly applicable to any other purpose. The liquid should be of a proper strength, as having a specific gravity of 1594, water being 1000 and it should contain about from 50 to 54 per cent of solid chloride of zinc. A tablespoonful of this liquid is sufficient to disinfect each discharge from the body.

6. *Chloride of iron* is applicable in exactly the same manner as chloride of zinc, and is only suited for the disinfection of the discharges from the body. It should have a specific gravity of 1470, and should contain about 40 per cent of metallic chloride.

7. *Permanganate of potash* is only suited for the disinfection of drinking water ; for not being a volatile disinfectant, and being very slow in its action and requiring much of it for any practical purpose, it is not available as a common disinfectant ; besides which it attacks all kinds of organic matter, and will therefore destroy clothing and be neutralized by every species of organic substance. As a disinfectant of water, however, in localities where good filters of animal charcoal cannot be obtained. it may be usefully employed to disinfect water by adding it thereto until the water retains a very pale but decidedly pink tint. The permanganate which is sold generally has a specific gravity of 1055, and contains about 6 per eent of permanganate of potash. It will take more than a pint of this liquid to disinfect a pint of the rice-water dischargefrom a cholera patient, and even then the disinfection is very uncertain.

8. *Animal Charcoal*. I may state, that for the disinfection of water and the removal of dangerous organic impurity, I have ascertained by experiment that the best treatment is first to filter the water through animal charcoal, and then to boil it for a few minutes. It may then be safely drunk.

The disinfection of bedding and all articles of clothing is best effected by exposing them in an oven to a heat of from 260° to 300° Fahrenheit. The exposure should be sufficiently long to insure the thorough heating of every part of the material to that temperature. When such a process can not be used, the clothing should be put into boiling water, and kept there until the water cools to the common temperature.

I refrain from entering into any explanation of the mode of action of these several disinfectants ; for whether the agent of disease is a living germ, capable of reproducing itself in the human body under certain conditions, as most likely it is, or whether it is an unorganized, or even as Dr. Richardson supposes, a crystalline compound, the practical results are the same and are unquestionable : and, in conclusion, I would say, by way of summary, that for the disinfection of sick rooms, chlorine and chloride of lime are the best agents ; for the disinfection of drains, middens, and sewers, carbolate of lime, and carbolic acid are the best ; for the discharges from the body, carbolic acid, chloride of zinc, or chloride of iron are the best ; for clothing the best disinfectant is heat, above 260° if a dry heat, and 212° if a wet heat ; and for drinking water, filtration through animal charcoal and a boiling temperature.

I may mention that the best disinfectant for stables and slaughter-houses is a mixed chloride and hypochlorite of zinc, and it has the advantage of mixing freely with the liquid matters of the slaughter-house, and not tainting the meat with any unpleasant odors. We have used it very largely for this purpose, and it is also applicable to the disinfection of houses in place of chloride of lime : which it much resembles in its chemical nature and mode of action.

PATENT OFFICE DECISIONS---COMBINATION TOOL PATENT.

An application was made by B. Boardman for a patent for a Combination Tool, which was rejected, the examiner giving as a reason that the tool was simply an aggregation of four distinct tools, answering four different purposes ; some widely dissimilar, and others analogous, but no single tool cooperating with the others to effect a common purpose. The examiner took another ground also, "that the same patent can not be for a combination of different machines, and for distinct improvements in each."

An appeal was taken from this decision to the Board of Appeals, and Judge Foote, examiner-in-chief, rendered an adverse opinion, quoting the decision of Judge Story in the case of Pitt *vs.* Whitman (2 Story, page 621), in which he said : "There is, in my opinion, no difficulty in maintaining the validity of a patent for a machine combining several distinct improvements, each of which is the invention of the patentee, and also including in the same patent a right to each of these several and distinct improvements. In other words, the patentee may in such a case take out a valid patent for the combination, and also include therein a right to each distinct improvement severally contained in the same machine."

The same principle was affirmed by Mr. Justice McLean, in Root *vs.* Ball (4 McLean, Rep. 180) : "The same patent may include a patent for a combination, and an invention of some of the parts of which the combination consists."

Since the decision of those two cases it has been a very common practice to include in the same patent a claim for the combination and for the parts of which it is composed. And suits upon such patents have been carried through every stage of litigation, and been sustained by the highest courts, without objectionfrom that cause, and the law must now be regarded as entirely settled on that subject.

We apprehend, therefore, that the examiner has not investigated this case with reference to the principles that properly govern it, and we overrule his decision, with a view to its re-examination.

Answers to Correspondents.

