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NEW YORK, SATURDAY, AUGUST 20, 1881.

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(Illustrated articles are marked with an asterisk.)

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THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 294,

For the Week ending August 20, 1881.

Price 10 cents. For sale by all newsdealers.

NON-EXPLOSIVE KEROSENE.

Very frequently of late we have received from correspondents, East and West, samples of "stuff" sold them by peddlers with the assurance that when a little of these preparations are mixed with the poorest burning oil the latter is rendered *perfectly safe*. Of course one of the chief inducements to use these compositions is the assurance that with them a much cheaper oil of equal illuminating power can be used safely.

This fraud is a very dangerous one, and perhaps the best way to stop it is by the diffusion of a little practical information respecting these oils.

In the first place, there is nothing that can be added to or mixed with poor kerosene oil that will in the least affect its dangerous qualities or make it any safer to use in lamps. The danger with such oils arises solely from the presence in them of light, easily volatilized, and very inflammable hydrocarbons, such as naphtha, the vapor of which, when mixed with air, explodes on contact with flame.

Kerosene and naphtha or benzine are derived by a process of distillation from the same substance—petroleum. The lighter oils—gasoline, naphtha, benzine, etc.—are first volatilized and condensed. As the products distill over they are tested from time to time with a hydrometer, and when it is found that the stream of distilled oil marks about 58° (Baume's hydrometer), what follows is turned into another tank until it is found that the gravity of the oil coming over has risen to about 40°, then the stream is deflected into another tank. The oil distilled between 58° and 38° is called kerosene or burning oil.

In this process about 15 per cent of the light oils are produced, and as there is comparatively little demand for them they are very cheap. Naphtha costs from 2 to 5 cents a gallon, while good kerosene costs from 20 to 25 cents. As great competition exists among the refiners there is a strong inducement to turn the heavier portions of the naphtha into the kerosene tank, so as to get for it the price of kerosene or to cheapen the latter. They change the direction of the stream from the still when it reaches 65° to 63° B., instead of waiting until it reaches 58°; and thus the volatile inflammable naphtha or benzine is allowed to run into the kerosene, rendering the whole of the latter dangerous. It has been shown that one per cent of naphtha will lower the flashing point of kerosene ten degrees, while with twenty per cent of naphtha the same oil will flash at eight degrees (Fah.) above the freezing point of water. It is, therefore, the cupidity of the refiner that leads him to run as much benzine as possible into the kerosene regardless of the consequences.

The specific gravity is not a safe guide respecting the character of such oils, as a poor dangerous oil may be heavier than a safe oil. Astral oil illustrates this. While it does not flash below 125° Fah., its gravity is 49° B. Poor kerosene flashes at 86° Fah., but has a gravity of 47° B.

Kerosene when properly refined is nearly colorless by transmitted light and slightly fluorescent by reflected light. Its density should be about 43° B. At ordinary temperatures it should extinguish a match as readily as water without becoming inflamed or *flashing*, and when heated it should not evolve an inflammable vapor below 110° Fah., and should not take fire below 125° to 140° Fah.

As the temperature in a burning lamp rarely exceeds 100° Fah., such an oil would be safe. It would produce no vapors to mix with the air in the lamp and make an explosive mixture, and if the lamp were overturned or broken the oil would not take fire.

The standard which has generally been adopted by law as a safe one fixes the flashing point at 100° Fah., or higher.

Professor Chandler, President of the New York City Board of Health, says: "Out of 736 samples of kerosene oil tested by me, only 28 were really safe, all the rest evolving inflammable vapor below 100° Fah." In his paper on the temperature of oil in lamps (*American Chemist*, August, 1872, p. 43) Dr. Chandler has shown that in some cases the temperature of their contents often rises above 100° Fah.

STATE TAXATION OF PATENTED ARTICLES.

We publish, in another column, an interesting decision by the Supreme Court of the United States, in which the question of the right of a State to enforce its local tax or license laws as against the sale of patented articles is once more considered and adjudicated. The defendant having refused to pay a county tax in Henrico County, Va., was indicted and found guilty. One of the points in the defense was that the sales related to patented articles, and that no State had a right to hinder such sales by taxation.

On appeal, the United States Supreme Court decides, in this case (and it has so held in other cases), that venders of patented goods must, like other people, conform to the State laws. The patent laws, it is true, confer on patentees the exclusive right to sell their inventions and discoveries, but this does not apply to tangible property or goods. The patentee may sell rights, licenses, and privileges of all kinds under his patent, and no State has the right to interpose any law, tax, or penalty to hinder or prevent such selling. This patented right relates to the invention or discovery, and is an incorporeal right which the State cannot interfere with. But whatever rights are secured to inventors must be enjoyed in subordination to the general authority of the State over all property within its limits. Hence the State may tax all sales of goods, whether they are patented or not. No tax, however, can be imposed upon a patent, or on any sales relating to rights thereunder.

The Supreme Court also held, in the case above referred to, that all State laws that discriminate in favor of citizens resident in such State, and against citizens of other States, are invalid. The State of Virginia cannot exempt its own citizens from license taxes, and impose them upon citizens of New York when they visit Virginia. To do so would be to regulate commerce, which, under the Constitution, is a national, not a State, right.

BUTTER COLORING.

It is a fact not generally known that much—it might be said nearly all—of the butter offered for sale in our large cities owes its "rich golden color" to artificial additions. The dairyman, as well as the butter dealer, has found that butter of a *good color* commands a readier sale than pale butter, and as a color is so easily and cheaply procured the temptation to improve (or, at least, to equalize) the natural tint of the commodity is not to be resisted. As long as the coloring matters used are harmless there can be no valid objection urged against the practice, and we have no reason to believe that anything really pernicious has thus been introduced into our food—at least of late years.

The coloring matters commonly employed are annatto and turmeric, or extracts of these; but there are also a number of butter-coloring compounds or mixtures sold for this purpose. For some of these it is claimed that they will not only impart the desired color to butter, but will keep it sweet and *fresh* for an indefinite time. The following are a few of these coloring compounds in use at present. Rorick's compound is prepared as follows:

The materials for 1,000 pounds of butter are:

Lard, butter, or olive oil	6	pounds.
Annatto	6	ounces.
Turmeric	1	ounce.
Salt	10	ounces.
Niter	½	ounce.
Bromochloralum	3½	ounces.
Water	q. s.	

The lard, butter, or oil is put into a pan and heated in a water bath. The annatto and turmeric are then stirred into a thin paste with water, and this is gradually added to the fatty or oily matters kept at a temperature of about 110° Fah. The salt and niter are next stirred in, and the mixture heated to boiling. The heating is continued for from twelve to twenty-four hours, or until the color of the mixture becomes dark enough. The bromochloralum is then introduced and the mass is agitated until cold, when it is put up in sealed cans.

Bogart's preparation is prepared as follows:

The materials employed are:

Annattoine	5	ounces.
Turmeric (pulverized)	6	"
Saffron	1	ounce.
Lard oil	1	pint.
Butter	5	pounds.

The butter is first melted in a pan over the water bath and strained through a fine linen cloth. The saffron is made into a half pint tincture, and, together with the turmeric and annattoine, is gradually stirred into the hot butter and oil and boiled and stirred for about fifteen minutes. It is then strained through a cloth as before and stirred until cool.

Dake's butter coloring is prepared by heating a quantity of fresh butter for some time with annatto, by which means the coloring matter of the butter is extracted, and straining the colored oil and stirring it until cold.

THE TAILS OF COMETS.

Camille Flammarion, in a paper read before the French Academy of Sciences, on the recent comet, says:

In my observations on this comet I have devoted myself principally to an examination of its physical aspect. This examination appears to lead to conclusions which are different from the opinions generally adopted as to the nature of cometary tails. . . . The perfect transparency of these trains of light leads us to think that they are *not material*, that they are not gases driven back into space by a repulsive solar force, but that they are an excitation—electric or otherwise—of ether produced by the mysterious star, on the side opposite from the sun, we might almost say in the line of its shadow!

On the 24th of December, 1811, Piazzi observed at Palermo, through the tail of the celebrated comet of that year, the stars P. XX., 149, and P. XX., 197, which, instead of being more or less obscured, were seen to be *more luminous*. . . . Apropos of these unexplained physical phenomena, let us dwell for a moment on the assuredly extraordinary circumstance which occurred last year, and which was only the renewal of one of the same kind observed already in 1843. On the 28th of January, 1880, at 36 minutes past 11 o'clock in the morning, the great comet discovered in the Southern hemisphere passed to its perhelion at 150,000 miles only from the solar surface. In adopting the figure 90,000 miles as the diameter of the head—the figure generally adopted also for the comet of 1843 (which, moreover, appears to be definitely the same as that of 1880), we see that from surface to surface there was only 108,000 miles. The proximity was more surprising still on the 27th of February, 1843. The two celestial bodies brushed each other at 33,000 miles only—that is to say, the comet traversed the solar atmosphere at a height less than that of the corona, and even of that of the protuberances, several of which have been ascertained to measure 200,000 miles in height. Now at these two epochs the comet was accompanied by a narrow and rectilinear train, which it car-

ried with it always on the side away from the sun, and which stretched out 125, 150, and even 200 millions of miles in length. To make in two hours a half revolution of the sun, it rushed along with a velocity of 167,700 feet per second (perhelion of 1843)—a velocity of the elliptical order, considering the fearful attraction of the sun, but which would have become rapidly parabolic at a little greater distance. Now at the distance of the earth, at 95 millions of miles, the rectilinear and rigid tail must have swept space with a velocity of over 19,500,000 feet per second!

Does not this circumstance, which has presented itself to our eyes twice in thirty-seven years, taken in connection with the perfect transparency of these trains of light, lead to the consequence that *the tails of comets cannot be material?* Is it an electrical illumination of the ether? Is it an undulatory motion excited by the comet itself on the side opposite from the sun? We do not as yet know all the forces of Nature.

A STRANGE EXPLOSION.

To the Editor of the Scientific American:

I was recently called upon by Professor S. P. Langley, Director of the Alleghany Observatory, to silver three heliostat mirrors for him that he intended to use in his present expedition to the Sierra Nevada Mountains. These mirrors he wanted with a surface as perfect as could be made, and they were to be so bright from the bath as to need absolutely no retouches with a polishing pad, as the microscopic scratches produced by the pad would be detrimental to his experiment. The silvering was a success; a beautiful and fine reflecting surface being obtained from the bath.

In making one of the solutions, I had put 240 grains nitrate silver in 2 oz. distilled water, and 240 grains absolutely pure potassa in the same amount of water; each in separate vessels. I now poured them together, with the usual result. The silver was precipitated in the form of a grayish brown oxide. I then poured in aqua ammonia to redissolve the silver, but for some cause unknown to me, after pouring in fully seven ounces of ammonia, three times the usual amount, the precipitate would not dissolve, and I gave it up for a bad job, as an excess of ammonia always causes a thin deposit of silver. I poured the solution into a pint jelly glass and set it on top of my writing desk with simply a bit of paper over it to keep the dust out.

Three days afterward, at about two o'clock in the afternoon, I sat down at the desk to answer a letter, but before I finished it I was called out of my shop, and I think I was not away three minutes when a fearful explosion was heard in the shop. I hurried in, as also did the neighbors, and I found my shop literally strewn with glass fragments of silvering dishes, bottles, graduates, and funnels, and the sides of the shop floor and roof splattered all over with particles of glass as fine as dust. Every place the solution had touched was turning brown. The crash was heard for a great distance, and the wreck was complete. The force of the explosion caused the bottom of the glass to embed itself fully a quarter of an inch deep into the hard cherry wood, showing that it must have been very powerful, the glass itself being blown into atoms. The thermometer marked 96 in the shade about the time of the explosion. Now I would like some of your chemical readers to explain this, if it is explainable. Did the fulminate of silver form in any way? The vessel being open a gas could not have done such destructive work. It was fortunate for me that I was called out when I was, or I should likely have lost a pair of valuable eyes. Of course I shall leave no such solution stand even uncovered hereafter. Nevertheless I should like to know what caused the explosion.

I. A. BRASHEAR.

Pittsburg, Pa., July 23, 1881.

[REMARKS.—The explosive in Mr. Brashear's case was Berthollet's fulminating silver, a very curious and dangerous substance which results from the action of ammonia on oxide of silver. A very good receipt for producing it, is as follows: Digest freshly precipitated oxide of silver in strong liquor of ammonia for twelve or fifteen hours, then pour off the liquid, and cautiously dry the black crystalline powder which remains and which is the fulminate. Also the decanted ammonia contains some fulminate, and this will be deposited on cooling after gentle warming of the liquid or on spontaneous evaporation. Only a very few grains of oxide of silver should be used in a single operation.

Mr. Brashear had in his jelly glass freshly precipitated oxide of silver and ammonia, and the digestion went on, all as the receipt prescribes. There was also in the glass nitrate of potash, which probably was an inactive substance, for it did not prevent the formation of the fulminate. Perhaps there was present for the explosion about as much fulminate as was possible to produce from 240 grains of nitrate of silver.

The Berthollet fulminate is one of the most unmanageable and dangerous of known explosives. One writer says: "This compound is exploded by the slightest friction or percussion, and should therefore be only made in very small quantities at a time and handled with great caution. Its explosive powers are tremendous; in fact it can hardly be handled with safety, even in the moist state. Many frightful accidents have happened from the spontaneous explosion of this substance."

It is a singular fact that this fulminate is mentioned by only a few of the modern treatises on chemistry, and that although it was discovered in the last century very little is known of its chemical relations. The fullest accounts of it are to be found in books which are now obsolete. We quote a few sentences about it from Akin's Dictionary of Chemistry, London, 1807: "Even when still wet if it be pressed upon with a hammer, or any hard body, it fulminates with extreme violence, but when dry, the touch of a slender wire or even a feather, or a heat of about 96° is sufficient to make it explode. Even a moderate concussion of the air is sufficient, so that a heap may be exploded by the concussion of any other in its immediate neighborhood. Sometimes too it will go off in the hand, when carrying from one place to another, so that in fact when it is once dry, the operator should be prepared for the explosion at any time, even with the most careful handling."

Berthollet's fulminate must not be confounded with the ordinary fulminate of silver which is employed in the toy torpedoes, and which is made by heating a mixture of nitrate of silver, alcohol, and nitric acid. The latter, although a terrific explosive, is comparatively safe.—ED.]

DUST EXPLOSION IN EHRET'S BREWERY.

The splendid building owned and occupied by Mr. Geo. Ehret, as a lager beer brewery, located between 92d and 93d streets, and 2d and 3d avenues, N. Y., was injured on the 30th of July, 1881, by an explosion of malt dust, which also set it on fire. It is one of the finest breweries in the country, seven stories high, and ornamented elaborately with insignia of the business and samples of fine bricklaying. Our engraving gives an idea of the magnitude of the structure. The crushed malt from the malt crushing machines in the lower part of the building is carried by an endless belt elevator through a closed box to an upper chamber in the top of the tower, whence the malt is distributed for brewing through spouts to all parts of the building. The fine dust occasioned by the crushing is suspended in

DUST EXPLOSION IN EHRET'S BREWERY.

the air in the chamber, and in this condition it will burn with explosive rapidity when ignited. The distributing chamber of the central system of this establishment was located on the upper floor, formed by a light transverse partition in the room beneath the clock tower, the lower end of the elevator being on the third floor, just below the crushing rolls which were on the fourth floor. The initial explosion, which was followed by two or three secondary ones, or noises like explosions, and the fire, took place at or near the upper part of the elevator case, bursting out a small area of perhaps its weakest part. The margin of the opening was scorched and splintered, but not set on fire, and the ceiling boards in the vicinity were also scorched as though they had been exposed to a flash of gunpowder.

The fire, however, appears to have originated in the attic above the malt bins in the western wing, which was probably the location of the second, and, perhaps, third explosions, if such really occurred. To persons inside of the building the falling of the bricks into the street and upon the roof of the two-story extension might have been mistaken for explosions of dust. The flat portion of the main roof of the western wing was lifted and took fire, and the iron stairway and ornamental railings were broken and thrown about. The sloping mansard roof at the western end, together with the metal cornice and the upper part of the brick wall, was blown out and fell through the roof of the two-story extension of the western wing into the dry room above the boilers, luckily going no farther in that direction. Near the location of the initial explosion at the center of the north front, the ornamented gable of the transept was blown out and fell into the street, where some very narrow escapes of people from sudden destruction are said to have occurred. The timely appearance of firemen upon the scene and their prompt efforts soon subdued the flames and saved this fine structure, but a large quantity of stored malt was ruined by water.

In regard to the frequency of this class of explosions, the *Times* has the following:

"Mr. Hasslocher, the superintendent, and several of Mr. Ehret's employes, spoke of the occurrence as being far from extraordinary. On the 4th of July, 1880, a common lucifer match among the malt was ignited in the malt mill, in which are two steel grinders, which make about 150 revolutions a minute. The flash of the match set fire to dust in the elevator, and an explosion occurred which did about $2,000 damage. Similar explosions have recently occurred at Huppfel's brewery and at Ruppert's. A pebble or a piece of steel among the malt in the mill could produce a spark which, if it came in contact with the saccharine fine dust in the elevator, would cause either a flash or an explosion according to the quantity of dust in the air. Just as good a flash can be produced with this malt dust as with lycopodium spores, which were once used in theaters to simulate lightning."

The same journal also says of the lecture of Prof. L. W. Peck, which was delivered in May, 1878: "He illustrates the theory that dust mixed with air is not only combustible, but explosive, by saying: 'If a large log of wood were ignited it might be a week before being entirely consumed. Split it up into cord wood, and pile it up loosely, and it would burn in a couple of hours. Again, split it up into kindling wood, pile it up loosely, and perhaps it would burn in less than an hour. Cut it up into shavings and allow a strong wind to throw them in the air, or in any way keep the chips comparatively well separated from each other, and the log would, perhaps, be consumed in two or three minutes; or, finally, grind it up into a fine dust or powder, blow it in such a manner that each particle is surrounded by air, and it would burn in less than a second.' Prof. Peck instanced the burning of the Washburn, Diamond, and Humboldt Mills on the 2d May, 1878, at Minneapolis. This fire was due to the explosion of particles of flour and bran mixed with air, and the force of the explosion was so great as to throw down walls six feet thick, and sheets of iron from the roof of the Washburn Mills were thrown so high in the air that they were carried away by the wind a distance of two miles. He also cited the fire in Greenfield's candy factory, in Barclay street, New York, on the 20th of December, 1877, as one which 'no one need regard as a mystery,' as large quantities of starch and sugar were kept there, and could have been thrown into the air by minor disturbances. Prof. Peck, by numerous and interesting experiments, demonstrated the explosive force of fine dust mixed with air and ignited under proper and favorable conditions. The lid of a box of two cubic feet capacity, with a man standing on it, was raised when flour blown on to a light within was ignited. In a similar experiment, dust from a factory gave similar results."

In the back volumes of the SCIENTIFIC AMERICAN and SUPPLEMENT will be found recorded a number of cases of disastrous dust explosions. One of the most fearful was that which took place at the Albion coal mines, Nova Scotia, last year.

