

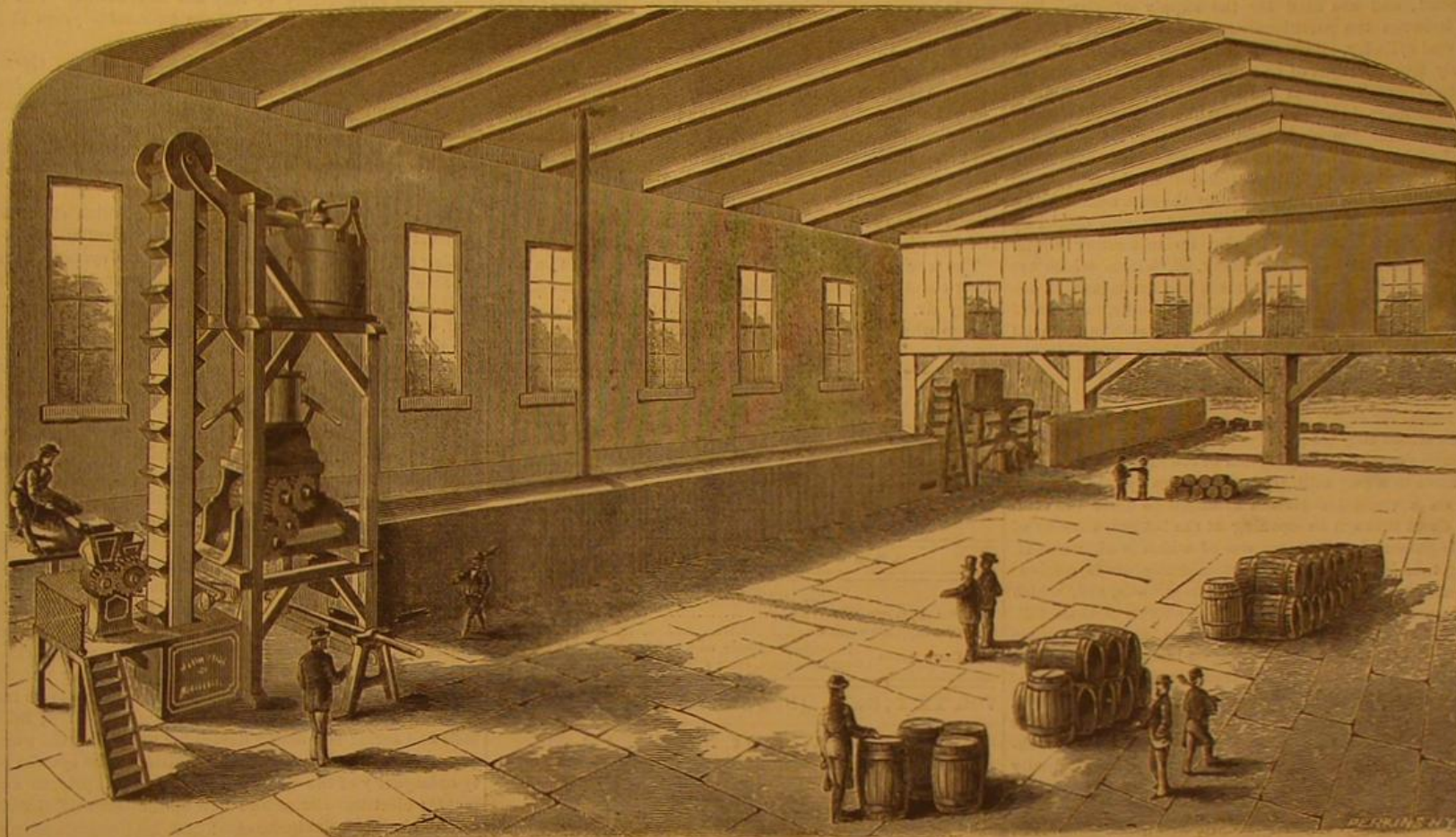
SCIENTIFIC AMERICAN

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LOISEAU'S APPARATUS FOR THE MANUFACTURE OF ARTIFICIAL FUEL.

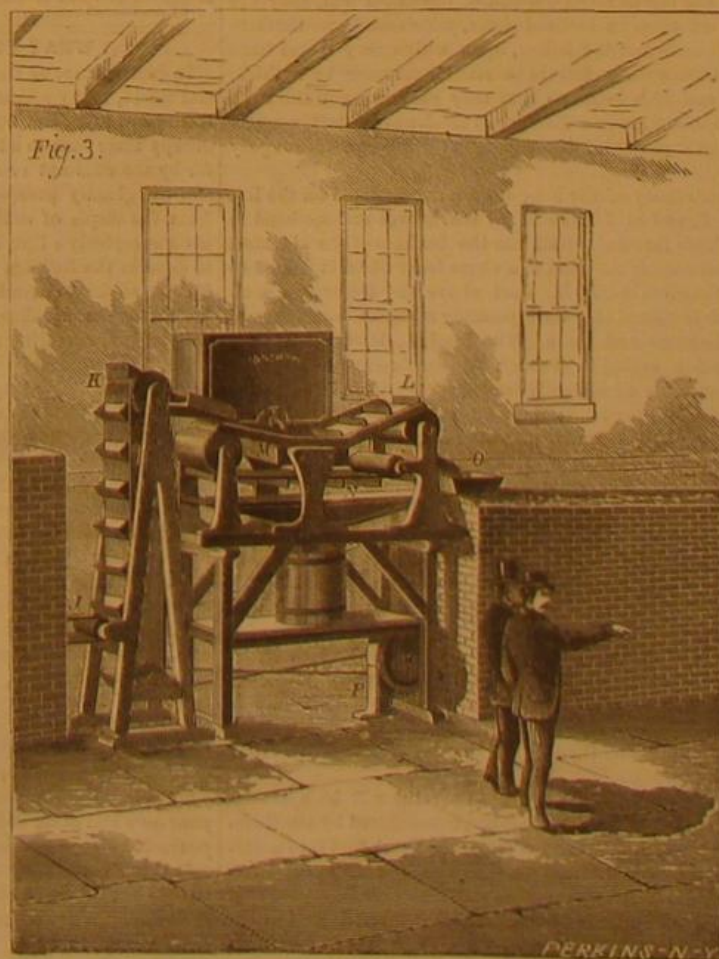
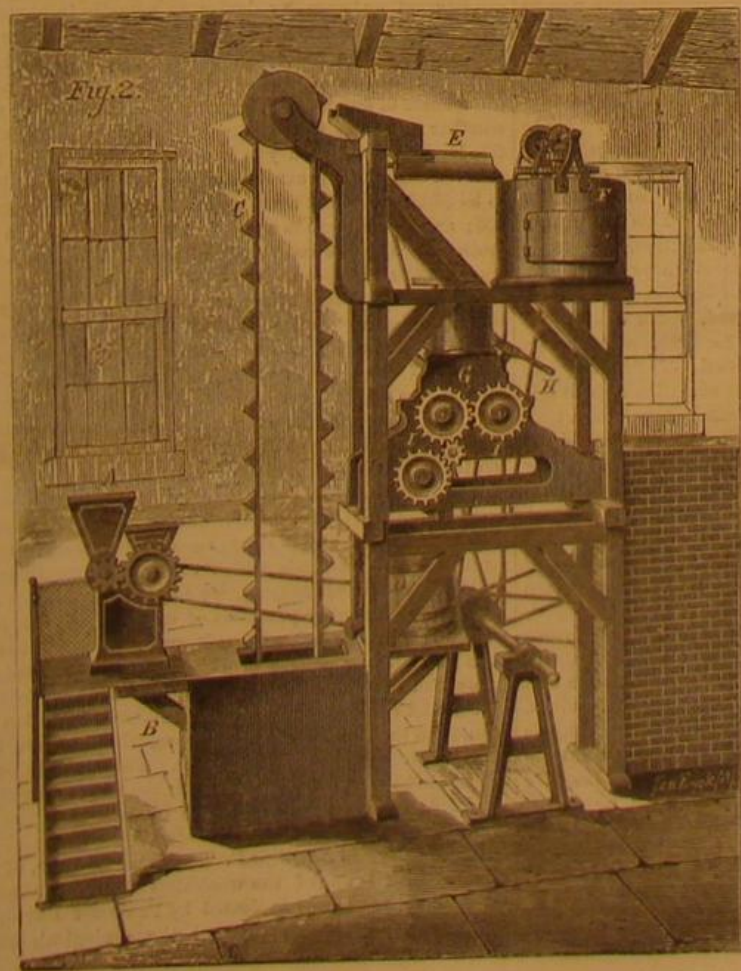
IMPROVED MANUFACTURE OF ARTIFICIAL FUEL.

The visitor to the coal regions of Pennsylvania, and indeed to all other localities where coal mining operations are in active and continual progress, will not fail to remark the vast heaps of waste or slack piled in the neighborhood of the mines. It is estimated that, on an average, from forty to fifty per cent of the entire yield, both of anthracite and bituminous coal, is, through the medium of mining, breaking, screening, and handling, reduced to this remarkable condition, causing loss to the producer and increasing the cost of the staple to the public.

During several years past, various inventions and processes have been devised for the utilization of this waste product through its manufacture into artificial fuel, mainly by combining it with coal tar, pitch, rosin and similar substances. The use of resinous cements rendered the fuel unfit for domestic purposes, on account of its smoke and disagreeable odor; while in employing clay, in connection with these materials, the costly machinery, great consumption of fuel for heating purposes, and extended handling, placed its expense of production too high to render competition with ordinary coal successful. Necessarily, therefore, it has been the aim

of the inventor of the machinery and process we are about to describe, to overcome these difficulties; and aided by a long experience in and by a thorough knowledge of the various systems of manufacture as practiced in Europe, he has produced a combination of devices which is considered a material improvement on any plan yet invented.

Briefly, the composition of the fuel is coal slack and common yellow clay free from sand, moistened with milk of lime. The manufacture is carried on automatically, the crude materials entering the apparatus at one end and emerging finished and ready for shipment at the other. No labor



during the progress of the operation is therefore required, nor does the machine, we are informed, need any attention except to replenish its supply and remove its completed product. Our engravings give a general view of the apparatus as set up in the factory, and also perspective elevations of its principal portions in greater detail. The entire length of the machine is 218 feet, including two ovens, respectively 100 and 50 feet long. Referring first to Fig. 2, at A are two hoppers placed above stationary cylinders. Within the cylinder on the left is a horizontal shaft carrying six radial partitions, which divide the interior of the cylinder into as many equal spaces. Into the larger hopper the coal slack is shoveled, and this, descending, fills the spaces between the partitions in succession, and is emptied out as the shaft revolves. The smaller hopper and cylinder are similarly constructed, and are used for the supply of clay. The spaces between the partitions are less in size than those in the coal cylinder, and are so constructed as to discharge regularly five per cent of clay, while ninety-five per cent of waste is supplied from the larger cylinder. The mixture takes place in a chute, B, which conducts the dry compound under the chain elevator, C. At this point the mingled coal and clay is moistened by sprinkling with milk of lime, or water to which five per cent of lime has been added, the liquid being distributed by the rose nozzle shown on the tank, D. The damp compound is now picked up by the elevator buckets and carried up to another chute, whence it passes to a short cylinder, E, within which are revolving spiral blades which force it into the mixer, F. Inside the latter are arranged seven upright shafts, each one of which carries four toothed arms, crossing each other in all directions. By suitable gearing, these shafts are rapidly revolved, working the compound in the mixer into a plastic mass. An ingenious device allows of the removal of any or all the shafts for repair or replacement without moving the frame on which they stand.

Through apertures in the bottom of the mixer, F, the mass next passes to a pug mill, G, in which are spiral wings, rotating on a vertical shaft and arranged to force the compound down through an opening at the bottom, the size of which is governed by devices, one of which is shown at H. Leaving thus in a continuous sheet, the mixture is received between two rollers operated by the wheels, at I, which rotate in contrary directions. The peripheries of these rollers are indented with molds, oval in form, so that the mass emerges, after pressure, in egg-shaped lumps. It should be noticed that this part of the apparatus constitutes the compressing system, and differs materially in its action from other devices, which aim to drive the mass into its smallest compass by a sudden and heavy blow, often causing breakage of the working parts. Here the water is gradually though rapidly squeezed out, leaving the pieces in compact and nearly dry condition.

Under the rollers is one extremity of an endless belt of wire cloth (not represented), strengthened along its length and at the middle by a wire rope. On the latter are attached cast iron balls, which are so arranged as to secure the wire rope to the belt, and which run in a continuous gutter placed under each portion of the band. The object of the gutter is to carry the weight of the belt, ropes, balls, and coal above and to support the return portion of the belt below. The balls, as they pass over the pulleys, fit into concave receivers cut into the peripheries of the same, thus insuring the wire cloth from slipping. Upon the band thus arranged, the lumps fall, and are carried straight into the first long oven, at the further end of which the opposite belt pulley is placed. At each end of this oven is a furnace by which it is heated. As soon as the lumps reach the end of the upper belt, they are thrown off upon an inclined chute, which conducts them to a second endless band below, upon which they travel back again; thence they fall in a similar manner to a third, fourth, and fifth belts; so that they pass through the oven five times, and, over a distance of five hundred feet, are subjected to a powerful heat, and finally emerge thoroughly dry.

The extremity of the long oven is represented on the left of Fig. 3, and at J the end of the lowest endless band is seen. This throws its load into the buckets of the elevator, K, which carries the fuel to a chute from which it passes to another endless band, L. Just above the latter is a tank in which is placed the waterproofing material, a mixture of crude benzine and rosin. The band, L, is forced by balls on its sides, acting in grooves, to pass down under this liquid, a quantity of which is drawn, by the faucet shown, into the shallow reservoir, M; and partitions are placed along the length of the belt to prevent the sudden fall of the pieces into the mixture and also to carry them out of it. The excess of liquid, which drops from the coal as it emerges from the bath, falls through the wire netting to a gutter, N, and hence it is collected in a suitable vessel placed below.

The lumps next fall into the second oven by the spout and hopper at O. Into this receptacle, in order to insure the evaporation of the benzine so as to leave a thin varnish of rosin over each piece, rendering it thoroughly waterproof, a current of hot air is driven by means of the fan blower, P. Subject to this powerful blast, the lumps traverse three belts in precisely the same manner described as taking place in the first oven, and finally drop from the last band into an adjustable chute, and thence pass into a coal car placed ready for their reception.

The advantage of this drying apparatus will be appreciated by comparing it with the labor, necessitated by the European systems, in heaping the large blocks of fuel into perforated cars, by hand, dragging the same into the ovens, waiting for their contents to become almost completely carbonized, then waiting still longer for both cars and load to be-

come cool, when even further handling is necessary to prepare the material for transportation. There is no mixture of resinous matter with the fuel, thus avoiding the loss of cohesiveness due to the consumption of the tar, pitch, or asphalt first taking place, which allows the small particles of coal to fall through the bars before they have given off their full heating power. The waterproofing compound simply forms a light varnish over the surface, which protects the interior from moisture, and, while rendering the handling of the lumps free from the annoyances of dust and dirt, serves also as a kindling material.

At a recent trial of the fuel under one of the boilers, at the present Fair of the American Institute, we were afforded an opportunity to examine its cohesive quality. The pieces were thrown into a furnace where very active combustion was in progress; and although allowed to remain there for a considerable period of time, they did not lose their shape or run together. As regards heating power, the inventor considers the same to be equal to the best coal. No unpleasant odor is given off, there is of course no slate, and we are assured that clinkering does not take place. The ash, being mixed with clay, is heavy; and hence, where the fuel is used for domestic purposes, does not rise in light clouds, covering carpets, furniture, etc., with dust. The oval shape of the lumps is designed to insure a free draft through the interstices. As to cost, the inventor demonstrates that the material can be supplied at about one dollar per ton.

The machinery and process has been patented in this and other countries through the Scientific American Patent Agency, by Mr. E. F. Loiseau, of Mauch Chunk, Carbon county, Pa., to whom inquiries for further information may be addressed.

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WHAT TO DO IN HARD TIMES.

In consequence of the present inactive state of the financial world, many persons are deprived of their usual employments and know not what to do with themselves, or how to occupy their time to advantage. They are also made to suffer by the constant croakings concerning the lack of money and the gloomy prospects ahead, which now so constantly form the staple of ordinary conversation. This sort of talk is on everybody's lips, spreads like an infection, and tends to depress the feelings of even the most buoyant persons. But we advise our readers to resist and disperse its influence. It is only an incubus, a passing cloud, which must soon break away, revealing new prospects for business and enterprise, better than ever before experienced. The country was never in a more healthy or prosperous condition than at this moment, and the present financial blockade is only of a temporary nature. The curtailment of work or the suspension of industrial establishments cannot long continue; for money holders must employ their capital, which stands idle and unproductive when factories and mills cease to work. A healthy reaction will soon set in, and in a few weeks the hum of industry and the clatter of progress will be heard throughout the land. Meanwhile we urge upon every man or woman who happens at this juncture to be unemployed, to seize the golden opportunity for self improvement of some sort, or the working out of something useful at home. To young men especially, we say: Do not become loafers and toppers. Keep away from grog shops and idle companions. Go to the libraries and read good books. Supply your minds with useful and ennobling subjects of thought. Hunt up your arithmetics and refresh your mathematics. Improve your penmanship. Learn to draw. Study the history of your own and other countries. In short, make effort to keep yourself busy about something that is profitable.

It is in hard times generally that new inventions flourish. People have time to study, and are perhaps urged to it by necessity. We shall be happy to assist our readers in this

respect, and we invite them to write to us by letter in respect to their new inventions. The effect of thinking and of studying out devices will benefit them, even if nothing novel should result.

As suggestions in this direction, we will mention a few of the subjects in which special calls for improvements are made. In reflecting upon these, the inventor will be likely to be led towards other and better things. All the wants of mankind are open to the improving touch of genius.

It will be remembered that the State of New York lately offered a reward of one hundred thousand dollars for the production of any method superior, in practice and economy, to the present mode of towing canal boats by horses and mules. The time for competition has expired, and no person has as yet satisfactorily produced the required invention. The reward may or may not be renewed. The fact that it has been offered for three successive years shows the need of the improvement.

We lately chronicled the reward offered by the German railway companies for a good self-acting car coupling. Many lives are annually sacrificed in this and other countries for the lack of a really practicable coupling.

The Society of Arts, London, offered several months ago five prizes, each of \$250 money and a gold medal, as follows: 1. For a new and improved system of grate, suitable to existing chimneys as generally constructed, which shall, with the least amount of coal, answer best for warming and ventilating a room. 2. For a new and improved system of grate, suitable to existing chimneys as generally constructed, which shall, with the least amount of coal, best answer for cooking food, combined with warming and ventilating the room. 3. For the best new and improved system of apparatus which shall, by means of gas, most efficiently and economically warm and ventilate a room. 4. For the best new and improved system of apparatus which shall, by means of gas, be best adapted for cooking, combined with warming and ventilating the room. 5. For any new and improved system or arrangement, not included in the foregoing, which shall efficiently and economically meet domestic requirements.

Among the simpler articles for which calls are made, the following may be mentioned: An improvement for straightening pins for home use; a new and cheap folding umbrella; a household water filter; stove attachments for cooking and saving fuel; cheap and light washing machine; a combined knife scourer and sharpener; a sweeping machine for floors and carpets; a scrubbing machine for floors; devices for cleaning and washing windows; flexible pipes for water and other purposes, cheaper than rubber or lead; flexible transparent membrane, capable of substitution for glass; folding beds and sofas; self-acting device for regulating the warmth of apartments; instrument for exhibiting to the eye the purity or impurity of the air in public halls and private apartments; electrical alarms and new applications of electricity of all kinds; portable houses; new and more economical methods of building cheap dwellings; new household appliances or combinations of every sort; new methods of advertising; improved styles for putting up articles; new ornamental designs, for furniture, carpets, oil cloths, and goods of every description; new mixtures of medicines; cements; new alloys; new chemical combinations. The subjects for inventions are almost exhaustless, and in future numbers we shall offer further suggestions.

A GREAT "LICK" IN ASTRONOMY--THE MILLION DOLLAR TELESCOPE PROVIDED FOR.

We note, with no small degree of gratification, that the project of a colossal telescope, which is to be the largest and most complete instrument that modern scientific knowledge can suggest, or ingenuity devise, is actually in progress of elaboration. The scheme of a "million dollar telescope," to which we have so frequently referred, and which has encountered such an earnest support among large numbers of the readers of our journal, is in fact to be carried out; though whether it will be found necessary to expend the whole of this large sum of money is not determined. It is known that the cost of the great Washington instrument, which was to be \$50,000, has not amounted to a sum greater than \$30,000; and hence there is a possibility that that of the mammoth telescope now contemplated may fall below the large aggregate first proposed.

In a recent address before the California Academy of Sciences, Professor George Davidson made the following remarks--words which we are sure will find their way to every quarter of the civilized world, and engender the liveliest pleasure to every lover of science and her advancement: "With a telescope of the largest size and most consummate workmanship that American skill can devise, properly located ten thousand feet above the sea in the clear skies of the Sierra Nevada, with every variety of apparatus commensurate therewith; with masters of observation and ingenuity in research; with ample funds reserved to devise other instruments and methods which those instruments and the highest genius must suggest, we hope at no distant day to see solved the mighty problems of creation that are yet beyond our grasp. Such an outfit and such provision have been the lifelong objects of James Lick; and after much earnest solicitation, I have overcome his shrinking from what he considers vain glory, and obtained his permission to announce to the Academy his intentions, which I have faintly sketched in the preceding sentence. There will be no let or hindrance in carrying out his views; the amplest means are provided; the rarest skill has been invoked, and the plans are taking definite and practical shape."

The *Mining and Scientific Press* of San Francisco, of which city Mr. Lick is one of the wealthiest denizens, notes that the scheme, as already indicated by Professor Davidson, is being quietly perfected, and that the geological, meteorological

logical and other peculiarities of various sites of the mountain range above named are soon to be carefully scrutinized and reported upon. A peak will be selected which, from its high altitude and clear surrounding atmosphere, will afford the finest possible view of the heavens throughout the longest period of the year, and there the observatory will be permanently located.

How large the proposed instrument is to be is of course impossible to say, definitely, nor can its probable cost be with any accuracy ascertained. Experiments must be made with glass, and the most careful investigation will be needed in order to determine the feasibility of constructing a lens of the extraordinary diameter and focal length required.

Our contemporary suggests a 40 inch objective as of a suitable size; but it seems to us that, when this undertaking is begun, nothing short of the grandest possible results should be aimed at. Hence the researches should be made with a view of determining how large a lens can possibly be manufactured. We have already pointed out the capability of a twelve foot objective with a focal length of 120 feet; which, with an eye piece of $\frac{1}{10}$ inch focus, would give a magnifying power of 28,800 times the linear dimensions, or over 800,000,000 times the surface of a body. Although the spectroscopy has proved that most of the nebulae which the great telescope of Lord Rosse has failed to resolve into stars are hot hydrogen, it is possible that so vast a power as above noted would render visible other clusters now totally unseen, and thus give to the eye the ability to gaze into the star depths billions of miles further than it has ever heretofore penetrated. The reader can easily calculate the apparent proximity to which the planets would be carried to our earth, and also the large visual angles which their spheres would subtend. Mars, for instance, would, so to speak, be brought within 4,000 miles of us, and would appear 100 times as large as the moon, covering an angle of 50°. The magnitude of the discoveries which might be made, while we are thus enabled to scrutinize the Martial surface mile by mile, cannot be estimated or even imagined. The problems regarding the physical constitution of Saturn's rings, of Jupiter and his possibly inhabited satellites, of the vagrant intermercurial planet and others which will readily suggest themselves, will receive new light shed upon them, by which, doubtless, a clear path to their solution will be found. As for our moon, let the reader seriously think of having that satellite within eight miles of him; so near that, if inhabitants there be, he can see them. Even if no more astonishing discoveries be made, the effects of volcanic action upon the surface will form a prolific field of study.

About one year ago, when first proposing the idea of so vast an instrument—a plan, by the way, which even up to the present time has continually called forth expressions of approval, coupled, frequently, with offers of subscriptions from many of our readers—we said: "It is impossible to speculate on what such a telescope would discover in regard to the other planets or the vast regions of the firmament; let us hope that some day the amount of capital necessary will be forthcoming, on the most liberal scale, for the progress of the most sublime of all the sciences." The day has arrived; the capital is forthcoming, and there is every favorable probability that, in less than five years, one of the grandest enterprises of modern times will be successfully consummated.

ENGLISH PRINTING PRESSES IN AMERICA.

In the early days of newspaper printing in this country the machinery came chiefly from England; but when the Yankees began to invent, the importation ceased, and for many years the United States supplied novel presses to British and continental publishers. But English ingenuity appears to have taken a new start, and has produced printing machines of such superior capacity that New York newspaper owners are now buying fast presses in London.

We lately witnessed the practical working of two of the celebrated Walter presses, at the *New York Times* establishment in this city, and must confess to an agreeable surprise at their perfection and extraordinary performances. They were built in London by Mr. Walter, the inventor, and set up here, under the immediate supervision of Mr. Gilbert Jones, of the *Times*.

They are known as perfecting presses, that is, both sides of the sheet are printed in passing once through the press. In ordinary presses, the sheets are introduced separately, printed on one side, then passed through again, and printed upon the other side. This involves much handling, the employment of cumbersome machines, and many attendants.

In the Walter press, the paper to be printed is arranged in the form of a roll, like the goods in a calico printing machine. This roll of paper, 3 feet in diameter, weighing one fourth of a ton, and containing paper enough for say six thousand copies of the *Times*, is placed at one end of the machine; the web passes thence between the printing types, which, in the form of curved stereotype plates, are secured upon the exteriors of a pair of geared cylinders. Rollers carrying ink press against the types, and the rotation of the type cylinders draws the paper along between them and the impression cylinders, thus printing the web on both sides; the web then passes between rotating shears, which divide the paper into separate sheets; and these, guided by a beautiful and ingenious arrangement of delivering tapes, are discharged in two separate piles, at the end of the machine opposite to that where the white paper enters. The paper travels through the press with a velocity of ten or eleven miles per hour, and delivers at its highest speed some sixteen thousand printed copies of the *Times*, which, as all our readers know, is a large quarto paper—one of the largest in the country. A single number of the *Times* contains an amount of

type matter equal to 147 ordinary octavo book pages. Perhaps we cannot better illustrate the astonishing rapidity of this machine than by saying that the printed matter it delivers in one hour would cover more than two hundred and thirty-five thousand book pages, or nearly four hundred volumes of six hundred pages each.

These remarkable printing presses are built with steel at all of the gearing parts, are the perfection of mechanism, and run with the steadiness of time pieces. One machine, attended by two men and two boys, is capable of a duty nearly equal to that of two of the old style, separate-sheet, ten-cylindered presses, operated by twenty-five men. One of these old time monsters now stands idle in the *Times* press room. It is twenty feet high and forty feet long, full of complications. The new and simple new comer, by which it is replaced, occupies hardly a third the room of the other.

We have not space here to describe the various other mechanical appliances employed in printing the *Times*, such as double engines, boilers, blowers, steam ink pumps, folding machines, stereotype apparatus, etc., all of which are of admirable character, and have cost the proprietors over one hundred and twenty thousand dollars. This peculiar machinery, taken in connection with the enormous editions of the *Times*, exemplifies to a certain extent the wonderful progress which the world is constantly making in knowledge and the mechanic arts.

THE NOVEMBER METEORS.

We would remind our readers that on the 13th and 14th of the present month the earth crosses the second of the great meteor belts, and that on the nights of the above dates, if clear, a quite brilliant display of shooting stars may probably be seen. The November star showers appear to be periodic in splendor. For intervals, ranging from a single year sometimes to five and six, meteors appear of remarkable magnificence and in extraordinary numbers, then they wane, and it is not until a cycle of 33 years has elapsed that the maxima again arrive. In other words, instead of these vagrant bodies being distributed uniformly around their vast orbit, forming a complete ring of meteoric particles, a large majority of them are clustered together in a dense cloud which makes a revolution around the sun once in 33 years, and intersects the earth's path at the position of our globe on the 14th of November.

It is a remarkable fact that, as astronomers have shown the coincidence of the path of the August meteors with that of the bright comet of 1862, so have Peters and Schiaparelli independently discovered that Tempel's comet of 1866—a body visible only with the telescope—has elements which may be regarded as absolutely identical with those of the November belt. As to what connection exists between comets and meteors, it is, with our present knowledge, impossible to determine. We know, however, that meteors have paths as eccentric as those of the orbits of comets, and hence it is deduced that the earth encounters no less than 56 meteor systems, thus giving proof that the total number of these systems in the universe must be estimated by billions.

The November meteors appear to radiate from the constellation *Leo*, and the aphelion of their orbit is something beyond the planet Uranus. Proctor considers that the denser portion of the system, known as the "gem of the meteor ring," cannot be less than 1,000,000,000 miles in length, while its thickness is in the neighborhood of 100,000 miles. The width is estimated at ten times the latter dimension; and taking the average of four displays, in the years 1866-69, it was found that the earth encountered one meteor per minute. Roughly calculated, the distance separating meteor from meteor would be about 1,005 miles, so that the great cluster cannot contain less than one hundred thousand million members. Herschel, from observations of the amount of light given by these bodies, and also by calculations based on the velocity with which they enter our atmosphere, concludes that they are very small, rarely exceeding a few ounces in weight; or, on an average, not over one one-hundredth part of an ounce each. This would make the weight of the cluster one thousand million ounces, or only 28,000 tons.

Professor Daniel Kirkwood communicates to the *American Journal of Science and Arts* a note on the November meteors, in which he mentions displays, remote from the regular epochs, which, he thinks, cannot be satisfactorily accounted for by the hypothesis of a single great cluster. He points out that, as the display on November 14 occurs in but five or six consecutive years at most, the nebulous cloud cannot extend around more than one fifth of the orbit. But meteoric phenomena have been witnessed about the 13th of November, when the principal group was near its aphelion, and in the years 1787, 1818, 1822, 1823, 1846, 1847, 1849. Those of 1818, 1822 and 1823 may be regarded as all derived from a single extended swarm. Those of 1787 were due to a return of the same cluster, as the intervening period was about 33 years; hence we may expect another shower from this source between 1885 and 1889. A short interval of 12 years, between 1787 to 1799, cannot be explained on the hypothesis of a single group, and accordingly it is inferred that the Leonids entered the solar system in two separate masses, to which the disturbing influence of Uranus gave slightly different periods. The meteors of 1846, 1847 and 1849 were observed after the periodicity of the shower had been recognized, and were noticed in consequence of a watch instituted for the purpose. In regard to these straggling members, it is considered that, whenever the earth passes through the meteoric current, its disturbing influence changes the orbits of such meteoroids as happen to be moving in its immediate vicinity. These disturbed portions of the ring, at their subsequent returns, must pass through the point of greatest perturbation.

As the periods will vary within very wide limits, the same is considered an obvious explanation of the phenomena.

DECORATED SCIENTISTS.

"It seems to us unjust and cruel that men of science, to whose labors it is mainly owing that our country and the world generally are mounting higher and higher in the scale of civilization, should be practically debarred from accepting the few honors that come in their way. Moreover we should think that those who have the framing of these regulations * * * should afford every facility to those who are thus honored to accept and wear the foreign orders which may be offered them."

We extract the foregoing lines from a recent issue of our excellent English contemporary, *Nature*, in which they occur in the course of an editorial on "Foreign Orders of Merit." It appears that the Emperor of Brazil and the King of Sweden wanted to decorate some of the British scientists, but these gentlemen, "from loyalty to Her Majesty's stringent regulations," refused the proffered distinctions. Whereupon the above named journal deprecates the course of its government in having such regulations, and urges that there is no reason why men of science, as well as military men, should not receive foreign rewards.

While no one more than ourselves would delight in seeing the scientific workers of any nation gain the most exalted of human distinctions—and no class of people better merit the same—we utterly fail to perceive either the applicability of these so-called orders as a reward for the attainment of learning or for original discovery, or even the inherent honor which our contemporary thinks so great. Does *Nature* mean to say that the fame of such men as Tyndall, Huxley, Lockyer, Spencer, Proctor, Darwin, Roscoe, Huggins, Carpenter, Joule, Grove, and a score of others whom we might readily name, would be enhanced in the smallest jot if their Majesties of Sweden or Brazil should hang a scrap of ribbon or a jewelled star on their doctors' gowns? Or further, is it supposed that any one of these illustrious discoverers would value, to the extent of a snap of his finger, the conferring upon him of medals and crosses by all the crowned heads on earth, in numbers sufficient to make the breast of his coat look like a checker board, like Marshal Bazaine's, as represented in published portraits? "Flunkeyism," as Thackeray terms it, and science can never be made to co-operate. The snob and the scientist are never mingled in one person. And if an ostentatious pride in a worthless gift, not from a people or even given in their name, but merely as a mark of favor by an individual or a ministry in power, is not arrant flunkeyism and snobbery, we fail to appreciate what is. For our parts, we doubt if a much more absurd idea could be proposed than to suggest that men whose grand labors and discoveries have benefitted a world for all time, and whose names will be household words to posterity for centuries, could be honored by the notice of a person who, now a king, will in a few years live in the memory of mankind but as an abstract index to a period of his country's existence.

Some time since we noticed in an English journal a somewhat similar article to that above quoted from, but which advocated the elevation of certain eminent scholars to peerages as a reward for their varied attainments. While it struck us then that Lord John Tyndall, or Earl Darwin, or Baron Huggins would sound decidedly incongruous, a rather more laughable idea occurred to us as to the probable effect if our American scientists should, through the pages of their favorite newspapers, set up a howl because the constitution prevents them, while citizens of this country, from obtaining patents of nobility or orders from foreign powers. Suppose, for instance, that Professor Agassiz should think himself ill used because Congress would not pass an act or constitutional amendment allowing him to be Duke of Penikese, or that Professor Mayer, of the Stevens Institute, should feel deeply injured because he would not be permitted to receive, from the Governor of New Jersey or the Khan of Tartary, a diamond cross or a red feather in recognition of his recent admirable discoveries in the mosquito line?