CORRESPONDENTS who expect to receive answers to their letters, must, in all cases, sign their names. We have a right to know those who seek information from us : besides, as sometimes happens, we may prefer to address the correspondent by mail.

SPECIAL NOTE.—This column is designed for the general interest and instruction of our readers, not for gratuitous replies to questions of a purely business or personal nature. We will publish such inquiries, however, when paid for as advertisements at 50 cents a line, under the head of "Business and Personal."

C. N., of N. Y.—You appear to need a little glycerin in your paste to prevent its drying too quick and too hard.

M., of Texas.—If as you say, you are not a $20,000 reb, you can apply for a patent on taking the usual oath of citizenship.

L. A., of N. J.—For facts in relation to peat, beyond those we have stated in these columns, we refer you to Rev. J. M. Morris, New Haven, Ct., author of a treatise on that fuel.

O. M. S., of R. I.—The principal inquiry of A. K. P. was, whether in carrying an iron ball of 1000 pounds weight to the top of a mountain four miles high, the loss in weight was actual or apparent. The influence of density in the atmosphere was thrown in as an after-thought. In the case under consideration the loss on this account amounts to less than two ounces, but for the mass of seasoned pine, that you refer to, it would be greater, the difference of weight in any case varying with the bulk.

G. S. B., of——, in answer to a correspondent who wants to keep coal fires in stoves over night, suggests that he cover the fire with fire bricks fitted to the size of the stove. On removing the bricks in the morning, a clean fire will be found, much easier revived than when ashes are used as covering.

A., of N. Y.—Meerschaum signifies sea foam. It is a mineral of soft earthy texture resembling chalk. It is found in Spain and several countries at the head of the Mediterranean.

J. W. S., of Mo.—You ask "what advantages has soapy water over clear water in the water finish employed by lathesmen?" We reply that the combination of an alkali with grease or carbon in a fatty form, known as soap, has a levigating and lubricating quality, the reason for which you can find in any chemical work. 2d. Wrought iron may be soldered to cast-iron by soft solder, the surfaces having been cleaned with muriate of zinc ; but what is the benefit? The soft solder has not the quality of tenacity sufficient to produce a union of the same qualities in iron. Brazing is the proper way of uniting the two qualities of iron. 3d. Wrought iron is case hardened by the use of prussiate of potash in powder. It converts the surface of the iron into steel.

D. F. C., of Mich.—The gluten on envelopes and internal revenue stamps is made either of dextrine—starch treated with acid—or is simply gum arabic dissolved in water. Common mucilage is made of this latter gum or animal gluten.

P. B. R., of N. H.—The clicking heard in steam pipes, when the steam is first let on, is occasioned by the condensed steam or water acting in a vacuum. When steam is first let on the temperature of the cold pipes condenses a portion of it, and thus instantly creates a partial vacuum, into which the water is forced on the same principle as in the water ram. The force of these blows is sometimes sufficient to start the joints.

N. T. P., of O.—No sufficient reasons of the differences among substances as to their power of conducting electricity, are known. In the present state of knowlege, many of the properties of matter must be accepted as ultimate facts, about the cause of which we are unable to reason.

W. S., of Pa.—The falling rain acts as a purifier of the atmosphere by dissolving and carrying down carbonic acid, smoke, and other contaminations. Snow acts in the same way but with very much less effect. The snow which falls at the latter part of a protracted storm, when melted, is water almost chemically pure.

G. B., of Ind., supposes a cylinder or cone of matter lighter than water, perfectly smooth, set upright on the bottom of a vessel containing water, the water covering the cone or cylinder and the water having no access to its base. Query : Will the cone or cylinder rise? We answer : It will not.

O. G. W., of R. I.—The season of shortest days is not the coldest, because the earth is still retaining a considerable part of its summer heat. The earth does not get thoroughly cooled down till late in January. The warmest season would be in June, except for the fact that the earth has not quite recovered from his winter chill.

F. S., asks :—Could not the desideratum of accuracy in telegraphic dispatches spoken of by your contributor H, in your issue of Dec. 8th, be obtained by connecting the ground line of the transmitting apparatus with the receiving instrument at the same office ; so that the electric current, after actuating the receiving apparatus at the terminus of the line would, on its return, operate that of the transmitting office ; thus presenting, as it were, an echo for the inspection of the operator ; enabling him to repeat the signal if he perceives that the circuit has not been completed.