Another Trial of the English Yacht Anthracite.

A recent letter from the Secretary of the Perkins Engine Company, Major George Dean, of London, England, informs us that a third economic trial of the machinery of the little Anthracite has lately been made by F. J. Bramwell, Esq., C.E., F.R.S., assisted by William Rich, Esq., C.E., while the vessel was running under steam on the river Thames. The letter accompanies an extended report of the three rigid trial tests that have now been made, the first and last of which were conducted by Mr. Bramwell, while the yacht was running on the river Thames, and the second, by a Board of United States Naval Engineers, Chief Engineer C. H. Loring, President, pursuant to orders from the Secretary of the Navy, while the vessel was tied to the wharf in the New York Navy Yard, August 13 and 14, 1880.

This vessel was fully described in current numbers of the SCIENTIFIC AMERICAN and SUPPLEMENT, and illustrated in the SCIENTIFIC AMERICAN, under date of August 7, 1880, by means of a large engraving, which shows her in elevation and section, and her machinery somewhat in detail.

It appears from the last report that since her successful voyage to America, the yacht has been fitted with a new propeller, and that she now has beaten her own record both as to power developed and economic performance, yielding a horse-power at the expense of 1·66 pounds of coal, and showing a gross of about 110 indicated horse-power, against 1·7 pounds of coal at the first trial, and 2·7 pounds at the second trial, with, respectively, a gross development of 80·9 and 80·15 horse-power. In regard to the apparently wide difference between the American and the first English tests, the Report of the Naval Board says: "A cursory glance at the cost of the indicated horse-power, in pounds of coal consumed per hour during the two experiments, shows the wide difference between 2·7115 pounds in our experiment and 1·7114 pounds in Mr. Bramwell's, or that the economic results in the latter were $\left(\frac{(2\cdot7115-1\cdot7114)100}{2\cdot7115}\right)=36\cdot88$ per centum superior to those in the former. This great difference, however, is only found when the crude coal is employed as the measure of the cost, and it includes not only the difference due to the condition of the steam (meaning as to superheat) in the two experiments, but the difference in the evaporative power of the coals."

Major Dean in his letter properly says of these trials: "Though differing, all bear such a favorable testimony to the value of the Perkins system, that the comparison will do much to help those interested in steam to judge for themselves as to the advantages claimed."

NEW INVENTIONS.

Messrs. Edward W. Chambers and Thomas P. Burnett, of Springfield, Ohio, have patented an improved chair for theaters, churches, halls, etc., which can be folded very easily and compactly. The invention consists in a chair in which the back is pivoted to the rear end of the seat, which is pivoted to two standards and to the arm rests, which are pivoted to the tops of the standards, so that the back will move toward the standards and the arm rests will be inclined downward, thus occupying very little space when the seat is raised.

An improved washing machine, patented by Mr. Alexander Fleming, of Orleans, Iowa, washes clothes by pumping or forcing water through them.

Mr. James Rankin, of Fairlee, Md., has patented an improvement in guano distributers arranged on the frame of a seed drill; and it consists of a guano hopper provided with a series of openings or slots in its bottom, in each of which slots projects a part of the circumference of a revolving wheel provided with a central groove, which receives and carries the guano to the seed spout, a roll provided with arms and staples and passing longitudinally through the hopper being employed to force the guano into the grooved wheels.

An improved trip hammer has been patented by Mr. Solomon Shetter, of New Cumberland, W. Va. This invention relates to a means for regulating the force of the blow given by the hammer, and for entirely stopping the motion of the hammer with ease and celerity without stopping the engine or other motive power by which the hammer is driven, and without the necessity for shifting a belt from a fast to a loose pulley.

An improved stop-cock has been patented by Mr. John Flanagan, of Newburg, N. Y. The invention consists in constructing a stop-cock with an inclined or slightly curved branch pipe, so that a steam tube can be readily inserted through or a force pump connected with the stop-cock for thawing out or removing obstructions from pipes.

Mr. William T. Hall, of Fayetteville, Ind., has patented a charge holder for firearms, a device for use in loading shot-guns and rifles, which can be more conveniently used than an ordinary powder flask and shot pouch, and by which the arm can be rapidly loaded. The invention consists in a shell or tube of a suitable size for holding a single charge and wad, and fitted with a finger slide for pressing out the wad, so that the charge can be poured into the gun.

Elegant New Western Steamer.

The Louisville *Courier Journal* says of the new Anchor Line steamer: Again the famous Howards, of Jeffersonville, come to the front by building as handsome and fleet a steamboat as ever graced the waters of our rivers. They have built a number of magnificent side-wheel passenger steamboats for the St. Louis and New Orleans Anchor Line, among which we may mention the more recent of which are the Belle of Memphis, City of Helena, City of Greenville, and City of Providence—all of which are noted for their speed, beauty, and elegance. Now they have finished and sent home the new City of Vicksburg, a twin of the steamer City of Providence—an exact copy of the last named steamer. The dimensions of the City of Vicksburg are as follows: Length of hull 280 feet, depth of hold 8½ feet, with 44 feet beam, all oak, well ironed, and fastened extra strong. The guards are 17 feet in width, giving the boat an extreme width of 78 feet and a carrying capacity of 1,600 tons. She has an easy model, with draught light, in running trim, of only 43 inches, making her a great business boat, and a real beauty. The machinery, from the foundry of Ainslie, Cochran & Co., of this city, is a perfect specimen of their handiwork. It is high-pressure, embracing cylinder 26 inches in diameter, with 9 feet stroke; working water wheels 34 feet in diameter, with 15 feet length of buckets. The steam power lies in five main boilers, each 30 feet in length and 44 inches in diameter, with four return flues in each, which give her an abundance of steam, and with her good model and light draught gives an assurance of being very fast. All the appliances required by the steamboat law, as well as those suggested by the advance of the age for safety, are in this boat, including extra boilers for the auxiliary engines—doctor, donkey, and steam pumps. The main saloon is 190 feet in length, 16 feet wide, and 13 feet 6 inches in height, exclusive of the arches. The interior is painted a pure French zinc white in gloss, requiring nine coats, which, together with the gold etchings and reliefs, taxed the utmost skill and patience of the artists in completing its beauties. In contrast or relief the state room doors are of hard wood, polished walnut, decorated or embossed in gold. The texas or upper cabin is 110 feet in length, and admirably furnished for passengers and the officers of the boat.

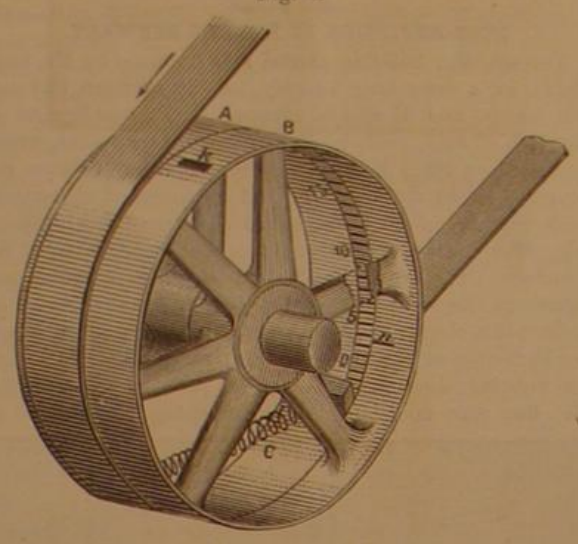
LATCHINOFF'S OPTICAL DYNAMOMETER.

Among the dynamometers employed for measuring the work absorbed by any machine, the one oftenest used is that of Morin, which traces a curve representative of the work. This instrument gives precise indications, but takes up much space.

I have undertaken to construct a dynamometer sufficently simple to be adapted to any kind of a machine whatever.

The improvements that have recently been made in machines for the production of light and in electric motors are rendering more and more necessary an apparatus which shall permit of measuring the effective power expended in setting in motion any given dynamo-electric machine. It is only with a like apparatus that can be determined the best conditions of performance; be compared the value of

Fig. 4.



the different apparatus; and be resolved a host of questions which, up to the present time, have been only approximately answered, their solution demanding a measurement of the work, and the Morin dynamometer being too costly, and too difficult to mount to be readily used.

My dynamometer is applicable to all swiftly revolving machines, and especially to dynamo-electric ones. The following is a description of it:

Upon the driving shaft are placed two pulleys, A and B (Fig. 1), connected with each other by the springs, C (Figs. 2, 3, and 4). A is a loose pulley, and B is fixed to the shaft. The belt, D (Fig. 1), moves the pulley, A, which, in revolving, first stretches the springs, C, and then puts the machine in motion. The stress exerted is measured by the tension of the springs. For estimating this tension I have made practical use of the principle of the phenakisticope, which is based on the persistence of luminous impressions upon the retina.

In the rim of the pulley, B, there is a slit, *k* (Figs. 1 and 4), and opposite to it, on the inside of the same rim, there is traced a very heavy line, *n*, in such a way as not to be hidden by the axle. If, while the pulleys are rapidly revolving, we look at the line, *n*, through the slit, *k*, it appears to be immovable.

Figs. 1 and 2.

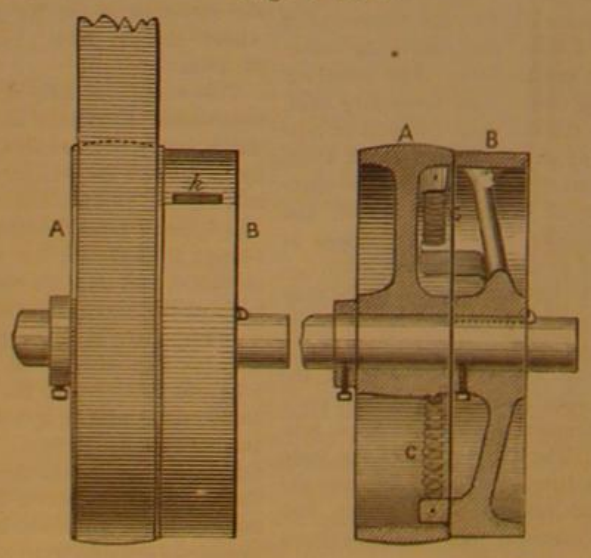
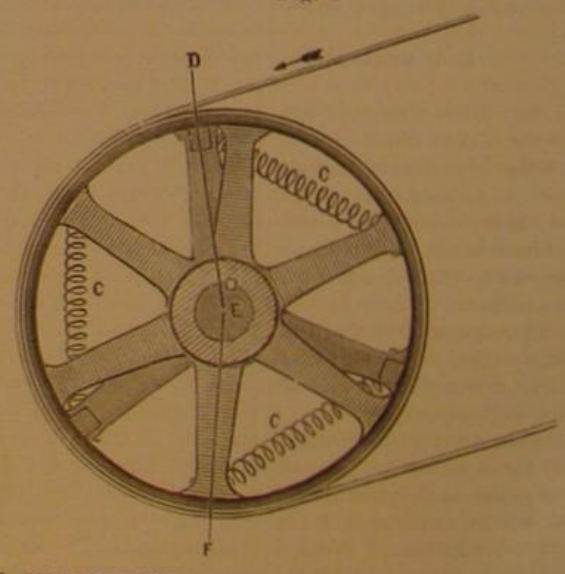


Fig. 3



LATCHINOFF'S OPTICAL DYNAMOMETER.

The inside of the rim of the pulley, A, is provided with a scale, which is made in the following way:

The pulley, B, is made immovable, and against the line, *n*, there is traced on the pulley, A, a zero mark; then, from the loose pulley there are suspended, by means of a cord, weights of five, ten, fifteen, etc., kilogrammes. At the different positions of *n*, corresponding to these weights, there are traced marks which constitute the scale.

During the working of the machine this scale will appear to be stationary, and one may distinctly see what division of the scale the line, *n*, is opposite. In this way it is easy to ascertain in kilogrammes the stress exerted on the pulley.

In order to calculate the work absorbed by the machine it is necessary to know the diameter of the pulleys and the number of revolutions of the machine. If a mechanical counter had to be employed, the process would be inconvenient and not very exact; but fortunately we have excellent trochometers at present which are based on centrifugal force, and which allow of the number of revolutions of the machine being directly read upon a dial, so that a glance through the slit in the pulley and at the dial of the trochometer gives the elements that are necessary to calculate the work. For greater convenience, the scale inside the pulley should be well lighted by a lamp having a reflector.

During the working of the machine the scale will not be absolutely immovable, but will have a backward and forward motion corresponding to that of the steam-engine, because the fly-wheel does not render the working of the machine entirely regular.

I shall not describe in this place the mode of fixing the pulleys, springs, and other parts, since such details are sufficiently indicated by the accompanying figure. I will only remark that the dynamo-electric machine is placed to the left of the pulley, A.

We might also measure the tension of the springs in a purely mechanical way, by causing an index needle to move over a dial by the aid of a screw passing along the shaft. I did at first think of adopting this method, but it seemed to me too complicated, so I abandoned it.

The advantages of my dynamometer are the following: (1.) It is very simple and of small dimensions, and may always remain fixed to the machine.* (2.) It requires no preliminary installation nor any calculation, a glance being sufficient to determine the work. (3.) It may be easily verified by suspending from the pulley, A, different weights, and seeing whether the divisions of the scale correspond with the latter.

The springs, by stretching through long use, may cause a deviation of the zero of the scale; but the divisions will not perceptibly change, even after the apparatus has worked for a long time.—*M. Latchinoff, in L'Electricité Russe.*

ENGINEERING INVENTIONS.

An improvement in car coupling has been patented by Mr. John H. B. McCray, of Blossom Prairie, Texas. This invention relates to self-couplers, and it consists of an open-top hook-shaped draw bar provided with a pivoted T-shaped vertically moving coupling bar, and provided also with an end socket for using the ordinary coupling link.

Mr. George E. Whipple, of Fort Edward, N. Y., has patented an improvement in that means for propelling vessels in which the water is drawn in through a longitudinal channel at the bow by a pump or other device and is discharged at the stern.

An improved direct-acting pumping engine has been patented by Mr. Edward G. Shortt, of Carthage, N. Y. The invention relates to certain improvements in that class of direct-acting steam pumps in which a single plunger is constructed at its upper end in the form of a piston to be acted upon by steam, while its lower end acts within a pump cylinder in connection with suitable ports and check valves, and in which the steam cylinder is in one and the same piece with the pump cylinder and in the vertical line of the same, with a valve chest and gear mounted upon the top of the same and operated through a connection with the piston.

Mr. Charles E. Macarthy, of Forsyth, Ga., has patented an improved car coupling, designed to couple the cars easily and securely by a lever under the car, and projecting at the side of the same, whereby all danger involved in going between the cars is avoided.

An improved packing for piston rods, pistons, etc., designed to secure a greater durability, to take up wear as fast as it occurs, and at the same time to form a tight joint, has been patented by Mr. Edward G. Shortt, of Carthage, N. Y.

An improved locomotive engine has been patented by Mr. Ephraim Shay, of Haring, Mich. The invention consists of a locomotive having its bogie wheels formed with bevel gear teeth combined with a horizontal and longitudinally arranged shaft, also having bevel gear wheels, the shaft being rotated by a direct connection with the engine; also, in novel means for providing for the horizontal and vertical adjustment of the connecting shaft between the crank shaft and the bogie wheels, and in novel means of conveying the power of the engine to said bogie wheels.

An improved machine for passing logs over dams has been patented by Mr. David B. Weaver, of Hopewell Township, Huntingdon County, Pa. This invention consists principally in providing the top of the dam with a strong beam or shaft having any suitable number of radial arms, the beam or shaft being adapted to be turned in its bearings by any suitable means for throwing logs over the dam.

* In order that the springs may not be strained too much, the belt should be kept constantly on the pulley, B, and shifted to the pulley, A, only during experiments.

Professor Sainte-Claire Deville.

The London *Chemical News* gives the following concise sketch of "one who, for the past thirty years, has had few equals and no superior in the fields of mineral chemistry and inorganic analysis." Etienne Henri Sainte-Claire Deville was born March 18, 1818, in the island of St. Thomas, in the West Indies. At an early age he manifested an ardent passion for the study of chemistry, which at that time found in France so many of its most distinguished professors. His abilities were manifested so early that at the age of twenty-six he was commissioned to organize the Faculty of Science, newly created in Franche Comté, and to preside over it as its dean. Here he undertook the analysis of the waters of the Doubs, and of the springs around the town of Besançon, and greatly improved the methods then known for water analysis. Shortly after, he succeeded in preparing nitric anhydride, which previously had been attempted in vain. Toluol was another of his discoveries. In his thirty-third year he succeeded Balard in the chemical chair at the Ecole Normale Supérieure, at Paris. Here his emoluments only reached the modest sum of 3,000 francs; chemistry in France, as well as in England, being supposed to be its own reward. His next researches related to the properties and the industrial preparation of aluminum—discoveries which attracted public attention throughout the world. He then turned his attention with signal success to the metallurgy of platinum, and its separation from its associated metals. His investigations on boron and silicon are also well worthy of notice, and his production of sodium at a cheap price has placed a powerful reagent in the hands of chemists, and has led the way to valuable results, both in the laboratory and in industrial establishments. His highest achievement, from a strictly scientific point of view, was the establishment of the laws of dissociation. Previously, decomposition was regarded as a simple phenomenon, effected and completed, in the case of every substance, at a fixed temperature. Deville showed that in some cases it is effected within certain limits of temperature, being arrested at a given heat by the equilibrium established between the decomposing body and the products of decomposition. A most admirable characteristic of the deceased *savant* was his strict accuracy—an attribute all the more deserving of honor in a man of his ardent and impetuous temperament. Among his pupils may be counted not a few of the most meritorious among the younger French chemists, such as Debray, Troost, Hautefeuille, Grandeau, Gernez, and others. M. Deville died on July 1st, at Boulogne-sur-Seine, and was buried on the 5th. His old friend, M. Pasteur, pronounced an eloquent and impressive *éloge* at the funeral. All honor to his memory, and may his experimental accuracy, which M. Pasteur calls the "probity of the chemist," find abundant imitators.

W. Milnor Roberts.

We are in receipt of the sad intelligence of the death by typhus fever, at Rio Janeiro, on the 14th of July, of Col. W. Milnor Roberts, past President of the American Society of Civil Engineers, and late Chief Engineer of Public Works of Brazil. We are indebted to *Engineering News* for the following:

Colonel Roberts was born in Philadelphia, February 12, 1810. His aptitude for mathematics early introduced him to the then new profession of civil engineering, and in the spring of 1825 he received his first appointment as a chainman of the Union Canal, of which Canvass White was chief engineer, and Sylvester Welch, locating engineer. At 18 years of age he was appointed engineer in charge of the most difficult division of the Lehigh Canal, from Mauch Chunk down, sixteen miles, and from that time forward he was always intimately connected with great canal and railway enterprises, principally in Pennsylvania and New York States, with intervals in Brazil and in the Western States. He held important offices under the United States Government, was Chief Engineer of the Northern Pacific Railway, Associate Chief Engineer of the St. Louis Bridge, and an active and important member of the Mississippi Jetty Commission. In 1879, shortly previous to his departure for Brazil, Colonel Roberts was elected President of the American Society of Civil Engineers, a society of which he was a very active and always interested member, and which will very keenly feel his loss. Though so far advanced in years, Colonel Roberts was an unusually active and energetic man, and some idea of the extent and difficulty of his labors in Brazil may be gathered from letters which have been published in this journal during the past two years. Colonel Roberts was possessed of a most genial and kindly disposition, and the news of his death will be received with feelings of great sorrow by the entire profession of which he was a member, as well as by a very large list of friends in this and other countries where he was known.