If the time ever should come when scientists of any nation seek after foreign baubles, such men will not be of those whom people call great, nor will the latter be the ones upon whom such distinctions will be conferred. In fact the distribution of honors will, we imagine, be something resembling the award of prizes by a certain old French semi-scientific, semi-literary society. This learned body rejected an essay by Voltaire, but eulogized to the skies a paper in which reference was made to the "freezing and torrid poles of our earth."

The Niagara River Bridge.

The last span of the bridge across the Niagara river, from Buffalo to Fort Erie, was quite recently placed in position. There are eight piers of solid masonry incased in an armor of half inch iron plate, to protect them from the ice. The Pratt truss, of iron, extending over spans of from 197 to 240 feet, is used. One of the two draws on this structure has an opening of 160 feet, and is said to be the largest in the country. The bridge has but one railroad track, but is leased by four roads—the Grand Trunk, Great Western, Canada Southern, and New York, West Shore, and Chicago railways.

PROGRESS OF THE HOOSAC TUNNEL DURING OCTOBER, 1873.—Headings advanced westward, 170 feet; eastward, 140. Total advance during month, 310 feet. Distance opened from east end westward, 14,747 feet; distance opened from west end eastward, 10,942 feet. Distance remaining to be opened to November 1, 1873, 242 feet. The whole length of the Hoosac tunnel is 25,031 feet.

RAMMING THE MOLD.

There are many simple little operations which every working man performs in the everyday routine of his trade, and



which, though inconsiderable of themselves, nevertheless are not devoid of interest when made the subjects of the draftsman's ready pencil. Of such a nature is the process depicted in our sketch—merely a molder busily engaged in ramming the sand into his flask. The pleasing combination of form attracted the casual notice of our artist a few days since, while visiting a large industrial establishment; and in a spare moment he jotted down the lines which, by one of those marvelous processes of photo-engraving, we have caused to be represented in perfect facsimile in thousands of copies of the SCIENTIFIC AMERICAN. The design will be an agreeable memento of possibly the daily practice of many into whose hands our paper may find its way, while, perhaps, it may be not entirely without a mission of its own. The earnest face of the workman and the firm grasp with which he wields his rammer show very clearly that he is delivering no gentle blows, and that his task is being done with a will which is a sure guarantee of its thoroughness. Now ramming molds is not a complicated performance, nor does it require the ability of a very skilled artisan; on the contrary, it is a very small portion of the multitudinous operations which must be accomplished before the perhaps great structure, to which the piece of metal in the flask belongs, is completed. But insignificant as this process may be, zeal and thoroughness are just as much called for as in the most delicate manipulations, and no mechanic will ever be the loser by using his best efforts on just such little things. Faithfulness in the accomplishment of small tasks brings with it the ability to perform thoroughly much greater ones; and the working man who proves himself energetic and honest in doing the former will soon find that his talents are needed in larger operations, which will insure him increased credit and profit.

The American Centennial Exhibition at Philadelphia in 1876.

The committee have adopted the general plan of Vaux & Radford of New York for the building, known as the "pavilion plan," which contemplates a building which will be mainly a succession of immense cast iron arches, the whole forming a rectangular elevation which can be enlarged in any direction to an almost indefinite extent, as the exigencies of the Exhibition may demand.

The principal part of the building covered by the pavilions becomes one spacious hall 408 feet wide and 2,040 feet long, with a transept 408 feet wide and 952 feet long. The vistas, of course, extend 952 and 2,040 feet in length. The building is capable of both central and intermediate points of emphasis, direct lines of transit throughout its entire length and breadth, diagonal lines of communication, if deemed necessary, and especially an entire relief from any appearance of contraction, because the visitor will always be in an apartment or pavilion 140 feet wide, that opens immediately into other apartments of the same width.

Features suggested by the plan of Sims & Brother, of Philadelphia, are to be introduced in constructing distinct parts of the building. The material will be iron and brick.

The Accidental Color of Bodies of Water.

From early ages, the red color of certain natural deposits of water has been a subject of human speculation, and has given rise to the many grotesque fancies of bloody showers, rivers turned to gore, and the similar ghastly imaginations with which ancient legends abound. Homer in his Iliad speaks of a dew of blood which preceded the combat between the Greeks and Trojans; and in the Bible (Exodus, chapter

VII), it is stated that "blood was seen in all the land of Egypt." Similar natural phenomena appearing in more recent times have engendered superstitious fears among the ignorant and have been eagerly seized upon by religious fanatics as "signs and wonders" from the heavens, indicative of direct and miraculous celestial intervention.

Modern science, however, teaches that fresh water, thus accidentally tinged, owes its color either to the presence of infusorial animalculæ (*euglena viridis*, *e. sanguinea*, *astasia hamatodes*), or to microscopic vegetation (*oscillatoria rubescens*, *sphaeroplea annulina*), and sometimes even to small insects, *entomostraca* (*daphnia pulex*, *cyclops quadricornis*). Sea water, as is well known, also presents hues of varied character. Thus the blue or green tint of the ocean on the coast of Greenland has been found due to an animalcule resembling the medusa. Of these minute beings 64 have been found in a cubic inch, 110,892 in a cubic foot, and 23 quadrillions 888 trillions are estimated to exist in a cubic mile. Arago considers that the green bands of water noticeable in the polar regions are due to myriads of medusæ, the yellow color of which, in connection with the blue tint of the sea, produces the green appearance. Near Cape Palmas, on the east of Guinea, the ocean sometimes becomes covered with animalculæ, floating upon the surface, so that it is said that vessels seem to be sailing through milk. Also on the coast of Portugal, the Atlantic for a space of some five miles square has appeared of a dark red, the phenomenon being due to a minute vegetable known as the *protococcus atlanticus*. So infinitesimal are these *algæ* that it is estimated that 40,000 of them would not cover a space of over 0.03 of a square inch. The waters of the Red Sea owe their periodic rubefaction to the presence of a confervoid sea weed, called *trichodesmium erythraeum*. Pallas states that there exists in Russia a salt lake called Mallinovo Ozen, or raspberry lake, because its salt, as well as the liquor left after distilling the same, is red, and has an odor resembling violets.

Doctor N. Joly communicates to *La Nature*, from which journal we extract the accompanying engravings, the following interesting details regarding his investigations into the phenomenon of accidental coloration or rather rubefaction of water in the salt marshes of Villeneuve, a few miles from Montpellier, in France. The liquid

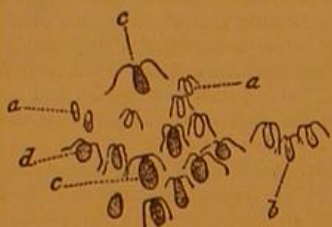


Fig. 1.

is of a strongly marked red color, resembling blood, and a quantity taken from the surface and examined with the microscope showed myriads of little beings. Their bodies were oval and long, sometimes cylindrical. While young they are colorless, afterwards turning green, and finally red. The mouth is in the form of a conical prolongation, and is retractile. No eyes could be recognized, nor could the stomach be distinctly made out. By the aid of powerful lenses two flagelliform prolongations, extending from the rear of the animalculæ were found, by agitating which it propelled itself in the drop of water on the slide of the instrument. The author was led by this discovery to the conclusion that the *protococcus* is an animal and a true monad. On further examining the animalculæ after death, they appear globular in form, and hence the mistake made in determining their nature by previous investigators. A single drop of alcohol, or even of fresh water, in the liquid (on the slide) in which the monads exist, causes them to become motionless and globular, while the same result takes place if they be cut off from



Fig. 2.

access to the atmosphere, as it appears that respiration is absolutely necessary to their existence. Fig. 1 shows the monads (*monas Dunali*) alive, and magnified 420 times. *a* are the young ones, colorless, *b* are older and of a green color, while those at *c* and *d* are adults, more or less red. Fig. 2 represents the animalculæ after death, in their globular state. It may be noted as an interesting fact that

they strongly resemble the *protococcus nivalis*, or microscopic vegetation to which the phenomenon of red or green snow in the arctic regions is due. They seek the light with avidity, always gathering, when confined in vessels, to the brightest side.

It has been believed by many savants that the *artemia salina*, a minute crustacean, also aided in giving the water of the salt marshes of the Mediterranean its ruby color. This Dr. Joly does not believe, and he proceeds to demonstrate some curious properties of this strange animal. He states that the *artemia* owes its own color to its consumption of the monads which are taken into its digestive canal. The *artemia* is naturally colorless, and its food, together with crystals of marine salt, shows through its body, thus causing it to appear red. Fig. 3 is a section of its digestive tube, in which *a* are the monads, not yet digested, and *b*, the cubical crystals of sea salt. The animal itself is represented in Fig. 4, in both its natural size and highly magnified. *o* and *y* are eyes; *a* and *c*, antennæ;

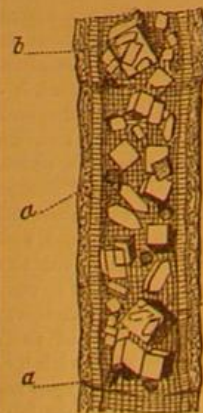


Fig. 3.

p is the incubating pocket, showing the eggs within; 1 to 11 are feet, serving both for purposes of respiration and propulsion; *a* is the abdomen, and *p*, the caudiform appendage;

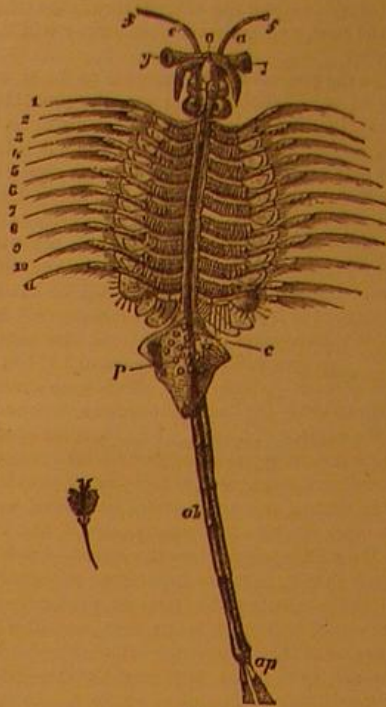


Fig. 4.

c is the digestive tube, colored red by the contained monads. It is a curious fact that the young are produced by parthenogenesis, and are always females.

How a Lawyer Spends his Spare Time.

We clip, from the New Orleans Republican, the following interesting sketch of the profitable manner in which a well known advocate employs his leisure moments. United States District Attorney Beckwith is evidently no less able as a mechanic than as a lawyer. Our contemporary says that: "When he can get away from his office in the custom house—away from his books and his briefs—away from his clients and his cases, and the adjustment of 'the doubtful balance of rights and wrongs,' then it is that he lets himself, with his latch key, into a building unoccupied save by himself, goes up into the third story, takes off his coat, rolls up his sleeves and goes to work.

"It is a queer looking rookery, this workshop of Beckwith's. Tools lie scattered around; two or three turning lathes are mounted in one end of the room; beyond them stands an upright boiler and a three horse power steam engine, mounted on an eleven inch base and capable of making 600 revolutions a minute; a neatly mounted forge, smoke stack, escape pipes, pulleys, bands, benches—everything made and erected by the lawyer-mechanic, the presiding genius of the place.

"The counselor, at whose correctness as a logician and pleader all marvel, astonishes still more those who glance into his workshop, at the perfectness of the machinery he turns out in his leisure moments. The busy lawyer is master here—files and screws and drills and ratchets are as handy to his touch as authorities in the huge bound books, on his shelves in his room in the granite building. The alchemist in his laboratory, seeking for the mystery which should transmute base metal to gold, was not happier or more enthusiastic than Beckwith is in devising some new appliance in his dusty workshop. Even his bellows he blows by a machine he has invented. The larger turning lathe, which he spent years in making, and months of that time in the perfection of a single screw, is adjustable with the precision of a microscope. The governor of his engine did not quite please him, so he has made a new one on a new principle, which works to a charm.

"Understand, all this is the lawyer's pastime. He is not an 'inventor.' He gets nervous when asked if the Beckwith sewing machine is his invention, and vehemently denies the impeachment. He takes no sort of pride, either, in his skill as a workman, and we know will not thank us for this intrusion into his workshop."

Earthquake in Panama.

Panama was visited by an earthquake on the evening of the 13th of October. There were two pretty severe shocks, with an interval of but a second or two between them. The second shock was most severe, and accompanied by a rumbling sound, resembling thunder. In Aspinwall, the shock was felt about ten minutes later, and seems to have been more severely felt than in Panama. The people were much frightened, and the fear of a tidal wave added to the excitement. The duration of the shock in Panama was about four or five seconds, so that it was over before the people had time to run out of their houses. Most people agree that the oscillations proceeded in a direction from southeast to northwest.

In a communication, recently received from Messrs. W. Ladd & Co., London, they complain that the strictures of Professor Morton, in respect to the bad packing of their cells, are unjust, and say that, while there have been many breakages in the past, due to carelessness of the packers, they have so fully remedied the trouble that they now rarely find the breakage of a single cell out of the large numbers they send to this country.

POSTAL TELEGRAPH CARRIAGE.

We publish herewith an engraving of a traveling telegraph office, now in use in Great Britain for opening temporary communications. The idea is to have a movable office, carrying its own cable, apparatus and batteries, which can be transported from place to place, either by road or rail, at the shortest notice, and which can be taken to the wires when the wires cannot be taken to it. This, which is the only carriage of the kind in use for similar purposes, is constructed to carry one of each of the different forms of instrument (six in all) in use in the postal system, and can comfortably accommodate as many as eight clerks in full work. It carries, also, nearly 150 battery cells, and so skillfully is the accommodation designed that these are all stowed away out of sight in odd corners, so that not a single atom of space is lost. Half a mile of three wire iron-sheathed cable is stowed away as snugly as possible in the "boot," and can be paid out and drawn in with the greatest ease in the world. The telegraph carriage has been used at agricultural shows and races, and similar occurrences, which sometimes take place away from cities.

New Method of Engraving.

At the recent meeting of the French Association for the Advancement of Science, M. Gourdon, of Lyon, described some novel facts which he had observed in the action of acids upon zinc covered with certain metals. Zinc plunged into dilute solutions of sulphuric, hydrochloric, and acetic acids is attacked only at the points where other metals are present. The metals which produce this phenomenon with most intensity are cobalt, platinum, nickel, and iron. Ammoniacal chloride of cobalt renders it possible to perforate zinc with water containing only one 10,000th part of sulphuric acid. M. Gourdon applies these results to various procedures for engraving. By writing directly upon zinc with different metallic inks, making use of the most active, containing salts of cobalt, for the blackest parts, and passing it then into acidulated water, an engraved plate is obtained. To reproduce leaves or plants, they are soaked in solutions of metallic salts, and applied to the zinc, which is then treated with weak acid. The author has discovered a new kind of heliographic engraving by transferring the silver from an ordinary photographic proof upon the zinc, which can be attacked by the acids in the parts where the silver has been deposited.

STEAM TRAVELING CRANES AT THE VIENNA EXPOSITION.

On page 95 of our current volume, we illustrated a large and powerful traveling crane employed in moving ma-

chinery and other heavy exhibits to their proper location within the buildings. We now produce a view of another and somewhat similar apparatus, by Messrs. J. H. Wilson & Co., of Liverpool, England, which has also been exhibited at Vienna. It is worked by a couple of 6 inch cylinders, and, in addition to the lifting gear, has gear for slewing, traveling, and raising the jib. The lifting gear is single only, the

iron, and has a radius of 12 feet; and the carriage or truck is cast iron, as well as the framing of the crane. The whole of the bending stress due to the weight comes upon the crane post, there being no supporting rollers, and this seems to us a defect; but in other respects the design of the crane is very good; the different motions are compactly arranged, and the whole of the gearing is easily accessible.



POSTAL TELEGRAPH CARRIAGE.

crankshaft pinion gearing direct into the wheel on the drum shaft. The brake is arranged so as to be applied by a hand wheel on a vertical spindle, the bottom end of this spindle being screwed, and turning in a nut on the end of a long lever. The spindle for the traveling motion is carried through the center of the crane post, a bevel pinion on its upper end being driven from the crankshaft. It is arranged to drive both the axles of the truck, instead of, as is so commonly the case, only one of them. A countershaft, lying across the top of the framing, is driven from the crankshaft, and carries a pair of bevel pinions, either one of which can be put in gear by means of friction cones, with a bevel wheel on the top of a vertical spindle, so that the latter can be driven in either direction. This spindle serves both for the slewing gear and for raising the jib. The former consists of simple spur gearing, with a pinion working into an internal circular rack on the top of the carriage. For raising the jib, a worm and worm wheel are used, working a deeply recessed pulley on a horizontal countershaft. It will be seen that the raising chain is fixed to the framing at one end, and carried round a pulley connected by a rod to the end of the jib.

The boiler (says *Engineering*, to which we are indebted for the illustration) is of the simplest possible construction, with one cross tube in the fire box. The jib is made of wrought

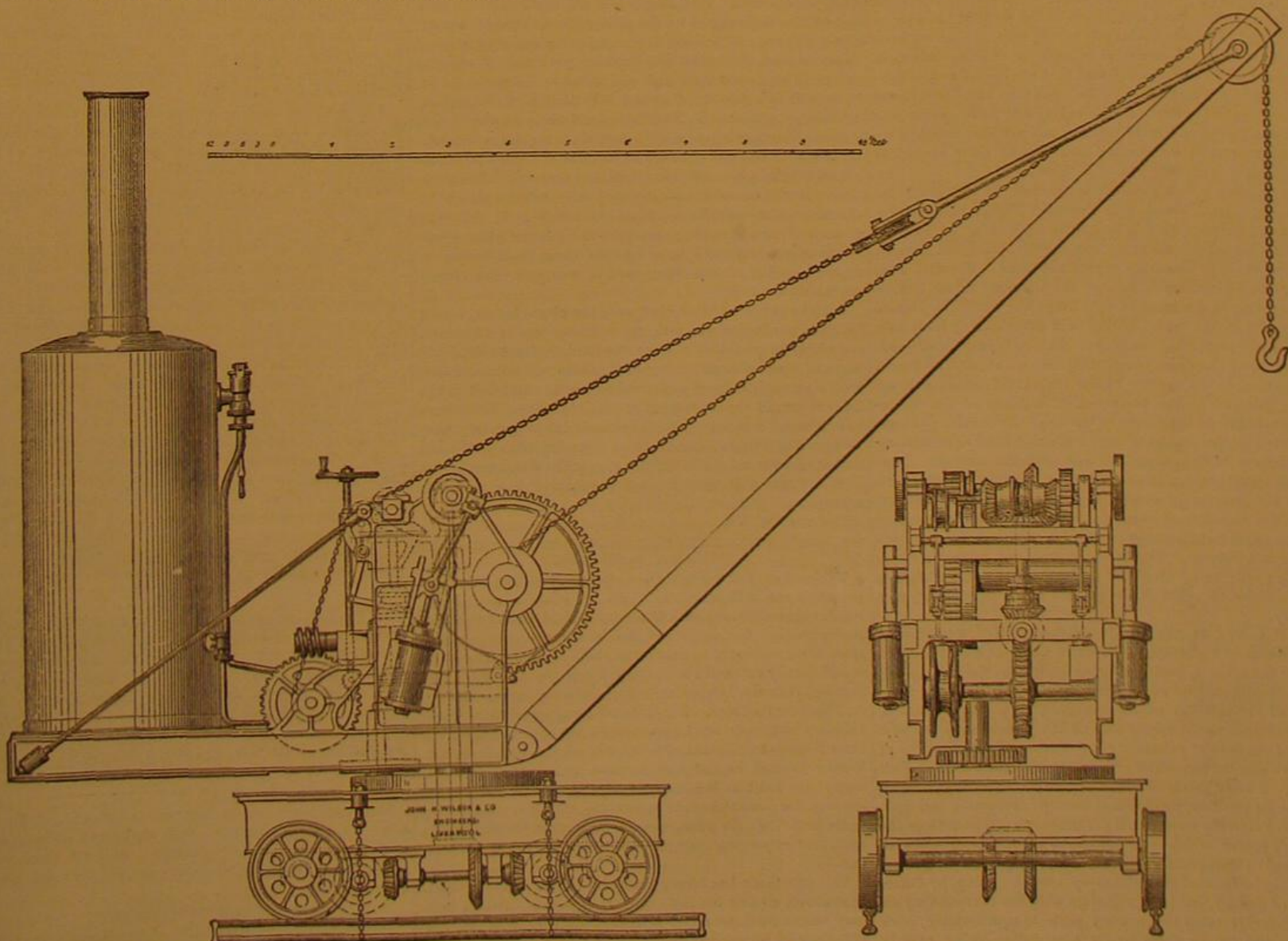
it was considered that the truth of the theory was fully proved.

The "lobster back" boiler was next tested under a steam pressure of 70 pounds, at which point a seam on the upper side of the shell became ruptured, the split taking place in a soft patch and extending over a length of 18 inches. The gages showed that, even after this break, the steam pressure continued to ascend although the rupture did not enlarge. No further damage was done. The conclusion drawn was that over pressure of steam will rupture a boiler if there be a weak spot, whereas a violent and dangerous explosion may ensue if the boiler be uniformly strong at all points.

The weak places in the apparatus, we learn, will be strengthened; and during the coming week, operations on the same boilers will be renewed. The safety valves are also to be tested at the same time. The Pittsburgh experiments have been postponed until the 18th inst.

New Car Starter.

Amos Whittemore, of Cambridgeport, Mass., has obtained a patent for a device whereby the momentum of the car is made to lift one end of the car in stopping, and the weight so raised is made so to act as to help the car forward in starting.



STEAM TRAVELING CRANE AT THE VIENNA EXPOSITION

Correspondence.

The Physical Substratum of Mechanical Power in Nature.

To the Editor of the Scientific American:

If your correspondent in regard to the subject of planetary motion, on page 275, would turn to a communication on page 228, I think he would find a physical explanation, without either accepting or casting aside the nebular hypothesis. As the subject is theoretically of the greatest importance, I would request the favor of a further illustration of the principle there advanced.

In my former communication I intimated that every particle of matter was the nucleus of a ubiquitous substratum of mechanical power, constantly exercised in attaining and maintaining equilibrium with all others. This is fairly worthy of being rigorously tested, when we consider that Newton exercised his vast mathematical powers in endeavoring to demonstrate that every particle of matter attracted every other, and that the non-mathematical Faraday, from physical considerations only, in his electrical researches, was induced to utter the singular expression: "The atom is everywhere."

The only attempt to explain gravitation by a mechanical theory which has met with any favor, and that but little, is the one of Le Sage. This supposes space to be filled with self-repelling corpuscles, which impel bodies together through acting as screens to their motion. Herschel considered this theory as too grotesque for serious consideration, while Sir W. Thomson has shown it to be inconsistent with the principle of the conservation of energy, unless the *vis viva* lost by the resistance of matter be exactly compensated by a fresh force of impulsion continually coming from beyond the limits of the stellar universe. The same objection applies to Professor Challis' theory of impulsion by etherial wave motion. Other objections there are which we will not dwell upon, such as the non-accumulation of the corpuscles on the together impelled bodies; but we may safely say with Herbert Spencer that astronomers have as good as given up the mechanical explanation. Professor Maxwell, in his splendid attempt to generalize the radiant forces, acknowledges that he cannot conceive an etherial medium possessing the property of causing matter to gravitate, combined with that of manifested radiant motion. But now conceive the equilibrating power of all matter to be ubiquitous, and a universal consistency results. All bodies, by the equilibrating energies of all others, are continually in a state of stress; submitting when unbalanced to the predominating tensions or pressures. The tensional power exercised by any body in drawing others to a balancing condition with itself will of course be directly as its mass; that of all bodies inversely as the square of the distance. The static or attained position of balance will be stable when the pressures, perpendicular to the lines of tension, are in power inversely as the distance from the center of combination (gravity) or, we might call it, fulcrum. In cosmic systems, the energy of motion in revolving bodies must correspond to the force of pressure in a balance. I hazard nothing in saying that, if ever we have optical instruments powerful enough to examine minutely the rings of Saturn, we will find that the bodies at the interior of the dark ring, being rather more than half the distance of those on the exterior of the outer, will have rather less than double the energy of motion, the particles between being of intermediate velocities, according to their respective positions, or distances from the planet.

So palpable is this physical connection, by the native energies of distant bodies, that Professor Nichol pictured Jupiter and Saturn as nicely balancing on a lever of varying length throughout the great inequalities, the mean length, during the ever recurring cycles, the same. Herschel also, for greater definiteness, figured the planetary orbits during the varying inclinations as rigid rings (on which the planets were sliding like beads), tilting each other during their motion, while preserving the general plane or fulcrum unaltered. This plainly shows an unalterable amount of motive power centralized in the system by the individual tensions being there balanced by the pressures, or motions of the bodies perpendicular to their lines of traction. Even tidal phenomena are less the results of pure attraction than equilibrating oscillations during terrestrial and celestial motions. Now no universal plenum of self-repelling corpuscles could produce and sustain (of course as a secondary cause) the conservative harmony of cosmic systems, for their extraneous action could have nothing to do with masses balancing each other at a distance. Nor is an infinitude of attractions contending with an infinitude of tendencies to fly off at tangents (the results of primitive impulses) at all satisfactory as a theory.

S. E. Cowes, an American, published, in 1851, a treatise on "Mechanical Philosophy," in which he repudiated the physics of the schools, basing his own system on the principle of the indestructibility and identity of force, apparently ignorant of the agitation of this question by a few in Europe. His boldness in the application of the principle carried him out of the pale of scientific recognition. His application of it, however, to terrestrial gravitation will not be out of place here. A body involved in the earth's motion shares, according to its position, the diffused force of revolution and rotation. Projected upwards, it describes a wider area from the earth's center, which is equivalent to an increased force of motion. Consequently the force of projection decreases, with the increase of gravitation—potential. Being, by difference of density, not in equilibrium with the surrounding atmosphere, it takes the nearest path to equilibration, back again; the falling force by its acceleration being exactly equal to the force necessary to make it describe a wider orbit.

The desire of not encroaching too much upon your valuable space hinders me from a more thorough treatment of this subject, and also from showing how the radiant forces become, by the principle, consistently generalized. Like Faraday I would "dispense with the ether but not the vibrations." And I must record my conviction that Science never can advance to a generalization of all the forces of Nature until it recognizes the fact that the substratum of mechanical power, appertaining to every unit, is as infinite and eternal as space and time in the will of God—that the Great Mechanic presides over a universe, and not merely a cohering multiverse. Philadelphia, Pa. WM. DENOVAN.

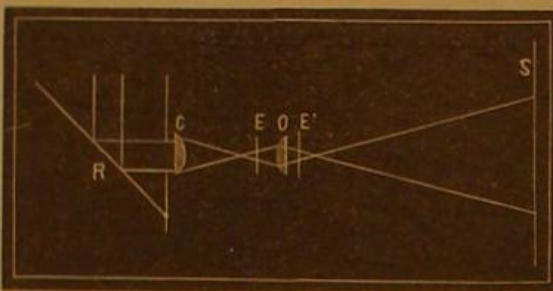
The Projection of Diffraction Phenomena.

To the Editor of the Scientific American:

As usually presented, the phenomenon of the diffraction of light is so obscure in effect that but a few can see it at a time, even when a powerful light is used. This answers well enough for one who is investigating the matter; but for presenting the phenomenon to a class or to a popular audience, there is no method that I know of to be found in any treatise. Therefore I hope the following description will meet the demand, as the spectacular effect is certainly very beautiful and striking:

For most of my projections, I use a *porte lumière*, and wait for the sun, if it is not shining at the time. The brilliancy and magnitude of the effects, and the trifling cost, render this method desirable in those institutions that are not well supplied with physical appliances; so I will describe the fixtures for that instrument:

The two large lenses, such as are usually combined for a condenser in the magic lantern, are used. The light is reflected from the mirror, R, through one of these lenses, C, used as a condenser. The other lens, O, is placed a little outside the focus of the condenser, at such a distance that the light is again converged and crosses between the line, O, and the screen; the size of the disk of light upon the screen will evidently depend upon the distance of this focus from it. I have found that, at the distance of twenty-five feet



from the lens, this disk can be utilized to the diameter of thirty feet or more for this experiment. Now bring a piece of wire gauze to the place marked E, not in the focus for ordinary projection. The meshes will not be distinct, but each one will be represented by the prismatic colors, so as to make a pretty show. If, in place of the gauze, a piece of perforated paper be used, the effect will be finer yet; and if still the eidiotrope be placed there and the rotation be given to it, there will be a fine blending and distribution of the colors, interesting and novel. Now let the eidiotrope be placed outside of the objective, O, at the place E', between the lens and its focus. I will not even try to describe the splendid effect which is thus produced, for it surpasses my power of description. It will be enough to say that it is not surpassed by the most gaudy exhibition of polarized light. If the eidiotrope be used and made to revolve at this latter place, some of the appearances will be much like those from double refracting media. If the eidiotrope has ever been thus used, I am not aware of it.

I might say in addition that, with the above lenses, a very brilliant rainbow of any size, up to thirty feet in diameter, can easily be projected. Move the lens, O, from within the focus of the condenser, C, outward; there will appear a disk with a strongly colored edge, which can be amplified to the desired size by the movement of the objective. The colors are arranged with the red outward, as in the primary bow. Bring a small paper screen with a rounded edge of such a curvature as to cut off all the light except the rim, when placed at E'. There will then be left a splendid bow upon the screen.

A. E. DOLBEAR.

Bethany, W. Va.

Wooden Railroads.

To develop the resources of a country, facilities for transportation are indispensable. Iron ore could be mined and lumber manufactured only to a very limited extent if wagon transportation for any considerable distance over common roads were necessary to reach a market. Where the business is sufficiently extensive to warrant it and the capital can be secured, railroads, either narrow or ordinary gauge, will afford the best facilities. But there are many localities in which ordinary railroads are impracticable, not from physical but from financial difficulties in the way of their construction. With a limited capital and a sparse population, railroads cannot be built in localities highly favored in natural resources for operations of quarrying, mining, and heavy manufacturing. In such cases, a substitute for the wagon road, less expensive than the railroad, becomes a desideratum.

This substitute has been proposed in a new style of wooden railroad, costing but little more to construct than an ordinary wagon road, yet affording transportation at less than one fifth the cost by wagon, and less also than the ordinary cost by rail, where interest on capital invested is considered. This

road differs essentially from the ordinary tram road, which consisted of sawn rails about three inches wide, laid on cross ties, and used with narrow tread iron-wheeled cars. Such roads, although some improvement on the common wagon road, with its mud holes and deep ruts, have given very unsatisfactory results. The differences extend to the tracks, cars, and motive power.

The track is formed of heavy logs, hewn on the upper side to the width of eight inches, and on the inside at right angles, sufficiently deep to form a straight edge for the flange. These logs are buried so that the top, or rail surface, is almost level with the road surface, resting on stout sills at the end and middle, to which they are secured by wedged treenails. The rails therefore are solidly bedded, and not liable to warp or twist. Twenty feet would be a convenient length on curves, but on straight lines longer pieces could be used, the ties being ten feet apart. The grading, of a sufficient width, on a side hill with gentle slopes, would cost about \$200 per mile for a three foot gauge; but of course the cost of graduation will vary greatly with the locality. Ravines and small water courses would in general be crossed with rough trestles or timber cribs. Hewing the timber would cost about \$200 per mile. In a wooded country, where timber can be obtained along the line of the road, where no large bridges are required and no rock has to be excavated, the cost of such a wooden railroad should be covered by from \$500 to \$2,000 per mile, depending upon the amount of earth work.

The cars proposed for such wooden railroads are simple frames placed on wheels, without springs, and covered with a floor of plank. The wheels are of wood, built up of pieces cut from two inch plank in the form of sectors, about 8 inches wide at the wide end. Four thicknesses of plank will build a wheel with a tread of eight inches, corresponding with the face of the rail. A cast iron hub is inserted in the center, through which an iron axle passes, and a cast iron flange is bolted on the inside. The timber should be of hard wood, well seasoned, the sectors laid so as to break joint and well bolted. Diameter of wheels, about thirty inches. Such cars, if used with horses, will cost \$40 to \$50, or about one third the price of a farm wagon. They will carry three tons, and can be made by any rough hand who can use carpenter's tools. If designed for use with locomotives in trains, draw-bars and springs must be used, and the cost per car increased.

MOTIVE POWER.

Horse or mule power can be used; but if the tonnage is considerable, it will be preferable to adopt a light engine of six or seven tons, with wide driving wheels, covered with vulcanized rubber tyres. Such engines can be manufactured at the Baldwin Locomotive Works for about \$4,000. Passengers could be carried on the proposed roads with such engines at a speed of ten or twelve miles an hour, which would make a great improvement on the stage coach.

Such roads would not rot out long before they would wear out, and the answer to the objection that they are not durable is simply that they will last just as long as the cross ties on an ordinary railroad, and it will cost less to renew them. Post oak ties in the South last from ten to fourteen years. The cost of transportation by wagons, for a distance of twenty-five miles, without return load, is fifty cents per 100 lbs., or ten dollars per ton of 2,000 lbs.