C. C., of N. Y.—You can obtain a good portable steam engine of the Wood & Mann Steam Engine Company, Utica, N. Y.

L. R. R., of Ill., sends us a communication suggesting various new theories concerning fountains and rivers. Bnt the theories are not sufficiently plausible for publication in a practical paper like the SCIENTIFIC AMERICAN. We quote as a fair specimen of the whole, the following sentence :—" And I am further of the opinion that all the fresh water which we receive at the surface has once been vaporized by the internal heat, and owes its purity and freshness to this cause ; and furthermore that it is the steam generated at certain depths which forces certain veins of water above the level of the ocean, and that when these jets of water find a basin in which to rest it becomes a spring or lake, and when it does not, it appears in the form of an artesian spring."

R. C. M., of Ill., suggests that damage may come to the Chicago tunnel (see page 404, Vol. XV.) when the water is let in, on account of the pressure due to the head of water, about 70 feet. If the external pressure in any part is less than the internal, the brickwork will give way But we take it that the engineers properly provided against such an accident.

B. of Va., wants information on the utilization of the refuse of distilleries : an important subject.

J. T., of N. B.—You can procure silicate of potash from Luhme & Co,, of La Fayette place, this city. A simple way of making it is to boil pulverized quartz or fine sand in a strong solution of caustic potash. There should be an excess of the quartz, and the boiling should be continued for several hours. The operation is performed in an iron kettle.

W. B. R., of ——Condensed milk is simply milk out of which 50 per cent or more of water has been evaporated. The process of evaporation is commonly carried on by means of a vacuum pan. There are a considerable number of patents, taken out by Borden, Lyman, Alden, Percy, and others, which cover details more or less essential to the best success. Milk boiled down in the open air does not taste like fresh milk.

C. F. M., of C. W.—The effect of burnished gilding may be got on papier machê or japanned work by the use of lacquered silver foil and other foils which are made to imitate gold.

J. S.. of Iowa.—If you place a solution of salt and gum arabic in a porous cup made of paper, leather, unglazed earthen, etc., and float the cup on water, the salt passes through into the water while the gum remains. In the same way you may separate any kind of saline substance from a gummy or mucilaginous solution. The salines are called crystalloids, and the gummy matters (glue, albumen, gum arabic, etc.) are called colloids. The process of separation was formerly known under the name of osmosis ; lately the name dialysis has been more used. * * * * Our correspondent says he made over a thousand gallons of sorgho syrup last fall, and a neighbor, three thousand gallons. But they still want a cheap process to produce it of better quality.

SUNDRY ANSWERS.—G. J. N.—We believe that no premium has been offered.——H. H. P.—Glass balls for pump valves have been used. ——G. W. H.—In interferences both parties may testify. No limit as to time. ——W. B. S.—If the matter is important, send a fee for search and repeat the enquiry. Our impression is that such an item was published.——A. F. C.—No difference in the quantity of water raised through a suction pipe 12 or 24 feet but greater power is required, the longer the pipe. Consult any book on natural philosophy.——W. T.—Water wheels made as you propose are quite old.——S. D.—We cannot furnish the brandy receipts.

Business and Personal.

The charge for insertion under this head is 50 cents a line.

D. D. S. inquires for a substitute for rubber that can be hardened or vulcanized in some way so as to answer for dental plates. Reply through this column, and give address.

G. H. A. You can apply the power of your wheels as you you propose with success.

Manufacturer, Box 3,294, Boston, Mass., wants a small bolt machine, and a quick method of case-hardening iron.

THE MARKETS.

The usual dullness, incident to this season, now rules the mercantile world. The close of the year is generally set apart by the business community for squaring accounts and straightening up the loose ends of their affairs, and no relief from this monotony need be reasonably expected till after the holidays, or, indeed, until the action of Congress upon a variety of questions which vitally affect commerce aud manufactures shall have assumed some definite form. The decline, during the past two weeks, in gold, has sensibly affected the values of many descriptions of merchandise, and prices are somewhat unsettled.

The coal season has been prematurely closed, and many producers will end the year with a preponderance on the wrong side of the balance sheet. Competent judges estimate the quantity of surplus coal now on hand above the actual wants, at about one million tuns. The severe winter weather of the past two weeks has caused some activity in the retail trade, aud low prices have brought many new buyers into the market. Consumers may rely upon it, that coal will be no cheaper, but the prospect at present looks to a speedy advance.

The cotton demand has been very fickle, and prices have fluctuated in sympathy with the gold quotations. At this date the demand is moderate, and prices are rather more steady.

The wool prospects are growing brighter. Trade is slow, and but a small advance is quoted. Yet an improved feeling is manifest, and these prices are readily obtained. The manufactories are only moderately supplied, the demand for spring and summer fabrics is beginning to be felt, and a speedy revival of the wool trade is looked upon as certain.