Improvement in the Paper Trade.

From statistics presented to the meeting of the American Papermakers' Association, which met at Saratoga on the 27th of July, 1881, it appears that 307 manufacturers had offered 897 tons for export without limit as to price. The increase, according to the report of the committee on export business, in the export of paper in 1880 over 1879 had been 16,500 tons. Statements were also made by prominent members to the effect that the out-put of the paper mills had been fully 25 per cent over that of the previous year, and paper is now sold as low in New York as in London

The total capacity of all the mills in the country is now 2,500 tons per day of all kinds of paper.

NEW RAIL FASTENING.

The engraving shows a new fastening for securing rails and chairs to the railway ties and sleepers recently patented by Mr. Isaac K. Bennett, of Moosup, Conn. Fig. 1 is a plan view of the chair and cushion, and Fig. 2 is a vertical transverse section of the chair, showing the rail in position. The chair, B, is secured to the tie or sleeper by square-headed spikes passing through holes in the bottom into the timbers. A rubber pad, B, is placed in the cavity of the

Fig 1

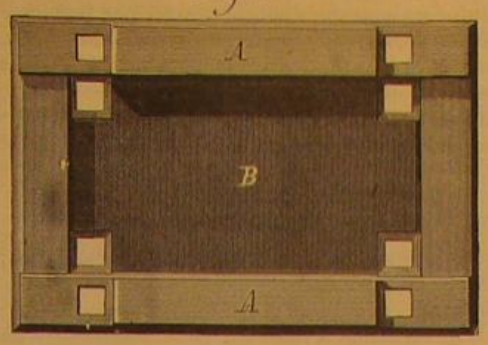
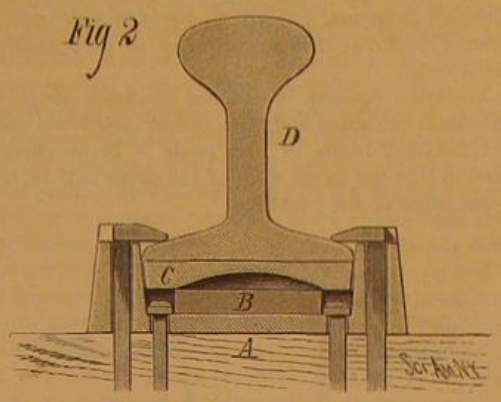


Fig 2



BENNETT'S RAIL FASTENING.

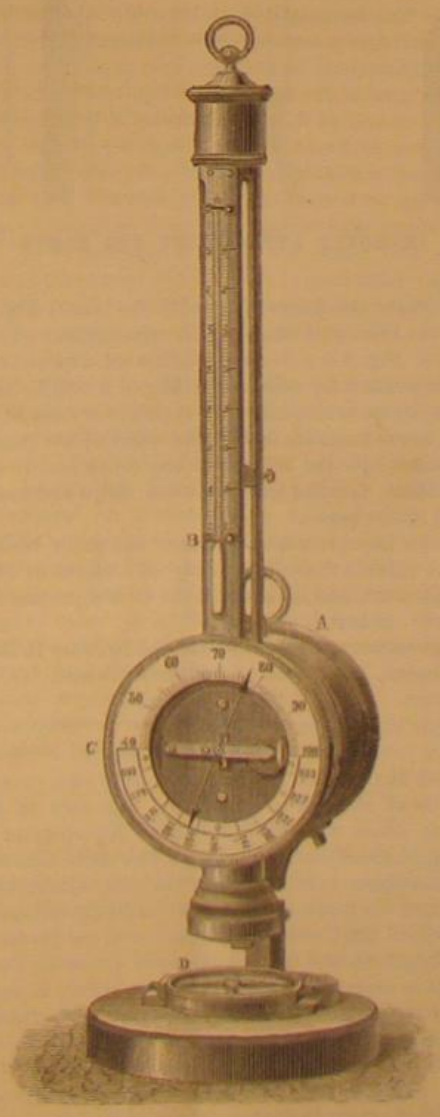
chair and covered with a metal plate, C, which fits the cavity in the chair, and is concaved on its under surface, forming an air cushion. The rail, D, rests on the plate, C, and is secured by hook-headed spikes passing through square holes in the chair into the timbers.

This method of fastening gives great elasticity to the joint and prevents hammering the rails end and bruising the ties.

This device may, with advantage, be applied to the middle or other portions of the rail.

PORTABLE METEOROLOGICAL STATION.

Under this name is designated an instrument especially adapted for the use of travelers in mountain excursions in



PORTABLE METEOROLOGICAL STATION.

order that they may be able to observe and accurately register the different atmospheric phenomena they experience, and so fill the gap that generally exists in the history of Alpine and other ascensions.

This instrument is so arranged that it can, in any place, conveniently and exactly determine the most important meteorological phenomena, the pressure and temperature of the air, and its degree of humidity. It is a combination of a barometer, thermometer, hygrometer, and compass, arranged in a small case that can easily be carried, as it weighs only one kilogramme.

The different parts are so perfectly balanced that the instrument can be used in any position and can stand without injury the rough usage of mountain traveling.

The barometer, A, is the aneroid, a well known instrument, and is especially adapted to show the pressure of the atmosphere and the elevation of the place of observation above the sea level.

The temperature is shown by a mercurial thermometer, B, fixed on a copper tube, that forms a general support for the whole apparatus. The thermometer registers the centigrade system from 25° below zero to 40° above.

The degree of humidity in the atmosphere is determined by a Saussure hair hygrometer, which is slightly modified in this apparatus. A well constructed hair hygrometer gives results sufficiently accurate for general meteorological observations, as the hairs work regularly, and their small bulk causes them to be easily affected by the surrounding air, which is a great advantage when there are only a few moments to make an observation.

This hygrometer is the only one available for those altitudes where the temperature is below zero, and where, consequently, neither the psychrometer nor the condensing hygrometer could be used.

Another advantage is that it shows immediately the degree of humidity, for a table, inscribed on the semi-circumference, C, of the circle, gives in a moment the equivalent of the degrees of the hygrometer in the fractions of saturation of the air.

By this method we can make most interesting comparisons of the humidity of the fogs and mists that are encountered on the mountains and in the vicinity of elevated lakes.

It is easy to see the utility of the compass, D, which shows the position of the country, and is especially useful to the traveler, when exploring an unknown place or surrounded by a heavy fog. The direction of the wind can also be easily ascertained by tying a piece of ribbon to the ring at the top of the instrument, and so making it still more useful.—*La Nature.*

STEAM-BOILER NOTES.

It will be remembered by those who gave attention to the subject of steam-boiler construction, how the steel plates used by Messrs. Elder & Co., of Glasgow, in the construction of the boilers of the Livadia, the Russian war yacht, behaved in the most capricious manner, after having passed the tests that are approved by Lloyds, the Admiralty, and the Board of Trade, and how since that event the attention of civil, metallurgical, and mechanical engineers throughout the civilized world has been drawn to the subject of so-called mild steel as a structural material for engineering works.

According to a recent report on the behavior of the steel plates above mentioned, by W. Parker, Esq., chief engineer surveyor of Lloyds' Register, which was read at a meeting of the Institute of Naval Architects of England, it appears that, up to the date of the Russian event, Mr. Parker and his colleagues of the Lloyds' Register had never observed a single instance of brittle steel plates during their manipulation of 17,000 tons that entered into the composition of no less than 1,100 steel boilers now in use in steamships.

The report shows that, during the construction of these Russian boilers (which were 14 feet 3 inches diameter, with triple-riveted lapped longitudinal seams, plates ¾ inch thick) a plate fell from the slings on to a piece of metal, the shock of which cracked it between the rivet holes at a distance from the place that received the blow; thereupon all the plates were annealed in a furnace specially adapted for the purpose.

The first boiler that was tested after completion gave way in three places before the required pressure, 140 pounds, was reached, and the second gave way in anticipation of the test; in other words, it was found to be cracked by those who were about to test it in a similar manner behind the rivet holes.

In the general chemical analysis which followed their failure nothing seems to have been found to warrant such conduct on the part of these plates. But the appearance of the fracture indicated that the metal was not of uniform structure throughout the thickness of the plate, and a series of special analyses performed on successive layers, each ⅛ thick, planed off, showed that there was a notable difference in the chemical composition of the middle as compared with the surface layers of the plate. There was more carbon, more phosphorus, and more sulphur in the intermediate layers; of carbon and sulphur they contained nearly double, at the middle, the average quantity of all the layers. Mr. Parker concludes from his investigation that there is nothing but the want of uniformity of structure to account for the singular freaks of these plates. He says: "The tensile strength was not reduced by the punching, but the plates, where punched, were *extremely brittle.*"

In 1848 the ex-Commissioner of Patents, in his report, which was published in the SCIENTIFIC AMERICAN of May 19,

1849, gives it as his deliberate opinion that the best remedy for boiler explosions is making the steamboat masters and other owners of exploded boilers liable for damages, and he recommends that property of such owners be held as a lien to respond to damages to plaintiffs, and that members of corporations be held jointly and severally liable. Whatever may be said of the justice of such legal enactments as the ex Commissioner then recommended, there seems to be little doubt that the effect would be salutary, inasmuch as it would cause steam users to look a little closer into the principles that underlie proper construction and preservation at full initial strength of their steam generators. It would thus promote a community of interests and tend to diffuse correct technical knowledge of the subject, and prevent its concentration among professional experts at whose mercy steam users, as a rule, are now compelled to move.

It appears from the local press of Detroit that the *boiler inspection and engineers' license* ordinance, as originally drawn and vetoed by the mayor, is about to be modified and another effort made to secure its adoption. The suggestions of the mayor relative to inspections will be adopted, at least in part, and provision made for appeal. The local engineers' association, it is claimed, approve the proposition to license them. They are to be divided into three classes, the license fees to be scaled so that they will pay the salaries of an inspector and an assistant.

Wagner's *Jahresbericht* warns against the use of copperas for the prevention of incrustation in boilers, as the acidity of most of the copperas products causes very destructive action of the boiler iron. The use of copperas was some time ago recommended by certain parties, who also patented it, and it has been tried in several works. At the time of its first coming out, a great many parties and authorities in this branch strongly opposed its use, but nevertheless many victims had to pay dearly for the experience they have now acquired. Things of this kind occur too often for our times, and inventions of doubtful merit are too often accepted as valuable additions to industrial purposes. They should be examined, not only by practical, but also by scientific authorities. Practice is a good thing, but theory combined with practice is far better, not only for the pockets of manufacturers, but also for the advancement of industry in general.

A portable steam boiler exploded at Decatur, Ills., on the 28th of July, causing a loss of $1,200 to L. F. Webb; nobody killed.

The locomotive of a freight train on the Chicago and North Western Railroad exploded on the 31st of July, about 14 miles from Milwaukee. A brakeman was killed and the engineer and fireman were severely injured. Five cars were demolished and the rails were torn up for some distance.

Since the explosion of the still at the Woolner Distillery on the 30th of July, Ignatius Woolner, Henry Cashin, Charles Hebner, John Kirkland, William Reif, Henry Goetz, William and Fritz Fehl, William Rice, August Stetler, and Theobold Seiler have died from the effect of injuries received, making twelve persons who have died. Thomas Lawless and William Fehl will probably die, in which case but four will remain out of the eighteen who were injured by the explosion. Nearly all the victims inhaled the escaping steam, and their sufferings have been intense.

The verdict of the coroner's jury is that the explosion was caused by an unnecessary pressure of steam in the still.

At nine o'clock on the evening of August 1, the boiler of French & Son's paper mill, at Carrollton Village, Ohio, exploded, demolishing the boiler house and the bleaching house. The explosion was terrific and threw fragments to a great distance in every direction. The loss is about $3,000. No person was injured.

The boiler in Smith, Grant & Co.'s coal and lumber yard, at Pawtucket, R. I., exploded August 2. Bernard McCudden, the engineer, was blown a distance of forty feet, and instantly killed. He was forty years old, and unmarried.

Improved Hectograph.

The principle upon which the process depends is this, that a superficial tanning of the gelatin, in the gelatin-glycerin pad, makes the surface, wherever tanned or rendered insoluble, capable of taking fatty inks, while the rest of the surface rejects it. In practice then it is only necessary to have a perfectly level hectographic pad, to write the copy with ordinary nutgall ink, to which a little extra tannin and extract of logwood has been added, and to transfer the writing in the ordinary manner upon the hectographic surface. Wherever the writing appears, the surface becomes tanned, and on now applying a roller with printer's ink, the written characters alone take the latter. The pad is to be inked after each impression. It is said that 300 to 400 sharp copies can be made upon dry paper. The only material necessary, besides the hectograph, is a slab, or zinc plate, for spreading out the printer's ink, a small printer's roller with handle, and a roll of wood or paper or rubber for pressing the paper against the pad.

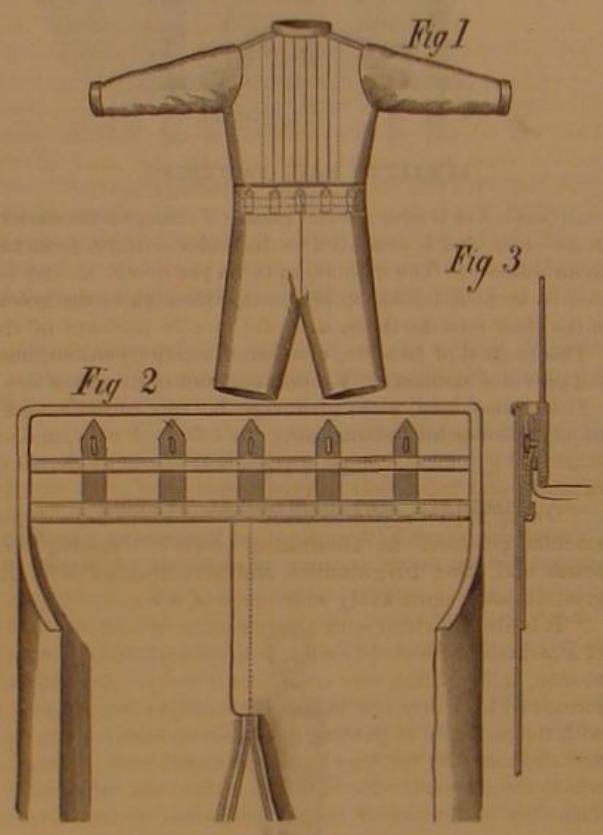
A Naphtha Locomotive.

During the month of June a number of experiments on the consumption of naphtha were made on the Tamboff Saratoff line by the engineer, M. Poretsky. The following points were established: (1.) Steam was got up from cold water to a pressure of 100 lb. on the square inch in two hours, and by burning 4 poods—or 144 lb—of naphtha. Usually in the same locomotive, with coals aided with wood, three and a half hours are required, and 26 poods of coals and wood—936 lb. (2.) The apparatus can be kept in use forty-eight hours without stoppage for cleaning, after which only two hours are required to clean out. (3.) In running 1,500 versts it was only required to stop the locomotive twenty minutes for fuel, and the driver and stoker have almost nothing to do, except to stop and start, the apparatus simply requiring opening more or less of the fuel. (4.) The flame is so well thrown over the whole of the fire box that after running 40,000 versts it is considered only one-half remount is necessary as opposed to coals. (5.) While it was found possible to evaporate 13½ lb. of water with 1 lb. of naphtha, the absolute result with new men and on the whole runs was 9 lb., or about two and a half times more than the coals used.

ATTACHMENT FOR PANTS.

The engraving shows a novel device for fastening pants to waists or vests, so that the buttonholes will not tear out nor the buttons be torn off when the wearer stoops or bends over. The invention is intended more particularly for use on children's garments, and will no doubt be welcomed and appreciated by those who are obliged to keep children's clothes in order.

The invention consists in a series of elastic strips with buttonholes at the upper end, attached at their lower ends to a band fastened inside of the pants. These parts are arranged so that the upper ends of the strips will be below the upper edges of the pants.



IMPROVED ATTACHMENT FOR PANTS.

Fig. 1 shows the pants attached to the waist; Fig. 2 is a view of the inner side showing the arrangement of the fastening, and Fig. 3 is a vertical section of a portion of the pants and waist. By reference to Fig. 2 it will be seen that the elastic strips are attached by their lower ends to a band fastened to the inner surface of the waist of the pants, and a band passes over the middle of the strips and is stitched between them, forming guides for the strips and sustaining the waist of the pants.

With this improvement the wearer can easily bend in all directions without fear of bursting off buttons or of injuring the garment, and it improves the fit and general appearance of the clothes.

This invention was recently patented by Mary R. Barhydt, of Burlington, Iowa, who should be addressed for further information.

A Minnesota Meteor.

A comet-like meteor, which appeared to pass close to the earth without striking or exploding, was seen in Eastern Minnesota, about 8:30 P.M. July 25. An observer at St. Paul, Mr. T. D. Simonton, says: "The meteor came from the south-eastern heavens, below the star Altair, some 15° or 20° above the horizon. It was exceedingly brilliant, with a well-defined head, as large or larger than the planet Venus at her brightest, and seemed to move about as fast as a rocket at a square's distance does just before it explodes. There was to me a sense of retardation in its movement, just as there is in a case of a rocket; but this was probably only apparent, because it looked so much like a bright rocket ready to explode, and because, in fact, I was expecting to see it explode every instant. Its direction was toward the north-west, toward which it crept as a fiery serpent, disappearing some 10° above the horizon. I use the word 'crept' because its movement was in no sense the darting motion of the ordinary meteor, but a deliberate, majestic course, giving one a great sense of the power with which it moved through at least 100° of the heavens. At its highest point I should think it was about 30° above the horizon. My estimate of the time the meteor was visible is from six to eight seconds, certainly not ten seconds. The tail was probably 10° in length."

A REMARKABLE CASE OF RETARDED DEVELOPMENT.

BY PROF. C. V. RILEY.

Early in the summer I received a statement from Professor I. D. Graham, of the Kansas State Agricultural College, at Manhattan, to the effect that he had hatched out some young locusts from eggs which had remained latent since the fall of 1876. While the occurrence did not strike me as impossible, it was, nevertheless, so remarkable that I entered into correspondence with him with a view of getting absolute proof of the accuracy of his statements. The young locusts which he sent me for identification proved to be *Caloptenus spretus*, or the destructive Rocky Mountain locust, and all the facts connected with them are so well attested that there is no doubt in my mind as to their trustworthiness.