Assuming the tractive power on such a wooden road, for the purpose of an approximation, to be double that of an ordinary railroad, or 20 pounds per ton, the angle of friction would be forty-eight feet to the mile. And a horse exerting a power of 150 lbs. at 2½ miles per hour, or 4 horses doing 600 lbs., would haul, on a grade of 144 feet to the mile, one fourth of the gross load on a level, or 7½ tons, giving 6 tons of net load. As a trip of twenty-five miles, returning empty, could be made in two days, assuming a team to be worth \$5 a day, the cost of the round trip would be \$10, or \$1.66 per ton, as against \$10 per ton by wagon transportation; and this, too, on grades of 150 to the mile, nearly—tolls for use of road not being included in either case.

This illustration will show the great economy of such roads over wagon transportation, even when operated by horse power; but where the business will warrant it, the rubber-tired locomotive should be used. If, after a few years, a business should be developed sufficiently to justify the expense, an iron railroad could be substituted, in which the original grading, as it would form a part, or the expenditure for it would not be lost. It is also to be observed that, the rails of the proposed wooden railroad, being even with the surface of the road bed, or nearly so, would permit the same road bed to be used for the ordinary vehicles.—General Haupt, in *Journal of the Farm*.

M. VIGNON has prepared mannitan by mixing mannit with half its weight of concentrated sulphuric acid, and keeping the mixture at 125° for two hours. Mannitan turns the plane of polarization to the right, and does not yield mannit even on boiling with baryta water for an hour. If mannit is heated to 250°, with a little water, a body is obtained which appears to be mannitan, but which turns the plane of polarization to the left, and yields mannit on boiling with water.

SEVERAL geese died in Mormon Island, Cal., a few days ago, and, upon dissection, gold dust was discovered "in fatal quantities" in their gizzards. And yet there was no suspicion that either of these was the golden goose we hear so much about.

DR. GATLING fired a quantity of the Mead-Meigs one inch caliber explosive bullets at the Gatling gun trial, at Fort Monroe, October 6, and reports the practice as very good.

QUANTITATIVE SPECTRUM ANALYSIS.

The subject of spectrum analysis has of late been so frequently and prominently brought before the public that it is only necessary briefly to recapitulate what has been done in order to understand the most recent tendency of investigation with this wonderful instrument, to which science already owes so much.

We must remember then, to begin with, that chemical substances, when volatilized in a flame, make known their composition by causing certain light lines to appear in the spectrum produced by making the light from the flame pass through a prism. Every chemical element has lines peculiar to itself, and their relative position in the spectrum is so constant that their appearance enables the observer at once to recognize the presence of substances. We can tell whether a light to be examined is due to a glowing gas, or proceeds from a liquid or solid body. A gas will produce bright colored bands separated by dark spaces, while a liquid or solid will give rise to a spectrum containing every shade of color without gaps. Thus the nature of the light coming from heavenly bodies is revealed to us, and it has been found, for example, that about one third of the nebulae are composed of incandescent gas. A glowing vapor will absorb the same kind of light as that which it emits; if therefore a brilliant source of light is surrounded by a glowing vapor, that vapor will not permit certain portions of the light behind it to pass through, and the absorption will be indicated by dark lines in the spectrum. These dark lines will be in the same places where the glowing vapor alone would produce bright ones. Hence it is that the spectrum of the sun, which is surrounded by an envelope of glowing gas, contains a great number of dark lines whose position reveals to us the substances present in the incandescent envelope. The same is true of the fixed stars, whose spectra are also characterized by dark lines.

When a luminous body is approaching us with great velocity, the waves of light crowd upon each other, become more rapid and shorter, and hence more refrangible, than if the body were stationary. Any given line in the spectrum of such a body will therefore be found nearer the more refrangible or violet portion of the spectrum than its normal position. If the luminous body is receding, the line will move towards the less refrangible or red end of the spectrum. The displacement of the line being accurately measured, we can calculate, from its known wave length and the velocity of light, the rate at which a fixed star is approaching or receding from the earth.

Terrific hydrogen storms are constantly taking place on the surface of the sun. On account of the glare of the light, these could only be seen formerly around the edge of the moon's disk during a total eclipse. Now they can be observed at any time by means of a spectroscopic of high dispersive power, which extinguishes the blaze of the sun sufficiently to allow them to be seen. The enormous velocity of the currents of glowing hydrogen projected upwards from the sun's surface can be measured on the same principle as that of a star approaching the earth.

If the light passing through colored solutions is examined by the spectroscopic, certain portions of it will be found to be absorbed, and their spectra will be characterized by dark bands, whose position and arrangement varies with the nature of the solution. It is thus that we can distinguish between different dyes, detect artificial coloring of wines (as, for example, by means of logwood), and decide upon the important question, likely to arise in criminal cases, whether a substance to be examined is human blood or not.

The fluorescent light produced, in a large class of substances, when illuminated by blue and violet light affords, on examination by the spectroscopic, a ready and most delicate means of determining their composition and even their state of hydration. Fluorescing substances, moreover, by rendering visible the actinic rays, increase the effective length of the spectrum and hence the delicacy of analysis.

Among many practical applications of spectrum analysis, one of the most important is in the manufacture of steel by the Bessemer process. A blast of air is forced through the melted iron to deprive it of a certain proportion of carbon. If this blast is continued a few minutes too long or stopped a few minutes too soon, the whole operation is vitiated. By examining the flame of the converter with the spectroscopic, the proper time to stop the blast is clearly indicated by the disappearance of the carbon lines and the change to a continuous spectrum.

But the uses of the spectroscopic do not stop here. Scientific men have of late been turning their attention in a new direction, that of quantitative analysis by means of the spectrum. Not content with discovering what substances are contained in a given compound, they are devising means to determine the quantity of these substances.

In a session of the French Academy of Science held November, 7, 1870, Janssen stated that he believed he would soon be able to determine sodium quantitatively by means of the spectroscopic. In his analyses, he was much annoyed by the constant presence of the sodium line, caused by the sea salt in the air; so he directed the slit of the spectroscopic upon the most brilliant portion of the flame of an ordinary gas burner instead of a Bunsen burner, in order to get a continuous spectrum in which the D line did not appear sensibly, because of the abundance of the neighboring lines. Sometimes he had to interpose several flames between the testing flame and the spectroscopic. This led him to conceive the possibility of estimating the quantity of sodium by the number of flames necessary. He also stated that the length of time it takes the sodium to volatilize might serve as a criterion of its quantity.

These crude ideas formed the basis of a series of experi-

ments undertaken quite recently by MM. Champion, Pellet and Grenier. After substituting colored glasses and colored solutions for Janssen's flames, and making a great many experiments, they constructed the "spectronatrometer," an instrument of considerable delicacy, but rather complicated in its arrangement. We will therefore confine ourselves to a description of its principles.

The soda in the substance to be analyzed is converted into the sulphate, the volatility of which is found to be intermediate between that of the chloride and the phosphate. Into the solution obtained a wire, of platinum-iridium '04 of an inch thick, is dipped and dried. It is then carried into a flat Bunsen flame with a perfectly regular motion by means of clockwork; and the intensity of the sodium line, produced in the spectroscopic directed upon the flame, is compared with that of a line produced from a solution containing a known quantity of sodium or from the volatilizing of solid pure sulphate of soda. The comparison is effected by causing the rays of the substance to be examined to pass through a glass prism containing a colored solution. This prism, being wedge-shaped, permits the experimenter to make the light pass through different thicknesses of the absorbing liquid (that is, from '04 to '60 inch) until he gets a sodium line equal in intensity to that of the standard of comparison. The inventors have made a large number of observations on solutions of known strength, and constructed a curve, whose abscissas represent the thickness of the layer of the solution in the prism through which the light has to pass, and whose ordinates correspond to the quantity of sodium present.

Dr. K. Vierordt, of Tübingen, the inventor of a delicate method of photometry by means of the spectroscopic, solves the problem of quantitative analysis of bodies giving an absorption spectrum in the following way: The slit of the spectroscopic, adjusted to a certain width, is divided into two parts. Opposite one half is placed a solution of the body to be determined, and opposite the other a solution of the same body whose strength is known. The first slit is then narrowed or widened until the absorption is the same in both halves of the spectrum, when the width is read off. By using a series of solutions varying decimally in strength, from the weakest to the strongest through which light will pass, curves may be constructed, in which solutions of unknown strength can be interpolated and their value ascertained. When a certain point is reached, further concentration of a solution will not affect its absorbing power regularly, and it is therefore necessary to dilute liquids which are very concentrated. Tables to facilitate calculation have been computed by Dr. Vierordt.

The most recent and perhaps the most important method yet discovered is due to Lockyer of England. It is based upon the following principles: When an alloy is introduced into the electric arch, the most volatile metal will be carried across to the other pole first, and its vapor will form so good a conductor that but little of the less volatile metal will get into the arch. To make the principle perfectly plain, we will quote an explanation given by Tyndall. When showing his audience the characteristic lines of silver and thallium, he found that the latter were far brighter, and that the former were diminished, when a bit of thallium was put in with the silver in the electric arch. "It is the resistance," he went on to say, "offered to the passage of the electric current from carbon to carbon that calls forth the power of the current to produce heat. If the resistance were materially lessened, the heat would be materially lessened; and if all resistance were abolished, there would be no heat at all. Now thallium is a much more fusible and vaporizable metal than silver; and its vapor facilitates the passage of the current to such a degree as to render it almost incompetent to vaporize silver." The more, therefore, of the more volatile metal is present in an alloy, the less of the other can be vaporized by the arch.

Now on examining the arch by means of the spectroscopic, Lockyer found lines extending across the whole width of the spectrum and shorter ones reaching only part of the way. The former corresponded to the more volatile, and the latter to the less volatile, metal. Now, as the length of the latter increases with the quantity of the metal present, it is evident that by measuring them we can ascertain that quantity. In these determinations, the electric current is obtained either from a powerful battery, a Ruhmkorff coil or a magneto-electric machine; and the heat of the spark is intensified and at the same time rendered constant by means of Leyden jars of constant surface. Instead of placing the alloy to be tested in one of the carbon electrodes, we might have the electrodes themselves composed of the metals. Suppose we make one of pure gold and the other of some alloy whose percentage of gold we wish to ascertain. Then by separating the electrodes sufficiently, we finally arrive at a point where the gold lines from the alloy no longer meet the lines from the pure gold, but will extend only part of the way, leaving a gap on their half of the spectrum. If we now keep the same distance between the electrodes, and experiment on alloys containing different percentages of gold, the length of their gold lines will be found to vary with that percentage. The length of the lines can easily be measured by causing the reflection of a graduated scale to fall upon the spectrum. In assaying, where we frequently have to do with samples of gold whose fineness differs but little, a series of electrodes of known composition may be prepared; and by comparing them with alloys of unknown fineness, it is easy to tell, by simple inspection of the spectrum, which is the finer. The lines of the one containing less gold will not extend all the way across.

The attention of the United States Mint has been called to this discovery of Mr. Lockyer's; and while this article

was in course of preparation, an officer from the Philadelphia branch was experimenting in the Stevens Institute of Technology with a view of testing its practical utility.

Photometry of Colors.

Mr. Wm. M. Lockwood, a practical photographer, read a paper before the National Photographic Association at the recent meeting in Buffalo, N. Y., in which he explains in an interesting and philosophical manner some of the mathematics of light, and the difficulties connected with the photographic production of colors. He says:

"I closed up my window so as to exclude all solar light; then, with a small gimlet, I bored two holes through this covering to my window, about half an inch apart, one over the other. By placing the ground glass so as to cover both these holes, I noticed that the two rays of light, passing through the holes and glass, seemed to unite at a distance of nearly five inches; the same trial with the purple glass made the rays unite at about seven inches; deep blue glass, at nearly ten; red glass, fifteen; and yellow glass, over twenty inches. To me this was a real discovery, because it settled in my mind that colors were of different focal length, and, being so, affected or reduced the iodide of silver, in sensitive films, each in a different way. I subsequently ascertained that Tyndall and others had established the focal length of colors, but have not, to my knowledge, determined their respective actinic force. I have another theory beside the above mentioned that goes to more fully establish the relative focal length of colors, and at the same time determines, to a certain extent, their actinic capabilities. Dr. Young and Augustin Fresnel, both eminent philosophers, were the first to establish the basis of what is called the wave theory of light. According to data arrived at by these gentlemen, a wave of pure solar light, in a clear atmosphere, is $\frac{1}{187500}$ of an inch in length; that of violet light, $\frac{1}{187500}$; that of blue, $\frac{1}{187500}$; red, $\frac{1}{187500}$; yellow, $\frac{1}{187500}$. In fact, 'the color of light is determined solely by its wave length.' Now the velocity of light being 192,000 miles in a second, if we ascertain the number of waves of each color in a mile and multiply this by 192,000, we obtain the number of waves that enter the eye, or attack the surface of iodide of silver, in a second of time.

Thus the waves of pure solar light amount to 913,384,192.-375,000. In the same interval of time 699,000,000 waves of violet light enter the eye or attack the sensitive film of your plate.

As violet light stands next to pure solar light in its actinic capabilities, you can easily understand what a large percentage the reflection of solar (white) light has over that of any other, the difference in this instance being 214,384,192.375.-000 in favor of white light in a second of time. Now, gentlemen, do you fully understand how it is that the human face, which is possessed of from three to seven distinct colors, tends to solarization in what we term the 'high lights'? Do you see how futile it is to attempt to photograph a red face with white draperies, a yellow face with purple clothing, a sunburnt and freckled face in white linen and laces? Do you not now see at what a fearful discount you work when you attempt to make a finely modeled picture under these circumstances? Do you wonder that so many otherwise good pictures are so flat, white, and chalky in the high lights? Seven eighths of all photographs made, which are failures in lighting and likeness, are attributable to this phenomenon alone. * * My cure is homoeopathic; 'similia similibus curantur,' or words to that effect. I use different colored reflectors, according to complexions. If red predominates in the face, use red as a modifier; if blue, yellow, or brown, use blue, yellow, or brown. The rule is: Look for the most non-actinic color in a face, and select the colors of your reflectors accordingly. Why? Because, by flooding the face with any color, you thereby tend to reduce all colors to a mean focus, or to reduce the difference in the length of the waves to an approximate length.

"I tried this theory for several months and find it works nicely, and will do away with seventy-five per cent of re-touching, which is an item now-a-days.

"I give you these thoughts, and the use of my system of lighting, free of charge. I have no patent. I have given you the particulars of my theory, not so much to provoke criticism as to provoke thought."

Persimmon Coffee.

The Commissioner of Patents has lately issued a patent to Edward Dugdale, of Griffin, Ga., for a new article of coffee, consisting of roasted persimmon seeds. Verily there is no end to the vagaries of the Patent Office.

That special SIXTY THOUSAND edition of the SCIENTIFIC AMERICAN, which is to issue about the 15th instant, is nearly ready for the press. Orders for advertisements on the back page came in so quickly, after the announcement of our intention to print a special edition, that the space was all taken some time ago.

One inside advertising page and the Business and Personal column will be left open for a few short advertisements till the morning of November 15. For terms, see inside page of this paper.

The SPECIAL number will be copiously illustrated, varied in contents, and full of useful information, which will insure its preservation by those who receive it.

After the sixty thousand are printed, orders from advertisers and others will be executed, for any number of copies of the paper desired, at reduced rates. When writing for terms, state the number of papers wanted. The larger the order, the less will be the price per hundred or thousand.

THE Danbury News man has discovered that car wheels are being made out of paper. He is now desirous of finding out whether that paper is Iron.

IMPROVED FIREPROOF CONSTRUCTION.

Such fires as those of Chicago and Boston have brought out the great want of fireproof material to be used in the finishing of buildings, such as roofs, cornices, partitions and interior walls. In the case of Boston, if the mansard roofs and the upper portions of the high buildings had been made of metal or other fireproof material, such vast destruction would have been impossible.

In the annexed illustrations, is represented one of the latest improvements in fireproof construction. It consists of wall surfaces and partitions, all the material composing which is of iron. The form of the lath is such that, when in place, it presents a firm surface; while at the same time, the latter is sufficiently open to receive and securely hold the plaster coat. The cost of the construction is claimed to be more moderate than that of any other plan now in the market.

Fig. 1 is a perspective view of a room which the workman is fitting up with the improved lath. The mode of fastening the latter to the studding for side walls and ceilings is clearly represented. As there are no screws, pins, or rivets, the workman with one blow of his hammer securely locks the two adjacent laths in place.

As shown in Fig. 2, the laths are made of strips of thin sheet iron, about 36 inches long, which, by means of a machine invented for the purpose, are formed to the required shape, perforated as at D, and delivered complete for bundling at the rate of one thousand per hour.

Fig. 3 is a full sized section of lath in position, with a side view of the perforated edge of the stud, A, showing the two tongues, B, by means of which the laths are fastened. A wedge-shaped tool is driven between the two tongues, so that they are bent outward, locking the edges of the laths firmly to the stud. As is evident, the strips may be secured in position with great rapidity.

Figs. 4 and 5 represent a side view and section of the corrugated studding, as used for full partitions where the plaster coat is applied to both sides. The same illustrations also show the mode of fastening the studs to the floor by an adjustable foot, C. Fig. 7 gives the arrangement of the studding where great stiffness is required to support the floors. Fig. 6 is a section of wall, showing how perfectly the plaster

such a state of purity that it may be unfailingly recognized by characteristic properties, and produced in court as evidence. D. A. von Bastelaer gives a process, already found of advantage in several judicial inquiries, which is based essentially on the solubility of phosphorus in ether and its almost perfect indifference towards solution of ammonia if in contact with it for only a short time. If the substance from which phosphorus is to be separated is not fluid, such as phosphor paste, it is first reduced by addition of

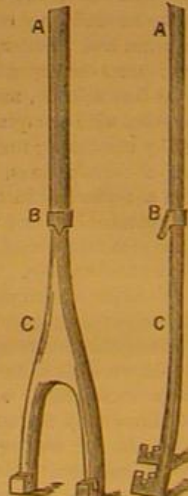


HOLMES' IMPROVED FIREPROOF CONSTRUCTION.—Fig. 1.

water to the condition of a sufficiently thin pap, in order that it may be thoroughly mixed with ether by agitating for some seconds. Not only the weight of the original substance taken, but also that of the added water, is noted. After the reduction, about 100 grains, or any other suitable weighed quantity, of the fluid mass is taken, mixed with as much ether, and left in contact therewith in the cold for four or five hours, during which period the mixture is to be violently shaken at frequent intervals. The ether, being now decanted, is replaced with an equal quantity of fresh ether, and these operations are repeated about three times. The united ethereal liquids, protected from dust, are allowed to evaporate spontaneously at 59° or 68° Fah. in a shallow dish. At this point some water is added, that the phosphorus may be protected from the action of the air after evaporation of the ether. If what remains after removal of the ether be gently warmed to 122° or 140° Fah, the phosphorus unites itself with a portion of the fat, forming a fluid globular mass under the water, while the remainder of the matter taken up by ether rises to the surface as a thin film. The globule containing phosphorus is now treated with about 10 or 15 grains of strong aqueous ammonia in a small flask and violently agitated. This treatment is repeated a few times. Lastly, if the adhering ammonia be removed by washing first with water acidulated with sulphuric acid, and then with pure water, the phosphorus remains behind, certainly somewhat soft in consistence, but otherwise exhibiting all the physical and chemical properties which characterize it. It may be brought in a little glass tube and handed to the judge as *corpus delicti*.

The "Jackson" Dipper.

Mr. B. Pennington presents to the photo fraternity, through the Philadelphia Photographer, a new plate dipper, which is evidently a most useful little affair. He dedicates it to the public, not intending to secure it by patent. The body, A, he makes out of hickory, covered with shellac. At C it is curved, to keep the plate at a proper distance from the handle. B is a silver slide, which moves up and down on the handle so that any size of plate may be held. One special advantage of this instrument is that plates may be placed in the bath back up; floating particles of dirt are thus prevented from injuring the film, which leaves the bath clean. Operators who love good work will find this dipper to be of value.



English Machinery for the American Market.

By reference to our advertising columns, an announcement from a celebrated English manufacturer will be found, offering, in this market, his ten inch lathes, the parts of which are made in duplicate by machinery, so exactly as to render them interchangeable. Parties wishing a superior lathe, of the size indicated, would do well to send to the manufacturer, G. E. Illingworth, Leeds, England, for photograph, and obtain his price list.

THE total number of admissions to the Vienna Exhibition from the opening to the closing day was 7,350,000.

Ice Caverns in Switzerland.

The Swiss Times says: Some fine caverns have recently been discovered on the right flank of the Montereasch glacier, near Pontresina. At about half an hour's march from the foot of the glacier, there is a gallery in the ice about 150 feet in length and 30 feet in height (just beneath the surface), which serves as the vestibule to the caverns. At its extremity there is an opening about the height of a man, within which there is a sharp descent over blocks of ice.

From this point ropes and lights are needed. Some distance from the portal rises a splendid vault, seemingly cut out of the pure ice, and two lateral galleries open out from this, but of less height. The temperature is not excessively cold, and the ice is dry. There is a lake within the large cavern, upon which blocks of ice are floating, and, in the distance, a small waterfall which supplies it. The colors of the vault and the crevasses show brilliantly, even under the moderate light of lamps.

ANTHON'S SEWER GAS TRAP.

Every one who has ever examined the operation of the common V trap has doubtless remarked that, at times, a gurgling noise proceeds from it just after the last portion of the water disappears from the basin, tub, or sink. This noise is caused by the trap emptying itself when the velocity through it is too great, and in such case the apparatus is said to siphon out. Thus acting, it no longer serves as a sewer gas trap, but permits the foul emanations to escape and enter the house.

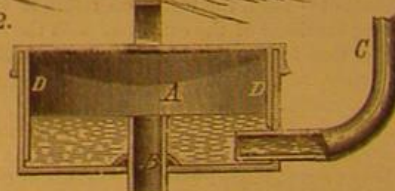
Experience of this fact, as well as the knowledge that such a trap, even when provided with a trap screw, can seldom be cleansed when stopped up without the aid of a plumber, has led the inventor to devise the improved apparatus represented in our engraving. There is a cylindrical

box, A, into which the soil pipe, B, is introduced so as to extend some distance above the bottom, as shown in the sectional view, Fig. 2. C is the waste pipe leading from the basin, the open end of which, communicating with the box, A, is at a lower level than the orifice of the pipe, B. The cover of the cylinder is arranged with the ordinary outer flange, having a bayonet joint to secure it in place (Fig. 1), and, besides, is provided with cylindrical walls, L, Fig. 2, which fit closely inside of box, A, and extend down below the surface of the water.

Fig. 1.



Fig. 2.



It is claimed that this device effectually prevents the escape of sewer gases from the pipe, B, as they cannot pass down through the liquid and under the lower edge of the inner cylinder. The cover being easily removable, no obstacle is placed to the cleaning out of the box without the aid of a plumber, whenever it becomes necessary.

Patented August 5, 1873, by Mr. George C. Anthon, of No. 13 West 35th street, New York city, who may be addressed for further information.

M. GRÜNER, France, has been engaged in measuring the quantity of heat needful to effect the fusion of cast iron slags, dross, and steel, in order to compare the heat produced in blast furnaces with the heat utilized. He finds that cast iron melts at from 2,831° to 2,874° Fah. The heat of a hot blast iron furnace, for cast iron, is ordinarily reckoned at 3,000° Fah. Bessemer steel, according to M. Grüner, melts at 3,013° Fah. Siemens estimates the heat necessary in a furnace to melt steel as 3,600° Fah.

Fig. 2

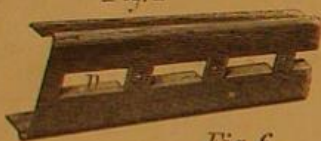


Fig. 3



Fig. 6



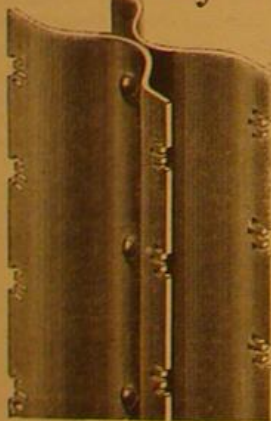
Fig. 4



Fig. 5



Fig. 7



coat is locked and secured by the form of lath; also how completely the clinching of the coat is distributed over the surface, thereby insuring even drying, without cracking. Plasterers who have laid coats on this lathing state they can cover twenty-five per cent more surface, with the same labor and time, than on the ordinary wood lath.

The system, avoiding, as it does, the use of rivets or screws, is quite novel, and is secured in its various forms by letters patent. It may be applied to a variety of purposes, and it has been suggested that freight depots, shops, and similar buildings, can be constructed by setting up the frame and lathing the exterior, outside of which a coat of stucco might be applied, thus giving a fireproof structure at small cost.

Further information, circulars, prices, samples, etc., can be obtained by addressing the inventor, Isaac V. Holmes, or The John Cooper Engine Manufacturing Company, at Mount Vernon, Ohio.

The Estimation of Phosphorus in Fatty Mixtures.

In order to separate phosphorus from articles of food, vomits, and other matters containing fatty substances, in

A MANSION AND MUSEUM COMBINED.

Mrs. Bowes, the wife of a wealthy Englishman, has recently built a new mansion, to be occupied not only as a residence but also as a museum and picture gallery, intended to contain for public exhibition a large collection of works of art and articles of vertu, to the purchase and assembling of which she has devoted much time and money. On the

The second floor contains the bed and dressing rooms, and the attics in the roof include the servants' bedrooms.

The exterior of the building is of polished masonry, of a superior quality of stone from Mr. Bowes' estate. The ornamental terrace in front is approached by a wide carriage drive; the steps in the center lead to the flower gardens. The grounds are intended to be laid out with walks, terraces,

Electro-Music Reporter.

A novel application of electricity to musical instruments, for the purpose of recording the inspirations of genius in musical compositions, is now in process of construction for Mr. C. T. Shelton, of New Haven, Conn. It is a telegraphic attachment to an organ. Beneath each note of the three manuals and of the pedals, and connected with each stop of the organ, is a small brass spring, which is pressed down whenever the piece to which it is attached is brought into action. From each spring, wires run to a galvanic battery of twelve cells, and to the recording apparatus, which may be situated at any convenient distance from the organ. When the spring is pressed down, connection between the battery and the recording apparatus is formed, and the electric current passes through. The recording apparatus is very simple, and similar to that used in Morse's telegraph. Attached to the clockwork, by which a uniform motion is produced, are two cylinders some eighteen inches in length, between which is carried a strip of paper divided into about 250 longitudinal divisions—one for each note and stop in the organ. Corresponding to each of these divisions is a magnet whose armature carries a lever armed with a style, which indents the paper as long as the electric current is passing through. Now, when any note or stop is brought into action the spring connected with it is pressed down, the circuit is completed, the corresponding armature is attracted to its magnet, and the division of the paper belonging to the note struck is indented with a line proportionate in length to the time during which the note is held down. A staccato touch will be represented by a simple dot, while a longer tone will be recorded by a more prolonged indentation. The clockwork is so geared that the paper is carried forward on the rollers at the rate of about one half an inch per second, thus recording each note in the most rapid playing at the rate of about ten notes per second by a line one twentieth of an inch in length, and longer notes by lines proportionally extended.

Reduction of Copper Ores.

The practical working of the Hunt & Douglas copper process, at the Ore Knob mine, Ashe county, N. C., is described as follows by J. E. Clayton:

The ore to be treated was a copper pyrites of low grade, dressed to contain from 100 to 120 pounds of copper to the ton of 2,000 pounds; the gangue was a clay slate. Our mode of treatment was as follows: The ores were crushed, sized by being passed through a sieve of forty holes to the linear inch, and sent to the calcining furnaces. These furnaces were simple three-hearth reverberatories, and were charged every eight hours with 2,000 pounds of the prepared ore; the charges, after being in the furnace for twenty-four hours, were withdrawn, weighed, assayed, and sent to the tanks. The calcination was effected at a low red heat, with a view of converting about one third of the copper in the charge into sulphate; the remainder being as oxides, with the exception of from five to seven and a half pounds to the ton remaining as unoxidized sulphuret.

The calcined ore was next charged into tanks of about 3,000 gallons capacity, two thirds filled with bath, in weighed portions of 8,000 pounds. The mixture was then agitated by a stirring apparatus connected with the tank, and steam injected in sufficient quantity to raise the temperature to about 120° Fah. After eight hours stirring, the mixture was allowed to subside, the copper solution drawn off into settling tanks, and about 600 gallons of weak bath drawn down upon the residues remaining in each stirring tank, to cleanse them of the copper liquor. This weak bath was then drawn off into tanks containing metallic iron, the cop-

per precipitated therefrom, and the liquid passed into a reservoir tank, to be again used in washing the residue from the following charge. The stirring tanks were then emptied and the residues wheeled away. The general average of loss in these residues was from six to ten pounds of copper to the ton of ore treated.

The strong copper solution, after fully subsiding in the settling tanks, was drawn into tanks containing iron (cast or wrought iron scrap), the copper precipitated, and the bath, with a small addition of salt, used in the treatment of a new charge of roasted ore.

After an experimental trial of a few months, we erected works equal to the treatment of the whole ore product of the mine. We, in the first start, prepared a given amount of bath, according to the inventors' formula, with copperas and salt; and found in working the process that, by calcining the ores at a low heat, avoiding a dead roast, and bringing from 25 to

MRS. BOWES' MANSION AND ART GALLERY, BARNARD CASTLE, ENGLAND.



ground floor, in the center pavilion, is the entrance hall, 45 feet 6 inches by 40 feet, and 30 feet in height, and adjoining is the principal staircase, 37 feet by 32 feet. Within, these have been built of polished ashlar work, having pillars and pilasters, with marble panels, carved caps, moldings, and spandrels. The stairs and galleries are all of polished stone, about 10 feet in width. On each side of the entrance hall are suites of large rooms; and behind are the museum, and painting and sculpture galleries, 200 feet in length by 45 feet in width.

The first floor is arranged the same as the ground floor, with the exception of the addition of a grand reception room above the entrance hall, from which a fine view of the beautiful surrounding country is obtained. The picture gallery is on this floor, and is 200 feet in length by 45 feet in width; it is lighted from the roof, and made entirely fire-proof.

lakes, gardens, and an orangery, and other buildings necessary for the purpose will be erected. The mansion was built from the designs of Mr. J. E. Watson.

Proposed Tunnel between Scotland and Ireland.

For many years there have been projects more or less before the public for uniting Scotland and Ireland by means of a tunnel; and the scheme has recently been again put forward, this time, however, with some reasonable probability of its being carried out. A single line tunnel, 15 feet wide at base, 25 feet wide at the maximum, and 21 feet high, the side walls of which would vary from 4 to 7 feet in thickness, is estimated by the present projectors to cost nearly \$23,000,000, with the approaches. The length of the tunnel would be about twelve miles, and it would extend from a point on the north shore of Ireland, near Belfast, under the Irish sea, to the extremity of the peninsula opposite, in Scotland.

33-per cent of copper into sulphate, the bath was easily kept at standard strength without the addition of any copperas whatever. The salt added was equal to twenty-five per cent, and the maximum of iron consumed, to seventy-five per cent of the copper produced.

Our cost of making copper, obtained as cement, exclusive of mining and dressing the ores, and not including the power required to work the stirring tanks, which was merely nominal, was, for producing 2,100 pounds of copper, from 21 tons of 54 per cent ores, \$76.96, equal to 3½ cents a pound.

The cost of the plant required is small. The furnaces are simple and inexpensive in construction, and require about 25,000 bricks each. The tanks cost, complete, about \$60 each, and the labor employed need not be skilled or high priced.

AMERICAN ACADEMY OF SCIENCES.

During the second day's session, papers were read by Professor Elias Loomis on the phenomena of great storms, in which he gave some results derived from the examination of the United States weather maps, and by Professor Theodore Gill on the number of classes of vertebrates and their mutual relations. Dr. Newberry repeated the paper read by him before the Portland meeting on the circles of deposition of American sedimentary strata, giving a comprehensive theory of the formation of all the sedimentary rocks in this country.

The association then adjourned to meet at the Stevens Institute, where Professor Mayer described a

NEW METHOD OF ANALYSIS OF COMPOSITE SOUNDS.

It is well known that if a surface advance regularly under a point of a body having a pendulum vibration in a plane parallel to the surface, this point will describe on the surface a sinuoidal or (as it is now more generally called) a harmonic curve. Ohm states that such a vibration, and only such, can produce on the ear the sensation of a simple sound—in other words, of a sound which has one and only one pitch. But the point of the sonorous body, whether it be a point of a membrane, of the drum of the ear, of the end of a vibrating rod, or of the air itself, may be actuated by a motion which, when it is caused to describe itself on the above mentioned surface, may depart greatly in its form from the simple harmonic curve. Yet in this case, according to Ohm, the ear will act on this composite motion as the analysis of the mathematician can act on its corresponding curve, and will decompose it into the simple harmonic vibrations which compose it. Therefore the ear will, in this case, perceive several sounds, each having one definite pitch, and with the proper degree of attention can take cognizance of any one of them, to the exclusion more or less of all the other components.

But if Ohm's proposition be true, then there must be a reason for it in the very dynamic constitution of the ear. This Helmholtz saw, and the discovery of the 3,000 chords of corti in the cochlea and of Schultze's bristles in the ampule led him to suppose that these bodies effected the analysis of the sound, vibrating sympathetically with its simple components.

If we represent any composite sound by a periodic curve, Fourier has shown and states in his theorem that such a curve can always be reproduced by compounding harmonic curves (often infinite in number) having the same axis as the given curve and having the lengths of their recurrent periods as $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, etc.

To decompose into its elementary harmonic vibrations the sonorous motions which such curve represents and indeed reproduces when it is drawn under a slit in a piece of paper which exposes only a point of the curve at once, it is required that only one vibrating point of the body should be experimented on, and that the composite vibratory motion of this point should be conveyed along lines to bodies vibrating sympathetically to the elements of the composite vibration, and that these sympathetically vibrating bodies should be capable alone of giving simple or pendulous vibrations.