Business in all descriptions of hemp is limited. Manilla remains dull but steady; other kinds are inactive and nominal.

In the metal market we note : Iron shows a decline in every variety. Pig is extremely dull, with a moderate supply. Glengarnock rules lower, and American is entirely neglected.

There continues a very small demand for lead, business in pig being confined to small lots of foreign. Bar, sheet, and pipe steady, and show no improvement in price.

Prices for spelter are merely nominal, and little demand is manifest. Pig tin is quiet, and we hear of very little business ; prices, however, are steady and firm. The demand for plates is also very light.

Consequent upon the decline in the gold premium, the price of American ingot copper has ruled lower, and the market has again become quite dull.

Petroleum is but little in demand, for either crude or bonded, and prices rule in favor of the purchaser ; though holders do not seem desirous of pressing sales.

Nails are quiet and steady. Paints are very dull. The demand for hemlock sole leather is less active, but prices are firm. Indigo contiuues in limited request. The lumber market is dull and heavy, the offerings of spruce are free and find not a large number of purchasers. From the yards there is a fair demand, at steady rates. The stock of lath on hand is large, and prices are in the buyers' favor.

Foreign Patents.

American Inventors should bear in mind that, as a general rule, an invention which is valuable to the patenter in this country is worth equally as much in England and some other foreign countries. In England the law does not protect the right of a foreign inventor as against the first introducer of an invention from abroad. For twenty years past the great majority of patents taken out by Americans in foreign countries have been obtained through Munn & Co's agency. Patents are secured with the utmost dispatch in Great Britain, France, Prussia, Belgium, Russia, Austria, Italy, The Netherlands, Spain, Sweden, Australia, and other foreign countries. Models are not required, but the utmost care and experience are necessary in the preparation of applications. Patentees who intend to take out Foreign Patents should send to us for a Pamphlet of full advice. Address

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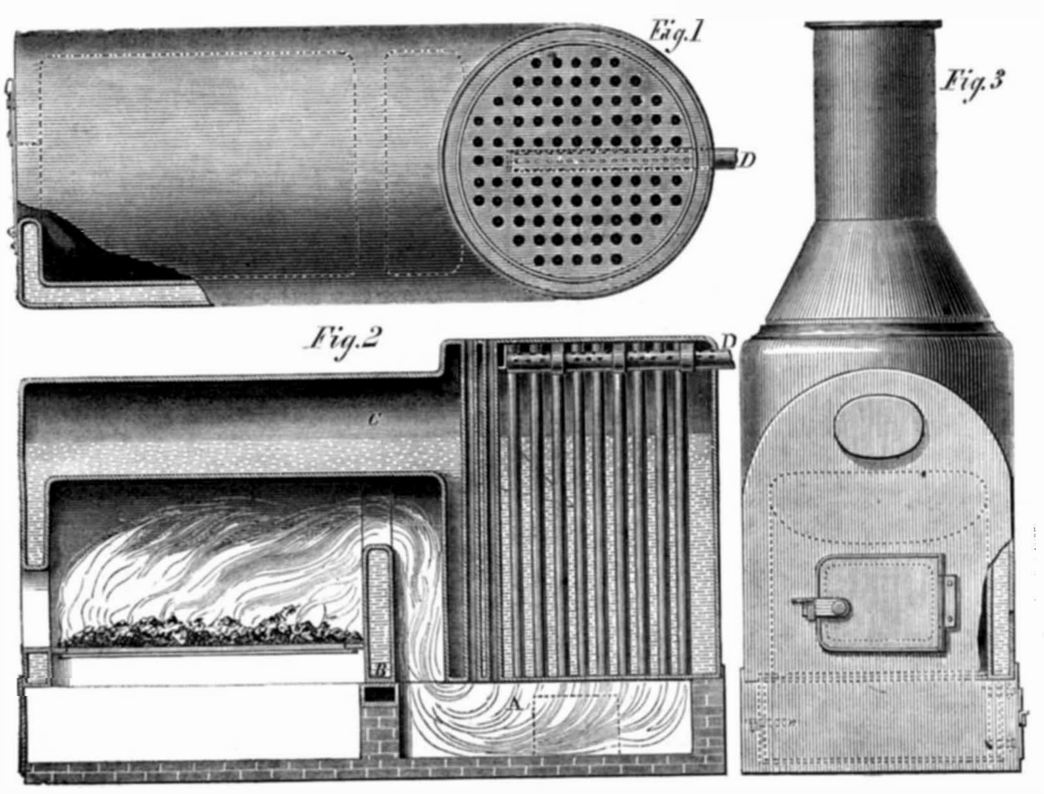

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