About the 15th of September, 1876, the Chemical Laboratory Building of the Kansas State Agricultural College was completed, and the grounds immediately surrounding it were graded.

In the process of grading the bits of stone, mortar, and the clay which remained after the excavations and work of building had been completed, were used. The eggs of *Caloptenus spretus* were found in large numbers, and when the college grounds were graded, many of them were buried. The specimens in question were buried to a depth of about 10 inches, and remained in that condition until the third week in May, 1881, when some workmen, who were regrading the grounds, discovered them. As they looked quite fresh after their long burial, Mr. Graham concluded to try the experiment of hatching them out. He placed them under favorable conditions, and in due time was rewarded by the appearance of an active brood of young locusts, of which he forwarded samples to me.

When discovered in May, these eggs were surrounded by black earth. This earth was enveloped in closely packed clay, which, in turn, was covered with "spalls," mortar, and other building rubbish. In 1876, when the grading was finished, a plank walk was laid alongside of the building and above the buried eggs. This walk had never been removed since that time until in May, 1881, when the eggs were found.

In view of all the facts in the case Mr. Graham believes that the walk so shaded the ground that the sun's influence did not penetrate very deeply into the earth at this point, and also that the peculiar composition of the earth surrounding the eggs, would keep them cool, moist, and in an almost air-tight place, all of which are conditions favorable for preservation.

However this may be, the fact that the eggs did remain in the ground unhatched for nearly four and a half years seemed undeniable, as also the further fact that the young when hatched were as active and voracious as their remote parents had been. The question arises as to how much longer eggs so situated might have remained undeveloped and sound, and it opens up a most interesting field for experiment.

It is not my purpose to discuss here the general influence of temperature in accelerating or retarding animal development, nor the many curious cases of retarded development among insects that are totally independent of temperature. Semper, in his recent work on Animal Life, has an excellent chapter on the influence of temperature, especially as to the optimum required for the favorable development of different species. As a rule a rising temperature stimulates and accelerates growth and development, and a falling temperature retards or torpifies, and this holds true with the eggs of *Caloptenus spretus*, as I have shown in experiments recorded in my ninth report on the insects of Missouri, and in the first report of the Entomological Commission. But there are many strange exceptions, as in the heat coma of tropical animals, the summer dormancy of certain lepidopterous larvæ, and the retarded development of individuals placed in the very same conditions under which others normally develop. There is, therefore, much mystery yet connected with the subject which offers a most inviting field for experiment, not only as to the other influences affecting retardation, but as to the length of time development, as under the influence of continued cold, can be kept latent without loss of vitality. The case here recorded is consequently most interesting, for it is evident that the eggs were not buried deep enough to be entirely free from the changes in the temperature of the earth at different seasons.

Washington, D. C., August 1, 1881.

Spiders Obstruct the Telegraph.

One of the chief hinderances to telegraphing in Japan is the grounding of the current by spider lines. The trees bordering the highways swarm with spiders, which spin their webs everywhere between the earth, wires, posts, insulators, and trees. When the spider webs are covered with heavy dews they become good conductors and run the messages to earth. The only way to remove the difficulty is by employing men to sweep the wires with brushes of bamboo; but as the spiders are more numerous and persistent than the brush users the difficulty remains always a serious one.

AMERICAN INDUSTRIES.—No. 74.

THE MANUFACTURE OF SEWING MACHINES.

Not the least prominent among those American manufactures which have made the reputation of our mechanics and inventors so well known throughout the world is that of the sewing machine. Not only was it here that the invention had its birthplace, but through all the succeeding years we have been adding improvements to enlarge the variety and perfect the quality of its work, to make it run more easily and more rapidly, and to lessen its cost while increasing its durability. Thus it is that, beside supplying our home demands with a greater variety of machines for especial uses than are known in any other market, we have not only furnished the models from which most of the European manufacturers now work, but we have, from the commencement of the business to the present time, steadily been large exporters of sewing machines and sewing machine parts.

In the illustrations on the first page of this paper we present views of the leading operations in their manufacture, as conducted by the Davis Sewing Machine Company, of Watertown, N. Y. This machine differs from most others in being what is known as a "vertical feed," that is, while the feed motion in other machines is commonly communicated by a horizontal under feed with a complicated movement, in this machine the work rests upon the perfectly smooth surface of the bed-plate except as it is moved forward by the stepping of the vertical feed in connection with each up-and-down movement of the needle. The company own the patent on this principle, and claim for it decided advantages over the under feed motion, as, in the latter, the feed moving while the presser foot is upon the goods, the under-ply will be carried forward faster than the other, the tendency being to cause a "gather" in the lower piece, so that it will yield more readily to the upper in any strain upon the garment, and thus prevent the making of a perfectly strong and elastic seam. In this vertical feed the presser foot is raised from the fabric when the feed takes place, so as to present no resistance to seams or ridges; the needle is in the fabric when the feed moves, and so helps carry the work along firmly and make the stitches of uniform length, and it is claimed that the machine is capable of sewing elastic goods, making a smooth and flexible seam with stitch alike on both sides, and also that it will sew any number of thicknesses without basting, working as well on the heaviest as on the lightest fabrics.

To one ordinarily conversant with the mechanical details of the sewing machine the view of the new No. 1 Davis machine, as shown by our artist, will be easily understood, and the motion of the vertical feed with the needle bar readily comprehended, as may also be said in regard to the tension wheel and check spring on the upper thread, the tension on the lower thread being regulated in a simple way by a pad spring on the under side of the bobbin in the shuttle beneath the bed-plate.

Of the manufacturing details in the construction of the machine, we give a view of one of the large machine rooms, where lathe work, milling, grinding, drilling, and many other operations are conducted, to give an exact fit and proper finish in all the working parts of the machine. The division of labor, for the attainment of the greatest possible excellence in the minutest detail, is the leading idea in the conduct of this part of the work, the different pieces being interchangeable, and all being inspected, tested, and gauged before finally passed. Many of the pieces subjected to most wear in the operation of the machine have hardened steel parts, and although there are fewer pieces in this machine than in many others, the working parts being mostly in the head of the machine, the design is to make it strong and durable as well as simple.

The putting on of the hard, polished black surface, shown in the representation of the japanning, is a department by itself. The japan is put on with a brush, in successive coats, the pieces being baked from ten to fifteen hours after each coat in an oven kept at a temperature of from 350° to 380° Fah. After this process the pieces to be ornamented go to another department, where a wide variety of decorations are put on them, either in painting, bronzing, gold leaf, or by the now very popular decalcomanie or transfer process. Great improvements have been made in this branch of the business within a few years past, so that the most tasteful ornamentation now costs but a fraction of what was formerly paid for the most ordinary work.

In the "assembling" of the machines, all of the work which has preceded is, to some extent, looked over and tested, except that connected with the setting up of the tables on their stands. In connection with the assembling is what is called the "jacking," that is, the machines, as put together, are, at different times during this part of the work, placed upon jacks, or frames driven at a high speed, and run for a sufficient time to enable the inspector to see that all the parts are properly adjusted. After this each machine is threaded and actually tested on a sample of work, and a machine coming direct from the hands of the manufacturers is always found with such sample under the presser foot.

In the multitude of sewing machines which have been placed upon the market it would be invidious to attempt any comparison here, covering so large a field. The Davis Company claim that their machine is better adapted to a wider range of work than are the under-feed machines, and the attachments they have cover devices for nearly everything yet done on a machine, from gauging and hemming to ruffling, tucking, and fancy embroidery. The company also point with considerable pride to the fact that they obtained the only first award of merit at the recent Exhibitions at Sydney and Melbourne, Australia, where several leading machines were represented.

At the most recent of the International Exhibitions, that held at Melbourne, Australia, the Davis machine last spring took the first award; the representatives of seven other machines appealed from this decision, and experts were then appointed to make a special examination, which resulted not only in confirming the award, but brought out the following report from the jury:

"The competition in sewing machines proved very keen, and great interest was evinced both by the representatives of the makers and the public in the result of the trials. The machines were removed from the stand, and were submitted privately to the jury, and their various qualifications explained by skilled operators. The jury then retained possession of them for some time, and at their leisure examined the workmanship and material, testing the latter for hardness by use of a file.

"Among domestic machines the highest place was awarded to a machine comparatively new in the Melbourne market, though by no means untried elsewhere, and known as the Davis vertical feed sewing machine. In this machine the shaft, pulley, and flywheel occupy the same position relatively to the other parts as in the well-known Singer form, and the vertical motion of the needle bar is produced by the usual crank pin moving in a heart-shaped cam; here, however, the resemblance ends, and the mechanism is of a most novel and curious kind. The shuttle, which moves in a curved path, is operated by a system of jointed levers proceeding from a small eccentric placed on the shaft immediately behind the driving pulley, thus dispensing with the miter wheels and vertical shaft hitherto so general. The feed apparatus is entirely removed from the usual position beneath the table of the machine, and is attached to the head. It consists mainly of a vertical bar placed close to the presser foot, and which receives suitable vertical and horizontal motion from mechanism contained in the head of the machine. We find the other points entirely novel:

"First. The presser foot, instead of being continuously urged downward upon the work, is lifted slightly at the instant that the forward motion takes place.

"Second. The feeding is accomplished while the needle is in its lowest position, and the needle partakes of the forward motion of the feed bar, pinning the two plies together and causing both to advance equally.

"The machine is also provided with a very complete series of adjustments for counteracting the effect of wear, and an improved automatic bobbin winder, and in all its details is carefully and judiciously worked out.

"Owing apparently to its peculiar feed motion the Davis machine possesses an astonishing power of passing over seams and other irregularities, and accomplishes with the greatest ease a remarkably wide range of work.

"It is also provided with a very ingenious and novel set of attachments adapted to work in unison with the new feed motion, and enabling very complicated operations to be performed with facility, and in many cases dispensing altogether with the necessity of guiding the work by hand. It was at first supposed by the jury that this excellent performance was in some measure due to the special skill of the operator. This view was, however, entirely negatived by the fact that a change of operators in no way impaired the result.

"The Davis machine is made for either foot or hand power, and performed equally well in each case. To it the jury awards the first order of merit as being prominent for simplicity, convenience, efficiency, and rapidity, both as a treadle and hand machine."

A good idea of the extent of the works of the Davis Sewing Machine Company is afforded by the illustrations on the first page, although it should be stated that most of the castings and all of the cabinet work are made outside by contract, leaving all of the facilities of the establishment for employment on that which is more directly machine work. The company was established in 1868, and from a small beginning then, the business has steadily grown, new buildings being erected and additional hands and machinery employed as called for by the growing demand. The works have not been stopped since their commencement, but their production has largely increased each year, even through the times of severest commercial depression.

The Company are represented by agencies in the principal American cities, and in Switzerland, Russia, and Australia.

Gas from Castor Oil.

At the gas works of Jeypore, India, illuminating gas is made chiefly from castor oil, poppy, til, or rape seed being used when the supply of castor beans is short. One maund (82 pounds) of castor oil produces about 750 cubic feet of 26½ candle gas, or 1,000 cubic feet of 18½ candle gas. The process of extracting the oil for carbonizing is as follows: First, the castor seed is passed through the crusher, when the shells only are broken off. The shells are then picked out by hand, and the seed is again introduced into the crusher, where it is ground to a paste. It is then passed into the heating pan, and, after being well heated, it is packed into horsehair bags and filled up hot into the press immediately. After about twenty minutes' pressing, the exuding oil being meanwhile collected, the cake is removed and ground over again. It is subsequently heated and pressed a second time until about 33 or 40 per cent of oil is obtained from the seed. The labor of preparing and pressing the castor seed costs two shillings (about fifty cents) per maund of oil. The total cost of the oil is somewhat over $5 per maund.

For generating gas, the oil is used as it comes from the press. Formerly, at other places, when the oil-bearing seeds were carbonized for gas without previous treatment as above described, the product was overloaded with carbonic acid from the woody part of the seeds, and correspondingly heavy cost for purification was incurred.

For out of town consumers the Jeypore gas works supply gas compressed to about three atmospheres by means of a pump driven by a bullock. The compressed gas is then delivered in a wrought-iron receiver to the point of consumption, where it is either transferred into fixed receivers and burnt by the aid of suitable regulators, or is delivered into small portable or service gasholders, and burnt in the usual way. A *ghat*, or landing-stage, two miles distant, is thus supplied with 400 cubic feet of gas every day, which is consumed by 30 jets, each burning 1½ cubic feet per hour for nine hours. There have not been any accidents from the distribution of gas in the portable reservoirs or otherwise. As railroad carriages are also supplied with compressed gas, it is evident that the introduction of this branch of service has widely extended the utility of the establishment. Another peculiarity of the Jeypore undertaking is the necessity that exists for the manager to unite the attributes of a farmer to his other acquirements, for the purpose of securing a constant and cheap supply of raw material for gas making. Last year, the manager, Mr. Tellery, personally superintended the sowing of 300 acres with the castor plant (*Ricinus vulgaris*).

RECENT INVENTIONS.

An improvement in the class of scrapers having wooden sides and a body constructed of steel or other thin metal, has been patented by Mr. William Haslup, of Sidney, O. The features of improvement and novelty are the means for connecting the sides and body both at the bottom and back of the scraper and the devices for attaching the bail.

An improved pocket knife has been patented by Mr. August Rischow, of Elizabeth, N. J. The object of this invention is to prevent the blades of pocket knives from being raised accidentally and from folding or collapsing while the knife is being used. The invention consists in a handle with longitudinal slots, in which bars fit, which are pivoted to the lower ends of the knife blades, which slide between suitable guides in the handle, and are provided with suitable packing.

Mr. Alexander Watson, of East Pepperell, Mass., has patented a combined coal hod and sieve, by the use of which partially burned coals may be cleared of ashes without raising dust.

An improvement in sash fasteners, patented by Mr. Stephen P. Rush, of Tyrone, Pa., consists in the peculiar arrangement of parts whereby the lower sash is locked when down and the upper sash locked when raised by the movement up and down of the sashes; or either sash may be locked in a partially raised or lowered position.

An improved method of preparing and welding pipe sections has been patented by Mr. Henry V. Hartz, of Cleveland, O. This invention relates to a novel method of preparing and welding together sections of metal pipe or tubing. It is designed more particularly for welding short sections on to old boiler tubes, so as to give them sufficient length to permit them to be again reset in the same tube sheets, the old tubes being too short to be reset without lengthening. The ordinary method of resetting old tubes is to mill down or hammer one end of a section of tube to an entering bevel or male end, and expand by hammering or milling the end of the other section to a tapering or female end adapted to receive the male end, after which they are joined and welded together by hand. The difficulty attending this plan is that much labor is required to prepare the ends, and the time required to turn and weld the sections on all sides is such that the heat decreases at the end of the operation, so as to fail to secure the most perfect uniting of the parts, and both skilled workmen and hand labor are required for the work. The invention referred to consists in simultaneously cutting off and scarfing or beveling the male or entering end by rolling a bevel channel around the tube on a mandrel, and continuing this rolling action until the section is severed, and at the same time holding down the metal on each side of the bevel channel to prevent enlargement of the cut ends; then in a second operation cutting and expanding the female end simultaneously by rolling a bevel channel around the tube on a mandrel, and continuing this rolling action until the section is severed, and at the same time allowing the metal on each side of the bevel cut to spread or move freely, to permit the cut ends to be expanded, by the mashing action of the roll, to a diameter large enough to receive the male end.

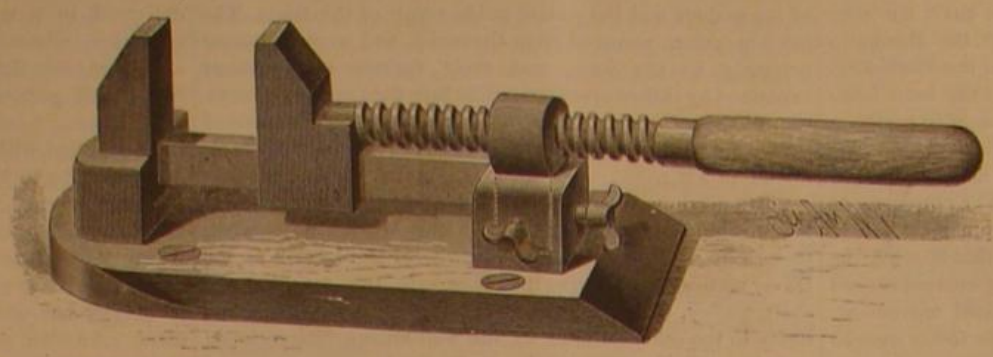
Anchors, as usually made, have two rigid flukes projecting in opposite directions from one end of the shank, an eye or ring at the other end, for connection of the chain, and a stock passing through the shank at the end where the chain is connected. Such anchors hold by either fluke, and, as will be readily understood, the fluke end will be lowest in the bottom while holding, the other end of the shank remaining above or being in the bottom but a short distance. Mr. John J. Moule, of Fishkill-on-the Hudson, N. Y., has patented an improvement, the object of which is, first, to cause the anchor to sink throughout the whole length of the shank and to give a hold on the bottom at both ends of the shank; second, to prevent the chain from fouling on the stock.

A NEW TOOL.

The engraving shows an improved tool which can be used either as a monkey wrench or bench vise. The wrench consists of a square bar, having upon one end a fixed jaw, and upon the other end an arm having a screw-threaded opening which receives the screw for moving the adjustable jaw placed on the square bar. The wrench is capable of being used like any ordinary wrench, and when it is desired to employ it as a vise it is held in a bed plate, arranged to clamp the bar of the wrench both lengthwise and sidewise.

This invention will be found very useful to those requiring a wrench and vise occasionally, and by mechanics who are frequently using both tools.

Further information may be obtained by addressing Mr. William H. Love, Love's Station, Miss.



LOVE'S COMBINED WRENCH AND VISE.

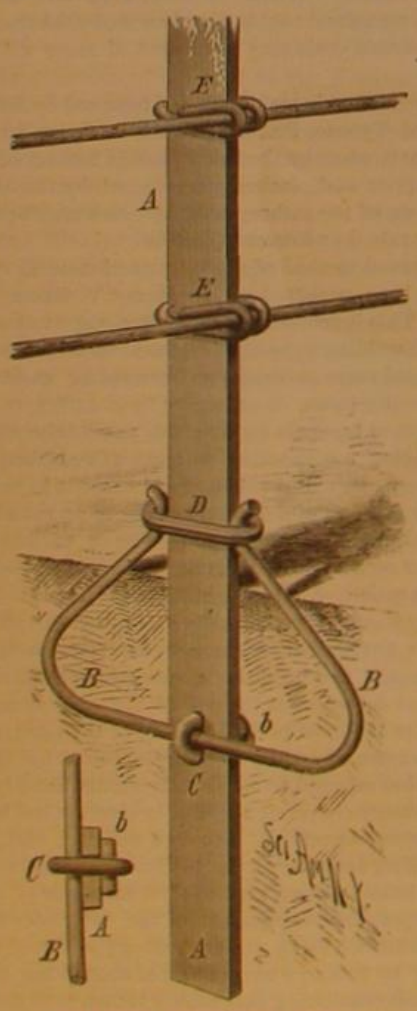
A Good Day's Work on a Railroad.