It is evidently impossible to subject to experiment the interior portions of the ears of mammals, and we must therefore study the progress of the change in the position of the inner ear as we descend in the scale of life, so that, if possible, we may at last find animals whose external ear is exposed to view. It appears that, as we descend from the mammalia in the scale of life, the exterior parts of the ear disappear and the interior portions advance toward the surface.

After this introduction Professor Mayer gave an account, illustrated with elaborate experiments, of a recent research on the analysis of composite or musical sounds, and detailed experiments on the organs of hearing of insects, or what are supposed to be organs of hearing.

After having first shown experimentally all the existing methods of the analysis of sound by taking one after another the elementary notes out of a reed organ pipe by the former known methods, he proceeded to analyze the same sound given by the reed organ pipe by his own method which is as follows: A membrane is placed near the sonorous body. Attached to a point of this membrane are several fibers from a silkworm cocoon. Each of these leads to a tuning fork. Now it is known that a tuning fork can only give a simple sound, that is, a sound having only one pitch. Hence if any of the sounds which are given by these forks exist in the sound given by the sonorous body, the forks giving these sounds, and only these, will vibrate. Professor Mayer showed this by placing on the prongs of the forks small pieces of wax. This system of analysis is found to be so delicate that, if the fork is

thrown out of tune by the weight of the piece of wax, so that it will give one beat in eight seconds with the sound which it had before it was loaded, it will thus detect this difference in the pitch. According to Weber, of Germany, the most accomplished musical ear can detect a difference of pitch in two notes whose ratio of vibration is as 1,000 to 1,001; but by this method a difference of pitch can be detected in two notes where the ratio of vibration is 4,000 to 4,001.

Professor Mayer then gave an account of experiments, in which he has partly succeeded in measuring the relative intensity of sounds by the quantity of heat that sounds give when the bodies producing them are caused to send their vibrations into india rubber. The rubber is in the form of a very thin sheet, stretched between the prongs of a fork and inclosed on the sides by a thermo battery. Professor Mayer is still conducting researches in this direction. Unless we can measure the intensity of sounds there is no science of acoustics. Last year Professor Mayer made an initial step in that direction by measuring with great accuracy the relative intensity of sounds of the same pitch. But to measure the relative intensity of sounds of different pitch is a much more difficult matter, and has not yet been successfully accomplished. Professor Mayer, however, hopes to succeed in this by converting a certain known fraction of a sonorous vibration into heat.

Professor Mayer now exhibited to the Academy the resultant curve produced by combining the first six harmonics of a musical note. This curve was then drawn in a circular disk of glass by removing from its blackened surface the continuous line of the curve, which returned on itself. This curve was now placed in front of a lantern, and the image of the line was projected on a screen. A slit in a piece of cardboard having been placed in front of the curve, and in the direction of a radius of the disk, and the disk being revolved, caused the spot of light on the screen to vibrate like the drum of the ear when it listens to a musical note.

Professor Mayer then proceeded to give an account, illustrated by experiment, of what he supposes to be the organ of hearing in insects. Placing a male mosquito under the microscope, and sounding various notes of tuning forks in the range of a sound given by the female mosquito, the various fibers of the antennae of the male mosquito vibrated sympathetically to these various sounds. The longest fibers vibrated sympathetically to the grave notes, and the short fibers vibrated sympathetically to the higher notes. The fact that the nocturnal insects have highly organized antennae while the diurnal ones have not, and also the fact that the anatomy of these parts of insects shows a highly developed nervous organization, leads to the highly probable inference that Professor Mayer has here given facts which form the first sure basis of reasoning in reference to the nature of the auditory apparatus of insects.

These experiments were also extended in a direction which added new facts to the physiology of the senses. If a sonorous impulse strike a fiber so that the direction of the impulse is in the direction of the fiber, then the fiber remains stationary. But if the direction of the sound is at right angles to the fiber, the fiber vibrates with its maximum intensity. Thus, when a sound strikes the fibrils of an insect, those on one antenna are vibrated more powerfully than the fibrils on the other, and the insect naturally turns in the direction of that antenna which is most strongly shaken. The fibrils on the other antenna are now shaken with more and more intensity, until, having turned his body so that both antennae vibrate with equal intensity, he has placed the axis of his body in the direction of the sound. Experiments under the microscope show that the mosquito can thus detect to within five degrees the position of the sonorous center. To render assurance doubly sure, Professor Mayer, having found two fibrils of the antennae of a mosquito which vibrated powerfully to two different notes, measured these fibrils very accurately under the microscope. He then constructed some fibrils out of pine wood, which, though two or three feet long and of the thickness of small picture cord, had exactly the same proportion of length to thickness as the fibrils of the antennae of the mosquito. He found that these slender pine rods or fibrils had to each other the same ratio of vibration as the fibrils of the mosquito.

REMARKABLE FLUORESCENCE IN NEW CHEMICAL COMPOUNDS.

The research has consisted in studying at the same time the fluorescence and the absorption spectra of various bodies, including the uranium salts, the organic substance anthracene and some of its derivatives, and a new body which he was fortunate enough to discover by the application of this method to products of the distillation.

As we have already referred to Dr. Morton's brilliant discovery of thallene and the similar substance petroleucene, it is not necessary to repeat his remarks regarding these bodies.

Resins.

The resins best known to commerce and used extensively in medicine and several of the mechanical arts are nine in number, and are known as copal, lac, amber, dammar, common resin, elemi, sandarac, mastic, and caramba wax. All these resins can be reduced to powder, and all can be dissolved by a union either with acids, oils, or alcoholic preparations. Gum copal is the concrete juice of a tree growing in certain sections of South America and the East Indies. The substance when pure is hard, shining, transparent, citron-colored, and inodorous. It is not soluble in water or spirits, but may be dissolved in linseed oil, when submitted to a heat a little less than sufficient to boil or decompose the

oil. When the solution is diluted with spirits of turpentine, it forms a beautiful transparent varnish. Shellac, or more properly lac, is a resinous substance obtained mainly from the *ficus Indica*, or banyan tree, on which it is deposited by an insect. It is composed of five distinct but very similar kinds, each of which is united with a small quantity of several other foreign substances, particularly a red colored matter. Stick lac is the compound in its natural state, incrusting small twigs. When broken off and boiled in water, it loses its red color, and is called seed lac. When melted, strained, and spread into thin plates, it is called shell lac. United with ivory black or vermilion, it forms red or black sealing wax. When lac is dissolved in alcohol or other solvents, and submitted to different methods of preparation, it constitutes various kinds of varnishes and lacquers. Lac is really dissolved by a union with caustic soda. Amber is a yellowish resin, and resembles copal. It is found on the seashore and frequently on alluvial soils with beds of lignite. It is capable of receiving a fine polish, and is used for ornamental purposes, to adorn pipes, walking sticks, etc. It is also the basis of a fine varnish. By friction it readily becomes electric. Amber will not dissolve in alcohol, but it yields to the action of concentrated sulphuric acid, which will dissolve all resins except caramba wax. The union with the sulphuric acid gives dammar a brilliant red tint, but to other resins a dark brown color. Dammar is obtained from certain trees indigenous to the East Indies; among others the dammara and the dammer pine. It is principally used for making varnish. Dammar dissolves easily in sulphide of carbon, oil of turpentine, linseed oil, and benzol. Common resin is the product of the southern pine, and is readily soluble in alcohol and the essential oils. Elemi is a concrete substance obtained from several species of trees growing in the tropics, but having much the same appearance and undoubtedly allied in origin. It is used by the medical profession in ointments and plasters, and by mechanics as a base for the manufacture of varnish. This resin dissolves with difficulty in alcohol and linseed oil, but gives way under the action of turpentine and benzol. Mastic exudes from the mastic tree, which grows in the island of Sicily in the Mediterranean Sea. It runs freely when an incision is made in the body of the tree, but not otherwise. It is of a yellowish white color, is semi-transparent, of faint smell, and is used as an aromatic and an astringent. It is also used by painters as an ingredient in drying varnishes. Sandarac is the product of a tree growing in Barbary. It is obtained in what are known as transparent tears of a white color, and is used principally for incense and the manufacture of varnish and, when pulverized and mixed with other substances in a pounce, as a perfume. The following resins will become pasty before melting: amber, lac, elemi, sandarac, and mastic; the others will become liquid at once. Ammonia will slowly dissolve copal, mastic, and sandarac; but on the other principal resins, it has very little effect.

Modern Miracles.

Under this heading we recently made mention of the alleged miraculous trickling stone in France, and expressed surprise that scientific persons like the editor of *Les Mondes* should lend themselves and their columns to the maintenance of an imposition so gross and barefaced as this.

Professor J. O'K. Murray, of St. Francis College, near this city, takes up the cudgel in behalf of the new miracle, and knocks daylight into the subject, and into the *SCIENTIFIC AMERICAN*, in the following heavenly style, which we publish in order that both sides may be heard:

"TO THE EDITOR OF THE BROOKLYN EAGLE:—For a slipshod, threadbare editorial commend us, from time to time, to the *SCIENTIFIC AMERICAN*. That any journal with such a respectable, high sounding name should make such an exhibition of shallowness, bigotry, and gross ignorance is quite astounding. The following quotations are from one of its recent leaders, headed 'Modern Miracles.' As a specimen of scant knowledge, obtuseness, and 'stump' writing, it is worthy the days of Know Nothingism. Alluding to the justly celebrated shrine of Lourdes, it treats its readers to the following unscientific twaddle:

'A sickly child laboring under a diseased constitution, and a spring, opportunely trickling from a stone, sum up the entire wonder. * * * A peculiarity of this especial mystery is that it is not susceptible of direct test, and is therefore a mere matter of faith. * * * If the editor of *Les Mondes* will visit any negro camp meeting in the United States, he will remark innumerable repetitions of religious ecstasy such as that of Bernadette. He will find both old and young of both sexes launching off into descriptions of golden cities and celestial inhabitants, which they sincerely believe, which will throw the peasant girl's story far into the shade.'

This is poor English, but the utter stupidity of the logic is immeasurably below the lingo in which it is clothed. It is wanton and ignorant insult to every intelligent Catholic. The fact is, when the *SCIENTIFIC AMERICAN* attempts to treat of such matters, it goes out of its proper sphere, and no longer knows 'what it is driving at.' I consider it beneath me to refute language which carries with it its own refutation. It is a sample of the supreme ignorance and gratuitous nonsense which occasionally crops out among certain snarling scoffers and *soi-disant* men of science, when they treat of some religious topic. About Catholicity or its miracles, such personages generally know a little less than nothing. A sewing machine or a balloon is a more proper theme for the exercise of their craniums. Pity and indignation alternately arrest the mind in reading the shabby effusions of these scientific upstarts.

J. O'K. MURRAY,
Professor in St. Francis College."

Iron and Steel Exhibits of the West.

Conceding the greatness of the Northwest as an agricultural and stock raising region, people have been content to think that its progress is comprised in the products which its superiority in these respects so generally yields. The prospect of its great cities assuming an importance as manufacturing points has almost been lost sight of by the masses. The displays made by the iron makers at the Chicago Exposition, says the *New York Times*, show what these products are, and indicate to what extent the mining wealth of the West is being taken advantage of by points brought near to the ore regions by rail and lake navigation.

Among the exhibitors was the North Chicago Rolling Mills Company, of which Captain E. B. Ward is president. These mills have an annual capacity of 25,000 tons Bessemer steel rails, 30,000 tons railroad iron, and 50,000 tons pig metal. The samples which the company expose are very fine and extensive, and attract a large degree of attention. The texture of the metal used in them is illustrated by rails twisted, curled, bent double, and subjected to any process which will show the torsion, strength and ductility of the metal. One of the most curious specimens is that of a polished steel rail, about four feet in length, twisted while cold. The test thus given to the quality of the metal is severe, and certain to bring to light any of its imperfections. The rail in question shows not a fracture, flaw, or even the slightest blemish.

A number of broken steel ingots were also among the exhibition. They weigh from 1,100 to 1,400 pounds each, are perfectly solid, and show a texture and density that is not excelled by any Bessemer steel mill in this or any other country. The company claim that they are making as fine an ingot as is manufactured in the world. The quality of the Lake Superior iron is particularly adapted to the manufacture of steel, and it excels the best brands of the foreign market. The company are the owners of vast mining interests in the Lake Superior regions, and they carry on the process of manufacturing through all the details, from mining the ore to turning out the rails. A piece which had been recently tested was on exhibition. It stood the remarkable test of 73,250 pounds to the square inch, with an elongation of sixteen per cent. A sample of chains manufactured of Bessemer steel, at the Wyandotte (Michigan) Rolling Mills, constituted an interesting feature of the display. A comparative list of these chains with those of English make shows the following result:

Size.	Quality.	Strength.
1½ inch.	American.	101,750
	English.	76,500
2 inch.	American.	28,875
	English.	19,000
2½ inch.	American.	38,000
	English.	26,000
3 inch.	American.	15,825
	English.	8,500
7-16 inch.	American.	10,250
	English.	5,750

Reduction of Auriferous Pyrites.

Dr. Ira M. Phelps has devised a process which is described as being of the highest metallurgical importance as well as scientific interest. The sulphur contained in the ore furnishes a large portion of the fuel; it being compelled, in a great measure, to consume itself. Oxygen and mercury, the former obtained from the atmosphere without money and without price, and the latter secured against excessive loss by properly constructed amalgamators, are the only chemicals needed except that furnished by the ore itself. The sulphur, which has hitherto been the most troublesome element, is made to do its duty not only in accomplishing its own destruction, but in effecting the release of the golden treasure it has so long and persistently guarded. That a thorough desulphurization of the ore is a necessary prelude to amalgamation is a conceded fact, and it is the difficulty of accomplishing this desulphurization that has led to so many failures. Dr. Phelps maintains that the cause of all the failures has been an insufficient supply of oxygen, the enormous bulk of air necessary to supply it never having been even approximately estimated or conceived. But in addition to this, there are four other conditions, to secure and maintain which is of vital importance: a supply of oxygen sufficient to meet all the demands of oxidation, a proper and timely regulation of the heat, the constant agitation of the ore, and sufficient time to perfect the chemical changes involved.

The importance of fine pulverization is fully recognized by Dr. Phelps, who takes especial care to point out the enormous difference, in the time required, which variation of size makes, a little variation in its superficies making a very great difference in the time required. Dr. Phelps claims to have obliterated this difficulty by introducing the ore underneath the draft current, and causing it to pass down the terrace floor of the inclined flue in a substratum of atmospheric eddies, without being once brought in contact with the ascending current.

The Deilement of Air by Volatile Vapors.

A paper on this subject was read in the Health Department of the recent Social Science Congress, by Mr. W. J. Cooper. Air, the writer held, to be fit for respiration, ought to be of extraordinary purity; but it was to be regretted that some well meaning workers in sanitary science recommended a course of action which (by adding noxious vapors to the impure air, for disinfecting purposes) not only increased the previous deilement, but prevented clarification, which was the main object to be attained. Air could not be charged with any volatile vapor without detriment, whether it was sewer gas from the drains, carbonate of ammonia from horse droppings, aroma from the dust cart, or the equally vile odor which arose from weak solutions of carbolic acid now used in some towns with the idea that it would destroy the germs

of disease. Eminent authorities had proved the fallacy of this notion. Carbolic acid in a concentrated form would arrest decomposition for awhile, but Pettenkofer's experiments had clearly shown that when the acid was further diluted germ development was actually encouraged; Dr. Dougall's recent experiments had exposed the futility of the use of the vapor of carbolic acid upon infective matter; and it was also known that, during the Franco-German war, although hospitals were saturated with carbolic acid, still hospital gangrene prevailed. With these facts before them, it was intolerable that the air of our public places, our dwellings, and our towns should be daily deiled by the volatile vapors arising from this objectionable substance with the vain expectation of preserving the public from infection, the effect being to encourage a rather expensive method of creating a nuisance.

Where carbolic acid was used, it could not be always ascertained whether the stench operated upon was removed or not, but they know that when applied to urinals the sickly, ammoniacal odor was not affected; the twofold atmospheric deilement of the carbolic and ammoniacal vapors being distinctly and separately distinguishable. There was much evidence to show that the air could not be impregnated with a vapor sufficiently powerful to destroy germs or infectious matter without damage to the tissue of the lungs. Liebig had stated that lung disease was produced by the use of chlorine as a disinfectant in hospitals. In the last published number of the proceedings of the Chemical Society, it was related that Mr. Ernest Theophron Chapman, an eminent chemist, who recently lost his life by an explosion in a chemical manufactory in Germany, had suffered in health for many years from the effects of the inhalation of chlorine, which brought on hemorrhage from the lungs, a complaint which would frequently occur when he was under the influence of any excitement. It was also known that the strong Highland workmen, employed at the St. Rollox Works in Glasgow, were rapidly destroyed by the chlorine vapor given off from the bleaching powder manufactory there. Bromine, iodine, and ozone were equally mischievous in their action. Before they could use enough iodine to have any effect upon germs, it would produce the well known iodine catarrh. Bromine would overpower the senses with its suffocating stench long before it could disinfect; and if the atmosphere were to be overcharged with ozone, it would be productive of equally deleterious consequences.

Recent investigations had fully exposed the futility of several methods practiced with the intention of destroying the germs of disease by attempting the impossible task of disinfecting air. These delusive theories had been based upon the fallacious supposition that a chemical re-agent retained its destructive power when very dilute. Experience has shown, however, that the very reverse happens in many instances. Strong sulphuric acid will set fire to wood shavings, and so destroy them. Dilute sulphuric acid will transform shavings into grape sugar, which is susceptible of fermentation. This was an illustration which held good throughout organic chemistry. Professor Rolleston informs us that unless so much sulphurous acid be put into the air of a room that no one could exist in it for a minute, all fumigation is abortive. Professor Wanklyn, in a recent paper on disinfectants, observes that the wisdom of the physician who places his little saucer with bleaching powder and muriatic acid in the chamber of his patient is comparable with that of the Cattle Plague Commissioners who tied carbolic cloths to the horns of the cattle to disinfect the air of the agricultural districts.

If the air of a room be foul, the obvious remedy is to open the window to let in the external air as the best possible purifier. If the room contains germs, they will probably find surfaces to rest upon, and it is by cleansing all surfaces that the room is to be purified, and not by futile attempts to disinfect an ever changing atmospheric current. As germs of disease must be looked upon as a dangerous enemy, they must be treated as an invading army and deprived of every possible feeding and resting place. As they are fostered in filth and putridity, all filth and decaying matter should be carefully removed, and decomposition should be arrested in sewers, on road surfaces, and in all holes and corners where putrefying matter of any kind is deposited. For the purpose of arresting decomposition, chemical substances should be used which do not by their nature deile the air, and are not dangerous, destructive or offensive; for it is of the utmost importance to make disinfection popular, and it is contrary to human nature to delight in substances which are irritating and obnoxious to the senses, and which have a tendency to cause a positive evil in the attempt to prevent a possible one.

In the discussion which followed, Dr. Carpenter expressed general agreement in the novel and striking ideas promulgated by Mr. Hooper, as did also Dr. Shrimpton, while Dr. Hardwicke fully corroborated the statements regarding the state of some of the hospitals during the Franco-German war. As an instance of the mischievous effect of carbolic acid as a disinfectant, Dr. Hardwicke stated that, finding the milk supplied to him, when mixed with tea, had an unpleasant taste, he made enquiries of the milkman, and found he had been using carbolic acid to disinfect a drain in his dairy, the milk had absorbed the vapor of carbolic, and so made the milk unfit to drink. He had also known many cases of fatal accidents occurring from its use.

THE addition of a small quantity of boric acid to milk retards the separation of cream, and the milk does not become sour when kept several days. Beer also, to which boric acid has been added, does not so quickly become hard. —A. Hirschberg in *Arch. Pharm.*

SCIENTIFIC AND PRACTICAL INFORMATION.

PREPARATION AND PRESERVATION OF MUSHROOMS.

Dr. Remsch, in *Les Mondes*, proposes to cover the fungus with a film of collodion and place it in an airy position. He states that the contraction of the mushroom is equal in every way, and that the chemical and anatomical constitution remains the same. An exact form, preservative against the destructive action of oxygen, and also against insects and germs, and the keeping of the substance for future experiment, are the advantages obtained.

THE SPECTROGRAPH.

The name is given to a simple little device for copying drawings, exhibited in the French department of the Vienna Exposition. It consists of a board, near the middle of which is a piece of window glass fastened at right angles to it by means of two grooved wooden uprights. When placed near a window, with a drawing or copy on the end of the board nearer the window, its reflection in the glass causes it to appear upon a sheet of white on the opposite side of the glass. In this way quite an accurate tracing can be made by one who is no draftsman.

THE OXYHYDROGEN LIGHT.

Dr. John Nicol describes, in the *British Journal of Photography*, a new mode of making lime cylinders as follows:

Four parts of precipitated chalk are intimately mixed with one part of ponderous carbonate of magnesia, and the whole made into a stiff paste with mucilage of gum arabic. The mass should be well beaten in a mortar, or in any other way to ensure thorough incorporation, and made a little stiffer than glazier's putty. It may then be rolled on a slightly oiled marble or porcelain slab, or smooth board, till it assumes the form of an ordinary ruler, and then cut into suitable lengths. The holes are easily made with a wire of the proper thickness; and if the wire be "olive ended," like those used for piercing tobacco pipe stems—that is, having a tiny bulb or button at the end to be inserted—it will penetrate straighter and easier. The cylinders thus finished only further require drying, which may readily be done in the kitchen oven; and as they must be thoroughly dry, they may be left there for two or three days.

THE VALUE OF SEWAGE.

Commenting on the sewage question and notably with reference to the utilization of the waste soil from Liverpool sewers, a writer in *Iron* estimates that a town of 100,000 inhabitants produces fertilizing material to the value of \$250,000 per annum. In the above mentioned city, it is considered that the sewage, if properly utilized, would be worth fully \$750,000 a year. The entire population of Great Britain, with all her colonies, is about 75,000,000 souls, and each person produces annually about two and a half dollars worth of valuable material. Hence the aggregate amount is valued at \$187,500,000, a sum equal to the joint annual yield of the Australian and Californian gold mines. Applying this vast total to agricultural purposes, it would produce fully ten times its value in breadstuffs, beef, milk, butter, and all kinds of vegetable and animal food. The United States contain about 40,000,000 people, and hence \$100,000,000 worth of useful substance is yearly wasted: a sum, it is hardly necessary to say, which, if added to the finances of the country, would lessen the chances of future panics and aid materially in paying off the national debt.

MEAT FROM AUSTRALIA.

A cargo of Australian meat has recently been sent to England, and its preservation during the voyage is effected by a new process, in which no antiseptic materials of any kind are employed. The beef and mutton is brought on board directly from the slaughterhouse and thrown into an iron tank, no particular care being exercised in arranging the pieces. The reservoir is placed within another and larger receptacle, and ice, produced by artificial means, is packed upon the cover of the inner vessel. The water due to melting runs over the upper surface and down the sides of the latter; and it is collected at the bottom, to be returned by tubes to the ice, to be again refrigerated. The apparatus is built in a kind of well, made between the upper deck and hold of the vessel, about amidships, and is protected by layers of sawdust and other non-conducting material. It is said that meat thus treated has been kept on shore for eighty-five days without losing any of its properties or becoming in anywise decomposed.

THE VIENNA EXHIBITION—AUSTRIAN COURT HONOR TO AN AMERICAN CONTRIBUTOR.

Telegrams to the *New York Herald*.

VIENNA, Nov. 1, 1873.

The Emperor of Austria has conferred the "Imperial Order of Francis Joseph" upon Hon. Nathaniel Wheeler, President of the celebrated Wheeler & Wilson Sewing Machine Company of New York.

More Distinguished Honors.

BALTIMORE, Md., Oct. 31.

The Maryland Institute has awarded Wheeler & Wilson the gold medal for the new No. 4 Sewing Machine. Other sewing machines received nothing.

Recent American and Foreign Patents.

Improved Middlings Separator.

Robert L. Downton, Collinsville, Ill.—This invention has for its object to furnish an improved apparatus for separating middlings into grades, so as to enable a larger per cent of first grade flour to be made from the wheat by mixing with the first grade or grades of the middlings. The unsorted middlings pass through a spout against a disk which distributes them centrifugally upon inclined aprons, whence they pass down, the heavier portions to an incline and the lighter into a cylinder. The latter are drawn by a suction fan through one pipe, and discharged through another into a chamber. Here the air blast is regulated to cause a deposit of a second grade, while the lighter passes on to another chamber. This operation is continued until as many grades are obtained as may be desired.

Improved Corn Planter Runner Bending Machine.

Smith W. Kimble, Springfield, Ill.—This invention relates to means for bending the runners of corn planters, and consists in a vibratory segment provided with slotted arms, between which are placed side rolls and a reciprocating top roll, combined with a curved former and a superposed bar the subjacent surface of the latter gradually approaching the top of the former from front to rear.

Improved Tanning Compound.

Michael W. Fry, Guyandotte, W. Va.—This invention relates to a method of neutralizing the acid which remains in hides after they have been tanned, and which are calculated greatly to damage the leather. It consists in removing the acid from previously tanned hides by immersing them in a bath or solution of ash and soda, according to a formula fully set forth in the specification of the patent.

Improved Hoe.

Harrison Parkman, Philadelphia, Pa.—This invention is an improvement in that class of hoes which are double bladed, that is, pointed on one side or edge and straight on the other or opposite one, to adapt them for different kinds of work. The invention consists in bending or striking up the hoe blade, so as to form a central rib on the inner side or surface thereof and a corresponding groove on the other side, the same extending from the center to the termination of the pointed end. The object of this construction is twofold: to strengthen the hoe blade and adapt it to work easily in the earth, and to form a suitable recess to receive the end of the handle socket or other device by which the blade is secured to the handle. The remaining feature of the invention relates to the construction of the handle socket whereby it is adapted for firm and durable connection with the hoe blade and for other purposes.

Improved Blowpipe.

John E. McClure, San Francisco, Cal., and David H. Almsworth, Salinas, Cal.—This invention relates to a peculiar construction of that class of blowpipes which are used in connection with a lamp, whose flame is expected both to vaporize the liquid in vessel and to be forced upon and melt metals or solder. The invention consists in a blowpipe of two connected chambers, having front convexities with intermediate air space, the ejection being located upon the upper convexity while the lower receives the flame that is to generate the vapor.

Improved Thrashing Machine.

Willard Verill, Elwood, N. J.—The grain is fed to an endless apron by which it is carried beneath the beaters, which are attached, to a shaft, and which are bent at a little distance therefrom, so that, as the said shaft rocks, the said beaters may strike squarely upon the endless apron and platform beneath. The extreme ends of the beaters are bent upward to prevent them from catching upon the endless apron.

Improved Harness Trace Buckle.

Hilary H. Hartzell, Holden, Mo.—The object of this invention is to produce a trace buckle, which forms a strong and more effective connection of the straps the greater the strains applied to them, being perfectly free from friction by casting, or breaking a trace off. The frame of the buckle is provided with an inclined loop at one end, and a loop at the other end, toward the hames. At the turning point is an indentation. A central lateral connecting piece carries the upright tongue of about the height of the end loops, which admit the heaviest and thickest traces in use. The trace is suitably perforated to fit over the tongue. Another loop consists of two parts, of which one connects with the hame strap, and has a side expansion to embrace the curved loop of the frame. A lateral bar divides the double loop centrally, and bears against the indentation, producing thereby a twofold connection of frame with the loop. A strain exerted on the trace and hame strap causes an upward gliding of the bar, and thereby a tightening of the hold on the trace.

Improved Harvester Rake.

John L. Owens, Cambria, Wis.—A tubular standard supports a beveled wheel which turns loosely thereon and carries a horizontal rim turned by the driving wheel. The rake arms are pivoted on the upper side of this rim, and arranged so that the inner ends work upon a stationary cam as they are carried along, which allows the arms to rise at the inner ends and fall at the outer ends to bring the rakes down to the apron. Suitable degrees are provided in order that this cam may allow some of the rakes to pass above the grain on the apron of the machine when the grain is so light that a quantity sufficient for a gavel does not accumulate as each succeeding arm passes. For intercepting some of the rakes, there is a tappet wheel with, say, three rows of tappets on its face, and capable of sliding lengthwise to bring either set of its tappets into action according as demanded by the volume of grain. The said sets each being arranged for having a different effect in throwing out the rakes—that is, varying the order of throwing them out. It is shifted by suitable mechanism arranged in a place where it can be reached conveniently by the operator to shift it at will, and provided with a holder by which it can be held in either of three positions corresponding to three sets of tappets.

Improved Saw Set.

Benjamin S. Castle, Johnston, O.—In the groove of a bench is arranged a setting plate over which is a setting clamp and setting tool. The clamp consists of a strong bar extending over the setting plate nearly its whole length, then bending horizontally beyond the edge, and then down through the frame to levers, which are forced down by a screw to press the clamp down on the saw, which is laid on the plate. The levers are forced up by a spring. The tool is forced down on the saw teeth by the blows of a hammer, and it is forced up by another spring.

Improved Cotton Gin.

Beall Hempstead, Little Rock, Ark.—The brushes consist of two flanges, in halves, and bolted together around the shaft, with brushes attached to the sides and projecting obliquely forward, or in the direction in which they turn, and meeting together at the middle of the space between the flanges. There are, also, bristles attached to the shaft, between the flanges, and projecting radially from it. The object of having the bristles project forward is to have them impinge with greater force against the sides of the saws than they otherwise would, and prevent them from being sprung backward away from it. A wide, endless carrier of canvas is arranged under the saws to receive the seeds and other droppings, and carry them out through the gin case. There is an endless chain carrier in the hopper, with teeth to convey the cotton along from the place of receiving it to the passage through the top of the gin case. This works in connection with an open wire bottom above the chains, an open wood bottom below them, or either alone, and a gate to spread and equalize the cotton, regulate the quantity supplied to the gin, open the bolls, and remove them and other coarse matters, which are arrested by the teeth of the gate or regulator, and caused to fall, through the open bottoms, to the gin case, from which they are carried, by teeth, into the drawer, which is removed from time to time and emptied.

Improved Machine for Making Chains.

Louis Souther, Springfield, Ill.—This invention has for its object to furnish a machine which shall be so constructed as to bend the iron into link form, weld its ends, and make a complete chain by a continuous operation. In using the machine, the parts being in position, a bar is laid upon the notched upper ends of flanges. As the machine moves forward the former is thrown into place and the flanges move upward, bending the bar around the former. Lips descend upon each side of the upper ends of the bent bar, and a die comes down, bending the ends of the bar down upon the upper part of the former. The die rises slightly, and the lips are forced toward each other, welding the ends of the bar between the lips, the former, and the die. The movement of the lips toward each other allows the lock or catch bar to drop, causing the lips in position. The former is then withdrawn from the link, and the sleeve, the lips, and the link make a quarter revolution, coming into such a position that another bar may be thrust through the link and laid upon the ends of the flanges. A locking bar now slightly descends, bringing its bend in contact with a block, which releases the lips, allowing them to spring apart and the link to drop upon the bar. The lips now return to their former position, the former is thrust forward, and so on. The chain, as completed, passes down through a hollow bar.

Improved Wind Wheel.

Nicholas Shepler and Daniel Shepler, Murrayville, Ill.—To the upper part of the wheel shaft are rigidly attached four or more short wings, to the outer edges of which are hinged other wings, which are all connected and held in the same relative position by a rope secured to each, and which allows them to move freely upon their hinges. A weight is so arranged as to hold the other wings against the wind in ordinary circumstances, but, should the wind increase in force, it will turn them back upon their hinges into a position more or less oblique according to the force of the wind. As the wind decreases in force the weight draws the wings back into their former position. A hood, made in the form of a half drum, and is designed to cover about one half of the wheel and protect the returning wings from the action of the wind.

NEW BOOKS AND PUBLICATIONS.

ILLUSTRATED BOOK AND DESCRIPTION OF LEFFEL'S IMPROVED DOUBLE TURBINE WATER WHEEL, FOR 1873. Springfield, Ohio: James Leffel & Co.

The authors of this work give not only copious illustrations of their celebrated wheel in this handsomely printed pamphlet, but also a great deal of general information in water power, the best mode of utilizing it, etc., which is important to mill owners generally.

THE PRACTICAL MAGAZINE: AN ILLUSTRATED CYCLOPEDIA OF INDUSTRIAL NEWS, INVENTIONS, AND IMPROVEMENTS. London: 7 Printing House Square. Boston: J. R. Osgood & Co.

This periodical maintains the high reputation which, since its first issue, it has enjoyed in this country and in Europe. It is one of the handsomest of all the journals which reach us, and is edited with great judgment and taste.

PROPORTIONS OF PINS USED IN BRIDGES. By Charles Bender, C. E.

VENTILATION OF BUILDINGS. By W. F. Butler.

These two handy books are Nos. 4 and 5 of Mr. Van Nostrand's Science Series.

ILLUSTRATED CATALOGUE OF THE BALDWIN LOCOMOTIVE WORKS, Philadelphia, Pa.

Messrs. M. Baird & Co., the proprietors of the world-renowned Baldwin Works, have published a very handsome catalogue, containing a succinct history of locomotive construction in America, and detailed descriptions of the numerous forms of engine built by them. The latter are illustrated by well executed photographs. The typography and binding are of the highest order, and do credit to the printers, Messrs. J. B. Lippincott & Co.

THE DAILY RECORD, OR EVERYBODY'S DIARY, FOR 1874. Price \$1.50. New York: Hastings & Co., 203 Broadway.

This is a convenient form of diary for commercial use. The space allotted to each day is one third of a page, which shows a week's record in each opening. Its convenience for use is enhanced by it being interleaved with blotting paper.