The work of changing the gauge of the Chicago, St. Louis, and New Orleans Railroad, between Cairo and New Orleans, was begun at 4 o'clock of the morning of July 29. The work was finished and trains were running at 3 o'clock in the afternoon of the same day. The work consisted in shifting the west rail 3½ inches, making the gauge 4 feet 8½ inches. The length of road changed was 571 miles, exclusive of sidings. About 2,500 experienced workmen were employed in gangs, each gang having charge of eight miles of track. The division from Cairo to Milan, 84 miles, was changed by 8:50 A.M. The division from Canton to New Orleans, 206 miles, was completed at 9:20 A.M. The work was in charge of Col. L. P. Brien, and was accomplished without mishap or delay.

AN IMPROVEMENT IN IRON FENCES.

The improvement in iron fences, shown in the annexed engraving, has recently been patented by Mr. Samuel Heaton, of Cedar Rapids, Iowa. It is noteworthy principally on account of its simplicity and cheapness. The post has but one aperture, and that is made so near the lower end as to have no effect on the strength of the post, and the braces and rods or wires are fastened by a very simple and effective means.

The post consists of a piece of flat bar iron, having an oblong hole punched in it near the lower end. The brace



HEATON'S IMPROVED FENCE.

consists of a curved piece of round bar iron, bent into approximately triangular shape, having its ends at the open angle, bent outward to receive the link which binds the ends to the post. The brace is attached by slipping the link over its free ends, and then passing the post through the link between the ends of the brace. The lower part of the brace is secured to the post by a link, previously placed upon it, which passes through the slot in the post and receives a key or wedge upon the opposite side.

The wires or rods forming the bars of the fence are secured by loops or staples which embrace the post and are bent around the wire.

The advantages of a post of this description will be readily understood without further description.

The Faure Battery.

Some personal feeling must exist in the minds of the French writers on electricity against M. Faure, judging from the way in which they compare his secondary battery with M. Planté's. Any one who chooses to test the Faure cell and the Planté cell cannot fail to be convinced that the former is decidedly the better one. Sentiment, passion, and prejudice enter so largely into what ought to be the calm reason of the French people that one is compelled to receive their conclusions regarding anything with some neutralizing substance—an acid or an alkali, as the case may require. In the Faure case the declarations of French electricians must evidently be accepted by minds otherwise constituted not simply with a grain, but with an overwhelming dose of salt. Prof. J. A. Fleming, of the University College, Manchester, England, says candidly that "the enormous superiority of M. Faure's cell over the old form of Planté's cell is evident at once on experimenting with it." And, by the way, Prof. Fleming is justly entitled to the credit of devising the following admirable method of showing large assemblies the action of the Faure battery, about the end of last June, before he had the opportunity of looking over M. Faure's patent papers. His own words are given with one bracketed qualifying clause: Sheets of lead were bent up into the form of shallow trays one foot square and one inch deep; in each of these was placed a layer of red lead, then a layer of flannel, then a layer of red lead, and, lastly, another lead plate. These trays, to the number of six, were then piled one above the other after being filled with dilute acid. The cells, being connected in series, were polarized by a ten cell battery of Grove's cells, and after twenty minutes charging had taken up [or rather had induced conditions of remanifesting] a very large quantity of electricity. At a short lecture during the evening the charged Faure battery was connected with a Gramme machine and drove it round with considerable velocity for some minutes. After thus employing part of the charge the remainder was used for heating several inches of platinum wire, and for driving for a few seconds a simple form of magneto-electric engines. These experiments amply confirmed those present of the practical character of M. Faure's invention.

MISCELLANEOUS INVENTIONS.

An improved swimming apparatus has been patented by Mr. William Beeson, of Dillon, Montana Ter. This invention relates to a novel construction of swimming apparatus, and it is in the nature of a detachable suit provided with pockets or receptacles for the body and limbs, and having between the pockets for the limbs a web portion, which acts like wings or fins, which, from the movement of the legs and arms, effect a propulsion through the water.

An improved pillow or bolster has been patented by Mr. William T. Doremus, of New York city. The object of this invention is to prevent the stuffing of pillows and bolsters from being crowded out of place by pressure applied to parts of the pillows or bolsters. The invention consists of a pillow or bolster made with an inner cover filled with stuffing, and an outer cover having a layer of stuffing interposed between it and the said inner cover, whereby the stuffing will be kept in place when under pressure.

An improved switch for butchers' tracks has been patented by Mr. Charles Cole, of West Newton, Mass. This invention relates to an overhead track on which runs trucks provided with hangers, upon which heavy articles can be suspended beneath the track and readily moved from place to place; and its objects are to provide a convenient way to connect the main track with the branches which extend to different parts of the room or inclosure, and to provide a convenient method of shifting such connecting main track from connection with one branch to connection with another.

An improvement in shipping cases has been patented by Mr. Charles R. Peaslee, of Louisville, Ky. This invention is an improvement in the class of shipping cases for large oil cans, in which interior grooves are provided for reception of the gudgeons or pivots of the can for the purpose of protecting them while the can is being shipped.

Mr. James H. French, of Willimantic, Conn., has patented an improved package for fire kindlers which will prevent the evaporation of the turpentine and other volatile substances contained in the kindlers.

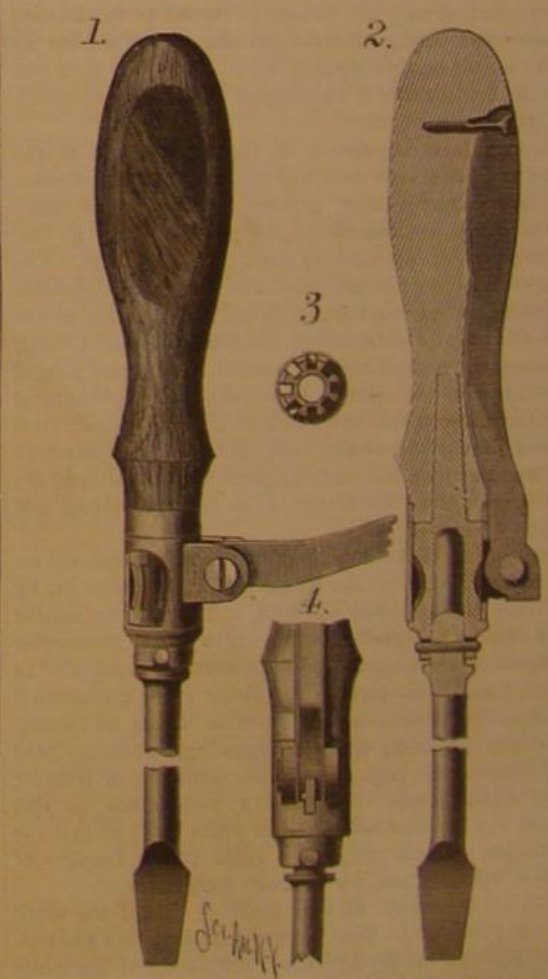
An improved cushion has been patented by Mr. William T. Doremus, of New York city. The object of this invention is to prevent the displacement and the packing of the stuffing in cushions for beds, lounges, chairs, and other articles of furniture. The invention consists of a cushion made of two or more small elastic parallel rolls connected along their adjacent sides, whereby the elastic material forming the stuffing is kept from being displaced and becoming packed.

A HANDY TOOL.

Slotted head machine screws, which leave the work flush by sinking the heads, are much used in machinery and tool construction, and sometimes are of so large diameter and such length of threaded portion as to present considerable resistance when nearly seated. The use of a wrench on the blade of the screw driver to give additional leverage is a coarse and makeshift method of overcoming the resistance, and, in many instances, is inconvenient, as the crowded position of the screw makes it difficult to get the necessary half or quarter turn.

The object of the improvement shown in the engraving is to obviate these difficulties and provide a handy and useful implement, which will not only take the place of the screw driver and wrench, but will serve as a substitute for the cumbersome and heavy ratchet wrench. It has all the advantages of a ratchet wrench in making short movements, and all the uses of the screw driver in driving the screw in the ordinary manner by means of the usual style of handle.

It is really a screw driver handle, with fixed steel socket, to receive the shanks of the screw driver blades, or of socket wrenches, as desired. On the socket is a sleeve that turns freely and covers a ratchet, or rather a square-toothed pinion, secured rigidly to the steel socket. There is pivoted to the sleeve a steel lever, which, when not in use, shuts into a recess in the wooden handle, and when thus shut the entire implement is only an ordinary screw driver, neither the ratchet nor the pivoted lever taking any part in its action. When used thus, as an ordinary screw driver, it merely drives the screw until the resistance becomes too great, when the lever, in connection with the ratchet, is brought into action. For this purpose the lever is allowed to swing out of the handle, and as it assumes a horizontal position its pivoted end, as a tooth, engages with the toothed ratchet inside the sleeve, and gives means for a leverage corresponding with the length of the arm, which may be nearly



SCREW DRIVER WITH LEVER ATTACHMENT.

that of the screw driver handle. A very slight movement of the lever serves to disengage it from one tooth and engage with the next, or with any other, the gradations depending on the number of teeth in the ratchet. A movement of one eighth of an inch, demanding eight teeth, is generally sufficient for the most cramped position. But a larger number of teeth in the ratchet, and a consequent shorter movement of the lever, may be had if necessary, or, if circumstances warrant, the lever may be swung so as to get one-quarter or one-half, even, of the circle.

Mr. L. E. Rhodes, the inventor, is a practical mechanic, in the employment of the celebrated Pratt & Whitney Company, Hartford, Connecticut. The implement has had sufficient trial and use to establish its value in the shop.

A New Safety Lamp.

Mr. Fleuss, the inventor of the diving helmet known by his name, and by means of which a man can take oxygen enough with him to remain under water more than an hour, has recently devised a new safety lamp based on the same principle. It is about twelve inches in height, and is composed of a stand, oxygen chamber, spirit tank, and cover. The oxygen chamber is spherical in shape, and is made of strong copper. It contains oxygen pumped in at a pressure of 260 pounds, and its outlet is a small pipe, furnished with an escape valve and regulator, opening close to the wick. Above the sphere is a little square tank containing methylated spirits for burning in the lamp, and upon it is closely screwed a socket holding the wick. Close to the wick is a thin iron rod, upon which is fastened, in the usual manner, a piece of lime. When the wick is lighted a stream of oxygen is turned upon it from the little pipe by means of the regulator and valve, and the flame is blown upon the block of lime, the light produced being of the most intense kind.

Over the lighted wick, the oxygen blowpipe, and the rod of lime a strong copper casing is screwed down, and the light is thrown through a bullseye in the side of this cover. The casing is dome-shaped, and is made with a double skin, the intervening space being filled with water. On the lower part of it is an outlet valve, by means of which the products of combustion are permitted to escape into the water between the skins of the case, and to find their way through it into the outer atmosphere, an escape valve on the top of the cover being the ultimate means of egress. The lamp is said to have borne all tests with most satisfactory results. It heats little, and is easily managed.

Deep-sea Soundings.

Captain George J. Belknap, commanding the United States steamer Alaska, reports to the Navy Department, under date Callao Bay, July 6, 1881. He gives detailed results of soundings in a run of 112 miles directly off shore. At a distance of 102 miles he found a depth of 3,368 fathoms, or nearly four statute miles, the deepest water yet found in the South Pacific, or in the eastern margins of both the North and South Pacific. Hoping to find a still deeper depression of the ocean bed he stood ten miles further to the westward, but only found 3,168 fathoms. In both casts the specimen cylinder brought up clay and greenish sand, and the bottom temperature of the deepest was about 34° Fah.

Grasshoppers in Turkey.

Turkey, it appears, is overrun with grasshoppers, and the government has been compelled to employ extraordinary measures to overcome the plague. A particularly voracious species has appeared in the Bodirum District (Smyrna), and the whole population is employed to combat the insects. At Angora all business was suspended for three days by order of the Governor-General, and all the inhabitants were ordered to march out into the fields to destroy the grasshoppers. Every inhabitant was compelled to deliver twenty oka (about fifty-six pounds) of dead grasshoppers to the officials. The swarms are said to emanate principally from Persia.

Remarkable Swarms of Dragon Flies.

In some parts of Germany dragon flies have been unusually numerous. At Kamenz, during the last days of May, enormous swarms of them, here and there in dense masses, and extending from five to ten miles in breadth, passed over the valley. The first swarm arrived about noon on May 30; its passage occupied two hours. In the evening a second swarm came from the direction of Weisswasser. The third swarm arrived on the morning of the 31st. Swarms of this description have not been observed since June, 1825. At Dresden the strange phenomenon was also observed.

Supposed New Species of Horse.

M. *Poliakoff, the* distinguished Russian naturalist, has examined a horse presented by Colonel Prejvalsky to the St. Petersburg Academy, and decides it to be a new species, which he has named Equus Prejwalskii. It appears that the new representative of the family of undivided-hoofed mammals is in some respects intermediate between the domestic horse and the wild ass, but it differs from the asinine genus in having four callosities, one on each leg. In the form of skull, absence of dorsal stripe, and other particulars, it resembles the domestic horse. This newly recorded animal is indigenous to the plains and deserts of Central Asia, and has not hitherto fallen under the dominion of man.

EARTH STARS.

Among the curious and interesting things that one fond of rambling over the sand dunes of Coney Island will meet with are the earth stars.

Nothing can be more puzzling to one unacquainted with such matters than to find a star-like plate lying flat on the sand, or with its points curved, as in Fig. 1, and bearing on its center a more or less globular body. At first sight we

Fig. 1. Fig. 2.

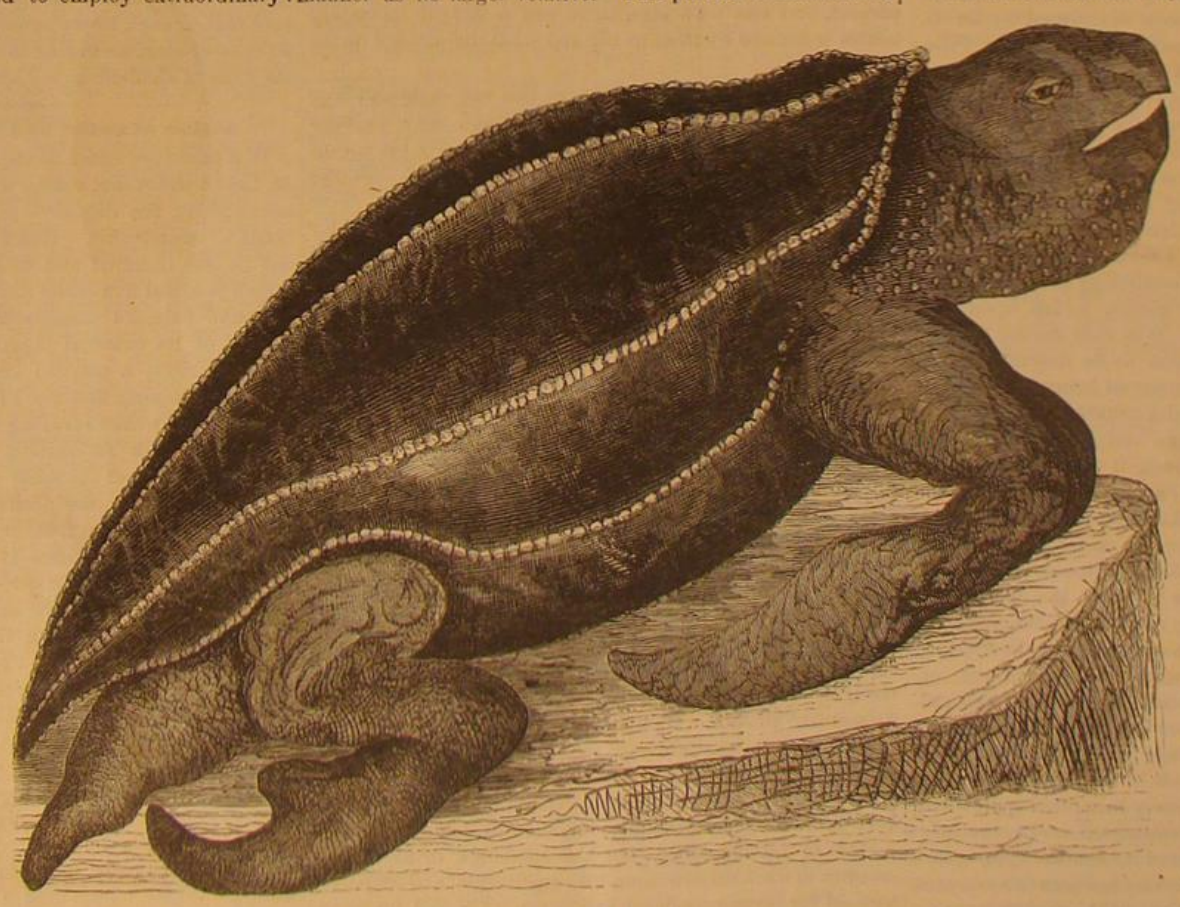
EARTH STARS.

would take it to be almost anything else than a plant, yet it is a plant, and a very interesting one, belonging to the vast class of fungi. Most persons are quite familiar with its near relatives, the puffballs, which at first are round masses of a white puffy substance, and later a globular membrane filled with blackish dust, which passes out on the slightest touch in smoke-like puffs. Each puff of this dust is made up of millions of minute spores, which serve to multiply the plant, and serve the place of seeds.

The starry puffball in its early stage would readily escape notice or be taken for a small common puffball, and, like that, is attached to the earth. Unlike the common one, our starry puffball has a thick papery or leathery outer skin, which, at the proper stage of development, bursts in a somewhat regular manner and exposes the puffball portion, the star-like envelope remaining attached. We sometimes see oranges peeled for table decoration in a manner that reminds one of the earth stars.

The outer skin bursts with such force as to throw the plant several inches away from the place where it grew; hence it is rarely that they are found attached to the earth where they grew.

The central puffball gives off clouds of spores in the same manner as its larger relative. This portion sometimes sits directly upon the center of its starry shield, as in Fig. 2, or is raised above it upon one or more short stems. The genus is named *Geaster*, which means earth star. There are eleven species in Great Britain, and only about six recorded for this country. During the hot, dry weather the earth star closes up, as shown in Fig. 2, but after a rainfall or during a heavy fall of dew the star slowly expands, and assumes the position shown in Fig. 1.



LEATHERY TURTLE.—*Sphargis coriacea*

A THREE HUNDRED DOLLAR TURTLE.

A magnificent living specimen of the so-called "leathery turtle," also "lyre turtle," and "trunk turtle," and *Sphargis coriacea* of the naturalists, was captured last week by Capt. Hines, of the fishing steamer Humphrey, while cruising for menhaden, some 125 miles off Absecom Light. When this turtle was first sighted it was fast asleep on the surface, evidently taking a sun bath.