LOCKWOOD'S DIRECTORY OF THE PAPER MANUFACTURERS in the United States and Canada. Price \$5. New York: H. Lockwood, 14 Park Place.

Mr. Lockwood has evidently spent much time and labor on the compilation of this work, which gives a full description of the locality, capacity and special product of each mill.

Inventions Patented in England by Americans.

[Compiled from the Commissioners of Patents' Journal.]

From October 10 to October 23, 1873, inclusive.

ARTIFICIAL FUEL.—E. F. Loiseux, Mauch Chunk, Pa.

BOAT TENT.—J. R. Adams, Oakland, Cal.

CUTTING CARDS.—V. E. Manger, New York City.

ELECTRIC SIGNAL.—T. S. Hall, West Meriden, Conn., et al.

FOLDING FABRICS, ETC.—W. F. Jobbins, New York City.

METAL NUTS, ETC.—S. Vanstone et al., Providence, R. I.

ORDNANCE, ETC.—W. M. Arnold, New York City.

STONE POLISH.—J. Birch, New York City.

TELEGRAPH.—W. E. Sawyer, Washington, D. C., et al.

TUCKING ATTACHMENT.—F. W. Brown, Cincinnati, O.

TWISTING MACHINERY.—W. Cockcroft et al., Chester, Pa.

Value of Patents, AND HOW TO OBTAIN THEM. Practical Hints to Inventors.

PROBABLY no investment of a small sum of money brings a greater return than the expense incurred in obtaining a patent even when the invention is but a small one. Larger inventions are found to pay correspondingly well. The names of Blanchard, Morse, Bigelow, Colt, Eliason, Howe, McCormick, Hoe, and others, who have amassed immense fortunes from their inventions, are well known. And there are thousands of others who have realized large sums from their patents.

More than FIFTY THOUSAND INVENTORS have availed themselves of the services of MUNN & Co. during the TWENTY-SIX years they have acted as solicitors and Publishers of the SCIENTIFIC AMERICAN. They stand at the head in this class of business; and their large corps of assistants, mostly selected from the ranks of the Patent Office; men capable of rendering the best service to the inventor, from the experience practically obtained while examiners in the Patent Office; enables MUNN & Co. to do everything appertaining to patents BETTER and CHEAPER than any other reliable agency.

HOW TO OBTAIN PATENTS.

This is the closing inquiry in nearly every letter describing some invention on which comes to this office. A positive answer can only be had by presenting a complete application for a patent to the Commissioner of Patents. An application consists of a Model, Drawing, Petition, Oath, and full Specification. Various official rules and formalities must also be observed. The efforts of the inventor to do all this business himself are generally without success. After great perplexity and delay, he is usually glad to seek the aid of persons experienced in patent business, and have all the work done over again. The best plan is to solicit proper advice at the beginning. If the parties consulted are honorable men, the inventor may safely confide his ideas to them, they will advise whether the improvement is probably patentable, and will give him all the directions needful to protect his rights.

How Can I Best Secure my Invention?

This is an inquiry which one inventor naturally asks another, who has had some experience in obtaining patents. His answer generally is as follows:—and correct:—

Construct a neat model, not over a foot in any dimension—smaller if possible—and send by express, prepaid, addressed to MUNN & Co., 37 Park Row, New York, together with a description of its operation and merits. On receipt thereof, they will examine the invention carefully, and advise you as to its patentability, free of charge. Or, if you have not time, or the means

at hand, to construct a model, make as good a pen and ink sketch of the improvement as possible and send by mail. An answer as to the prospect of a patent will be received, usually, by return of mail. It is sometimes best to have a search made at the Patent Office. Such a measure often saves the cost of an application for a patent.

Preliminary Examination.

In order to have such search, make out a written description of the invention, in your own words, and a pencil, or pen and ink, sketch. Send these, with the fee of \$5, by mail, addressed to MUNN & Co., 37 Park Row, and in due time you will receive an acknowledgment thereof, followed by a written report in regard to the patentability of your improvement. This special search is made with great care, among the models and patents at Washington, to ascertain whether the improvement presented is patentable.

Rejected Cases.

Rejected cases, or defective papers, remodeled for parties who have made applications for themselves, or through other agents. Terms moderate. Address MUNN & Co., stating particulars.

To Make an Application for a Patent.

The applicant for a patent should furnish a model of his invention if susceptible of one, although sometimes it may be dispensed with; or, if the invention be a chemical production, he must furnish samples of the ingredients of which his composition consists. These should be securely packed, the inventor's name marked on them, and sent by express, prepaid. Small models, from a distance, can often be sent cheaper by mail. The safest way to remit money is by a draft, or postal order, on New York, payable to the order of MUNN & Co. Persons who live in remote parts of the country can usually purchase drafts from their merchants on their New York correspondents.

Caveats.

Persons desiring to file a caveat can have the papers prepared in the shortest time, by sending a sketch and description of the invention. The Government fee for a caveat is \$10. A pamphlet of advice regarding applications for patents and caveats is furnished gratis, on application by mail. Address MUNN & Co., 37 Park Row, New York.

Reissues.

A reissue is granted to the original patentee, his heirs, or the assignees of the entire interest, when, by reason of an insufficient or defective specification, the original patent is invalid, provided the error has arisen from inadvertence, accident, or mistake, without any fraudulent or deceptive intention.

A patentee may, at his option, have in his reissue a separate patent for each distinct part of the invention comprehended in his original application by paying the required fee in each case, and complying with the other requirements of the law, as in original applications. Address MUNN & Co., 37 Park Row, for full particulars.

Design Patents.

Foreign designers and manufacturers, who send goods to this country may secure patents here upon their new patterns, and thus prevent others from fabricating or selling the same goods in this market.

A patent for a design may be granted to any person, whether citizen or alien, for any new and original design for a manufacture, bust, statue, alto relievo, or bas relief; any new and original design for the printing of woolen, silk, cotton, or other fabrics; any new and original impression, ornament, pattern, print, or picture, to be printed, painted, cast, or otherwise placed on or worked into any article of manufacture.

Design patents are equally as important to citizens as to foreigners. For full particulars send for pamphlet to MUNN & Co., 37 Park Row, New York.

Foreign Patents.

The population of Great Britain is 31,000,000; of France, 37,000,000; Belgium, 5,000,000; Austria, 36,000,000; Prussia, 40,000,000; and Russia, 70,000,000. Patents may be secured by American citizens in all of these countries. Now is the time, while business is dull at home, to take advantage of these immense foreign fields. Mechanical improvements of all kinds are always in demand in Europe. There will never be a better time than the present to take patents abroad. We have reliable business connections with the principal capitals of Europe. A large share of all the patents secured in foreign countries by Americans are obtained through our Agency. Address MUNN & Co., 37 Park Row, New York. Circulars with full information on foreign patents, furnished free.

Value of Extended Patents.

Did patentees realize the fact that their inventions are likely to be more productive of profit during the seven years of extension than the first full term for which their patents were granted, we think more would avail themselves of the extension privilege. Patents granted prior to 1861 may be extended for seven years, for the benefit of the inventor, or of his heirs in case of the decease of the former, by due application to the Patent Office, ninety days before the termination of the patent. The extended time inures to the benefit of the inventor, the assignee, under the first term having no rights under the extension, except by special agreement. The Government fee for an extension is \$100, and it is necessary that good professional service be obtained to conduct the business before the Patent Office. Full information as to extensions may be had by addressing MUNN & Co., 37 Park Row.

Trademarks.

Any person or firm domiciled in the United States, or any firm or corporation residing in any foreign country where similar privileges are extended to citizens of the United States, may register their designs and obtain protection. This is very important to manufacturers in this country, and equally so to foreigners. For full particulars address MUNN & Co., 37 Park Row, New York.

Canadian Patents.

On the first of September, 1872, the new patent law of Canada went into force, and patents are now granted to citizens of the United States on the same favorable terms as to citizens of the Dominion.

In order to apply for a patent in Canada, the applicant must furnish a model, specification and duplicate drawings, substantially the same as in applying for an American patent.

The patent may be taken out either for five years (government fee \$30) or for ten years (government fee \$40) or for fifteen years (government fee \$60). The five and ten year patents may be extended to the term of fifteen years. The formalities for extension are simple and not expensive.

American inventions, even if already patented in this country, can be patented in Canada provided the American patent is not more than one year old.

All persons who desire to take out patents in Canada are requested to communicate with MUNN & Co., 37 Park Row, N. Y., who will give prompt attention to the business and furnish full instruction.

Copies of Patents.

Persons desiring any patent issued from 1836 to November 26, 1867, can be supplied with official copies at a reasonable cost, the price depending upon the extent of drawings and length of specification.

Any patent issued since November 27, 1867, at which time the Patent Office commenced printing the drawings and specifications, may be had by remitting to this office \$1.

A copy of the claims of any patent issued since 1836 will be furnished for \$1.

When ordering copies, please to remit for the same as above, and state name of patentee, title of invention, and date of patent. Address MUNN & Co., Patent Solicitors, 37 Park Row, New York City.

MUNN & Co. will be happy to see inventors in person, at their office, or to advise them by letter. In all cases, they may expect an honest opinion. For such consultations, opinions and advice no charge is made. Write plainly do not use pencil, nor pale ink; be brief.

All business committed to our care, and all consultations, are kept secret and strictly confidential.

In all matters pertaining to patents, such as conducting interferences, procuring extensions, drawing assignments, examinations into the validity of patents, etc., special care and attention is given. For information, and for pamphlets of instruction and advice

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Protect your Buildings with Patent Liquid Slate Roof Paint. Fire Proof and Elastic and very Cheap. Send for Circular of Prices and Certificates. New York City Oil Co., 116 Maiden Lane, New York, Sole Agents.

For Bolt Forging Machines, and Holding Vices to upset by hand. J. B. Abbe, Manchester, N. H. Manufacturers of Flour Machinery, send circulars to E. C. Campbell, Millham, Center Co., Pa.

Wanted—A Supply of Superior White Hickory, either in log or sawn. Address, with particulars, to J. Graham, 61 Cedar Street, New York.

Sharp's Rifles, \$8; Box 1263, Boston, Mass.

Wanted—I will give \$2,000 a year Salary, and furnish Machines, Horse, and Wagon, to a good man in each State for selling the "Domestic Steam Clothes Washer." Sample Washer at wholesale, price \$3.00. J. C. Miller, Pittsburgh, Pa.

Patent on a new double rotary and reciprocating Churning Machine, simple and cheap. For Sale. Address J. L. Britt & Son, Raleigh, N. C.

Those having a good Second Hand Mather and Planer on hand will please send a description of it with price to the 210 7th Street, John Case, Frenchtown, N. J.

Inventors, or Parties having small Patent Novelties they wish to put on the market, will find it to their advantage to correspond with City Novelty Co., Buffalo, N. Y.

Small Tools and Gear Wheels for Models. List free. Goodnow & Wightman, 21 Cornhill, Boston, Mass.

Wanted—Set of Patterns for a Model Locomotive Engine; also, set for Stationary Engine. Small size. Goodnow & Wightman, 21 Cornhill, Boston, Mass.

Patent on a powerful popular Microscope for Sale. Address James H. Logan, 12 Cedar Avenue, Allegheny, Pa.

Steam Boiler and Pipe Covering—Economy, Safety, and Durability. Saves from ten to twenty per cent. Casimers Spence Company, foot East 5th St., N. Y.

Brass Gear Wheel, for models, &c., made to order, by D. Gilbert & Son, 212 Chester St., Phila., Pa.

"A Combined Hand and Power Planer," for Machinists. Send for a circular, to Jos. A. Sawyer & Son, Worcester, Mass.

Notice of Removal—The American Photo Relief Printing Co. (Woodbury Process) have removed to No. 421 North 24th Street, Philadelphia, to which No. please address all orders, &c. I. Carbutt, Manager.

Superior to all others—Linet & Co.'s French Files. They are cheaper than English files. They are heavier, better finished, and better tempered. Send for price-list. Homer Foot & Co., Sole Agents, 30 Platt Street, New York.

The New Elastic Truss presses uniformly all around the body, and holds the Rupture easy, night and day, till cured. Sole cheap by the Elastic Truss Co., 63 Broadway, New York.

For Sale—Second hand Planer, nearly new. Planes 4 ft. x 2 ft. x 19 inches. Enquire at J. Frisbie & Co., New Haven, Conn.

Telegraph & Electrical Inst's—Cheap Inst's for learners—Models and light Mach's. G. W. Stocely, Sec., Cleveland, Ohio.

Brown's Coal Yard Quarry & Contractors' Apparatus for holding and conveying material by iron chain. W. D. Andrews & Bro., 14 Water St., N. Y.

English Roof Paint, all mixed in oil ready for use, 50c a gallon, 116 Maiden Lane, New York.

Patent Petroleum Linseed Oil works in all pains as boiled Linseed Oil. Price only 50c a gallon, 116 Maiden Lane, New York.

Buy Gear's Improved Automatic Dovetailing Machine, Boston, Mass.

Patent Chemical Metallic Paint—All shades ground in oil, and all mixed ready for use. Put up in cans, barrels, and half barrels. Price, 50c, \$1, and \$1.50 per gal. Send for card of colors. New York City Oil Company, Sole Agents, 116 Maiden Lane, New York.

Beltting—Best Philadelphia Oak Tanned. C. W. Aray, 301 and 303 Cherry Street, Philadelphia, Pa.

Mercurial Steam Blast & Hydraulic Gauges of all pressures, very accurate. T. Shaw, 913 Ridge St., Phila.

For patent Electric Watch clocks, address Jerome Rodding & Co., 39 Hanover Street, Boston, Mass.

Mining, Wrecking, Pumping, Drainage, or Irrigating Machinery, for sale or rent, see advertisement, Andrew's Patent, inside page.

Lathes, Planers, Drills, Milling and Index Machines. Geo. S. Lincoln & Co., Hartford, Conn.

For Solid Emery Wheels and Machinery, send to the Union Stone Co., Boston, Mass., for circular.

Buy Iron Working Machinery of Gear, Boston, Mass.

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

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

Five different sizes of Gatling Guns are now manufactured at Colt's Armory, Hartford, Conn. The larger sizes have a range of over two miles. These arms are indispensable in modern warfare.

Diamonds and Carbon turned and shaped for Scientific purposes; also, Glaziers' Diamonds manufactured and reset by J. Dickinson, 64 Nassau St., N. Y.

Mechanical Engineer and Draftsman.—An active and energetic man, with good address and education, wanted, as outside man, to solicit orders and make himself generally useful. Address, with references and expectations, New York Post Office, Box 2915.

Hydraulic Presses and Jacks, new and second hand. E. Lyon, 43 Grand Street, New York.

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

Just Published—"Workshop Receipts" for Man, facturers, Mechanics, and Scientific Amateurs. \$2, mail free. E. & F. N. Spon, 45 Broome Street, N. Y.

Damper Regulators and Gage Cocks—For the best, address Murell & Kistner, Baltimore, Md.

Steam Fire Engines, R. J. Gould, Newark, N. J.

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

At American Institute and Chicago Exposition—Booth's Universal Paneling, Variety Molding and Dovetailing Machine. Manufactured by Battle Creek Machinery Company, Battle Creek, Mich.

Workman's Hand Book—Indispensable to all engaged in Manufacturing pursuits. For Cabinet Makers, Upholsterers, Undertakers, Picture Frame Makers, etc., it contains important information, and new receipts of great value. Price \$1.50. Mailed to any address by C. Abel, Cheboygan, Mich.

Notes & Queries.

R. W. S. asks: How are toy balloons made?

P. W. asks: What two metals cause frictional electricity with very little rubbing?

W. J. asks: Where can the photometric apparatus of Erdmann be seen, or where is it described at full length?

C. S. says: In building the dome for a new telescope, I desire to make it exceedingly light, so that it may revolve more easily. Over a light ash frame, I glue thin pine boards, and, on the boards, canvas. The dome will be very rigid. I want some reasonably cheap material to cement on the canvas, so that, in case rain gets through any crack in the paint, the canvas will not come off. The dome is to be of 22 feet diameter and 10 feet high.



P. W. should read Noad's "Student's Manual of Electricity." See our advertising columns for books on mechanics.—A. D. W. will find a recipe for paste on p. 173, vol. 24.—B. J. will find directions for repairing rubber garments or boots on p. 155, vol. 25.—C. S. will find a recipe for glue impervious to moisture on p. 220, vol. 25.—O. A. D. can mold India rubber by the method described on p. 237, vol. 25. Wood can be fastened to rubber with glue.—E. L. W. and J. E. B. should refer to p. 220, vol. 25, for a blackboard composition.—C. A. K. will find instructions for bleaching sponge on p. 272, vol. 25.—J. R. W. should read the article on p. 220, vol. 25, for instruction as to a substance that will ignite in contact with the water.—S. will find a recipe for jet black drawing ink on p. 10, vol. 25.—W. B. will find directions for making plastic (not imitation) rubber on p. 223, vol. 25.—J. C. should try the recipe for cement for meerschaum on p. 22, vol. 25, on his broken ivory. Read Lyall's "Manual of Geology."—C. H. S. should consult our advertising columns for books on mechanics.

C. A. T. asks: Which do you consider the most efficient wheel to be used for a flat bottomed boat with a sharp prow and a stern? Her sides are perpendicular; size of boat is 5 x 25 feet. Should I use side wheels, paddle wheel at stern, or the Fowler wheel? The draft of boat does not exceed 10 inches. Which do you consider will drive the boat the fastest? We can not use a screw to any advantage with such light draft. With sufficient power, what speed could we get from the best wheel? Answer: You might get a speed of from 5 to 6 miles an hour, by using a stern wheel; and if it was made with feathering floats, it might be quite small.

F. H. J. says: I am about to construct an engine with 4 inches stroke x 2 inches bore. Would steam pipe of 1/4 inch internal diameter and exhaust pipe 1/4 inch internal diameter be large enough? 2. Would a boiler 20 inches long x 12 inches diameter x 1/4 inch thick, of iron, furnish enough steam to run such an engine 150 revolutions a minute? How many pounds steam would a boiler of the above description stand and how many pounds would it take to run the engine 150 revolutions a minute? Answer: 1. The following table, taken from W. S. Auchincloss' valuable work on "Link and Valve Motions," will doubtless be of interest to many of our readers:

Speed of piston, in feet per minute.	Area of steam pipe.	Area of exhaust pipe.
200	0.023 area of piston.	0.010 area of piston.
250	0.032 "	0.014 "
300	0.041 "	0.018 "
350	0.049 "	0.022 "
400	0.058 "	0.026 "
450	0.067 "	0.030 "
500	0.076 "	0.034 "
550	0.085 "	0.038 "
600	0.094 "	0.042 "

The engine of our correspondent is to have a piston speed of $150 \times 4 \times 2 = 1200$ feet per minute, so that the areas given in first line of the table will be more than sufficient. These would give a steam pipe a little over five sixteenths of an inch in diameter, and an exhaust pipe nearly seven sixteenths. 2. This question cannot be answered definitely, as our correspondent does not state how much power he wishes to produce. If the engine is well constructed, it should give 150 revolutions per minute, running light, with a very low pressure of steam. Probably it would be well to proportion the boiler with about 20 square feet of heating surface per horse power.

W. Y. C. asks: 1. Are the yearly differences in the variation of the magnetic needle always the same for New York city? 2. Are the differences from year to year always the same for any place? 3. If not, is there any place which has an equal yearly difference, and what is it? 4. If the answers to 1 and 2 are affirmative, what are the yearly differences of any two or all places alike? 5. What is the relation between the differences of places, if any? 6. Is there any rule for finding the variation of the needle for any year, at any place? If not, what are the variations for January 1, 1872 to 1877? 7. If the yearly difference varies, what is the rate of variation? 8. What are the extremes of the variation east and west, what is the length of time between them, and when will the next extreme be reached? 9. Does the line of no variation extend around the earth? If so, does it all lie in a plane? Is this plane the plane of a great circle, and does the line joining the extreme northern and southern points of this great circle make a fixed angle with the axis of the earth, and if so, what is that angle? If the angle is variable, what is the rate of variation, and what is the angle at present? 10. Where does the line of no variation run on the surface of the earth at present, and what is its rate of progression at the equator? 11. What are the fusing and decomposing points of solidified nitrate of silver and nitrate of copper, or do they fuse before they decompose? Answer: 1. No. 2. No. 3. Extended observations would seem to indicate that there is no such place. 4. The yearly differences of many places, situated on lines of equal variation, are nearly the same. 5. If you mean by this the general law, probably there is none, as the magnetic variation is affected by climatic influences, and other variable elements. 6 and 7. Empirical formulae have been established for various stations, based on a number of observations, but it is not certain that they are correct. In New York the annual variation seems to increase or diminish at the rate of one minute in ten years. 8. This is by no means accurately determined. 9 and 10. There appear to be two zones, or lines of no variation, one in America and the other in Asia. Neither line lies in a plane. 11. Nitrate of silver is fused at 450° Fahr., without decomposition. Nitrate of copper decomposes before the melting point is reached.

J. P. asks: 1. Can one or two spinning jennies or mules be profitably operated by gin gear, so that any farmer who has the means may spin his own cotton before it leaves the gin house? In other words, can one or two such machines be worked economically? 2. How many spindles are run by one frame, and what is the cost per spindle, or what is the cost of all the apparatus necessary to convert the lint into thread? Answer: 1. Probably not as economically as they are used in a large manufactory. 2. You had better address a dealer.

P. F. D. asks: If a model bridge 10 feet long bears 150 times its own weight, will one 100 feet long (having all its dimensions correspondingly increased) bear 100 times its weight, supposing both to be equally well constructed? You say that models are generally stronger than structures; is this because they are better built, or why? Answer: It does not follow because a model bridge of 10 feet will support 150 lbs., that a bridge of ten times the length and ten times the size in its parts will support ten times that load. Models of bridges are generally stronger in proportion than large structures because the materials are subjected to less proportional strain. The load that a bridge can sustain becomes less and less as the span is increased.

A. L. R. asks: 1. Are not inside cylinder passenger locomotives more expensive than outside cylinder engines, or why is it that so many more outside cylinder engines are now built in this country than inside cylinders? 2. What is the chief objection to inside cylinder engines? Answer: Outside cylinder engines are better adapted to sinuosities and irregularities of the track, which is probably the reason why they are so largely used in this country.

A. F. H. says: I have lately constructed an electric or telegraphic clock, and find difficulty in reversing the current. I employ platinum cups filled with mercury and platinum points for immersion. The platinum points will oxidize and, in course of time, stop connection. Is there anything to prevent this? Hard friction I cannot well employ. Answer: We know of nothing that will prevent the oxidation of the platinum points by the continual succession of electrical sparks. You might use a break in the form of a slider, as in Bala's electric clock. This slider is worked by the pendulum rod, and ought to offer little friction.

R. K. asks: Why does a locomotive engine cut her guides in running backwards, and not in running ahead, even in wet weather, so that it cannot be from dust arising from the ground? It is not from lack of oil. We have two engines that will do it nearly every time. Answer: We see no reason why this should occur in general. We infer from your remarks that such action only takes place in two of your engines; from which it would seem as if the trouble might arise from imperfect fitting.

J. W. asks: 1. When, where, and by whom was lead ore first discovered? 2. Has volcanic action anything to do with the formation of true fissure veins? Answer: Lead is one of the metals most anciently known, being mentioned in the books of Moses in the Bible. 2. Geologists do not agree in regard to fissures which now constitute veins. Some attribute them to unequal support in different parts of the same mountain, in consequence of which the unsupported part sinks; others ascribe them to drying and cracking of the strata; while others, and perhaps most at the present day, declare their origin to be due to earthquakes and subterranean fire or volcanic action.

G. H. W. asks: Are the very small wax tapers dipped, or run in molds? Answer: They are cast in molds.

G. W. H. asks: What acid will cover new cast iron with a thick coat of rust, in from 10 to 12 hours, so as to destroy its porosity? How strong should it be used? 2. Is it possible to force water from a boiler up and into radiating pipes, if the pipes do not contain a vacuum? Answer: 1. Probably a solution of sal ammoniac will be the best thing to use. 2. We should suppose not, under ordinary circumstances.

C. asks: Is there any thing that will give sausage skins a sweet smell, as they are sometimes quite offensive? Could anything be made to give them the flavor of white wax? Answer: We would recommend packing your skins, fresh or immediately after pickling, in common molasses or a mixture of molasses and vinegar. Coating them with a thin film of wax might answer as regards the flavor, but would probably be too expensive.

M. J. F. asks: How can I color wax? I want to produce green, red and yellow, and also the intermediate shades, such as are used in the manufacture of wax flowers. The colors used must stand heat sufficient to melt the wax, in which I dip the molds to secure proper shape for leaves, etc. Answer: Stir into the melted wax the following pigments, in quantity until properly colored, thoroughly incorporating the ingredients. For green, Schwenfurfert green, the aceto-arsenite of copper. For red, vermilion. For yellow, chrome yellow. Use more or less coloring matter according to the shade required.

C. R. asks: How can I prepare the best and cheapest fireproof paint for wood? Answer: Soluble glass, sometimes called water glass, makes a good fireproof varnish. You might use other or other pigment to give body. To make soluble glass: fuse together 1 part silica (fine white sand) and 2 parts carbonate of soda. Use boiling water as a solvent.

A. B. says: I claim that the Monitor was the first turret ship ever built. A party claims that the first one was built in England. Answer: We think you are right, although it is claimed that several models for this class of vessels had previously been made.

N. W. asks: 1. Is there any way in which water can be intermixed with coal oil, and stay mixed? 2. Can you tell me how to make lemon extract? Answer: 1. It is possible to make an emulsion or mechanical mixture of coal oil and water. Take any convenient quantity of coal oil, and add from 10 to 20 per cent of water, according to the specific gravity of the oil; the greater the specific gravity, the more water. Churn the two together thoroughly, by stirrers or beaters, adding during the operation from 2 to 5 per cent of the water used, of caustic lime. 2. Steep dried lemon peel in hot water; then filter the liquid and evaporate to dryness.

W. J. S. asks: 1. How can I tin a soldering bolt? 2. How can I make soldering powders? Answer: 1. Clean the bolt, heat it, apply nitric acid, and rub it on the solder. 2. Soldering powders are generally put up in different colored papers, white and blue. The blue paper contains 2 drams of the double tartarate of potassa and soda, and 2 scruples of bicarbonate of soda; and the white paper, 30 grains of tartaric acid.

H. S. asks: 1. How are brass castings bronzed? 2. How is brass purified in the crucible? 3. Can the metal be overheated in the melting? 4. What

metal will wear the best in fresh water on a screw wheel steamer outside bearing, 1 to 6 copper and tin, or 1 to 8 copper and tin? Answer: 1. Dissolve 2 drams of sal ammoniac and 1/4 dram of binoxalate of potash, in 14 ounces of clear vinegar; apply the mixture to the brass, first heating the latter slightly. 2. The impurities generally rise to the surface. 3. Yes, the zinc may be volatilized. 4. Probably Babbitt metal will do as well as anything.

T. C. E. asks: 1. How is shellac dissolved in borax to make the cement for amber? What will dissolve the gum of the peach tree? Alcohol will not. Water will only soften it. 2. How is Indian ink made? 2. Can you give me the algebraic formula for finding the area of a pipe to convey the steam necessary for any horse power? 4. Please give me a formula for finding the power exerted by a given bulk of water, having a given depth, on a suction water wheel of a given diameter. 5. To raise any given amount of water to a given height, what proportion of applied power does a centrifugal pump require, as compared with any other pump? 6. How can I temper brass springs? Answer: 1. Shellac and borax are both solids. Probably either will dissolve the gum you speak of. 2. Indian ink is mostly, if not entirely, manufactured in China. It has been analyzed, and appears to be composed of lampblack and animal glue. 3. See article on efflux of steam, page 115, current volume. 4. We do not understand what you mean. 5. It depends on the height to which the water is to be raised. Within certain limits, the centrifugal pumps are more economical than a direct acting steam pump. 6. By hammering them.

S. W. asks: 1. How many square feet of canvas will give a horse power on sailing vessels? In using windmills on land, does it require a much larger number of square feet of surface to average a horse power than on the water? When the windmills are placed in a favorable position, how many feet of surface are required to give a horse power? 2. At what angle should the sails of a windmill be set to give the best results? 3. Why do not the mechanics often use wind power? 4. Where does the common house fly have its nest or breeding place? 5. In Georgia there is a small fly which gets into a person's eyes and ears, and, in this wet season, a great annoyance. It is very small, has a yellowish body, and does not bite, but it will go right into the eyes or ears; a very little wind will drive it away. Where does it multiply? Answer: 1. The force of the wind in pounds per square foot, as given below, approximately for different velocities:

Velocity in miles per hour.	Force in pounds per square foot.
1	0.005
2	0.009
3	0.015
4	0.022
5	0.030
6	0.037
7	0.045
8	0.053
9	0.061
10	0.069
11	0.077
12	0.085
13	0.093
14	0.101
15	0.109
16	0.117
17	0.125
18	0.133
19	0.141
20	0.149

2. This depends on the relative velocities of the wheel and wind. 3. They could, if the wind would accommodate itself to their wants. 4. In cracks or crevices. There are so many varieties of flies that we could not attempt to describe them. 5. We cannot tell.

J. A. M. asks: How do electricians calculate the resistance on a telegraph wire, and how do they determine where a rupture has taken place? Who is the best author on the subject? Answer: To ascertain where a break has occurred in a telegraph wire, the charge of electricity which the wire from either station will contain is first measured; and if the charge per mile is known, the amount actually observed will give the distance of the break. A galvanometer is used for this purpose. Consult Noad's "Electricity."

W. R. H. says: I wish to build a small steam boat, about 30 feet long and 5 feet wide. 1. What should be the size of her engine and boiler? 2. What should be the diameter and pitch of screw wheel? 3. What would be about the cost of her machinery, complete? 4. How many persons could she carry conveniently? 5. When loaded with as many as she can hold what would be her speed on still water? 6. Are there any regular builders of such small steamers; and if so who are they? Answer: 1. Cylinder 6 x 9, boiler with 125 square feet heating surface. 2. Diameter 2 feet pitch 3 feet. 3. From twelve to fifteen hundred dollars. 4. From fifteen to twenty. 5. Seven or eight miles an hour. 6. Yes. Insert a notice in our Business and Personal columns.

N. asks: Can you give me a delicate test for the presence of citric and tartaric acids? 2. Also the composition of the onion, and tests for the same? Answer: 1. Citric acid is frequently adulterated with tartaric acid. To detect this, dissolve the acid in a little cold water and add to the solution a little acetate of potash. If tartaric acid be present, a white, crystalline precipitate of cream of tartar will be produced on agitation. Citric acid is soluble in water and alcohol, and the precipitate from its aqueous solution, by acetate of lead (citrate of lead), is dissolved by nitric acid. Tartaric acid is slightly soluble in alcohol, and a solution of potash causes a white granular precipitate of cream of tartar, soluble by agitation in excess of the precipitant. 2. Onions contain gum, sugar, and an oil containing sulphur.

M. B. asks: What are the ingredients of vulcanized rubber, and their proportions? Answer: Vulcanization of rubber is effected by combining it with sulphur or the mineral sulphurets. The process is differently conducted in different manufactories. Casot-choue combines with from 12 to 15 per cent of sulphur, and vulcanization can be effected by dissolving the rubber in naphtha, charged with a sufficient quantity of sulphur to become a compound solvent of the rubber 10 to 12 per cent of its weight of sulphur is then added to the naphtha paste and thoroughly incorporated. The article is then molded into any form required. The temperatures for vulcanization by the common method range from 320° to 350° Fahr.

J. C. G. asks: Can you tell me of a good elementary book upon electricity, and a good practical and scientific work on telegraphy? Answer: Apply to any good bookseller for Noad's book on electricity, and for Pope or Culley on electric telegraphy.

G. F. asks: Is there an instrument for finding buried gold and silver? Answer: No.

F. S. asks: How can I galvanize, or tin, or otherwise make brilliant and rust proof, a flat polished surface of cast iron? Answer: Dip the plate first into muriate of zinc, and afterwards into a tin bath.

P. S. A. asks: How do lapidaries drill quartz and hard stones? What kind of tools do they use? Is any kind of grit or quartz required? Answer: They ordinarily employ steel drills, with either diamond dust or the dust of the stone that is to be drilled.

P. C. C. asks: 1. By what rule (if any) can I determine the power per square foot of a river current? 2. How large a paddle wheel do I need to place in a current running three miles per hour, to obtain 10 horse power? 3. Is there a better than the paddle wheel for use in a current? Answers: 1. The theoretical power per square foot of a river current is found by multiplying the discharge in pounds per square foot per minute by the velocity in feet per minute, and dividing by 33,000. 2. Make the wheel so that it will have at least two floats in the water at a time, exposing about 13 square feet of surface to the current. 3. We think not.

H. B. B. asks: 1. In driving electro-magnetic engines, is intensity of current, or quantity, required? 2. What is the most powerful electro-magnetic engine known, and on what principle is it constructed? 3. Has any electro-magnetic engine been constructed for driving small machinery economically? 4. What is the most constant cheap battery manufactured? 5. What is the chief difficulty in the general use of electro-magnetic engines? Answers: 1. Both intensity and quantity are required. 2. Professor Page, in 1850, constructed an electro-magnetic engine, of between 4 and 5 horse power, which was exhibited at the Smithsonian Institution. It worked upon the principle of the attraction of a helix upon a piece of soft iron suspended vertically in it. Other machines have been made upon the principle of the attraction and repulsion of electro-magnets upon armatures of soft iron, made to revolve in front of them. Such machines are made to drive sewing machines. 4. Daniell's is a good constant battery. 5. The difficulties are the limited distance within which the magnetic attraction is practically exerted and the cost of maintaining the battery current.

S. A. W. asks: 1. When were the first United States postal cards issued for general circulation? 2. A few months back you told of a sure cure for rats made by mixing plaster of Paris and some other substance together. I want to find what the other substance is. 3. If a rat should be killed by that method, and get in between the walls, what would remove the smell? Answers: 1. In the early part of May, 1873. 2. Wheat flour. A very good rat poison is made by putting some phosphorus into flour paste, adding some lard and spreading on bread. 3. Probably nothing, except removal of the rat.

A. K. says: Beavers are building a dam in a stream which we have to ford, and the dam has backed the water up until the ford is three feet deeper than it was before the dam was built. Now A. contends that when the stream rises two feet, the stream at the ford will still be three feet deeper than it would if the dam was not there; I don't think it will. Which is right? The banks are, of course, supposed to be perpendicular. 2. What will cure the effects of poison ivy? It is very plentiful here, and some persons are affected so that their eyes swell till they are shut, and remain so for several days. 3. Is there any difference between poison ivy and poison oak? The kind that grows here is not a vine, but grows in dwarfish bushes six or eight inches high. 4. Is there any ink which will write jet black or bright blue, and, after a few days or weeks, disappear entirely? How can I make it? Answers: 1. As we understand the question, you are right. 2. The sublimate of bismuth is said to effect a cure. 3. We think not. 4. We do not know of any.

J. B. says: 1. Suppose I have a vertical cylinder, something more than two feet high, open at the top and fitted with an airtight piston of one square inch area. Let the piston be supposed to be without weight and capable of moving in the cylinder without friction, and let the cylinder be impervious to and destitute of capacity for heat. Further, suppose the piston placed one foot from the bottom of the cylinder, and the air at both sides of the piston to be of the same temperature and pressure; now if the air underneath the piston has its temperature raised 273° C., the volume will be doubled and the piston will be raised one foot. Again, let the original conditions be resumed, and let the piston be prevented from rising; on heating the enclosed air 273° C., its elastic force will be doubled. Let any further supply of heat be now withheld, and let the piston be made free to rise with merely the weight of the atmosphere to keep it down; it is evident the elastic force of the enclosed air will cause the piston to rise, so long as there is an excess of pressure underneath it; heat will be consumed in this operation, and the temperature of the air will fall, no heat being supplied from without. To what height will the piston rise, and what will be the temperature of the enclosed air? 2. Suppose I compress a quantity of air to a pressure of ten atmospheres, what would be its temperature? And after compression, if the air be cooled down to 18° C. and be then allowed to expand and perform work, what will be its temperature after expansion? Answers: 1. It would be necessary for us to know the original temperature of the air. You will find the whole question thoroughly treated in the late Professor Rankine's treatise on the "Steam Engine and other Prime Movers." 2. You do not say how much you propose to expand the air.

S. M. S. asks: What will kill roaches immediately? I have been feeding them with strychnia for a week, and their sanitary condition is greatly improving. Answer: If the poison alone is not sufficient for their extermination, you should try something more efficacious. Phosphorus paste is recommended.

S. J. J. says: There is a leak, under heavy pressure, at the lower end of the water column of a mining pump. Suppose the leaking to be π gallons per minute; is the loss of power as great as though the same quantity escaped from the upper end of the column and fell back into the main? Answer: Yes, if the pressure under which the water escapes is the same as that of the water that is elevated.

C. M. N. says: The dates on worn coins can be read by heating to a dull red and dropping into cold water. The letters and figures will appear black, and the plain parts white. If they do not show brightly, try at a different redness. A piece of coin, hammered perfectly flat and smooth, will show plainly. I think the reason that a worn coin will show is that the coin is pressed, and of course the raised parts are softer; and the heating and sudden cooling has a different effect on the parts. Another reason is that coins do not wear perfectly flat; the raised parts are still slightly elevated, although they do not show.

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

J. H. M., of L. I., describes certain growths, asking what they are. Answer: Numbers 1, 2, 3, represent a very common fungus called *Uromyces mucosus*. It belongs to the same family of parasitic plants as *Uromyces glaucum*, *Uromyces graminum*, *Uromyces aspidium* and others. The fact that the rain water was filtered and placed in a tightly corked bottle does not prevent their growth; because the germs from which they originate are pres-

ent in the air enclosed in the bottle and in the water itself. If the water were first boiled and then sealed up free from air, no fungus would grow. From the description given of No. 5, the object appears to be a crab which frequents fresh water pools, by name *macrura*, belonging to the general order *Decapoda*. No. 4 is a bud of the sweet pepperbush or white alder, the *clethra alatifolia* of Linnaeus. It is a shrub, from three to ten feet high, growing in wet copses, from Maine to Virginia, near the coast. In July and August, it is covered with handsome fragrant blossoms.

A. S.—Potter's clay, but not perfectly free from uncombined silica.

COMMUNICATIONS RECEIVED.

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

On Butter. By J. A. V.
On Railway Religion. By J. P.
On Tracks in Sandstone. By A. M. B.

Also enquiries from the following:

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

Correspondents who write to ask the address of certain manufacturers, or where specified articles are to be had, also those having goods for sale, or who want to find partners, should send with their communications an amount sufficient to cover the cost of publication under the head of "Business and Personal" which is specially devoted to such enquiries.

Correspondents in different parts of the country ask: Where can I obtain a lead-burning apparatus? Which is the best college where to study architecture? Who makes heavy spiral springs? Where can I get head-stocks for lathes? Makers of the above articles will probably promote their interests by advertising, in reply, in the SCIENTIFIC AMERICAN.

[OFFICIAL.]

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October 21, 1873,

AND EACH BEARING THAT DATE.

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APPLICATIONS FOR EXTENSIONS.

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

26,902.—PLANTING MACHINE.—S. H. Gray, January 7.
26,906.—STITCHES.—A. F. Johnson, January 7.
26,914.—CLOTHES WRINGER.—R. O. Meldrum et al. Jan. 7.
26,919.—REPEATING FIRE ARM.—W. H. Morris et al. Jan. 7.
26,942.—CAR SEAT.—T. T. Woodruff, January 7.
26,948.—SEWING MACHINE.—A. F. Johnson, January 7.
27,008.—FINISHING BOOT HEELS.—H. Saloshinsky, Jan. 14.

EXTENSIONS GRANTED.

25,874.—BRONZING MACHINE.—G. H. Babcock.

DESIGNS PATENTED.

6,962.—GRAPE ARBOR.—C. H. Crump, Boston, Mass.
6,963.—CLOCK PENDULUM.—H. J. Davies, Brooklyn, N.Y.
6,964.—BREAST PIN, ETC.—G. W. Loomis et al., N. Y. city
6,965.—COOKING STOVE.—E. Mingay, Boston, Mass.

TRADE MARKS REGISTERED.

1,293.—SAUCES.—A. P. Arreeta et al., New York city.
1,504.—RAZORS.—H. Baker & Co., New York city.
1,505.—RUBBER GOODS.—M. A. Catey, New York city.
1,506.—CHAMPAGNE.—Chillingworth & Son, London, Eng.
1,507.—UMBRELLAS.—A. M. Davies et al., New York city.
1,508.—CANNED FOOD.—Gordon & Dilworth, N. Y. city.
1,509.—OATMEAL.—J. McEann, Beaumont Mills, Ireland.
1,510.—SNAP HOOKS.—New York Wire Snap Co., N. Y. city

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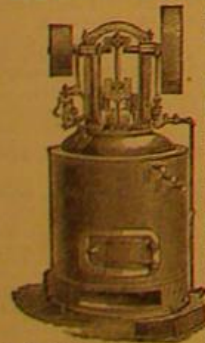
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IN ADVANCE.

THE K. M. I. STEAM ENGINE.

The principal feature of the novel form of steam engine illustrated here-with, to which the attention of the reader is directed, is the valve, which is equally well adapted to either double or single machines. The double cylinder engine is constructed with cranks at right angles, has no dead point, and consequently requires no fly wheel, the leverage varying between one and one and a half cranks, nearly. The valve is actuated by bevel gearing communicating with similar mechanism on the main shaft, which may be in the center, or on the outside of the bed plate as represented in the perspective view, Fig. 1. To this portion of the apparatus, however, more particular reference will be made hereafter.

Fig. 2 is a section of the steam chest, A, valve, B, cut-off plate, C, and valve seat, D. The valve stem, it will be noticed, carries a bevel cog wheel above the steam chest, and is held in a suitable frame. The direction of the live steam is indicated by the bent arrow, at E, and the course of the exhaust by similar means at F. Proceeding to the consideration of the various portions in detail, we represent in Fig. 3 the bottom of the valve, B. G

is the dome which, as already indicated, opens into the live steam port, H, which is cut to one eighth of the circle; I is the exhaust aperture, cut to three eighths, whence the steam passes into the steam chest, as before noted, at F, Fig. 2. Around the dome, G, is formed a short cylindrical rim which passes down through the cut-off plate, C, and into the valve seat, so as to hold the valve in place. The arrow drawn beside Fig. 3 shows the direction of the rotation of the valve. In Fig. 4 is depicted the variable cut-off plate, C, which is a thin disk of metal; in it are four openings, which correspond with similar apertures, each equal to one eighth circle, in the valve seat, Fig. 5. These orifices embrace the stops, J, Fig. 5, which are pieces of metal secured to the valve seat and of the same thickness as the cut off plate. The object of these stops is to prevent the movement of the plate from affecting the points of admission of steam into the cylinders. The plate is controlled by the governor by means of suitable mechanism connecting with the cogged octant, formed at its circumference and fitting in a recess in the side of the steam chest. It is stated that the governor adjusts the cut-off, by moving the plate, with the greatest ease, the valve gliding over the latter with very slight friction.

The valve seat, as shown in Fig. 5, is pierced for a double cylinder engine. The openings, 1 and 3, connect with the right cylinder, and 2 and 4 with that on the left, the steam ways crossing, as indicated by the dotted lines. The valve moves over the seat in the direction of the arrow, Fig. 5, which, as before noted, is pierced for a fixed cut off at half stroke, since one eighth passing over one eighth gives one quarter revolution or one half stroke; while, as the exhaust port is cut three eighths of circumference, necessarily three eighths passing over one eighth gives one half revolution, or full stroke for exhaust.

According to the inventor, this valve is capable of these modifications as follows: First, the valve constitutes the steam chest, the steam taking the ordinary course, the live steam port connecting with the steam chest and the center dome connecting with the exhaust port, which

opens downward only, the joints being visible and showing any leak that may exist.

In the second, the course of the steam is reversed; the live steam port of the valve opens into the center dome. The exhaust port, opening upward, discharges the exhaust steam into the steam chest above the valve. This modification is already described and shown in Fig. 2.

In the third plan, a part of the top of the steam chest is attached to the valve stem, in surface slightly less than the bottom of the valve, producing a balanced valve, the top

works a similar wheel, L, upon the rod which connects with the valve gear. Between the wheels, K, and sliding loosely upon the shaft, is a sleeve forming a clutch which may be brought into action, as plainly indicated, with either. The sleeve, although moving freely along the shaft, is rigidly connected with it by a feather and slot, so as to partake of its rotary motion. It is evident, therefore, that the wheel, L, thus receives its motion from but one wheel, K, while the other is inoperative, and hence, as is evident from the arrangement of the gearing, may, by altering the position of the sleeve, be caused to rotate always in the same direction.

The claims of the inventor regarding the merits of his device, advantages which we learn secured for it much attention and favorable comment at the recent Louisville Exposition, may be briefly summed up as follows: That, in dispensing with the fly wheel and the eccentric, and in the free movement of the valve, there is a saving of a great part of the resistance arising from the moving parts of the engine itself. That the double engine costs no more, and the single engine less, than the common non-cut-off engine of the same power. That in economy of steam, and consequently of fuel, it accomplishes all that engines of the highest grade can accomplish, while it is remarkable for simplicity and cheapness of first cost. That it cannot get out of order except by breakage or wear of parts, and can be managed by an unskilled hand. The valve, it is also stated, can be attached at small expense to engines now running, giving them the fixed and automatic cut-off, with a saving of half the fuel for the same amount of work. The double engine, it is believed, has peculiar adaptation to road steamers, steam plows, etc.

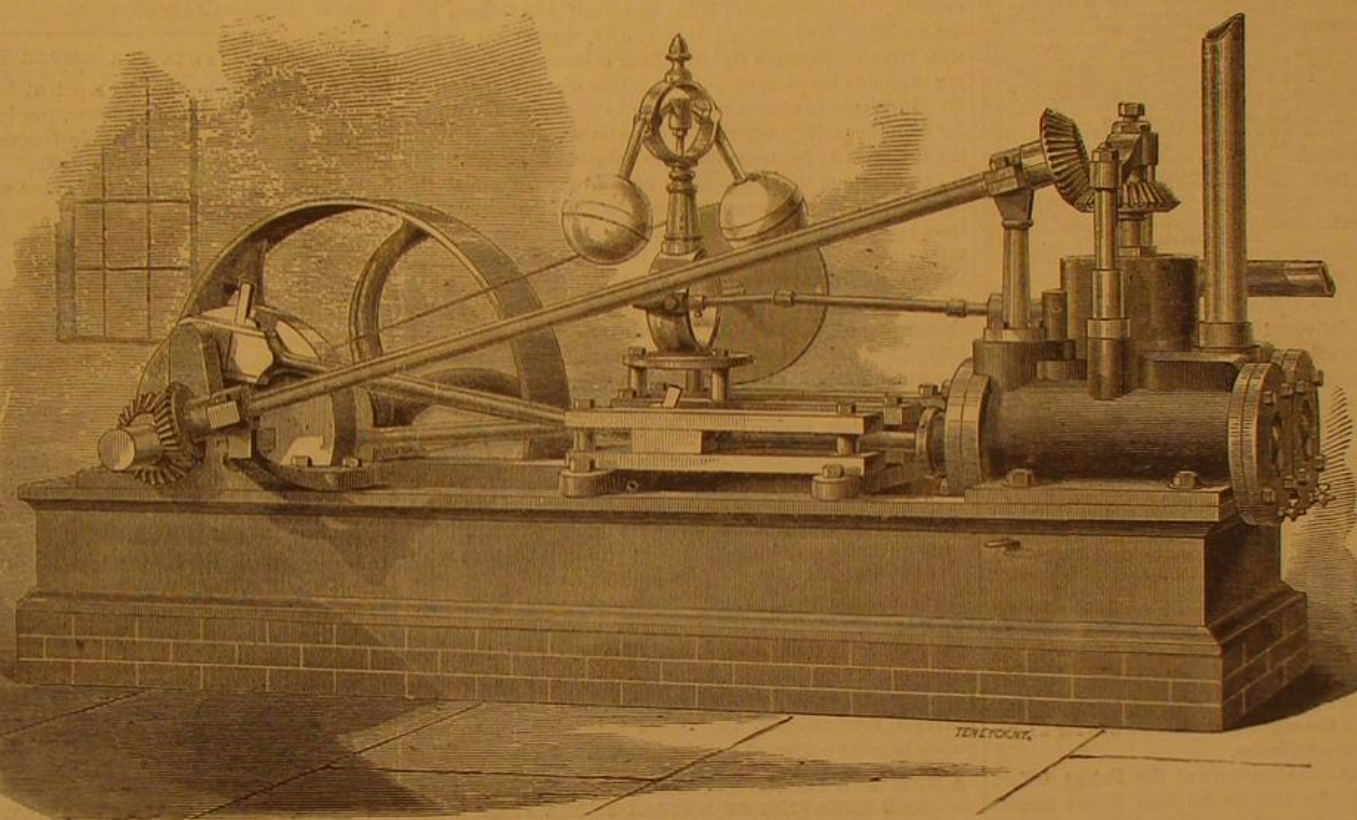
Our engraving is taken from a photograph of this form of the machine, as exhibited at the above mentioned exposition.

Patented September 9, 1873. For further information address the inventor, Colonel R. T. P. Allen, Superintendent Kentucky Military Institute, Farmdale P. O., Franklin county, Ky.

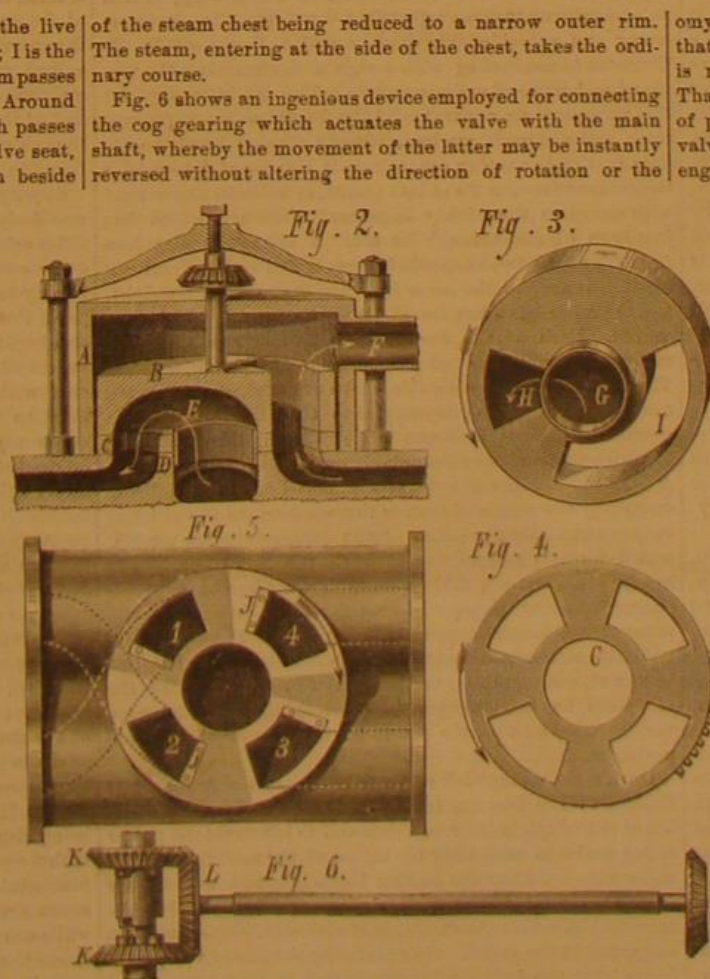
The Cotton Window in the Guildhall, London.

Mr. W. J. Cotton, a London merchant, and an alderman, has recently presented to the city a stained glass window, in commemoration of the troublous times of the scarcity of cotton during our late civil war, and the generosity of the Londoners in aiding the Lancashire operatives. Alderman Cotton was a zealous worker on behalf of the relief fund; and if, by accident, the memorial window perpetuates his own name, no one will grudge him the distinction.

The window illustrates the cotton plant, in the different stages from its growth to its final application to clothing, by twelve medallion pictures, showing sowing, growing, picking, packing in the field, loading at New Orleans, at sea in an American clipper, discharging in the London Docks, carting, in transit on the rail, the Manchester Piccadilly (the Cottonopolis), manufacture in cotton mill, and wearing, the last named being a family group. The color of the groundwork is lavender; the borders are ruby, with an amber ribbon; the designs are filled in with ruby, amber, and lavender, the gothic scroll work being brownish white.



THE KENTUCKY MILITARY INSTITUTE STEAM ENGINE.



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THE VALUE OF PATENTS.

A recent number of the *Official Gazette* contains a full report of the address delivered by Mr. J. M. Thacher, our present Assistant Commissioner of Patents, before the so-called Patent Congress, at Vienna, last summer. In this effort, Mr. Thacher begins at the beginning, avers that invention is "the product of the highest faculties given by God Almighty" to man, and therefore ought to be secured to him by letters patent. He declares that man has a more valid right to the exclusive possession of his inventions than even to his landed estates, and perceives no obligation on the part of the inventor or discoverer to disclose new knowledge to others, unless permitted to control and use that knowledge as he would other property. Having strongly insisted upon the correctness of these propositions, which by the way are at variance with the teachings of the wisest philosophers, he next proceeds to show that this inventive property, these natural rights of the inventor, ought by law, to be taken away from the originator after he has for a limited period enjoyed their possession.

In relation to official examinations at the Patent Office, our author is of the opinion that the inventor, whose mental genius and discernment are eloquently lauded throughout the address, is incompetent to examine the novelty of his own invention, and determine for himself whether it is worth his while to pay in the official fees and take out a patent. Nor is the inventor's attorney qualified to solve this momentous question. It should be left, Mr. Thacher says, to a corps of scientific experts; but, as he thinks they may be liable to err, he suggests that there ought to be another set of experts to re-decide the decisions of the first experts. This, in fact, is the way the thing is done at Washington. One hundred of these scientific gentlemen, aided by four hundred clerks and helpers, all of whom are supported at the expense of the inventors, now officiate at the Patent Office, but Mr. Thacher wishes to increase the number. "Unfortunately," he says, "it is the pocket that controls men, more or less, in every station and in every country." It is indeed a misfortune for our inventors that their pockets are obliged to control and supply so large a number of examining officials. Save us, we say, from any increase. We are glad to turn from the mazes of the metaphysical portion of the Assistant Commissioner's address to that branch which relates to the practical results and values of inventions, for here we find information, useful and interesting to everybody. He says:

"The number of patents granted since 1836 is about 140,000. The number of applications for patents has steadily increased from year to year, until it now averages from 20,000 to 21,000 per annum, and the number of patents granted annually is from 13,000 to 15,000. To perform the work of examining this large number of applications, the corps of expert examiners has been increased from time to time, until it now numbers about 100—to wit, 24 principal examiners, and the same number of first, second, and third assistant examiners, together with a special examiner of trademarks and also of interferences. The clerical force has been correspondingly increased, so that officials of all grades now employed in the Office may be stated in round numbers as about 500.

The bare statement of the number of patents granted since 1836 is sufficient to bear me out in the statement that our system has proved to be a most remarkable stimulant to inventive genius, not only in our own country, but throughout the world. But you will very naturally inquire. How many of these patents are valuable? Of course it is impossible to obtain statistical information that shall be entirely reliable on this point, but my official experience has given me such data that I am enabled to form an opinion approxi-

mately correct. I have discussed the matter with others, and have sought information from manufacturers, patentees and legal gentlemen who have made a specialty of the practice of patent law, and I think I do not exaggerate at all when I say that one half of the patents granted in our country may be considered remunerative. Now I do not wish to be understood by this that one half of these 140,000 patents have brought fortunes to the pockets of the patentees. They have become remunerative to a certain extent—that is, they have paid expenses and something more. A small proportion of them have become largely remunerative, and the patentees, or their representatives, have obtained large fortunes from them. I think, therefore, it may be said that the influence of our system upon inventions and inventors themselves has been beneficial beyond all expectation.

But you will also ask: What has been the influence of our patent system upon the manufacturing interests of our country? I have taken occasion to make some inquiries upon this point also. A short time before I left Washington the Secretary of State sent out, to inventors, manufacturers, and others interested in patents, a series of inquiries, among which were some as to the influence of our patent system upon the manufacturing interests of the country. With scarcely an exception, so many of our manufacturers as responded answered that the patent system was beneficial, beyond all manner of doubt, to the manufacturing interests of the country. It is estimated, both by myself and others who are qualified to judge of this matter, that at the present time from six to seven eighths of our enormous manufacturing capital is based upon patents, either directly or indirectly. In fact, it is almost impossible to organize a company for manufacturing purposes in America without first securing the control of patents for some valuable invention.

I think, then, that we may be said to have reached this conclusion, that our inventors, patentees, and manufacturers have all benefited greatly by our patent system. At the same time the public welfare has been greatly promoted by the general introduction of many valuable inventions, which otherwise would have remained undeveloped, and by the cheapening of many articles by the invention of new and improved modes of manufacture. At the same time we believe the whole world has been benefited by the liberality of our law. We make no distinction between foreign and native applicants, but invite inventors from the whole world to give us the benefit of their inventive genius upon the same liberal terms that we grant to our own citizens, putting upon them no restriction as to time or place of manufacture, or introduction of the invention into public use. * *

Let me express the hope that you will not adjourn without establishing a permanent committee as the representative of this congress, so that an organization may be created by means of which the discussion of this subject may be continued from time to time until, finally, civilized governments shall become convinced of the righteousness and expediency of the principles here advanced, and there shall be universal recognition of the rights belonging to, and the public benefits conferred by, the inventors of the world."

A NEW AND IMPORTANT DISCOVERY RELATING TO THE BEHAVIOR OF METALS UNDER STRESS.

In calling attention recently to the original investigations in progress at the Stevens Institute of Technology, it will be remembered that we referred in some detail to the interesting and valuable experiments which Professor R. H. Thurston is conducting with a view of determining the torsional resistance of various metals. The machine used for this purpose is an apparatus of the Professor's own invention; and although we have already alluded briefly to its construction in another connection, it may be of interest for the reader to review its salient points, in order to understand with clearness the highly important discovery which has just been effected through its aid. A triangular cast iron frame supports two suspended arms which swing about independent axes in the same line; one arm carries a weight, and the other has a handle at its extremity, by which it is moved. Each of the axes has a rectangular recess, in which each end of the test piece, previously squared, is fitted. The frame carries also a guide curve of metal, so constructed that its ordinates are proportional to the twisting moments exerted by the weighted arm while swinging through an arc to which the corresponding abscissas are also proportional. A pencil holder bears against the guide curve; and being carried by the weighted arm, is thrown forward as the latter swings out under the action of the force producing torsion, which force is transmitted through the test piece. The handle arm carries a table upon which a piece of paper is clamped, so that the pencil traces thereon a curve, the ordinates of which are proportional to the torsional movements, while its abscissas represent the relative motion of the two arms and, consequently, the amount of torsion to which the test piece has been subject. This line, therefore, gives a very legible and accurate record of the results of each experiment.

During the recent visit of the members of the Academy of Science to the Stevens Institute, Professor Thurston took occasion to explain his researches and to illustrate the power of his device in exhibiting the action of the molecular forces under stress. After the session had adjourned, a test piece was left in the machine under heavy strain, in order to determine if possible the existence of viscosity, which had been suspected in the metal. On examining the piece twenty-four hours later, the investigator discovered, to his surprise, that not only could no evidence of yielding be detected, but that, on his attempting to produce further distortion, an even greater resistance was offered than when the first stress was applied. The curve traced by the pencil, instead of being coincident with the line previously described, became paral-

lel therewith, and some twenty per cent higher above the axis of abscissas.

Repeated experiment has confirmed this remarkable discovery, and Professor Thurston considers that he has substantiated the fact that metal, strained so far as to take a permanent set and then left under the force-producing stress, actually gains in power of resistance up to a limit of time, which in these experiments was about seventy-two hours, and to a limit of increase which has a maximum, in the best irons, of about twenty per cent. We need hardly point out the importance of this conclusion, which, though it has been suspected for some time by many engineers and men of science, is now for the first time definitely proved. The result is of course negative, and necessarily completely upsets the common notion that metal continuously strained beyond its limit of elasticity loses its strength.

We understand that further experiments will be speedily made, so that we hope to be enabled before long to lay before our readers more detailed information, together with copies of curves and other interesting results obtained. We note with pleasure that numbers of specimens of cast, wrought, and malleable iron, steel and many other varieties of metal, are being sent to Professor Thurston by prominent manufacturers in all parts of the country; so that the coming investigations bid fair, not only to add greatly to the already well earned reputation of their author, but largely to the knowledge of the scientific professions.

PATENTS FOR SIMPLE THINGS.

In a recent application for a patent for an improvement in attaching metallic heels to boots, the invention consisted in extending the outsole the whole length of the boot and in fastening the heel upon such outsole. The application was rejected for the reason that it was not new to carry back the outsole as described, nor was the heel new; therefore the attachment of a heel to such sole was not an invention, though the ordinary method was to attach the heel to the insole, the outsole being only extended up to the heel. The applicant appealed to the Assistant Commissioner of Patents, who reversed the decision of the Board of Examiners, and held that, however small or insignificant an invention appeared, it ought to be patented if useful. In this case, the attachment of the heel to the outsole made a firmer fastening for the heel, was better than the common plan, and therefore patentable. This is good doctrine; and if the Patent Office would only stick to it and carry it out into practice with uniformity, the interests of inventors would be greatly promoted. But, unfortunately, the decisions of the Patent Office are irregular. It too often denies on one day what it grants the next day. We cannot always rely upon the Office to issue patents for simple improvements, like roasted persimmon seeds, a knot upon the thread of an envelope, or, as in this case, nailing a heel upon the bottom of a boot. Yet it is for the issuing of patents upon just such simple improvements that 100 principal examiners and their 400 helpers are thought by some people to be necessary, and for whose support inventors are taxed.

BOSTON REBUILT.

Just one year has elapsed since the occurrence of the disastrous conflagration which laid one of the fairest portions of the city of Boston in ashes. Sixty-five acres constituted the extent of the burned district; 776 buildings were consumed, and an aggregate total of \$75,000,000 lost. The destroyed edifices were insured to the amount of \$56,000,000; and of this sum \$34,000,000 has, it is stated, been paid, although twenty-six Massachusetts insurance companies have failed in consequence thereof.

Shortly after the calamity, a building act was passed, which was designed to provide in a measure against similar casualties arising from like causes. This law forbids mansard or other roofs being more than one story high or more than twenty feet above the upper floor of a building, unless fireproof throughout. Bay windows are not to be constructed at a height exceeding three feet above the second story. Exteriors of structures above forty-five feet high must be covered with incombustible material; if over sixty feet, they must be fireproof. The limit of height of buildings is fixed at seventy feet, and party walls bounding lofty roofs must be carried at least two and a half feet above the same, and be corbelled and coped with stone or iron. With these regulations in force, and with the teaching of experience before them, the citizens have proceeded with the rebuilding of their ruined edifices; and as a result, structures have been completed and are still rising which, it is believed, will not succumb even before a repetition of the great fire.

The burnt section included 31 streets, 8 places, 5 squares, and 1 court; in reconstructing which 17 streets have been widened, 4 extended, and a large square laid out, at a total cost to the city of over \$5,000,000. The general plan of the streets is little altered; 365 buildings have been erected or are in progress, of which 115 are finished and occupied, 10 unoccupied, and 240 uncompleted. Among these, there are but 72 mansard roofs against 264 flat roofs, the former being either wholly of brick or iron, or else covered entirely with fireproof material. The majority of the edifices are of four stories, there being but two, one of six and the other of seven stories, exceeding this height. The external and party walls are all 20 inches thick to an elevation of two stories above the street, and 16 inches thence to the roof. The "fire walls" which surmount the party partitions are of the height above noted and 12 inches through. Galvanized iron is largely used for cornices, and, with cast iron, for exterior finish. The total cost of the completed buildings is \$3,762,500 and they cover 1,192,918 superficial feet of ground.

As regards architecture, we learn that many of the edifices

will be of exceptional beauty and magnitude. The majority are of the modern gothic order, and much ingenuity of design is manifested in constructing the flat-roofed buildings so as to avoid the unfinished appearance incident to the abrupt termination of the façade. Three great structures are to be erected by the New York Mutual Life, the New England Mutual Life, and the Equitable Insurance, companies, which are to be of magnificent design, and, with the new Post Office and Rialto building, are to be completely fireproof throughout. There are also a number of warehouses and other mercantile edifices, which in many instances are more spacious and elegant than those which they have replaced.

The same energy which has made Chicago rise from a heap of ruins into a grander and even more magnificent city than before, has within the short space of a year blotted out the recollection of an almost overwhelming disaster, by labor which seems all but Herculean. Hardly had the story of the calamity ceased to be the current topic of thought before workmen were busily laying foundations, and this in the face of losses which dealt a blow to the entire business community of the nation. Not only the people of Boston, but of the whole United States, may well be proud of such indomitable enterprise. It adds but another proof, to that already shown by our unfortunate war, that in this country we know neither the extent of our energies nor of our resources, until the same are put to the trial which demands their strongest action.

PHYSICAL AND MENTAL OVER-CULTURE.

A noted British novelist, now on a visit to this country, in one of his most popular narratives, exemplifies the case of an athlete who, by a severe course of training, has brought himself to a high state of physical perfection, in order to compete in the lists of a foot race. When the time arrives for the test of his powers of endurance, the runner begins his task; but ere he can reach the goal, his overtaxed system gives way, and he falls stricken with paralysis, a hopeless bodily wreck. Instances of similar kind in real life are but too common. The death of the celebrated oarsman Renforth while at the thwart is still within public recollection, and the decease of Heenan, the once famous pugilist, is a more recent exemplification of the retributive action of Nature when the laws by which the confines of the possibilities of human muscular effort are transgressed.

A man's body may be compared to a finely adjusted and accurately balanced steam engine, and his vital energy and mental power to a constant motive force acting upon a uniform area of piston. It needs no demonstration to prove that an engine has a certain fixed capability; it can develop so many horse power, and then reaches its limit. If we make more ponderous wheels or stronger rods and shafting, equal to the performance of much more arduous work, and then expect that the same power, merely by operating such heavier machinery, will produce increased results in overcoming greater burdens, common sense tells us that we look for an impossibility. And yet this is precisely what we seek to accomplish by causing exaggerated muscular development. We destroy the equilibrium of the machine; and as a result, the action of the power by which it is set in motion is either weakened or arrested. The physical seats of vital energy in the human frame are in the so termed vital organs: as in the overtaxed steam engine the molecules of vapor dash and expend their force against the piston unproductive of any motion, so in the body; one part (the heart) unable to drive the increased flow of blood required for the augmented needs of other members, becomes overwrought and eventually diseased; the lungs, equally unable to maintain the process of burning up the effete matter poured into them by the veins, degenerate and waste away; and the brain, failing to establish the connection between motor nerves and will, shatters by paralysis the delicate mechanism. All, in fine, are causes which as surely arrest the motion of the human machine as does the load beyond its powers that of the apparatus of iron and steel.