After surrounding it with a "purse" net, a second and third net had to be used before the powerful reptile was securely entangled, so rapidly did he tear the nets asunder with his powerful fore and hind flippers. A crane was rigged on the deck of the steamer, by which means the turtle was carefully landed on the deck and brought to New York city to be sold—two amateur showmen of the market being the purchasers at $250, though Mr. Starr, of Bunnell's Museum, shortly afterward offered $300 for it. Under a canvas on the Fulton Market slip it reposes on a platform, where it is "bountifully fed on water melon rinds and butter-fish," as the showmen state.

This curious and very interesting animal is well worth seeing, as this one is the first living specimen that has been brought to New York since the one was captured off Long Island Sound, September 7, 1826. The one at the market will weigh in the neighborhood of 2,000 lb., and measures over 7 feet in length, is 43 inches broad, 3 feet thick, and the flippers are 47 inches in length, which, without doubt, ranks it as the largest living turtle ever brought to the Fulton or Washington market.

At the Berlin Fisheries Exhibition the United States Fish Commission exhibited in the collection of American turtles one of the finest specimens of the leathery turtle ever captured on our coast, and which was acknowledged to put Yankee-land ahead on the turtle question.

In color the skin or the shell of the leathery turtle is of a deep blue-black, and shining, reminding one of polished leather or black vulcanized rubber. About the throat are numerous mottlings of light blue spots. In place of the usual shield of horny plates that are to be found on all turtles, this variety is covered with innumerable small plates about the size of a ten-cent piece, which are situated under the leathery skin.

The upper shell, as will be seen by the illustration, is of a peculiar form, being composed of nine keel-like longitudinal ridges. The central and most prominent one, situated on the top of the back, is the highest. These dorsal ridges are all more or less scalloped, and are of a dirty bluish white. The front and hind flippers of this turtle are very stout and powerful and destitute of nails; in general form they are fin-like and capable of driving the animal through the water with great speed and force. The inside of the throat is lined with sharply tipped spines which point inwards, so that whatever enters has of necessity to be swallowed. The stout neck supports a large and massive head with strong and powerful jaws, the upper one being provided with notches, into which the sharp hook or beak of the lower jaw fits.

This turtle is undoubtedly an inhabitant of tropical waters, and is probably brought to our waters by the action of the Gulf Stream and other ocean currents.

The immense size and weight of this turtle would render it a prize indeed to any lone and poorly-paid fisherman who might run across a specimen once in a while, were it not that the flesh is poisonous when eaten and produces severe sickness.

The food of the leathery turtle consists of the larger and coarser varieties of marine plants, such as the gulf weed and laminarias. The shells of these turtles have often been used for small boats, as well as drinking troughs for domestic animals and bath-tubs for children.

The habit of the leathery turtle is much the same as that of the green turtle, logger-head, and hawk's-bill turtles. When sleeping or resting it floats on the surface. When feeding it is capable of remaining under water a long time before rising to the surface for a fresh supply of air.

A large specimen, which was captured in Massachusetts Bay, in 1824, when asleep and basking, was sold for $200 to the New England Museum.

The largest specimen ever exhibited in this country was one that measured over 10 feet; this was lost at the burning of Barnum's (old) Museum. This one was captured off Sandy Hook, in 1816, which, including stuffing, setting-up, etc., cost Peale, the founder of the American Museum, afterwards Barnum's, $400. The first recorded specimen taken on our coast was in 1811. From 1811 to present date, some thirty specimens have been caught, most of them having been secured by the Smithsonian Institution, so that an animal of such uncertain occurrence must be considered very rare. The leathery turtle, like all other deep-sea turtles, never visits the shore except during the breeding

season to deposit its eggs. Ancient mythology is responsible for the legend that Mercury first acquired the idea of the form of the lute or lyre from the general appearance of this turtle; the ridges along the back being suggestive of the strings, and the broad hind feet representing the foot of the instrument. The French name for this turtle is *luth* (a lute).

NATURAL HISTORY NOTES.

Interesting Case of Commensalism.—Dr. Möbius, in his recent work on the fauna of the Mauritius Islands, gives a description of two crabs of most extraordinary habits. Both belong to the family polydectinæ, the species of which have their front claws armed with large teeth. Latreille, who first named the crab *Polydectes cupulifer*, remarked that a gummy substance was always to be found at the ends of the claws of this species, and Dana described the animal as having always something spongy in its hands. Dr. Möbius has discovered the remarkable fact that these things held in the two claws of the crab are in reality living sea-anemones. These anemones are attached to the immovable joint of each claw, while the teeth of the movable joint of the claw are kept buried deep into the flesh of the sea-anemones, and thus hold them fast, although each anemone can easily be pulled away from its position with the forceps in specimens preserved in spirits. The mouth of the sea-anemone is always turned away from the crab. The same curious combination exists in the case of another species of the same family, but of a different genus, *Melia tessellata*, which also inhabits Mauritius. Professor Möbius gives the following account of the matter: "I collected about fifty male and female specimens of *Melia tessellata*; all of these held in each claw an *Actinia prehensa*. The recurved hooks of the inner margins of the claw joints of the crab are particularly well adapted to hold the actinias fast. I never succeeded in dragging the living actinias out without injuring them. If I left the fragments of them when pulled out lying in the vessel in which the *Melia* was the crab collected them again in his clutch in a short time. If I cut the actinias in pieces with the scissors I found them all again in the claws of the crab after a few hours. It is very probable that the actinias aid the crab in catching its prey by means of their thread-like cells, and that the actinias, on the other hand, gain by being carried from place to place by the crab, and are thus brought into contact with more animals which can serve as food to them than they would if stationary. This is a very interesting case of commensalism."

A Locomotive Dicotyledon.—So far as has been generally known hitherto the power of voluntary locomotion of plants from place to place is confined to members of the lower orders of cryptogams, namely, algæ and fungi; but an interesting case of voluntary motion among dicotyledonous plants, in a species of *Loranthus*, has been discovered by Dr. G. Watt, of the Educational Department, Bengal Lower Provinces. It is only while the seed is germinating that the motion takes place, but the mode of traveling is very peculiar and quite different from that of any other known plant. The plant is a native of Bengal, and like all other members of the genus is parasitical, growing upon a few evergreen trees, particularly upon some species of *Memecylon*. The fruit, like that of its relative, the mistletoe, and nearly all other members of the order, consists of a mass of very viscid pulp surrounding a single seed, and on separating from the parent plant adheres to whatever it may chance to fall upon, and after a time begins to germinate. It is only during the first stage of germination that the motion to be described takes place, and it is evident that the power of being able to move about is to enable the plant to find a suitable place to grow upon. The radicle at first grows out, and when it has attained a length of about an inch it develops upon its extremity a flattened disk, and then curves about until the disk is applied to any object that is near at hand. If the spot upon which the disk fastens is suitable for further development of the plant, germination continues, and no locomotion takes place; but if, on the contrary, the spot should not be favorable, the germinating embryo has the power of changing its position. This is accomplished by the adhesive radicle raising the seed and advancing it to another spot; or, to make the process plainer, the disk at the end of the radicle adheres very tightly to whatever it is applied; the radicle itself straightens and tears the viscid berry away from whatever it has adhered to, and raises it in the air. The radicle then again curves and carries the berry to another spot, where it again adheres. The disk then releases itself, and by the curving about of the radicle is advanced to another spot, where it again fixes itself. Dr. Watt says he has seen this repeated several times, so that to a certain extent the young embryo, still within the seed, moves about. It seems to select certain places in preference to others, particularly the leaves, which in the *Memecylon* are evergreen and very dense. The berries on falling are almost certain to alight on the leaves, and, although many germinate thereon, they have been frequently observed to move off the leaves on to the stems, and finally fasten there.

The Origin of the Cat.—St. George Mivart, in his recent work on the cat, says that the early history of the domestic cat is uncertain. It is not the common cat of zoology which is the wild or native cat, an animal that existed abundantly in the forests in the time of Julius Cæsar and was seen in Wales within the last twenty years. It appears to have come down to us from the Eyptians, being mentioned, Mr. Mivart informs us, in inscriptions as early as 1684 B.C., and being, as well known, an object of religious worship and the venerated inmate of certain temples. It was an emblem of the sun to the Egyptians, and, according to Herodotus, the death of a cat from natural causes was followed by the ceremony of shaving the eyebrows in token of mourning. From Egypt it must have been introduced into Greece, though Professor Rolleston, in his article on cats in Humphry and Turner's *Journal of Anatomy*, considers that the cat of the ancients was the *Mustela foina*, the "beech" or "stone" marten. It was not a domestic animal among the Hebrews, though it was known to them, as we read in the apocryphal book of Baruch, who lived, it is supposed, in the reign of Jeholakim, about 600 B.C., that "upon their bodies and heads sit bats, swallows, and birds, and the *cats* also." In regard to the pedigree of the cat, Mr. Mivart traces it from unknown insectivora-like animals, which produced, among other forms, *Arctocyon*. From this, as a root, the carnivorous branch divided into cynoid and arctoid branches—the former developing into the typical *Canidæ*; the latter, after giving off other branches, leading to the *Ursidæ*, and, through *Procurus*, to the *Viverridæ*, *Hyænidæ*, *Cryptoproctidæ*, and *Felidæ*.

Dr. Andrew Clark on Alcohol.

Dr. Andrew Clark lately delivered an evening address on alcohol, in the Great Portland Street School-rooms, London, to a crowded and deeply interested audience. He said he purposed offering a few informal remarks upon the influence of alcoholic drinks upon health, upon work, upon disease, and upon the succeeding generation. This question of alcohol was of the first importance to us as a nation and as individuals, and hence a great responsibility rested upon those who professed to speak upon it with authority. He ventured to say that he knew something about this question. For twenty-five years he had been physician to one of the largest hospitals in this country (the London Hospital), and there, as elsewhere, it had been a part of his business in life to ascertain the influence which alcoholic drinks exercised upon health, and he had with deep interest and attention striven to get at the truth of the matter. In the first place let him distinctly say that alcohol was a poison, as were also strychnine, arsenic, and opium; but in certain small doses strychnine, arsenic, and opium were useful in special circumstances, and in very minute doses alcohol could also be used without any obvious prejudicial effect upon health. He was not going to discuss what these minute doses were, save to say that they were very minute. A perfect state of health (and it was rarely to be found) could not be benefited by alcohol in any degree, and in nine times out of ten it was injured by it. He said this not as a total abstainer, though he earnestly hoped that all the rising generation would be. Instead of the ideal state of health which might be enjoyed save for the nature of our surroundings, the sins of our parents, and our own sins, there was a sort of secondary health possessed by most of us, and what did alcohol do for this?

He had two answers to give—that this sort of health bore apparently with alcohol better than the other, and sometimes seemed as if benefited by it; and this was exactly the sort of health that formed the great debating ground of different people with respect to the use of alcohol. Secondly, there were some nervous people always ailing, yet never ill, for whom he had a profound sympathy, who seemed to derive great comfort from alcohol, and to these he had sometimes said, "Take a little beer or wine, but take great care never to go beyond the minute dose." He did not defend this, but simply stated it to show what he thought. As to the influence of alcohol upon work, Dr. Clark went on to encourage his hearers to try the experiment of total abstinence, and observe the result in regard to work. Let them, however, try it fairly, and not allow themselves to be deterred from it by the evil prognostications of friends. He was certain that if this experiment were tried each individual present would come to the conclusion that alcohol was not a helper of work, but, on the contrary, a hinderer.

Now as to the effect of alcohol upon disease. He went through the wards of his hospital to-day and asked himself how many cases there were due to natural and unavoidable causes and how many to drink, and he came, after careful thought, to the conclusion that seven out of ten owed their ill-health to alcohol. He did not say that these were excessive drinkers or drunkards—in fact, it was not the drunkards who suffered most from alcohol, but the moderate drinkers who exceeded the physiological quantity. The drunkard very often was an abstainer for months together after a period of intemperance, but the moderate drinker went steadily to work undermining his constitution, and preparing himself for premature decay and death. He had no means of finding out how many victims alcohol claimed each year, but certainly more than three-fourths of the disorders of fashionable life arose from the drug of which he was speaking. Finally, Dr. Clark dwelt upon the heredity of the alcoholic taint, and closed by saying that sometimes when he thought of all this conglomeration of evils he was disposed to rush to the opposite extreme—to give up his profession, to give up everything, and to enter upon a holy crusade, preaching to all men everywhere to beware of this enemy of the race.

Pulque.

BY E. E. HOPEL, M.D.

Pulque is the national drink of the Mexicans. It is produced by the fermentation of the maguey or *Agave americana*. This plant has been considered diuretic and antisyphilitic. There is no authentic record as to who first made pulque or neutli. Many are the traditions extant among the Mexicans concerning its first manufacturer. It seems, however, to be the more general belief that it was Xochitl, daughter of a nobleman called Papantezin, who lived in the time of Tapancaltzin, eighth king of the Toltecs. From time immemorial pulque has been considered to contain medicinal virtues in a very high degree as well as all the other products of the maguey, and at one time the maguey was even said to hold a spiritual life and was held in reverence. To-day pulque is esteemed by the ignorant classes as having a variety of curative powers, and physicians use it for its alcoholic and nutritive properties. It is held as a stimulant, tonic, and antispasmodic. They recommend it to the infirm, weak, anæmic, and nursing mothers.

ITS COMPOSITION.

It is obtained by fermenting the juice expressed from the central portion of the maguey plant. After expressing the juice between rollers, or, as was formerly done by means of suction, it is carried to the vats for fermentation. These vats consist of raw ox-hides loosely suspended in a strong wooden frame, with the hair on the outside. These hide-made vessels contain the cryptococcus or ferment, which is a residuum of the former fermentations. After a few hours fermentation is fully established and the pulque is drawn off, always leaving a residuum in the vessel for the next fermentation. The liquid obtained from the maguey plant has a density varying from 1·029 to 1·042, and contains in 100 parts 9·553 of sugar, 0·540 of gum and soluble albumen, 0·726 salts, and 89·181 of water, holding in solution resinous matter, fats, albuminoids, starch, dextrine, and glucose.

According to Don Jose Ramos, its salts contain potash, soda, and lime in moderate proportions, and magnesia and alumina as chlorides, carbonates, sulphates, and silicates; hence the great value in which it must have been held in former times and in which it ought to be held at the present day.

From the composition of the juice of the maguey one may have an idea of the therapeutic effects of the pulque, allowing for the change which these constituents may undergo through fermentation. Pulque has no definite proportion of alcohol, for one may readily see from the way it is manufactured that it cannot have any definite standard. It, however, contains a very small proportion of fusel oil and carbonic acid in large quantities. Considering that its manufacture is not based upon any standard of purity, or even with ordinary care, its density cannot be given with any certainty, though it varies from 0·9943 to 1·0200 ("La Esquela de Medicina"). To-day it is attracting the attention of the medical fraternity because of the evil effects upon the liver caused by its excessive use among the lower classes, not, however, in the light of pulque as a compound, but because of the evil effects of the alcohol which it contains. It is, therefore, proposed to adopt some other form of manufacture that a much lower percentage of alcohol may enter into its composition, according to a fixed standard, and thus avoid the evils of alcoholism.—*Therapeutic Gazette.*

Action of Coffee and Sugar on the Stomach.

In a paper presented to the Société de Biologie (*Rev. Méd.*) M. Leven states that coffee, so far, as is often supposed, from accelerating the digestive process of the stomach, rather tends to impede this. When thirty grammes of coffee, diluted in one hundred and fifty of water, is given to a dog, which is killed five hours and a half afterward, the stomach is found pale, its mucous surface being anæmic, and the vessels of its external membrane contracted. The whole organ exhibits a marked appearance of anæmia. Coffee thus determining anæmia of the mucous membrane, preventing rather than favoring vascular congestion, and opposing rather than facilitating the secretion of gastric juice, how comes it that the sense of comfort is procured for so many people who are accustomed to take coffee after a meal? A repast, in fact, produces, in those whose digestion is torpid, a heaviness of the intellectual faculties and embarrassment of the power of thinking; and these effects, and the disturbance of the head, are promptly dissipated by the stimulant effect which the coffee produces on the nervous centers, as shown by experiments with casein. Coffee and tea, when taken in excess, are a frequent cause of dyspepsia, for the anæmic condition of the mucous membrane being periodically renewed, a permanent state of congestion is at last produced, which constitutes dyspepsia. Sugar, which with many doctors has a bad reputation, is an excellent aliment which assists digestion, and should not be proscribed in dyspepsia. By experiment, digestion of meat is found to take place much more completely when sugar is added. Coffee exerts both a local and general action, operating locally by means of its tannin, by diminishing the caliber of the vessels, but acting on the general economy by exciting the nervous centers and the muscular system. It renders digestion slower, and is only of good effect by relieving the feeling of torpor after meals. Its injurious action on digestion may be corrected by adding sugar so as to counterbalance its effects on the mucous membrane. This adding sugar to coffee is not only a pleasant practice, but one contributing to digestion.

Nitro-Benzol in Oil of Bitter Almonds.

The oil is mixed with a little alcohol, a solution of pure potash, and a few drops of ferric chloride. The mixture is allowed to stand for some hours, shaken, and distilled, avoiding with great care bumping or spirting, and the direct action of the flame upon any part of the oil. A portion of the distillate, dehydrated, is heated in a test tube with a few fragments of pure potash. If the oil was pure the mixture

remains colorless. If nitro-benzol was present there is produced a dark coloration from the formation of azo-oxybenzol, and as a little aniline is also formed, a few drops of solution of chloride of lime added to the cold mixture produce a violet coloration.—*Enrica Pegna, in Zeitschrift für Analytische Chemie.*

Asphalt.

A lecture on "asphalt" was lately read by Mr. E. B. Bell, C.E., before the members of the Balloon Society, London. The material was, it was shown, a natural production, consisting of from 5 to 15 per cent by weight of pure bitumen combined by carbonate of lime. Although its composition was well known, and the components could be derived in abundance, and at moderate cost, asphalt had not yet been artificially produced with success, either chemically or commercially. Its employment was of the highest antiquity, it having been well known to the Egyptians, Assyrians, and Babylonians, although, curiously enough, no allusion to it was made by Roman or Greek writers, nor could it be found in the works of those classic nations. It appears to have been rediscovered by Dr. D'Eyrinis, who published a work in 1721, enthusiastically advocating its use, not only as a cementitious material, but as a universal panacea in medicine. Dr. D'Eyrinis found out the material while making a geological excursion in the year 1718, in the Val de Travers, canton of Neufchatel, Switzerland, and for nearly a century this was the only mine worked.

In 1838 the first footpaths were made of the material at Paris, and the Seyssel mines were opened; but owing to commercial speculations, asphalt lost favor, and it was not till 1854 that the first Parisian carriageway, that of the Rue Bergère, was paved with it. Since 1871 a very large proportion of the streets of Paris, both the carriage and footways, had been laid with asphalt. The first experiment in London was in May, 1869, when 485 square yards of Threadneedle street were laid with it, and its use had been largely extending. The material was at first used as mastic, boiled on the spot in large caldrons, but latterly it had been found better to use it as a powder, rammed by manual pressure. The present treatment was that the rock was brought to England and stored in the open. It was thrown into a stone crushing machine, and having been reduced to pieces about the size of a walnut, the material fell on to a shute, from the bottom of which an endless chain of buckets carried the material to the hopper of a Carr's disintegrator, in which it was reduced to powder. It was then heated in cylinders over a coal fire.