The case of Heenan illustrates these truths perhaps as forcibly as any that can be cited. The man was a model of physical perfection, not ponderous in build or gigantic in frame, but to all appearances one in whom the parts of the body, while cultivated to their full extent, remained in statuesque symmetry. And yet despite the capacious breast and broad shoulders—points in themselves supposed to indicate almost unlimited strength of lungs—these last mentioned members, in the constant strain upon the system, proved unequal to their task, and fell prey to the wasting and insidious disease which resulted in death.

While, with such evidence as this before us, the tenets of the ultra advocates of "muscular Christianity" may well be questioned with reference to the benefits derivable from the attainment of a so called high physical condition, on the other hand, it is true that no less dangerous results are to be apprehended from the converse practice, the development of the mind at the expense of the body.

Again referring to the steam engine for a simile, let us consider the consequence, supposing that working parts and load remained constant, of our crowding into the cylinders an enormous steam pressure. Manifestly there would be either a much more rapid wearing out of the machine, caused by the overwhelming power, or more probably the complete breakdown. Thus it is with the individual who, by excessive study and brain work, overweighs the balance in the contrary direction, and, by neglecting to maintain the equilibrium of mind and body, succumbs to the impoverishment of his physical system. Illustrations in point are to be found among the members of every profession,

among the students of every institute of learning. Young men, ambitious to gain scholastic honors and spurred on by the applause of preceptors and friends, too often find failing health and despondent spirits the precursors of permanent bodily infirmity, induced by overstrict application, too many hours of study, absence of simple and nourishing food, and neglect of wholesome exercise. Undeterred by premonitions of Nature, toward the close of their course, in order to reach a coveted prize—as valueless to them in after life as it is intrinsically worthless—they tax their energies beyond their powers of endurance. Then, as the runner in the race or the oarsman at his oar physically breaks down at the moment of trial, so the overworked brain succumbs when it is subject to the final strain. The student, whose hollow eyes, pale face, and wasted form denote nights of unvaried toil, finds his powers inadequate to do him justice, and his memory fleeting at the hour when he desires their firmest aid; and he endures the bitter experience of seeing others, intellectually beneath him but physically his superiors, withstand a trial before which he fails.

Study is to the mind as exercise is to the body; both alike act as developing powers, but neither body nor mind can be carried to a relative excess of cultivation except at the expense of the other. "*Mens sana in corpore sano*" does not refer either to pundits or prizefighters. It means a mind well balanced, well organized, and varied in ability, coupled with a body healthy, vigorous, and strong—the one capable of grappling with the highest thoughts and ideas, the other with the deepest ills and obstacles incident to every walk in life.

BOILER EXPLOSION.

While a commission of scientific experts are busily engaged in expending \$100,000 in discovering the occult causes of boiler explosions at one extremity, comparatively speaking, of this city, at the other end of the town a body of laborers, headed by an engineer, endeavor to lift and transport a steam boiler (with a blazing fire under it and subjected to a heavy pressure of steam) by means of crowbars placed underneath. As a result of which (in the opinion of the engineer directing the job), and attributable to the canting of the apparatus from one side to the other, causing sudden flows of water to the highly heated surface of the boiler, thus too rapidly generating steam, a terrific explosion ensues, seven persons are slaughtered, and a dozen or more seriously wounded.

The scene of the tragedy was in Fourth avenue, near 128th street, at which point the tunnel for the underground track of the Hudson River and other railroads is in process of construction.

The boiler was of the upright tube style, about 6 or 7 feet high and 44 inches in diameter. It had a square fire box, with horizontal tubes in the upper portion and vertical tubes from the top of the same to the boiler head. The fracture took place in the center of the shell; the largest fragment, some 1,000 pounds in weight, landing in the fourth floor of a building 550 feet distant. It is stated that the boiler had been recently tested to 120 pounds pressure, and was considered in every way safe, while the engineer positively asserts that the gage, just previous to the accident, did not show any extraordinary amount of steam.

PHOSPHOR-BRONZE.

Combinations of phosphorus with bronze alloys are not new to the chemical laboratory. Phosphurets of copper were produced in the middle of the last century, and have since frequently been examined and their properties carefully studied.

Without considering many minor investigations which have been made regarding this important alloy, we may here note at once that the most complete researches are those of Messrs. Montefiore-Levi and Kunzel, of Val Benoit Nickel Works, near Liège, Belgium. As far back as 1860, this firm was engaged in an elaborate inquiry into the means of improving gun bronze, and in 1868-70 conducted a very extended series of experiments for the Russian government. The results of these as well as of subsequent trials are well summed up by M. Dumas in a note to the French Academy of Sciences. He says: "The characteristics of the alloys change. The color, when the proportion of phosphorus exceeds 1 per cent, becomes warmer, and like that of gold largely mixed with copper. The grain and fracture approximate to those of steel. The elasticity is considerably increased, the absolute resistance under a fixed strain becomes in some cases more than doubled; the density is equally increased, and to such a degree that some alloys are with difficulty touched by the file. The metal, when cast, has great fluidity, and fills the mold perfectly to the smallest details. By varying the dose of phosphorus, the particular characteristic of the alloy which is most desired can be varied at will."

We can now proceed to the consideration of the most recent data obtained from experiments lately concluded or actually in progress in Europe, and reported in a recent issue of the *Engineer*. In Germany trials are being carried on at the Royal Academy of Industry in Berlin, to ascertain the qualities and capacities of the metal under heavy strain, and especially the comparative resistance to often repeated strains, whether tensile or indenting. A bar of phosphor-bronze tried under a constant strain of 10 tons per square inch resisted 408,330 pulls of this amount; while a bar of ordinary bronze broke before the strain of even 10 tons per square inch had been attained. A bar of phosphor-bronze under 10 tons of strain resisted 862,980 bends, while the best gun metal broke after 102,650 bends. Another bar of phosphor-

bronze, now being tested under 9 tons strain, has thus far resisted 1,260,000 bends. In Austria, the following comparative results have been obtained:

	Absolute resistance.	Point of elasticity.	Stretch in percentage.
Phosphor bronze, .81,795 lbs. per sq. in.	54,915 lbs. per sq. in.	1.6	1.6
Krupp cast steel, .72,238 "	14,420 "	11.0	11.0
Ordinance bronze, .81,792 "	5,563 "	15.3	15.3

Best English copper sheets lost during six months immersion in sea water 3,058 per cent. Phosphor-bronze sheets lost only 1.158 per cent.

In Belgium, Messrs. Montefiore-Levi & Co. have carried on a large series of experiments, proving that the presence of oxide of tin and suboxide of copper lessens the tenacity, elasticity, and tensile strength of the bronze. Shavings of old bronze were melted, and a bar cast at 1595°C. The remaining liquid bronze was poled, and a second bar cast at 1608°C. The remaining metal was de-oxidized with phosphorus, and a bar then cast at 1614°C. The three castings were made out of the same crucible and in the same manner, into three iron molds. The results found were that the old bronze had tripled its tenacity, 6.8 as against 2 per cent, and considerably augmented its absolute resistance (2384 to 1613).

In England, Messrs. Alexander Dick & Co. have recently established, in London, a special foundry for phosphor-bronze casting, and are also to produce sheets, wire, etc. Experiments, made for this firm by Mr. D. Kirkaldy and carefully tabulated, show the great superiority of phosphor-bronze for all articles hitherto manufactured of ordinary bronze or gun metal. What steel is to wrought iron it seems that phosphor-bronze is to ordinary bronze. Another table gives the tensile strength and resistance to torsion of various wires, showing also a large superiority in these particulars of the alloy over other metals. In fact, referring to the increment of tensile strength gained by phosphor bronze when drawn into wire, it is considered that the same is astounding; and the *Engineer* adds that, even with a large margin reserved for probable error, enough remains to prove that phosphor-bronze, drawn into wire or laminated into sheets, must prove, if practicable to be produced with perfect uniformity, a most important addition in future to the list of our constructive materials. Having pliability, with a tensile strength approaching that of steel, the specific gravity of bronze, and nearly the electric conductivity of copper, it cannot fail to have important applications for the electric telegraph engineer. For small articles, now made of brass, such as curtain rings, picture frames, etc., the same, cut from spirals of phosphor-bronze, with the ends soldered so as to avoid annealing the wire by conducted heat, would be an immense improvement. Although experiments toward using the alloy for artillery are incomplete, it is probable that further investigation may demonstrate its fitness for that purpose. We have already published a long paper on its employment for tweers, for which it offers the advantages of greatly increased toughness and density, and consequent great resistance against change of temperature and the influence of molten masses. Finally, should copper become cheaper, say to double the cost of an equal weight of wrought iron, phosphor-bronze might be used in place of iron in ship-building. It is superior to Muntz yellow metal, a substance patented by John Scott Russell for the latter purpose, in that it does not become crystalline and brittle, while its passive strength is four or five times as great.

With our vast deposits of copper, notably in the Lake Superior region, there appears to be every facility for the prosecution of investigations leading to the manufacture of this important and valuable alloy in the United States. We therefore consider that the subject merits the careful attention of American metallurgists, who, we trust, at no distant period, will contribute the results of their own experiments to those thus far adduced by their brethren of the old world.

SCIENTIFIC AND PRACTICAL INFORMATION.

A NEW ELECTRIC LIGHT.

M. Ladiguin has recently invented a new plan for electric illumination, which is quite simple, and which, it is believed, may be advantageously used for lighting mines, as there is no danger of its causing the explosions incident to such localities. It consists in a bit of charcoal or other poor conductor attached to a wire communicating with a magneto-electric machine. The charcoal is enclosed in a glass tube in which the air is replaced by a gas which will not combine with the carbon when the same is brought to a high temperature. The tube is sealed, and the machine set in motion by a small steam engine or other motor, when the charcoal gradually becomes incandescent, emitting a pleasant and quite brilliant light, the intensity of which, it is said, may be graduated at will.

THE ACTION OF ANTISEPTIC SUBSTANCES UPON VIRUS.

M. Davaine has recently examined the following substances, which he classes in regard to their power as antiseptics in the subjoined order: Ammonia, silicate of soda, ordinary vinegar, and carbolic acid; then caustic potash, chloride of oxide of sodium (?), hydrochloric acid, permanganate of potash, chromic acid, sulphuric acid, iodine. The power of ammonia, of vinegar, and of carbolic acid being represented by 1—200, that of iodine would be by 1—12,000. Iodine should therefore be considered as the best antiseptic to be employed in the treatment of maladies such as malignant pustule, boils, carbuncles, and the like, when, not having become localized under the form of a simple pustule, they have taken up a certain extension. Injections of 1-6000 of iodized water are recommended.

IMPROVED CHURNING APPARATUS.

The object of the device represented in the annexed engraving is to furnish a convenient means of operating a single churn or any desired number of churns at once, in accordance with the amount of milk used and power to be applied.

To the end of the driving shaft is attached a hand crank or a pulley, A, which is connected by a belt to a suitable motor. The shaft rotates in bearings in the framework of the machine, and carries a large gear wheel, B, which, through a smaller wheel below, actuates a balance disk, C. To a crank pin on the latter are connected the rods, D, which, through the horizontal levers pivoted to supports on the frame, communicate motion to the churn dasher shafts.

The frame of the apparatus may, if desired, rest upon a platform, in which recesses may be made for the reception of the lower portions of the churns. The peculiar form of dasher represented in the foreground of the engraving is made by halving two bars to each other and attaching them at their centers to the extremity of the dasher handle. The middle portions of the ends of the bars are cut away, and the arms thus formed are made V shaped upon the upper side, while they have grooves of similar contour on their lower faces. The under side of the middle portion of the dasher is concave, in order, it is stated, to gain a better hold upon the milk and to prevent spattering.

In the cover is formed a chamber, of which the funnel shown forms an upward continuation. The object of the chamber is to receive the milk and fine butter which may be carried up by the dasher shaft. Its bottom is formed by attaching to the cover a plate, E, the under side of which is made convex, so as to scatter the milk that may be projected against it by the dasher. This plate is secured by screws and may be readily removed for cleaning, etc.

Instead of the form already described, the dasher may be made of the shape shown at F, its upper side being conical, and its base slightly concave. The invention is of simple construction, and, according to the inventor, of very efficient operation. He informs us that a child, by its aid, using a simple churn, can easily produce butter from four gallons of cream in ten minutes, and that with three churns, actuated by one horse power, thirty gallons can be similarly treated in fifteen minutes. Patented through the Scientific American Patent Agency, November 4, 1873. For further information address the inventor, Mr. George Ridler, Rickardsville, Dubuque county, Iowa.

A New Torpedo Boat.

A new torpedo boat was lately launched with success at the Navy Yard, Brooklyn, N. Y. It is a double hull vessel, being built with two vertical sections and five watertight bulkheads, and will be furnished with a vertical wheel of peculiar construction, by means of which she will be guided as well as propelled. She is constructed wholly of iron, is 175 feet long, 28 feet wide, and 14 feet deep. On the bow she will carry a gun of 11 inch caliber, and on either side and on the bow two torpedo booms will project. The torpedo has been building for two years, and she will not be finished until next year.

What Made the Chimney Fall?

At the cement works of Gostling & Co., Northfleet, Eng., the upper part of an immense chimney, 220 feet high, composed of the best bricks and mortar, grouted with Portland cement, recently fell, just as the last brick for its completion was being laid. Seven lives were lost. The remainder of the chimney was subsequently torn down. An official enquiry as to the cause of the disaster was held. The jury were unable to decide what made the chimney fall, and brought in a verdict, in respect to the killing, of accidental death, with an expression of sympathy for the owners of the chimney, whose loss was quite heavy.

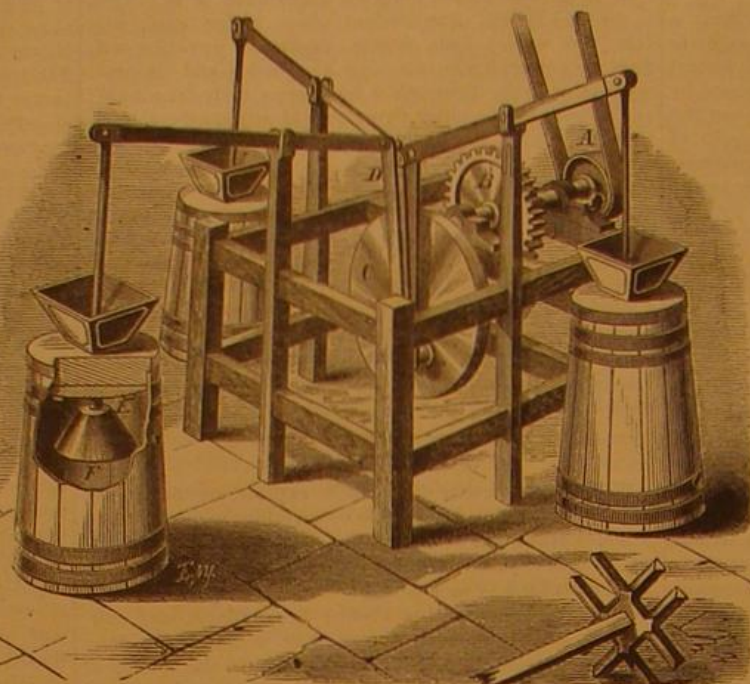
It is possible that some of our readers may be able to point out the cause of the disaster, and we will therefore give some of the particulars, as deduced from the evidence of scientific experts, workmen, the architect, the builder, and the proprietors.

1. The materials were perfect, the workmanship the very best, the method of building excellent; the work was not hurried, more than sufficient time being allowed, namely sixteen weeks, the rate of progress being 14 feet per week.

2. The work was most carefully watched at all times during its progress, and always found plumb; had been plumb a few minutes previous to the fall, and then stood exactly correct.

3. The walls of the chimney were thicker and stronger than chimneys of equal height were ordinarily made. The base on which the chimney rested was 30 feet square, base of chimney 22 feet diameter top of chimney 11 feet diameter outside. Thickness of wall at base, 3 feet 9 inches. The first set-off, at 26 feet 3 inches, was 3 feet 4½ inches, at 52 feet 6 inches it was reduced to 3 feet, at 78 feet 9 inches it was reduced to 2 feet 7½ inches, at 105 feet it was reduced to 2 feet 3 inches, at 131 feet 3 inches it was reduced to 1 foot 10½ inches, at 157 feet 6 inches it was reduced to 1 foot 6 inches, at 183 feet 9 inches it was reduced to 14 inches, and it was carried out at 14 inches. A large chimney in West Cumberland, belonging to the West Cumberland Iron and Steel Company, was 250 feet high; diameter of the shaft as

it comes out of the ground, 22 feet; thickness about 2½ bricks, which would be about 1 foot 11 inches, so that they were pretty nearly a third thicker at the base; at 160 feet this shaft breaks off to 1½ bricks, that is 14 inches, while at 157 feet theirs was 18 inches. The chimney at Workington was 200 feet; diameter at base 23 feet; thickness of work at bottom, 2½ bricks, that is, 1 foot 11 inches, while they had a thickness of 3 feet 9 inches; at 100 feet, this was 18 inches while theirs was 2 feet 8 inches. The shaft at St. Rollox Chemical Works, Glasgow, was 422 feet from the surface, the thickness at the bottom was 3½ bricks or about 2 feet 8 inches, while this chimney was 3 feet 9 inches, or proportion-

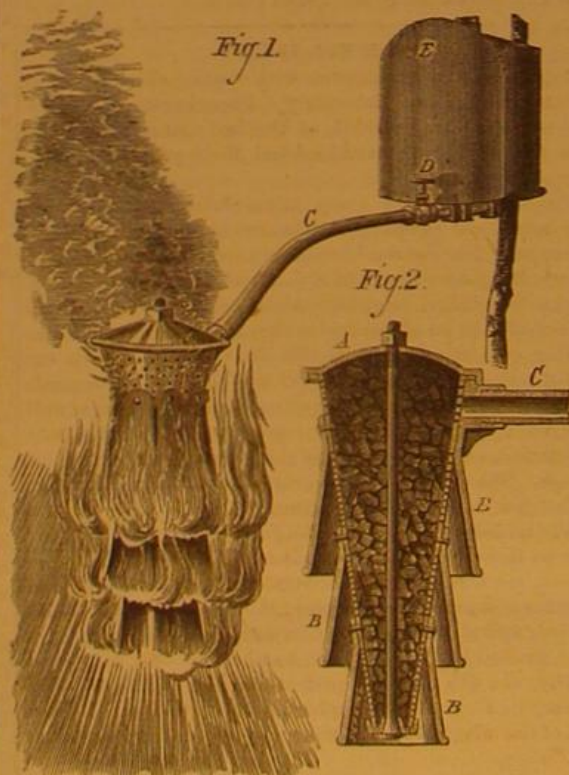


RIDLER'S IMPROVED CHURNING APPARATUS.

ately nearly double the thickness. The cap was begun about a week before the accident, the greatest projection of the body of the cap was 18½, and it took 10 feet to get out each brick, overlapping barely ¼ inch; there were eight projecting ribs in it which projected 4½ beyond, so that it came out a 2 foot projection. They were well supported and not a source of weakness. The weight of the shaft was 1,674 tons, the weight of the cap being 19 tons 3 cwt.

BARTHOLOMEW'S IMPROVED TORCH.

Mr. Seth Bartholomew, of Sturgis, Mich., is the inventor of the ingenious form of torch represented in the accompanying engravings. The device may be used for fishing purposes by night, or as a means of illumination during political or other public demonstrations, instead of the ordinary stationary gasoline flambeau generally employed.



It consists of a cast or wrought iron cresset, A, shown in section in Fig. 2, perforated and made in the shape of an inverted cone. This is traversed axially by a rod, the lower end of which forms the bottom of the receptacle, and the upper extremity is screw-threaded in order to hold the nut which secures the cover. Attached and surrounding the cresset is a series of inverted funnels, B. The apparatus is applied and, at the same time, supplied with gasoline or other combustible liquid by a pipe, C, which connects with a suitable can or reservoir. The latter is secured to a post or tree by sockets, and is provided with a screen, E, to protect its contents from the heat of the flame.

The cresset being filled with fragments of brick or other porous material, and the reservoir charged with liquid, the

valve, D, is opened. On a match being applied, the finely separated fluid within the cresset takes fire and burns as represented in Fig. 1. Should it be desired to lower or extinguish the light, the operator is enabled to do so by manipulating the cock, D. The brick filling, being wholly non-combustible, will not smolder as a wick would, but will retain its full efficiency for instant service. The funnels may be greater or less in number than represented, and the cresset, if desired, may be otherwise supported and connected with the reservoir by a flexible tube.

Dr. Grace Calvert.

Dr. Grace Calvert died recently at Manchester, England. As an analytical chemist, Dr. Calvert's renown was European. He left England as a youth to pursue his education in France, and in the schools of that country secured many honors—defraying the cost of his education by the awards which he obtained. He subsequently pursued the study of chemistry, and was appointed assistant chemist at the Gobelins Works, under his learned master, Chevreul. Soon after his return to England, he commenced reading a series of papers before the Society of Arts, on chemistry applied to industry; and on February 12, 1851, brought forward the discoveries of Mons. Chevreul in relation to the laws of color, his object being to explain upon what basis those laws are fixed, and to point out their application in the effective arrangement of colored fabrics in the Great Exhibition of 1851. In 1846 he settled in Manchester, and was soon after appointed Professor of Chemistry at the Royal Institution there. He was also, for some time, a lecturer at the Manchester School of Medicine. His connection with the Manchester Sanitary Association led him to hygienic investigations—one of the principal results of which was a patent for the application and preparation of carbolic acid. In this he followed up the discoveries of the Prussian, Runge.

Another of his patents was for desulphurizing coke, by means of chloride of sodium, and this has led to an extensive business. In some other directions Dr. Calvert's persistent experiments were doomed to become commercially valueless just at the moment when they had attained to success in the laboratory. This was the case with a patent for sizing cloth, and with another for the production of aniline colors. Dr. Calvert's process for obtaining the aniline from coal tar was soon superseded by its more profitable preparation from benzene. Dr. Calvert made a series of elaborate experiments with picric acid, for dyeing purposes, and also with tannic acid for tanning leather. In scientific circles great interest attached to Dr. Calvert's protoplasmic investigations.—*Journal of the Society of Arts.*

The Hartford Steam Boiler Inspection and Insurance Company.

The Hartford Steam Boiler Inspection and Insurance Company makes the following report of its inspections in the month of September, 1873:

The number of visits made during the month were 1,405; boilers examined, 2,858; internal examination, 792; external, 2,738. The hydraulic pressure was applied in 236 cases. Total number of defects discovered was 1,199, of which 287 were regarded as dangerous. The defects were as follows: Furnaces out of shape, 46—11 dangerous; fractures, 110—43 dangerous; burned plates, 67—25 dangerous. Several of these cases resulted from the neglect of the fireman to try the gage cocks before starting fire in the morning. The boilers were blown down Saturday night, and then refilled; but the blow-off cock did not close tight, or a defect in the check valve in the feed water pipe allowed the water to run out of the boiler before Monday morning. The red hot, warped and twisted plates soon gave notice of the situation. Blistered plates, 202—28 dangerous; deposit of sediment, 223—27 dangerous; incrustation and scale, 210—24 dangerous; external corrosion, 70—14 dangerous; internal corrosion, 34—14 dangerous; internal grooving, 12—6 dangerous; water gages defective, 79—14 dangerous; blow-out defective, 26—11 dangerous; safety valve overloaded, 43—15 dangerous; pressure gages defective, 189—24 dangerous; errors ranging from —44 to +7 pounds. Boilers without gages, 61—8 dangerous; deficiency of water, 5—3 dangerous; braces and stays broken, 54—19 dangerous; boilers condemned as unsafe to use, 8.

We are under obligations to correspondents who, from time to time, furnish letters for publication in our columns upon a great variety of practical topics. We highly value these contributions, and hope that our mechanics and others will oftener take the pen and contribute from their valuable store of practical information. During the coming months we hope to enrich our columns with a greater variety of practical subjects, and shall look for an increased number of useful contributions from our readers.

VARIETIES COTTON THREAD.—Cotton thread may be dyed in two or three colors by covering some parts with parchment paper, tightly wound, and thin tin or lead foil, holding the latter in place by binding threads. If tied sufficiently tight when the skeins are introduced into the dye bath, the protected parts remain white; and by protecting the dyed portion, and unwrapping the white portion, another color may be applied.

Completion of the Great Bridge across the Niagara River.

The great international bridge across Niagara River from Buffalo to Fort Erie, in Canada, has been lately completed. The Buffalo Commercial Advertiser furnishes the following interesting description:

"To state the fact roughly but plainly, the entire length of the bridge is about three quarters of a mile. But more in detail the length is as follows: In the main river, 1,800 feet; over Squaw Island, 1,300 feet (trestle work), and over Black Rock Harbor, 450 feet. The entire length of the superstructure in the main river is 1,890 feet; in Black Rock Harbor, 440 feet. There are nine spans in the portion on the main river and three in the Black Rock Harbor: four of 190 feet in the clear, and three of 240 in the clear. Over the main river also are two draw openings, of 160 feet each; total length of draw girder, 362 feet. In Black Rock Harbor are two draw openings of 90 feet each, and one fixed span 220 feet in length. In the main river are eight piers and two abutments; and in the harbor, two piers and two abutments. The abutments are 40 feet long by 30 wide at the bridge seat level. Over the bridge is laid a track for railroads, and a common sidewalk for foot passengers. The piers and the abutments are built of sandstone from Georgetown and Acton, Canada, and from Berea, near Cleveland, Ohio.

The iron of the superstructure was from the Phoenixville Iron Company's Works, Phoenixville, Pa. The first caisson was launched on the 13th of July, 1870, and work progressed steadily up to the time of completion. It must be remembered that the current of the river, at the point where the bridge is located, runs from five and a half to ten miles an hour, according to the state of the wind. This was throughout one of the greatest difficulties encountered, and frequently retarded progress. Then, too, the depth of water varies from twelve to forty-five feet. The ice in winter, some may think, would damage the bridge in course of time, but the ice breakers afforded ample protection, and cut to pieces blue ice two feet thick with comparative ease. Another remarkable thing connected with the history of the bridge is that, during the whole course of the work, not a single life has been lost. The workmen have, many of them, often been exposed to dangers, but always have escaped.

The respective weights of the different spans over the river are as follows: 190 feet, 130 tons; 240 feet, 208 tons; 362 feet draw, 353 tons; and the entire quantity of iron used in the whole bridge amounts to upward of 2,000 tons. At the request of Captain Tyler, the English Government Inspector of Railways, who visited the bridge in November, 1871, on behalf of the English shareholders, one of the spans of 190 feet was loaded with 210 tons of iron rails, equally distributed over the floor beams (a weight greater than that of a continuous train of locomotives covering the span), and left in that condition for three days. This test was highly satisfactory, the deflection being found to be only about one inch, and the truss returning exactly to its former condition on the removal of the load.

The bridge has been leased, to the various railroads which will cross it, for twenty years. The roads are the Grand Trunk, the Great Western, the Canada Southern, the New York Central, the Erie, and the New York, West Shore and Chicago. Most of these railroads have already constructed their approaches to the bridge, and will commence sending trains across at as early a day as possible. The original plan contemplated a carriage way, but this was abandoned for the reasons that, as the bridge was three quarters of a mile long and so many trains were to cross it, there would very seldom be a chance for carriages to cross without interfering with the trains.

The entire cost of the bridge, in round numbers, is not less than \$1,500,000. Of its practical benefits we leave the reader to judge, merely stating in conclusion that it supplies a want long felt by the different railroads which have for so many years been obliged to cross the Niagara River on the steamer International.

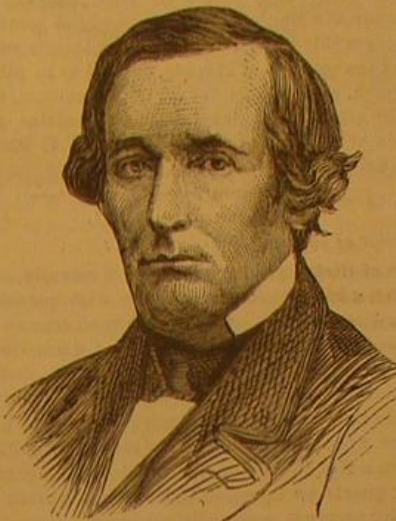
New Comets.

The present year is marked by the discovery of quite a number of new comets, and the re-observations of others previously noted but since invisible. Particularly is this the case in comparison with 1872, when only one of these vagrant bodies, and that a fragment of Biela's comet, was seen. Up to the current date seven have been observed, which were found as follows: No. 1 on the 3d of April, by Stephan at Marseilles. This comet is identical with No. 2 of 1867, originally discovered by Tempel. The second body is a new one, and of short period, and was noted by Tempel on July 3 at Milan. Another new comet was observed by Breolly at Marseilles on August 20, and a fifth, of considerable brilliancy, passing southwardly, by Paul Henry at Paris, on the 23d of the same month. On September 1, Stephan, of Marseilles, obtained feeble views of Brorsen's, and on the 3d of Faye's, comets. Another new discovery was made on November 10 by Le Verrier at Paris, of a comet which has a slight motion to the southwest, and the last new arrival has been found on November 11 by the Vienna Academy of Sciences.

Professor Kirkwood suggests that persons having the use of comet seekers will do good service to astronomy by searching for these wandering celestials at the present time. It may be added, as an incentive, that the Vienna Academy offers a gold medal for every new discovery.

PARDEE HALL AND ITS FOUNDER.

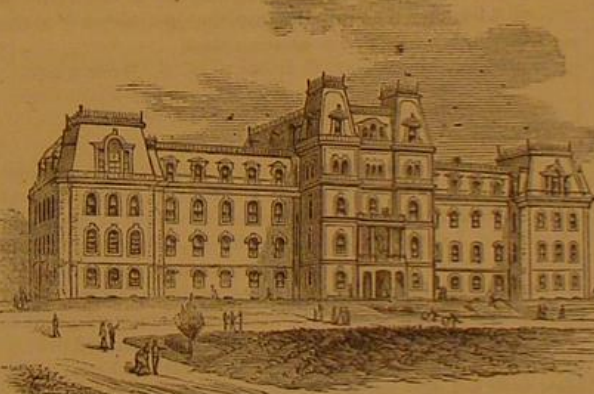
We recently noted the formal donation, by Mr. Ario Pardee, of a large and handsome edifice to Lafayette College, at Easton, Pa. The building, which has been named Pardee Hall, is to be used as the scientific department of the institution. We give herewith an engraving of the structure, and a portrait of its liberal founder. The edifice, to the erection and fitting up of which \$250,000 has been devoted, is situated on an elevated knoll in the eastern portion of the college grounds. It has a total frontage of 256 feet, and its main building is five stories high, and extends back for a distance of 61 feet. On each side are lateral wings, 61 feet in length and 31 in width, joining which, at their extremities, are cross wings, 42 feet front by 82 feet in depth.



MR. A. PARDEE, FOUNDER OF PARDEE HALL.

The architectural effect is quite imposing, the handsome mansard roof and two turrets giving a massive appearance to the whole. The material used in construction is Trenton brown stone, with light Ohio sandstone trimmings.

The first floor contains metallurgical lecture rooms and private laboratories, apartments for the study of blowpipe analysis, assaying, ore dressing, and similar branches. Extraordinary facilities are afforded for instruction in the science of mining, there being, among other interesting objects, a complete model of coal mine plant operated by steam, from which the functions of all the different machines and processes can be seen at a glance.



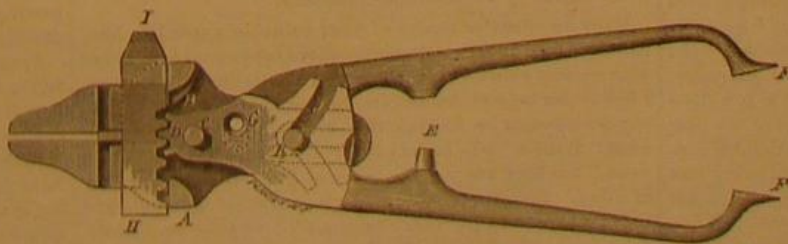
PARDEE HALL, LAFAYETTE COLLEGE, EASTON, PA.

The second story is devoted to geological and mineralogical cabinets, which are arranged to adjoin a spacious lecture hall. Valuable collections of specimens relating to the sciences of mineralogy and geology have been provided, together with necessary apparatus, books, etc. The third floor contains the cabinets and lecture rooms for the classes in the various branches of engineering, and the two upper stories are fitted up with every requisite for the study of chemistry.

The contemplated supply of apparatus has not been placed in the building, so that we shall probably find it necessary to refer in more detail to the various novel instruments and plans in aid of study, at some future time.

WHITEHEAD'S COMBINATION TOOL.

"Very handy to have in the house" is an expression



which may be unhesitatingly applied in reference to the useful little invention depicted in our engraving. It is a small tool chest compressed into a single implement which may be readily carried in one's pocket.

There is a double flanged frame or casing, A, which is connected by supports, B. Pivoted at C are the handles which, at their rounded ends, have teeth, D. On a projection on one of the handles is a punch, E, and at their ends are longitudinally projecting pieces, F, the inner extremities of which serve as calipers and the outer ends as the points of

a pair of dividers. Both handles are provided with conical holes, G, corresponding to similar apertures in the frame. These are not placed centrally above each other, but some distance to the right and left of the longitudinal axis of the tool, so that the sides of the orifices act, on closing after opening the handles for the admission of a wire, like shears, cutting the same at the point desired. Two straight shanks, H, are wedged transversely into the frame, and slide on the guiding supports. Their lower sides are supplied with a series of teeth which gear into teeth, D. Attached to the shanks, and at right angles, are jaws which act as pliers. One of the shanks is also provided with a steel blade, I, which serves as a screwdriver. The curved slots, J, correspond with longitudinal slots in the frame which guide the connecting bolt, K. The latter is formed in square shape so far as it moves in the lower guide slot, and at its upper end is threaded and provided with a thumbscrew; when the thumbscrew is loose, and the handles are opened and closed, the bolt, K, is caused by the slots, J, to traverse in the longitudinal slots of the frame, and to produce a parallel movement of the jaws and their application as pliers. By tightening the thumbscrew the jaws may be set and used as a hand vise. The tool may be made of malleable iron, steel or any other suitable material.