Each charge consisted of about 2½ tons, and took from two to three hours to attain the requisite temperature, and varied according to the amount of vapor to be driven off, and had to be very delicately regulated. If the material was not sufficiently heated, it would not adhere enough under compression to give the laid surface a hard face. If, on the other hand, it was overheated, the bitumen was fused, and little but comparatively worthless limestone left; as a rule, the heat varied from 220° to 250° Fah., but much was left to the experience of the skilled calciner. The powder was now ready for laying, and owing to its dense, compact nature it would retain the heat for many hours. A concrete foundation having been laid and allowed to set firmly, the asphaltic powder was brought to the street in open carts and spread transversely across the carriageway in widths of from 3 feet to 4 feet, in a thickness about two-fifths above the specified compressed section. It should still have a minimum temperature of 115° Fah. It having been raked with as much regularity as possible over the concrete, the powder was rammed all over with heavy iron, mushroom-headed punners, heated in portable furnaces to a temperature that prevented adhesion. This ramming was the crucial point of the operation, and was at first done very lightly, the pressure being augmented as the material attained solidity. An opening presented itself to mechanicians to devise some mode of mechanical ramming; many plans had been suggested, but at present none had answered. The objection to rollers was that they drove the powder forward in a wave, and the force was not advantageously applied; a steam hammer executed the work better, but the practical difficulty of laying the temporary rails had been fatal to the method. After the surface was compressed by the punners, the surface was seared with a smooth iron, and it was gauged by a long straight-edge, beaten to a uniform level, and the roadway was finally thrown open for traffic as soon as it had cooled to the temperature of the atmosphere.

The lecturer then indicated the advantages of the asphalt as a paving material from the sanitary, mercantile, ratepayers', and humanitarian points of view. He thought all would agree that that material was best for roadways which created least dust and mud, presented the most continuous surface, and retained least damp. Dust in itself, apart from its impure character, was injurious to health, and was rendered worse by the deleterious substances contained in it. Asphalt stood foremost, he held, in its imperviousness to filth and moisture, and hence no exhalations could pass through it from the ground below, nor did it suffer any change under moisture. It was also almost noiseless, and although exceeded in this respect by wood, asphalt had not the peculiar rumbling sound which that material caused. To the mercantile portion of the community it was not only commended by its freedom from dust and mud, but from the absence of vibration, and the minimizing of tractile force needed to draw given loads. The unpopularity of asphalt with many engineers and architects arose from the fact that streets were laid with preparations of gas tar, or pitch and limestone, or clay, which resulted in a soft surface during the first year or two, giving off oils by evaporation, and breaking up after two or three years' wear. The cost of cleansing and watering was greatly reduced by the use of true asphalt. Comparisons made by Lieutenant-Colonel Haywood, the City Engineer, showed that one cartload of refuse was swept from every 344 square yards of macadam, from every 500 square yards of granite, from 1,666 square yards of wood, whereas 4,000 square yards of asphalt had to be traversed before a load was obtained. The expense and inconvenience of renewal was also reduced. One of the greatest conveniences for a crowded city was the fact that an asphalt roadway once down, the street need never be blocked for repairs. Cheapside had now been laid for eleven years, and the traffic had never been interrupted for an hour during mending. The watering, again, was reduced to the flushing of the channels with streams of water.

The common objection to asphalt was that it afforded a bad foot-hold to horses. In itself, however, whether dry or quite wet, it was not slippery, but when the air was humid and after slight dirt upon the surface rendered it greasy. Lieutenant-Colonel Haywood had proved by statistics that fewer horses fell on asphalt than on granite, and this was confirmed by much independent evidence. Further than this, horses hurt themselves the less by a fall on asphalt than on granite. It was chiefly on the transition from one material to another that accidents occurred, and the true remedy appeared to be to lay all with the same class of paving. In conclusion, the author showed that among the other uses of material were in flooring warehouses and granaries, for which its imperviousness to damp and vermin strongly recommended it.

Sunken Floors.

So few of the floors constructed in new houses are, says the *Building News*, equal to their work, that the attention of architects and builders might be profitably called to the subject. In going over some of the newly-erected houses in the suburbs of London, it is not infrequent that one finds dwelling house floors which have sunken so much in the center as to destroy the comfortable assurance that they are safe. These instances occur chiefly in houses erected by speculative builders, who seem to be under no regulation of any kind in respect of floor timbers. We have noticed serious deflection in the floors of a house rented at over £100 per annum, the consequences of which are cracked ceilings below, opening crevices between skirting and floor, and an uneven surface which makes every table shaky, and prevents large pieces of furniture like sideboards and bookcases being placed against the walls without a considerable propping underneath their front supports. Numerous books on the strength of materials have appeared, but the builder seems to regard such knowledge as merely theoretical, and is generally guided by the sizes of other timbering which he has found to answer. He does not always seem to understand the well established theorem that the strength of two pieces of timber of equal length not always in proportion to the area of cross section.

Many practical builders have a conviction that if a timber as a joist has a larger cross section than another it must be stronger. Thus they fancy a piece of timber 8 inches by 3 inches, which equals 24 square inches in sectional area, cannot be so strong as a piece 5 inches by 6 inches which has 30 inches in area. The fact is, the smaller piece is the strongest of the two if both are placed upon edge, as every one knows who has studied the principles on which the strength of beams depends. It is easy to convince the most practical of this seemingly inexplicable fact. If two beams of like size are placed side by side, the two will resist twice the amount of one of the pieces. This is so self-evident that experiment is not needed to establish the fact; in the same way, three beams will resist three times as much as one, and so on of any number. In plain English, when lengths and depths are equal, a beam of 6 inches in breadth will bear three times as much as one of 2 inches in breadth. It may be shown by experiment quite as readily that the strength increases more rapidly with the depth. In point of fact, another law of proportion is observed—namely, that having two beams of the same breadth and length, but of different depth, the strength increases more rapidly than the depth; thus it is found a beam 9 inches deep bears more than three times as much as one only 3 inches deep. These are very simple statements derived from facts and experiments, and no complex conception of the resistance of certain fibers on both sides of a neutral axis, or equations in algebra, are required to establish them.

In dwellings the load on a floor is chiefly made up of furniture, though this is generally placed, at least the heavier articles, round the walls of rooms. The space occupied by tables and other objects in the center of a room reduces the available standing area, and thus, for all ordinary floors, 70 pounds per superficial foot may be calculated for as the full load in extreme cases. Rules founded upon the resistance of beams to rupture are, however, of little use, as the floors may be seriously affected by deflection, and deflection is directly as the cube of the length. In regarding stiffness, the load per foot has been given by one authority as 90 pounds per foot, including weight of materials; and the rule involving several dimensions is expressed in the formula—

$$c\,l^3 = i\,b\,d^3,$$

from which, by inversion, the distance from centers, the length, the breadth, and the depth of beams, may be found. Thus the first of these will be generally found the most convenient in practice; which may be expressed by—

$$c = \frac{i\,b\,d^3}{l^3},$$

in which c denotes distance apart from centers of beams; l, the length of beam, both in feet; i, a coefficient for the wood used; and b and d, the breadth and depth. It makes all the difference to place joists an inch nearer, though builders like to give as much interval as they can, for economy's sake. Instead of joists being placed 12 inches apart, it is oftener to find them 13 inches or even 14 inches, and the consequence is a scantling which has been found to answer in a well-built house fails when it is introduced with a greater distance or interval. Then, the modern speculative builder's floor is seldom properly stiffened by cross bridging; there is only one row, instead of two or more. Of course no practical man will deny the advantage of bridging his floor joists; it helps wonderfully to prevent deflection under a concentrated load, for the joist immediately beneath the load is relieved of direct strain, and the joists on each side take a share of the weight. Generally it may be taken that a properly bridged floor is capable of sustaining, without mere deflection, twice as much load as the same floor without bridging, so that the cost of the introduction is amply repaid. It is a misfortune the Building Act does not deal with floors as it does with walls, by laying down certain scantlings for the guidance of builders, as a weak deflecting floor in course of time tends to render the house unstable, by acting injuriously upon the walls. Builders might be willing to follow regulation scantlings for their joists and rafters who could not be induced to calculate for themselves, who would scorn the idea of studying moments of resistance, or who would never be able to work out a formula.

Railway Progress in 1880.

Advance sheets of "Poor's Railway Manual" for the current year show that there were added to the mileage of railways in operation last year 7,174 miles, raising the aggregate from 84,225 miles, reported to the Manual, to 93,671 miles. The *Railroad Gazette's* figures make the number of miles of road in operation at the beginning of 1880 greater by 2,272 miles than the Manual states, while the estimate for 1881 is accounted substantially correct.

The Manual's statistics of roads and equipment for the past year show as follows:

	1880.	Increase.	Per Cent.
Miles of road, total	93,671	7,174	8·3
Miles of road reporting	84,225 (Dec.)	490	0·6
Miles of second tracks and sidings	21,978	1,937	9·7
Miles of steel track	33,680	...	...
Number of locomotives	17,949	865	5·1
Number of passenger cars	12,789	780	6·5
Number of baggage, mail, and express cars	4,786	267	6·0
Number of freight cars	539,355	59,165	12·3

By decades the progress of railroad building in this country since 1830, when there were but 23 miles in operation, is summed up as follows:

From 1830 to 1840	2,785 miles.
" 1840 " 1850	6,213 "
" 1850 " 1860	21,614 "
" 1860 " 1870	22,279 "
" 1870 " 1880	40,757 "

The capital, gross earnings, expenses, and net earnings per mile of road, and percentage of net earnings on capital of the railroads of the United States, for ten successive years, have been:

Year.	Stock and Debt.	Gross Earnings.	Expenses	Per Ct. of Ex. to Earn.	Per Ct. of Earn. on Capital.
1871	$59,726	$9,040	$5,863	64·8	5·32
1872	55,116	8,116	5,224	64·4	5·25
1873	57,136	7,947	5,172	65·1	4·86
1874	60,944	7,513	4,776	63·6	4·49
1875	61,533	7,010	4,425	63·1	4·20
1876	60,791	6,764	4,228	62·5	4·16
1877	61,650	6,382	4,075	63·8	3·74
1878	59,040	6,232	3,847	61·7	3·04
1879	58,070	6,244	3,670	58·8	4·49
1880	60,650	7,307	4,277	58·5	5·00

Capital per mile has varied but little since 1874, at the close of the railroad construction period. Gross earnings per mile decreased continuously from 1871 down to 1878, made very little gain fromt the lowest point in 1879, but in 1880 leaped up at once, becoming the largest for six years. Expenses made a similar leap, yet not so far but that net earnings per mile were the largest since 1871. So the percentage on the capital formed by the net earnings decreased continuously from 1871 to 1877, and since 1877 has increased, and most of all last year, when it became just 5 per cent, which is as good an average as most European countries exhibit; this has been exceeded only in 1871 and 1879.

Fertility of Volcanic Soils.

The rapid and exceptional fertility in volcanic soils, such as those about Mount Etna, has been attributed to a superabundance of phosphoric acid. M. de Gasparin, however, is led to reject this view. An exuberantly fertile garden between Catania and Nicolosi contains, he finds, only two-thousandths of phosphoric acid; fertile land at Nimes and Caen has hardly more than one-thousandth. Other cases are given. The rapid production of the land about Etna he considers to be due mainly to the continuance of muddy formations and the climate, which hastens the decomposition of lava, so that the supply of organic materials is presented or formed with exceptional promptitude.

DECISIONS OF THE COURTS RELATING TO PATENTS.

Supreme Court of the United States.

WEBBER *vs.* VIRGINIA.

1. TAXATION — LICENSE — SALE OF MANUFACTURES — PATENT.—A State may require the taking out of a license for the sale of a manufactured article, and the fact that the article is produced under a patent will not defeat this power.

2. COMMERCE—TAXATION AGAINST NON-RESIDENT MANUFACTURER.—A tax upon the manufacturers of another State, while those of the State itself are free from such taxation, is invalid, since it discriminates against the rights of the non-resident manufacturer, and violates the constitutional provision vesting all commercial control in the Federal Government.

In error to the Supreme Court of Appeals of the State of Virginia.

In May, 1880, the plaintiff in error, J. T. Webber, was indicted in the County Court of Henrico County, in that State, for unlawful selling and offering for sale in that county to its citizens certain machines known as "Singer sewing machines," which were manufactured out of the State, without having first obtained a license for that purpose from the authorities of the county or having paid the tax imposed by law for that privilege. The indictment was founded upon the forty-fifth and forty-sixth sections of the revenue law of the State, which are as follows:

45. Any person who shall sell or offer for sale the manufactured articles or machines of other States or Territories, unless he be the owner thereof and taxed as a merchant, or take orders therefor on commission or otherwise, shall be deemed to be an agent for the sale of manufactured articles of other States and Territories, and shall not act as such without taking out a license therefor. No such person shall, under his license as such, sell or offer to sell, such articles through the agency of another, but a separate license shall be required from any agent or employe who may sell or offer to sell such articles for another. For any violation of this section the person offending shall pay a fine of not less than fifty dollars nor more than one hundred dollars for each offense.

46. The specific license tax upon an agent for the sale of any manufactured article or machine of other States or Territories shall be twenty-five dollars, and this tax shall give to any party licensed under this section the right to sell the same within the county or corporation in which he shall take out his license; and if he shall sell or offer to sell the same in any other of the counties or corporations of this State he shall pay an additional tax of ten dollars in each of the counties or corporations where he may sell or offer to sell the same. All persons, other than resident manufacturers or their agents selling articles manufactured in this State, shall pay the specific license tax imposed by this section. (Acts of Assembly, 1875 and 1876, p. 184, chap. 162, secs. 45, 46.)

To the indictment the accused pleaded "not guilty;" and on the trial it was proved that he had sold and offered to sell sewing machines in Henrico County, as charged, but that at the time he was acting as an agent or employe of the Singer Manufacturing Company, a corporation created under the laws of New Jersey; that this company had a place of business in Richmond, Virginia, where it was licensed as a resident merchant for the year beginning May 1, 1880, and had paid the required license tax and where it kept a stock of machines for sale; that the machines sold by the accused were the property of the company, and were manufactured by it out of the State and in accordance with specifications of a patent of the United States granted in 1879 to one W. C. Hicks, and by him transferred to the company. It also appeared that the accused had not taken out a license to sell the machines in Henrico County, and was not himself taxed as a merchant, and had not taken orders for the machines on commission or otherwise. On the trial his counsel requested the court to instruct the jury that if they believed the Singer Manufacturing Company had paid for a general merchant's license for the year beginning May 1, 1880, and received such license, or that the machines sold were constructed according to the specifications of the patent held by the company, and that the accused was acting in the sales made only as its employe, he was entitled to a verdict of acquittal. The court refused to give these instructions, and, at the request of the attorney for the Commonwealth, instructed the jury, in substance, that if they believed the accused had, at different times within the year previous to the indictment, sold or offered to sell in Henrico County to its citizens Singer sewing machines manufactured beyond the State, and at the time he was neither the manufacturer himself nor the owner of them, and was not taxed as a merchant in the county, and had not taken orders therefor on commission or otherwise, and had not obtained a license to sell the same in the county, and had not paid to the proper officer the tax imposed by law for selling the same in that county, they should find him guilty. The jury found the accused guilty, and he was sentenced to pay a fine of fifty dollars, besides costs. On appeal to the Circuit Court of the county this judgment was affirmed, and on further appeal to the Supreme Court of Appeals of the State the judgment of the Circuit Court was affirmed. To review the latter judgment the case is brought here on writ of error.

Field, J.:

In the County Court, where the accused was tried, the only defense presented by his instructions was that he was acting as the agent of the Singer Manufacturing Company, which had a license from the State as a resident merchant in Richmond to sell the machines, and also held a patent of the United States authorizing it to manufacture and sell them anywhere in the United States. To this defense the answer is obvious. The license being limited to the city of Richmond gave no authority to the company to sell the machines elsewhere, and of course gave none to its agent. Besides the question as to the extent of the territorial operation of the license depended upon the construction given by the Court of Appeals of the State to the statute, and its decision thereon is not open to review by us; and the right conferred by the patent laws of the United States to inventors to sell their inventions and discoveries does not take the tangible property, in which the invention or discovery may be exhibited or carried into effect, from the operation of the tax and license laws of the State. The combination of different materials so as to produce a new and valuable product or result, or to produce a well-known product or result more rapidly or better than before, which constitutes the invention or discovery, cannot be forbidden by the State, nor can the sale of the article or machine produced be restricted except as the production and sale of other articles for the manufacture of which no invention or discovery is patented or claimed may be forbidden or restricted.

The patent for a dynamite powder does not prevent the State from prescribing the conditions of its manufacture, storage, and sale, so as to protect the community from the danger of explosion. A patent for the manufacture and sale of a deadly poison does not lessen the right of the State to control its handling and use. The legislation respecting the articles which the State may adopt after the patents have expired it may equally adopt during their continuance. It is only the right to the invention or discovery—the incorporeal right—which the State cannot interfere with. Congress never intended that the patent laws should displace the police powers of the States, meaning by that term those powers by which the health, good order, peace, and general welfare of the community are promoted. Whatever rights are secured to inventors must be enjoyed in subordination to this general authority of the State over all property within its limits. These views find support in the language of this court in *Patterson vs. Kentucky* (97 U. S., 501; 7 Reporter, 353). In accordance with the views there expressed we can find no objection to the legislation of Virginia in requiring a license for the sale of the sewing machines by reason of the grant of letters patent for the invention. There is, however, an objection to its legislation arising from its discriminating provisions against non-resident merchants and their agents, and this is presented by the instructions given to the jury at the request of the attorney of the Commonwealth. The forty-fifth section of the revenue law declares "that any person who shall sell or offer for sale the manufactured articles or machines of other States or Territories, unless he be the owner thereof and taxed as a merchant, or take orders therefor, on commission or otherwise, shall be deemed to be an agent" for the sale of those articles, and shall not act as such without taking out a license therefor. A violation of this provision subjects the offender to a fine of not less than fifty dollars nor more than one hundred dollars for each offense. The forty-sixth section fixes the license tax of the agent for the sale of such articles at twenty-five dollars. The license only gives him a right to sell in the county or corporation for which it is issued. If he sells or offers to sell in other counties or corporations he must pay in each an additional tax of ten dollars. The section then declares that—

"All persons other than resident manufacturers or their agents selling articles manufactured in the State shall pay the specific license tax imposed by this section."

By these sections, read together, we have this result: The agent for the sale of articles manufactured in other States must first obtain a license to sell, for which he is required to pay a specific tax for each county in which he sells or offers to sell them, while the agent for the sale of articles manufactured in the State, if acting for the manufacturer, is not required to obtain a license or pay any license tax. Here there is a clear discrimination in favor of home manufacturers and against the manufacturers of other States. Sales by manufacturers are chiefly effected through agents. A tax upon their agents when thus engaged is therefore a tax upon them, and if this is made to depend upon the foreign character of the articles—that is, upon their having been manufactured without the State—it is to that extent a regulation of commerce in the articles between the States. It matters not whether the tax be laid directly upon the articles sold or in the form of license for their sale. If by reason of their foreign character the State can impose a tax upon them or upon the person through whom the sales are effected, the amount of the tax will be a matter resting in her discretion. She may place the tax at so high a figure as to exclude the introduction of the foreign article and prevent competition with the home product.

It was against legislation of this discriminating kind that the framers of the Constitution intended to guard when they vested in Congress the power to regulate commerce among the several States. In *Welton vs. Missouri* we expressed at length our views on the subject, and to our opinion we may refer for their statement. No one questions the general power of the State to require licenses for the various pursuits and occupations conducted within her limits and to fix their amount as she may choose, and no one on this bench—certainly not the writer of this opinion—would wish to limit or qualify it in any respect, except when its exercise may impinge upon the just authority of the Federal Government under the Constitution or the limitations prescribed by that instrument; but where a power is vested exclusively in that Government, and its exercise is essential to the perfect freedom of commercial intercourse between the several States, any interfering action by them must give way. This was stipulated in the indissoluble covenant by which we became one people.

In a recent case we had occasion to consider at some length the extent of the commercial power vested in Congress, and how far it is to be deemed exclusive of State authority. Referring to the great variety of subjects upon which Congress under that power can act, we said that—

"Some of them are national in their character and admit and require uniformity of regulation, affecting alike all the States. Others are local or are mere aids to commerce, and can only be properly regulated by provisions adapted to their special circumstances and localities. Of the former class may be mentioned all that portion of commerce with foreign countries or between the States which consists in the transportation, purchase, sale, and exchange of commodities.

Here there can, of necessity, be only one system or plan of regulations, and that Congress alone can prescribe. Its non-action in such cases with respect to any particular commodity or mode of transportation is a declaration of its purpose that the commerce in that commodity or by that means of transportation shall be free. There would otherwise be no security against conflicting regulations of different States, each discriminating in favor of its own products and citizens and against the products and citizens of other States."—(*County of Mobile vs. Kimball*, 102 U. S.)

Commerce among the States in any commodity can only be free when the commodity is exempted from all discriminating regulations and burdens imposed by local authority by reason of its foreign growth or manufacture.

Reversed and remanded.

A Large Electro-Magnet.

MM. Von Feilitzsch and W. Holtz have recently made, for the University of Greifswalde, an electro-magnet of enormous dimensions. The price of a bar of iron made in one single piece would have been too expensive, while, on the other hand, in a system formed of several pieces poles become developed at the contacts. The electro-magnet was, therefore, constructed of 28 plates of iron, 7 millimeters thick, bent into a horseshoe shape, and of a size such that their combination forms a cylinder 195 millimeters in diameter. These plates are varnished, in order to avoid the formation of extra currents; they are connected together by iron bands, and so arranged as to form a cylinder of uniform diameter. The total height is 125 centimeters, the distance between the poles 596 millimeters; the total weight 628 kilogrammes. The magnetizing helix is composed of 100 kilogrammes of plates of copper, forming 15 layers, insulated from one another by gutta percha.

Outside there are 175 kilogrammes of wire, 2 millimeters thick, forming 5 double layers of wire, and the extremities of the different parts of the circuit communicate with terminals fixed on insulated columns, which allow of any required connections being made. The poles are topped with two plates, 33 millimeters thick, which can be set at any required distance apart, and are capable of carrying various accessories. A movable plate, placed between the two branches, can be placed at any convenient height for the experiments. With this apparatus, excited by 50 small Grove cells, it was possible to melt in two minutes 40 grammes of Wood's metal by Foucault's experiment, and if the poles were set close, the resistance stopped the movement in spite of the tension of the driving band. It is very easy to show the rotation of the plane of polarization in heavy glass, when the latter is traversed by a ray of light, etc. In this apparatus, as has been pointed out, the bar of iron weighs 628 kilogrammes, and the wire 275 kilogrammes, while in the one constructed by Plücker, and which was the largest existing, the weights were only 84 and 35 kilogrammes respectively.—*Les Mondes.*

A Mountain Steamer.

Steam navigation among the mountain ranges of Colorado is one of the peculiarities of that wonderful region. A Denver paper says: "A sail over the placid and translucent waters of Twin Lakes will convince the traveler that Colorado affords some of the most beautiful aquatic scenery in nature. Twin Lakes are located three miles from Twin Lake station, Denver and South Park Division U. P. Railway, or 157 miles southwest of Denver, at the eastern base of the Sawache Range, at an elevation of 9,333 feet above the level of the sea. The lower lake covers 1,525 and the upper 475 acres, and they are united by a small, swift, clear stream, about half a mile in length, which winds through grassy meadows, studded with scattering shade trees, affording delightful picnic or camp grounds. On the north stands Mount Elbert, altitude 14,360 feet above the sea, or 5,027 feet above the lakes. Directly opposite (at the south side of the Lakes) are the Twin Peaks, also giants of the Rocky chain. The sheets are, therefore, thoroughly mountain-locked. The mountains last named are clothed with rare foliage and are full of game. The lakes abound in trout." The paper above quoted says the little steamer plying on Twin Lakes "has the distinguished honor of being nearer to Heaven than any other craft in the wide, wide world."

Business and Personal.

The Charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

Notes & Queries

HINTS TO CORRESPONDENTS.

No attention will be paid to communications unless accompanied with the full name and address of the writer.

Names and addresses of correspondents will not be given to inquirers.

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

Correspondents whose inquiries do not appear after a reasonable time should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them.

Persons desiring special information which is purely of a personal character, and not of general interest, should remit from $1 to $5, according to the subject, as we cannot be expected to spend time and labor to obtain such information without remuneration.

Any numbers of the SCIENTIFIC AMERICAN SUPPLEMENT referred to in these columns may be had at this office. Price 10 cents each.

(1) C. & Co. write: 1. We have a 6 horse boiler which we use to run off our newspaper one day each week. Which would be best for the boiler, to blow it off each week, or to permit it to stand with the usual amount of water in it? Should it stand empty or filled? A. If you use fresh water, keep the water in the boiler, and after steam is blown off close all openings till you wish to use it again. 2. Which is the best method of preserving small rubber hose when not in use? A. Keep it in water.

(2) X. F. asks how to clean a rusty gun and make it shine brightly. A. Plug the barrel, and rub and scour with fine emery moistened with dilute sulphuric acid (acid 1, water 5), then with emery and oil, and finally with a woolen rag and oil. 2. What is a good and durable wash, silver or nickel, for a gun? A. We know of no practical way of putting on a good coating of nickel or silver by wash. 3. Give me a recipe to silver or nickel-plate a brass telegraph instrument. A. See articles on these subjects on pp. 153, vol. xliii., and 81, vol. xliv. 4. What is a good thing to clean and polish up brass? A. Scour with a little oxalic acid, then with a little fine emery and oil.

(3) J. L. M. asks how to construct a box for holding electroplating solution and articles while being plated. How large should the box be to be supplied with electricity from one-half pint bichromate battery? How must I connect the wires of the battery with the box? A. It depends upon what solution the bath consists of. See instructions for making tanks, etc., for electroplating baths in articles on nickel plating and electro-metallurgy, pp. 153, vol. xliii, 81, 3, 33, 116, and 133, vol. xliv., SCIENTIFIC AMERICAN.

(4) J. B. A. asks: What mixture shall I use to stain a white ash fishing pole a very dark brown. It has already had a coat of varnish? A. Boil ¼ lb. Vandyke brown, and 2 oz. carbonate of soda in 12 oz. of water, and add ¼ oz. of bichromate of potassa; or use a weak aqueous solution of permanganate of potassa in water. It is better to remove the varnish first with sandpaper, and varnish after staining.

(5) F. V. asks: 1. Is there anything I can mix with aniline that I can paint on pearl with that will penetrate as a die and leave the color in the button? A. There is no available mordant. You can use gum water, or colorless French spirit copal or damar varnish as a vehicle. 2. Can you tell me how to etch pearl? What is a good cement to fasten cut steel on pearl and glass? A. You will find the information on pearl and pearl inlaying which recently appeared in this paper. 3. I have some cut steel that has rusted after being fastened on pearl. Can you tell me of something that will take the rust off and not hurt the pearl? A. Use a little oil and emery flour. 4. Is there any way to soften pearl to make it cut easy? A. No. 5. Is there any way to paint with nitrate of silver so it will not spread after putting it on? I also find some difficulty in making the silver go on only in spots; it acts as water does on a greasy surface. A. You can mix the silver solution with a little gum water to prevent spreading.

(6) R. E. M. writes: I have been told by engineers that beef tallow used in a steam engine cylinder would cause the follower and piston heads to wear in holes. We use tallow in our cylinder, and cavities large enough to lay the finger in have appeared in the follower. Do you think it is from the above reason, and why does tallow have this effect? What is the best lubricant for steam cylinder, and where can it be obtained? Is beeswax or black lead good to use in a cylinder? A. Tallow, when submitted to the action of live steam for a time, is partially decomposed, and several fatty acids are liberated which corrode the hot metal. If the cylinder requires it use best mineral sperm oil ground to a thin paste with finest graphite. See Lubricators, page 4, current volume. For addresses of dealers in cylinder oils see our advertising columns.

(7) C. E. R. asks how to make a good green writing ink. Have tried the receipt in SUPPLEMENT, No. 158, and get only a pale yellowish green. A. Make a strong solution of one of the aniline coal tar greens in water.

(8) A. C. B. writes: I wish to set an engine, and think of setting on a concrete foundation. Sand and gravel are not more than forty feet distant; Stone for building purposes about a mile and a half. Will concrete make as good a foundation as stone? If so, what cement is best, and how prepare and proceed? Engine is 7¾x18 inches, and runs 300 revolutions per minute, running circular saw. A. We recommend you to use stone; concrete, if not of the very best, will be apt in time to give way under the action of the engine.

(9) R. A. R. writes: 1. I am building a grain elevator, in which the grain will be lifted to a height of about 45 feet from the pit, and it is desirable that the elevator head should be, as nearly as possible, perpendicularly over the foot. Would a slope of two or three feet in that height be sufficient? And would it discharge properly with that slope if run at from 150 to 180 feet to the minute? A. No; buckets would not deliver. Speed of buckets should be at least twice 180 feet per minute. 2. What width of rubber or leather belting would be required to drive the above, the belt running at 180 feet to the minute, over a 16 inch pulley on elevator shaft at top, and driven by a 3 foot pulley at bottom (distance between the pulley shafts 30 feet), the power being one horse? A. 8 inches wide; the upper pulley should be nearly or quite 4 feet diameter. 3. Which would be the best for the last mentioned belt, rubber or leather? A. Rubber. 4. How many bushels per hour should one horse be able to elevate to the height mentioned, making a fair allowance for friction, etc.? A. About 1½ bushels per minute, at a speed of 530 feet.

(10) C. asks: 1. When a belt between two pulleys runs true and even on one of the pulleys and has a tendency to run off the other, the presumption is that the shaft of the latter is not level, and if so, will the belt run off the higher or the lower edge of the pulley? A. The two edges of the belt run at different velocities and the belt travels toward the side running at the highest velocity. 2. Why is it that the same belt has sometimes a tendency to run off the same side of both pulleys? A. Probably because the two sides or edges of the pulleys have different diameters. 3. Is there any cheap publication which gives all necessary information respecting belting, its strength, the best methods of lacing, etc.? A. "Cooper's Use of Belting," price about $3.50.

(11) C. M. K. asks: Can you give me some good and cheap plan of making a "bar photometer" for testing the candle power of gas or other light? A. See photometers and photometry, in Nos. 64, 30, 44, 8, 43, 236, 234, and 253, SCIENTIFIC AMERICAN SUPPLEMENT.

(12) L. C. (Razan) says in regard to silver-plating large articles with a small bath: I have often silvered, with a sponge, very large objects for which I had no vessel big enough, and the matter is very simple. I take the anode (copper wire) and wind it around a wooden stick, connecting the object (as cathode) with the negative (zinc) pole. The two are then brought into contact and kept moist with a sponge dipped in the plating bath. In this way plate either brass, German silver, or Britannia metal, to any thickness desired.

(13) W. L. writes: I have noticed in several answers to correspondents and in at least one article in your valued paper an allusion to what they call the whitewash on the "White House." As I know something of that preparation I think it proper that I inform you and your many readers. About the year 1836, John Ogden Dey, Esq., a maternal uncle of mine, visited Washington. He was a man of very observant habits, and in his inspection of the White House and the old Capitol building (the central part of the Capitol as it now stands) he found that the stone of which it was erected was being acted on severely by the weather, the outside of the stones had splintered by exposure and contraction and the disintegrative effect of the atmosphere to such an extent as to seriously threaten its permanency. He sought the Committee on Public Buildings and proposed to remedy the evil, not with stucco, but with a cement wash. After a full interchange of opinion he was empowered to send the material and instructions to Washington, which he did; and it was put on the next year, and has stayed there ever since, protecting the building material effectually. The information was given without fee or reward. The old man has passed away long since, and, in justice to his memory, as well as to inform the public, I have penned this. The material used was "Onondaga Hydraulic Cement," from State of New York, mixed with a small amount of glue and with milk, the exact proportions I do not now remember. I have seen several brick houses covered with this cement that has stood all kinds of weather for years. Some I have in mind were washed thirty-five years ago, and still retain the full coat and look as well as when put on. The cement has to be applied soon after it is mixed, and put on as thick as the brush will carry it. Sometimes two or more coats are required.

[OFFICIAL.]

INDEX OF INVENTIONS

FOR WHICH

Letters Patent of the United States were Granted in the Week Ending

July 19, 1881,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

A printed copy of the specification and drawing of any patent in the annexed list, also of any patent issued since 1866, will be furnished from this office for one dollar. In ordering please state the number and date of the patent desired and remit to Munn & Co., 37 Park Row, New York city. We also furnish copies of patents granted prior to 1866; but at increased cost, as the specifications not being printed, must be copied by hand.

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CHAPTER I. INTRODUCTION.—Money in the Rocks; The Underground Wealth of our Country; Valuable Minerals Disguised; How Great Fortunes are Missed; Number of Minerals in the United States; Object of this Work, and How to Use It; The Best Mineral Regions. II. DIRECTIONS FOR DETERMINING SPECIMENS BY THE KEY.—How to Test Minerals with the Simplest Means; Prospecting with a Jack-knife and Common Sense; Use of the Key; How to tell Pyrites from Gold, and Quartz from Diamond; All the Useful Minerals Grouped According to Hardness and Color. III. DESCRIPTIVE LIST OF USEFUL MINERALS.—The Gems; Precious Metals; Valuable Ores and Useful Minerals of the United States from Agate to Zinc; Their Distinguishing Characters, Uses, and Localities; A Mineralogy for Miners; Agate; Alum; Amethyst; Anthracite; Antimony Ore; Asbestos; Asphaltum; Azurite; Baryta; Bituminous Coal; Blende; Bog Iron Ore; Brittle Silver Ore; Brown Coal; Calamine; Cannel Coal; Carnelian; Celestine; Cerussite; Chromic Iron; Cinnabar; Cobalt Pyrites; Copper; Copper Glance; Copper Nickel; Copper Pyrites; Diamond; Emery; Fluor Spar; Frankinite; Galena; Garnet; Gold; Graphite; Gray Copper Ore; Gypsum; Horn Silver; Iron Pyrites; Jasper; Kaolin; Lenticular Iron Ore; Limonite; Magnetic Iron Ore; Magnetic Pyrites; Malachite; Manganese Spar; Marble; Mica; Micaceous Iron Ore; Niter; Oxyd of Manganese; Platinum; Red Copper Ore; Red Hematite; Red Silver Ore; Rensselaerite; Rock Crystal; Rock Salt; Rutile; Serpentine; Silicate of Copper; Silver; Silver Glance; Smaltine; Smithsonite, Spathic Iron; Specular Iron; Spinel Ruby; Steatite; Strontianite; Sulphur; Tin Ore; Topaz; Tourmaline; Variegated Copper Ore; Wad; Willemite; Zincite. IV. PROSPECTING FOR DIAMONDS, GOLD, SILVER, COPPER, LEAD, AND IRON.—Mineral Riches, how Discovered; Indications; Searching for Diamonds, and how to Distinguish them; Paying Localities of Gold; "Fool's Gold;" Prospecting for Silver and Copper; Where to Look for Lead and Iron. V. ASSAY OF ORES.—When an Ore will Pay; Washing for Gold and Platinum; How to Assay Gold in the Simplest Way; To Test any Rock for Gold and Silver; To Find the Purity of Gold; To Detect and Assay Silver Ores; Assay of Copper, Iron, Zinc, Tin, and Lead Ores; Ready Method of Testing Graphite. VI. MINERAL SPRINGS.—What are Mineral Springs; General Location; Gas Springs; Iron Springs; Sulphur Springs; Alum Springs; Epsom Springs; Salt Springs; Warm Springs; Artesian Wells and Oil Wells, and Where to Bore for Them. VII. ARTIFICIAL JEWELRY—HOW MADE AND HOW DETECTED.—Mock Diamonds; "Paris Brilliants;" The Manufacture of Pastes; False Ruby, Topaz, Sapphire, Emerald, and Carnelian; How to Distinguish True and False Gems; Imitation Pearl and Coral; Artificial Gold; List of Precious Stones. VIII. DISCOVERY OF GOLD IN CALIFORNIA. IX. DISCOVERY OF SILVER IN NEVADA. UNITED STATES GOLD AND SILVER STATISTICS.

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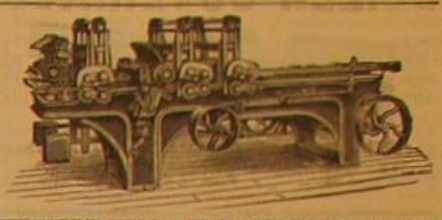

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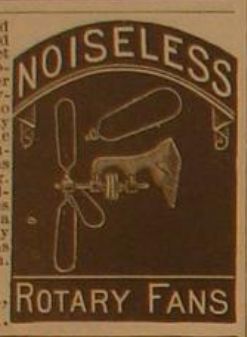

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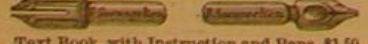

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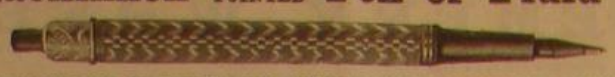

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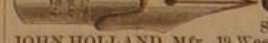

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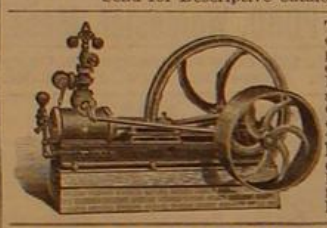

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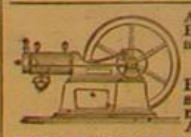

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