It was patented June 10, 1873, through the Scientific American Patent Agency, by Mr. H. B. Whitehead, of Holly Springs, Marshall county, Miss.

Ice-Making Machinery at the Vienna Exposition.

The making of ice by artificial means is a matter of rapidly increasing importance, not only on account of the increase it affords in our domestic comforts, but also on account of its usefulness in many manufacturing branches. The ice-making machine has already been of great service in breweries, as it renders the brewer independent of the supply of natural ice, while the ice machine may also be used for the direct cooling of the air and the wort. Besides, ice made artificially by machinery is colder and therefore harder than natural ice, a fact which has clearly been proved by experiments lately made, when equal weights of both artificially and naturally produced ice were placed in warm water of equal temperature, the result being that the artificial ice took more than twice the time for melting that was required by the natural ice.

At Vienna were exhibited three ice-making machines, one by Messrs. Siebe and West, of Lambeth, London, one by Messrs. Vaas and Littman, of Halle-on-the-Saale, and a third by the *Actien-Gesellschaft für Fabrication von Eismaschinen*, formerly Oscar Kropff and Co., of Nordhausen, Prussia. The principle applied in Messrs. Siebe and West's machine consists of the production of a cold temperature by means of the evaporation of ether, and of the continued use of the same ether without any significant loss. The machine consists of a refrigerator, a condenser, an air pump, and an icemaking box. The machine works in the following manner: As soon as the air pump is put in motion, the ether in the cooling vessel evaporates, and, of course, absorbs heat from the tubes by which the cooling vessel is traversed. The ether vapor thus produced is forced by the air pump into the condenser, where, under the combined influence of the pressure and the cooling action of the water circulating through the condenser, it resumes the liquid form and returns through a small tube to the refrigerator, in order to be there again changed into gas.

This process is continued with the use of the same ether as long as the machine is kept working. The great cold produced in the cooling vessel acts on the fresh water to be frozen in the ice box by means of a current of salt water introduced into the tubes which pass through. The temperature of the salt water decreases quickly on its way through the refrigerator on account of heat being absorbed from it by the ether changing into gas, and it then circulates, with a temperature considerably below the freezing point in the ice box, round a number of iron or copper vessels filled with the fresh water to be frozen into ice. The salt water, the temperature of which increases again by coming into contact with the vessels containing the fresh water, is taken back to the refrigerator, where its temperature is again reduced. The process of freezing is thus uniform, self-regulating, and uninterrupted, until the fresh water has been changed into ice. The latter is then removed, and the vessels are filled again with fresh water, and are again exposed to the cooling of the brine current. These machines of Messrs. Siebe and West's are now constructed

like horizontal steam engines; they are exceedingly simple and compact, and have a steam engine attached, or may be worked from an existing shaft. The ice is made in single cakes, weighing between 8 pounds and 100 pounds, according to the size of the machine. If these cakes are placed one upon the other, they freeze together, so that blocks of any size may be formed. It is stated by Messrs. Siebe and West that they can produce from 10 pounds to 30 pounds of ice with their machines

for two cents, and that one pound of coal produces between 3 pounds and 10 pounds of ice. The time taken in removing the ice and refilling the freezing vessels for the next operation occupies from 30 to 60 minutes. Messrs. Siebe and West state further that a temperature of 50 degrees below zero Fah. has been obtained with this apparatus, and that from 50,000 to 500,000 cubic feet of air may be cooled per hour to 30 degrees Fah., or a smaller body of air to a lower temperature. The ice made by this machine at the Vienna Exposition was beautifully clear and

crystalline, as pure and hard as best American or Norwegian ice.

Examining now the two German ice-making machines, we find that their construction is in nearly every respect identical; and although based on the same thermodynamic principle, these machines differ nevertheless considerably from the English machine, in appearance as well as in working. The English machine appears to us a compact, thoroughly well considered construction, while the German machines show a great number of tubes, and vessels, and cocks, which require a good deal of attention. The general *modus operandi* of the German machines is as follows: A boiler is partly filled with a concentrated solution of hydrochlorate of ammonia, which is heated, and ammoniacal gas is thus generated. This gas is forced through serpentine pipes in a condenser to a refrigerator, and from there it is admitted into the serpentine pipes of the ice box. The ammoniacal gas is exposed on its way to the ice box to a pressure of 8 or 10 atmospheres, while it is considerably cooled in the condenser, the serpentine pipe of which is surrounded by cold water, the results being that the ammoniacal gas becomes condensed to a fluid form. The serpentine pipes of the ice box are surrounded by a solution of hydrochlorate of lime; and the liquefied ammoniacal gas, passing through these pipes, resumes its gaseous form, and absorbs heat from the solution of hydrochlorate of lime. The boxes with the water to be changed into ice are placed in the ice box, and immersed in the solution of hydrochlorate of lime. The fluid gas evaporated in the serpentine pipes of the ice box passes into an accumulator, where it is absorbed by the fluid freed from ammonia, from which the gas has been produced by heat, this fluid having passed from the boiler through the refrigerator to the accumulator. The fluid is then again forced back by means of a pump into the boiler, whence it passes off again as ammoniacal gas.

These ammonia machines are built in six different sizes, for the production of from 10 pounds to 1,000 pounds of ice per hour, requiring for the same time from 5 to 500 cubic feet of water, and from 5 pounds to 60 pounds of coals. The space occupied by the smallest machines is 6 by 4 feet, and that required for the largest is 45 by 20 feet. The ordinary shape of the ice produced by the machines is a square plate, $2\frac{1}{2}$ inches thick, $7\frac{1}{2}$ inches wide, and $29\frac{1}{2}$ inches long, weighing about 20 pounds.—*Engineering*.

Correspondence.

Hydraulic Mining in California.

To the Editor of the Scientific American:

An article copied from the *Calaveras Chronicle*, appearing in your issue of November 15, is calculated to mislead your readers, as it entirely mistakes the process of hydraulic mining as it was five years ago, or even twelve years ago. No doubt that changes have been made, in that the great power of water has been more universally adopted for mining purposes. I am an old Californian, and will now simply relate a trial that I witnessed in the summer of 1859, in the county of Placer, near Forest Hill, being one of a committee to test the different nozzles, in order to ascertain which among the various constructions would produce the best results in cutting down an embankment.

The water was brought in a flume on the mountain side. The conducting pipe was of iron, 8 inches in diameter, except that, near the lower end where the nozzle was attached, there was about 50 feet of five ply canvas, wound spirally with rope $\frac{1}{2}$ of an inch in diameter, all made solid together. The perpendicular pressure was 196 feet; the bore of the nozzles used varied from $1\frac{1}{2}$ to 2 inches in diameter; the nozzles were of various tapers, some being tapered to within a few inches of the end, then going straight; and there were various other forms. The character of earth was cemented gravel, so hard near the bed rock that it was said that a man could not pick up, by hand, four ordinary wheel barrow loads in a day. The embankment worked upon at that time was about 25 feet in depth, but it grew deeper as they worked up into the mountain.

The work of the hydraulic was fearful to behold, and one could scarcely believe one's own eyes. Taking hold of the stream of water as, in its fury, it poured from the nozzle, I could compare it to nothing better than a piece of polished ivory; and it could not be penetrated with the finger. I tried to split the stream with my pocket knife blade, by holding the edge against the nozzle at the end, but could not hold the knife sufficiently firmly to do it. The operator stood about 22 feet from the embankment, the water pouring with terrific fury into the bank, roaring, clashing, and filling the air with stones, the gravel flying in every direction. The stump of an oak, newly cut, about 18 inches in diameter, stood near the edge of the embankment, with a few roots hanging over. The operator requested us to mark the time required to wash it from the bank clear; in less than 20 minutes it was undermined and rolled down hill, and every root was washed clean. As an experiment, the bark was peeled from a green oak, 20 feet distant, by the furious water. When the top dirt was washed off, down to within a foot or so of the bed rock, the operator directed the stream under the lower edge and raised large flakes (or lifters, as he called them) hurled them over and over, breaking them up among the rocks, and sending them into the long sluice, where (with rocks, some weighing more than a ton) they went thundering down for nearly half a mile in length, where most of them were ground up, leaving the bewitching contents at the bottom of the sluice.

Directing the stream against the side of large boulders, which four men could not have turned over by hand, they

were easily rolled over and over by the force of the stream. The nozzle which carried off the prize was some 6 inches at the large end, where the water entered, and I think $1\frac{1}{2}$ inches at the discharge end; it was very long (7 or 8 feet) and a portion of the small end bored out perfectly smooth to an exact focus of 22 feet, being the distance from the bank at which it was most commonly used. If used at a sharper focus, the currents seemed to cross each other and confuse or scatter the stream beyond; with a portion of the end bored straight, the stream seemed to scatter from the point of discharge. As the washed rocks occasionally accumulated on the washed bed rock below the embankment, impeding the course of the dirt to the mouth of the sluice, the operator would (with a kind of sweeping stroke) direct the stream so as to sweep everything before it, often shoving ten cart loads or more at a single sweep over the bank into the sluice.

Even before this time, I had seen hydraulic mining (at Alpha and Omega, and at Nevada, as well as in other localities) of which, even in this day of improvements, California need not be ashamed; it leveled the mountains and often buried men alive.

J. E. EMERSON.

Beaver Falls, Pa.

Petroleum as Fuel.

To the Editor of the Scientific American:

A series of trials have been made here recently, on a small scale, to determine what may be done with petroleum as a fuel under steam boilers. The boiler used was an ordinary eight horse upright one, about three feet diameter and six feet high, with the usual number of one and a half or two inch vertical flues, the lower flue sheet being about fourteen inches from the grate. The device for burning the petroleum was placed upon the grate, and a stream of oil, scarcely larger than a No. 16 wire or the rapid dropping of the oil (about six quarts an hour), mingled with a certain quantity of air under pressure, was sufficient to raise steam to thirty pounds to the inch in thirty-five minutes. Considering that during this time the furnace door was kept wide open for the purpose of observation, and that the boiler was in a cold room and entirely unprotected by jacket, I think this may be regarded as a good result.

It seems to be requisite that the air should have considerable tension, and mingle with the burning oil in jets, and in quantity proportionate to the quantity of oil, in order to ensure perfect combustion; for it was noticed that, while the apparatus was being adjusted, considerable smoke occasionally arose; but as soon as proper adjustment was reached and the boiler and apparatus had warmed up, the consumption was quite free from smoke and gas.

Although these tests (some half dozen in number) have been upon a small scale, consuming only about one barrel of oil, all told, they certainly indicate that petroleum has the qualities of a strong and economical fuel.

Worcester, Mass., Nov. 6, 1873. F. G. WOODWARD.

Tracks in the Solid Sandstone.

To the Editor of the Scientific American:

Having heard that there were numerous mule, deer and turkey tracks to be seen on a ledge of rocks, situated about four miles northeast of this place, on the farm of Mr. John Stevenson, I visited, in company with Mr. Louis Graff of this place, and made a thorough investigation of the surface of the spot. We found that the rocks, which are a very hard sandstone, extended thickly over several acres of ground. The top surface of almost every loose rock was marked plainly with tracks like those of small mules of various sizes; some few were not over an inch in diameter. We found one very distinct track, showing the hollow of the hoof, and of the size and exactly like that of a common sized horse. We found a few tracks like those of deer, some such as a deer makes when leaping, others made as when walking. Several tracks were made in slipping; some showed notches, as made by the notched hoofs of the wild horses on the western plains. We found, where the unbroken stratum had been exposed by the washing of the rains, that its surface was also covered with the same kind of tracks as those on the loose rocks.

We were informed that many rocks had been hauled away as curiosities; and that there used to be found on the rocks distinct turkey tracks, and perhaps the tracks of other kinds of birds.

A. M. BOULAND, M. D.

Van Buren, Crawford county, Arkansas.

Railway Religion.

To the Editor of the Scientific American:

Many an attentive reader of your valuable paper has been pained to read an article under the above caption, on page 297 of your current volume. Knowing your reputation for fairness, I had rather believe that the article spoken of found its way into your columns by accident than by design. There may be some "divines" who believe that "the world was made in a week," but they are not the index of the Christian ministry of today. Clergymen are not of all men most ignorant; and they that are not altogether unacquainted with the modern developments of science, is clearly proved by the fact that not a small number of them are among the readers of the *SCIENTIFIC AMERICAN*. We have searched in vain among the utterances of the late Evangelical Alliance to find one which came anywhere near calling scientific men "servants of the evil one, infidels, and scoffers." Yet it is taken for granted that the delegates will do so from their pulpits on the first suitable occasion.

There can be no real controversy between science and religion. Fanaticism and ignorance may get into collision, but the intelligent clergyman is just as apt to adopt the teach-

ings of pure science as the scientist is to respect the claims of religion.

JAMES FITCHER, Principal.

Hartwick Seminary, N. Y.

LABORATORY NOTES.

BY S. P. SHARPLES.

ELECTROTYPING WITH IRON.

M. Klein, a Russian chemist, has succeeded in electrotyping with iron. He used a bath consisting of a concentrated solution of sulphate of iron and ammonia, and four Meidinger cells. For an anode he used an iron plate having a surface about eight times that of the cathode, and connecting this also with a copper plate. He found by this means he could get a perfect coating of iron. On leaving the bath, the iron is as hard as tempered steel and very brittle; heated to a cherry red, it becomes malleable, and may be engraved as easily as soft steel.

CEMENT FOR PIPES, STILL, RETORTS, ETC.

J. Spiller recommends a mixture of pulverized iron borings, kaolin, and sirupy silicate of soda as a lute for fixing on the heads of stills which are required to stand a high temperature. We should judge the same might be found useful in other situations, such as the joints of cast iron furnaces, for instance.

PRESERVING GELATIN SOLUTIONS.

Lanjouric finds that the addition of 1 per cent of fuchsin to a solution of gelatin will prevent its putrefaction. A quantity prepared in this manner was kept 11 months without change. The addition of a very minute quantity of aniline violet to gelatin or to an infusion of coffee was also found to prevent its putrefaction entirely. It is hard to understand how these substances do this, if they have no poisonous properties.

COPYING MEDALS.

Copies of medals or other similar articles may be readily made by a very simple piece of apparatus. A cast of the medal is first taken in wax. This is done by moistening the medal or coin slightly, and then pouring the melted wax over it. The object of the moistening is to prevent the wax sticking to the surface of the metal. While the wax is still warm, a piece of copper wire should be imbedded in it to serve as a support, and to connect with the zinc in the decomposing cell. After removing the medal from the mold, the surface of the mold is dusted over with fine plumbago until it appears quite black; all excess of the carbon is then carefully removed with a soft brush. If fine iron filings can be had, a few of them are sifted over the face of the mold, and a solution of sulphate of copper is poured on it. It is then carefully washed; this serves to give a very thin coating of copper, and facilitates further operations, but may be omitted if not convenient. Care must be taken, in putting on the plumbago coating, that it comes in contact with the copper wire. A very convenient way of applying this wire is to bend it into a ring slightly larger than the medal to be copied, lay it on the table around the medal, and pour the wax over both at the same time. Scraping with a knife exposes it completely. The mold being prepared, take an ordinary glazed earthenware basin four or five inches deep, and in it set a small flower pot, having previously plugged up the hole in the bottom of the pot with a piece of wood, a little wax, or other suitable material. The flower pot is to be filled with a weak solution of common salt. The outer basin is then filled with a strong solution of sulphate of copper, and a little bag holding crystals of sulphate of copper is hung in it to keep it saturated. Add a few drops of sulphuric acid to both solutions, place a piece of zinc in the flower pot, and connect it with the wire of the mold. The mold being now put in the outer solution, a coating of copper soon shows itself. The mold may be left in the solution two or three days, if a thick coating is desired.—*Boston Journal of Chemistry*.

Trees as Historians of the Past.

M. Charles Gros has recently communicated a note to the French Academy of Sciences on the study of the yearly rings, shown when the trunk of a tree is transversely divided. These layers by which, as is well known, the age of the tree may be determined, do not diminish in relative thickness by a constant law. In view of this, M. Gros seeks a cause for the irregularity, and, it seems, has arrived at the conclusion that the data, mean and extreme, of meteorological phenomena, when known and tabulated, might be compared year by year with the annual ligneous layers formed during such periods in many different varieties of trees.

From the comparison it is not impossible that some interesting ideas relative to the laws of development of trees may be obtained. But, moreover, these laws once established, the trees in their turn might become precious collections of meteorological evidence for places and times where observations cannot be made. *Les Mondes* suggests rather a striking example of what might be learned from ancient trees, as follows: "Suppose that there should be found in Egypt a very old though living tree, the origin of which dated back to the time of Joseph. If, on cutting the trunk, the rings corresponding to that period showed seven thick and seven thin layers, there would be tangible evidence of the truth of the Scriptural tradition of the seven years of plenty and seven years of famine, besides of the immediate causes of humidity, temperature, etc., to which such phenomena might be due."

DRIER FOR OIL COLORS AND VARNISHES.—Water, 100 parts; gum lac, 12 parts; borax, 4 parts.

PRIZES FOR IMPROVEMENTS.

The Society of Arts, London, has lately issued a detailed statement of prizes offered for various practical improvements. We present the list, believing that, if our readers may not wish to compete, it will be suggestive of subjects for invention, and lead to new discoveries in other matters, if not in those here mentioned. We have recently published a list of five other rewards offered, for improvements pertaining to the use of gas, by the same Society, which it is unnecessary here to repeat.

The Council, in issuing this list of subjects and asking for communications upon them, state that they are aware that some of the suggestions put forth may, at first sight, appear difficult of realization. In some instances, the thing sought involves the use of known substances in the industrial arts in a manner in which they are not at present employed, but in which there is reason to believe they are capable of being used with economy. In other cases the aid of the chemist is sought to develop such a form of action upon the material used as will induce the creation of new industries, or aid the extension of old ones by economizing processes, render them less detrimental to health, or lessen the risk of accident to those employed.

Steam is the motive power now generally employed, but its use on common roads seems at present, for various reasons, inadmissible. Other agents, such as mercury, gunpowder, and petroleum, have been tried, but hitherto without success. There are, however, many other materials in nature to which scientific men and others may well turn their attention for the development of power, and put them in a form which shall render them available to the engineer and mechanist. It is believed that not one of the objects here sought is incapable of realization; and the Council hope that men of science—engineers, manufacturers, colonists, and agriculturists—will combine with men of capital to realize and bring many of them into commercial use.

\$1,000.—SWINEY PRIZE.—JURISPRUDENCE: Under the will of Dr. Swiney, a silver goblet, of the value of \$500, containing gold coin to the same amount, is presented on every fifth anniversary of Dr. Swiney's death "to the author of the best published treatise on jurisprudence." The next award of this prize will be made on the 20th of January, 1874. Competitors for this prize should send in copies of their published works to the secretary not later than December, 1873.

\$500.—TREVELYAN PRIZE.—PRESERVED FRESH MEAT: The sum of \$500, placed at the disposal of the Council by Sir W. C. Trevelyan, Bart., with the Society's medal, is offered for the discovery of a process for preserving fresh meat in an uncooked or raw state better than by any method hitherto employed, applicable to the preservation of meat in countries where it is now almost valueless, so as to render it an article of commerce.

FOTHERGILL PRIZE.—Under the will of Dr. Fothergill, funds are bequeathed for the offer of a medal, and "the following subjects are proposed to the Society for their consideration: (1.) The best method of preventing destructive fires, and of detecting incendiaries. (2.) Of speedily extinguishing fires when water is scarce. (3.) Of speedily securing valuable property from the flames, and also from thieves. (4.) Of preventing or diminishing the numerous fatal disasters from fashionable muslin dresses catching fire, whether by rendering such dresses less combustible, or having constantly in readiness a large cloak of incombustible fabric, composed of asbestos or amianthus, with which instantly to envelop the whole body. Paper of this kind (incombustible) might preserve from fire valuable deeds and other manuscripts. A premium for the encouragement of such a manufacture is also recommended. The above to be varied at the Society's discretion." On the present occasion the Society's medal is offered as follows:

GOLD MEDAL.—UNINFLAMMABLE WOOD: For the economical production of an unflammable wood, so as to render buildings in which it is employed less destructible by fire.

HOWARD'S PRIZE.—GOLD MEDAL OR \$125: For the production of a traction engine of moderate power, capable of being employed as a substitute for horse power on tramways and in the streets of cities and towns. The engine to form one structure in combination with the tramway carriage. The power may be generated by any means, provided that noise, noxious fumes, and the discharge of refuse into the air or on to the road surfaces are avoided.

GOLD MEDAL.—For the discovery or manufacture of a means for safely and economically generating power, suitable for use in place of steam. It should be free from refuse, noxious fumes, and injurious effects on the metals with which it may be brought into contact, or on the workmen employed.

SILVER MEDAL OR STOCK PRIZE.—Under the will of John Stock, funds are bequeathed for the offer of a medal for the encouragement of drawing, sculpture, and architecture. **SHELL CASES.**—On the present occasion the Society's medal is offered to female artists, for the best case, designed and executed on any of the shells ordinarily used for that purpose.

GENERAL PRIZES.—GOLD AND SILVER MEDALS.

MOLDS FOR METAL CASTING.—For the production of molds for casting, constructed without seams, and capable of resisting the temperature employed in running bronze and other molten metals; specimens of the molds and casts to be sent to the Society.

COATING VESSELS.—For an economical method of coating large vessels of zinc, such as baths, so as to present a bright and clean surface, not readily oxidized and as durable as a tinned or japanned surface.

VACUUM.—For the introduction and use of a vacuum, for the drying and preservation of fruits and vegetables, either with or without heat of low temperature.

VACUUM.—For any new and economic application of a vacuum in the preparation or finish of manufactured goods.

ELASTIC TUBING.—For an elastic material for tubing suited to the conveyance of gas, and not liable to be affected by moisture, alterations in temperature, or to be acted upon by the gas itself.

ROLLERS FOR PRINTING.—For a composition for feeding rollers for printing by cylinder machinery, similar in consistency and texture to the gelatin rollers used in letterpress printing, but adapted for working in water colors.

IMPROVED CHEMICAL BALANCE.—For the best chemical and assay balance, suitable for the use of students and experimentalists, which (loaded with 600 grains in each pan) will show a difference of .005 or less. To be sold at a moderate price.

INCOMBUSTIBLE WICK.—For the production of an incombustible wick, suitable for use in lamps.

CASTS (WHITE MARBLE).—For a means of casting ornamental panels, or marble groups of figures, flowers, etc., in white marble, so as to retain the transparency of the marble itself, as well as the polished surfaces of artistically finished works.

WASTE COAL.—For a more economical and efficient method than any at present in use of preparing waste coal, so as to render it available as fuel for engineering or domestic purposes.

COAL WORKING MACHINERY.—For an account of the modes at present in use for getting coal, and suggestions for improvements calculated to render the use of machinery more general in coal mines.

LIGHTING COAL MINES.—For a means of lighting coal mines, so as to increase the light in the workings, and at the same time reduce the risks arising in the use of the ordinary miner's lamp.

TUNNELING.—For the best account of the machinery used in tunneling, with suggestions as to the best means of applying either compressed air or water power in the working or getting of minerals.

FREEZING MACHINE.—For a machine or process, either chemical or mechanical, for lowering the temperature of substances by the abstraction of heat, more effectually and at a less cost than is done by machines at present in use. The machine must be capable of working efficiently in the tropics.

ETCHING AND ORNAMENTING IRON.—In a permanent way by the use of chemical agents; or by the application of enamels; or by both conjointly, for the decorations of iron fire grates, fenders, gaseliers, etc.

FOR THE APPLICATION OF LITHOGRAPHY OR BLOCK PRINTING.—To stopping grounds, for etching upon glass or metals by means of chemical agents.

A VARNISH.—or coating which can be applied to iron wires, so as to protect them against rust, and which shall not be liable to chip off when the wire is bent or rubbed.

A GALVANIC ELEMENT.—which shall combine the constancy of the Daniell's cell with the low resistance and high electromotive force of a Grove's cell.

AN ELECTRIC CONDENSER.—which shall combine high capacity with small bulk and small residual charge.

A SENSITIVE POCKET GALVANOMETER.—The size should not exceed that of a watch.

POTATO DISEASE.—For a method of preventing the potato disease.

NEW EDIBLE ROOTS.—For the discovery and successful introduction into England of any new edible root or tuber useful as food for men or cattle, capable of resisting frost, and suitable for extensive and improved cultivation.

HYDRAULIC ENGINE.—For a small, simple, cheap, and effective hydraulic engine, which, in connection with the constant water supply of towns, can be applied to work lifts in warehouses, drive lathes, the bellows of organs, etc.

UNsinkable SHIPS.—For plans for the construction of an efficient and seaworthy vessel, such that, when perforated either by shot or accident and filled with water, she shall in part maintain her floating power.

DIVING APPARATUS.—For an improved diving apparatus, in which divers may work free from the inconvenience of great pressure, and at greater depths than by means of the diving bell, helmet, or other existing appliances.

ELECTRIC WEAVING.—To the manufacturer who first practically applies electricity to the production commercially of figured fabrics in the loom.

NEW GUMS OR OILS.—For any new resin, gum, or oils, the produce of India or Africa, calculated to be useful in the arts and manufactures, and obtainable in quantity at a moderate price. Samples of not less than 25 lbs. of gum, and 50 lbs. of oil, to be transmitted to the Society.

MINES.—For the best method of applying air or water as a traction power in mines.

TELEGRAPHS.—For an economic and permanent means of telegraphing through uninsulated wires, between places not less than 1,000 miles apart.

COLONIAL SILK.—For the importation of silk cocoons, the production of any of the Australian colonies, in a dried and preserved state, in bulk, and fit for silk-reeling in England.

SURFACE BLOCKS.—For a ready means of reproducing designs by artists, as surface blocks, possessing sufficient relief to admit of their being worked at the steam press sharply and without blur.

GUNPOWDER.—For a method of constructing magazines for the storing of gunpowder, gun cotton, nitro glycerin, and other highly explosive compounds, so as to give increased security against explosions, and more effectually to provide against the possibility of large masses of material exploding, or, in case of explosion, communicating with other and adjacent quantities of explosive material.

PETROLEUM AND OTHER LIGHT OILS AND SPIRITS.—For a

cheap and effective method of constructing storehouses for the storage of petroleum and other light oils in towns and cities, so as to give greater security to the adjacent properties.

PEAT.—For the introduction into commerce, as a substitute for coal, of fuel manufactured from peat, and suitable for combustion in domestic fireplaces, the furnaces of steam engines, and for industrial purposes generally.

Patented inventions are not excluded from receiving the Society's rewards. The Council reserve to themselves the right of withholding all or any of the above medals or premiums, as the judges may report. The Council is willing to receive communications on subjects not included in the above list. The degree of originality and value of suggested improvements will have material influence on the adjudication of the award. In all cases a full account and description of the invention for which a medal or premium is sought must be sent to the Society. All communications must be written on foolscap paper, on one side only, with an inch and a quarter margin. They must be accompanied by such drawings, models, or specimens, as may be necessary to illustrate the subject. The drawings should be on a sufficiently large scale to be seen from a distance when suspended on the walls of a meeting room.

With regard to colonial produce of all kinds, it is absolutely necessary that a certificate from the Governor, Collector of Customs, or other qualified person, should accompany the samples sent to the Society, certifying that they really are the produce of the particular district referred to. The samples should be sufficient in quantity to enable experiments to be made and an opinion to be formed of their quality and uses; and it is desirable that the cost price in the district from which they are forwarded should be given. In every instance the probable extent of supply, with the average yield, if cultivated, and whether similar articles have hitherto been exported from the colony or not, and in what quantities, should be stated.

All communications and articles intended for competition must be delivered, addressed to the secretary, at the Society's House, London, free of expense, on or before the 31st of December, 1873 or 1874. In the first case they will be considered during the session 1873-4; in the second case, during the session 1874-5.

Any communication rewarded by the Society, or any paper read at an ordinary meeting, will be considered as the property of the Society. Should the Council delay the publication beyond twelve months after the date of its being rewarded or read, the author will be permitted to take a copy of the same, and to publish it in any way he sees fit.

Zinc Bandages in Surgery.

An interesting and important experiment in surgery was performed at the Park Hospital, a few days ago, in the presence of a number of distinguished surgeons, by Dr. Fluhrer, inventor of a new bandage for fractured limbs. The contrivance consists of a number of perforated zinc strips, which, when once arranged, form an absolutely inflexible bandage, not to be disarranged by any violence or uneasiness of the patient. As soon as these cover the point of fracture, the limb is firmly set and the natural outline restored. In one of the wards of the Park Hospital is Francis Lefry, a truckman, who had a compound fracture of both thighs. No parallel case of dual fracture, it is said, is on medical record; and, as the most unpromising, the doctor selected it for a practical test. After ether had been given to the patient, Dr. Fluhrer bent over the sole of each foot a broad zinc strip in the form of a loop, the extremities of which were securely wrapped with cloth bandages previously steeped in plaster of Paris, which were prevented from slipping by the tooth-like projections of the reverse side of the punctured zinc. The terrible fracture of both thighs, when the limbs were stripped for this purpose, could be plainly perceived. To the loops were fastened stout cords, which passed over the grooves of pulleys affixed to the adjacent wall, and were drawn taut by Warden Brennan. Dr. Fluhrer next mummified the limbs with a multiplicity of bandages, over which he laid his zinc strips, and covered them with a second stratum of bandage. Immediately the lumpiness about the region of injury disappeared, and the doctor expects that, in six weeks, this bandage will be removed, and in two more Lefry will use his legs.

Two New Steamships.

Two new steamers have recently been completed at the ship yards at Wilmington, Del., belonging, respectively, to the Cromwell and Metropolitan lines, and named the Knickerbocker and General Whitney. The former vessel is of iron, of 2,000 tons register, 280 feet long, 34 feet beam, and 23 feet depth of hold, costing \$260,000. She has a vertical inverted condensing engine 44 x 72, and four tubular boilers. With steam up in only two of the latter, it is stated, the ship easily made a speed of 10 knots per hour. She will ply between this city and New Orleans.

The General Whitney is also of iron, and is besides a very fine model of marine architecture. Her length is 245 feet, beam 40 feet, hold 28 feet and tonnage 1,848. There are two inverted engines 36 x 60 and three cylinder furnaces to each boiler. The engines and boilers are carefully enclosed in iron, and the engine room is remarkably commodious and well lighted. The vessel has some novel arrangements in the shape of four independent hoisting engines, operating seven freight cranes stationed at various points. By this means the time consumed in receiving or discharging cargo will be materially reduced. The port shutters are also of new invention, and are easily worked by one man, though of exceptionally ponderous construction. The ship will be used for freight purposes only, between this city and Boston.

IMPROVED TURBINE WHEEL GOVERNOR.

We illustrate herewith a novel and simple form of apparatus which, it is claimed, acts as an efficient and reliable governor for turbine or other water wheels. The construction is of a type generally familiar, the balls being thrown out by the centrifugal force of the rapid rotation, which of course increases with the speed, thus, through suitable apparatus, controlling the gate, and hence the quantity of water which reaches the buckets of the wheel.

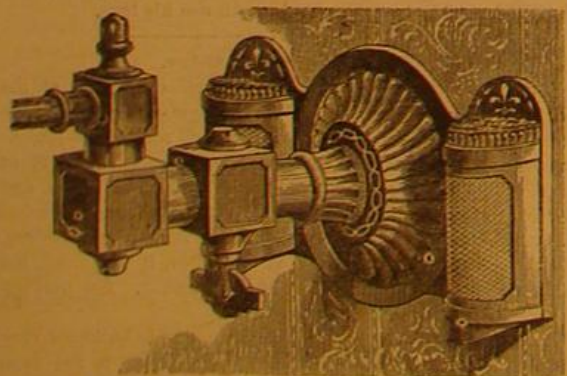
A is the driving band and pulley by which motion is given to the governor shaft. Pivoted to lugs immovably secured to the latter, at B, are the bent levers, which terminate in the balls as shown. These communicate with other pivoted rods, the connection between which is clearly indicated in the engraving, and which finally connect above and below with sleeves, C, which slide freely up and down the governor shaft. To the sleeves are secured portions of clutches, the corresponding parts of the latter being attached to two loose pulleys, D and E. Pulley D connects with another pulley on a second shaft, F, by means of a straight belt. Pulley E, however, is attached to the same by a crossed band. Consequently the effect is that, when the pulley, D, is in action, the shaft, F, rotates in the contrary direction to that which it assumes when the pulley, E, is in operation. Shaft F has a pinion, G, on its lower end, which pinion communicates with a gear wheel on the gate shaft.

The operation of the device can now be easily followed. The turbine is started by opening the gate by turning the large hand wheel shown on the shaft. To do this the pinion, G, which is connected with the shaft, F, by a slot and feather, is lifted by the foot lever, H, so that its teeth no longer engage with those of the gear wheel. As soon as the turbine is in motion, however, the pinion is allowed to fall back into place. The pulley, A, rotating the governor shaft, transmits motion to the balls through the rigid connection of their arms at the point, B. It is evident that, as the rapidity of motion increases, the balls will assume a position more nearly perpendicular to the vertical shaft, and in so doing will raise the upper sleeve so that the clutch upon it and the pulley, D, engage, causing the pulley to be carried around. By this means the shaft, F, and pinion, G, will be rotated so as to turn the gate shaft and partially close the gate, thus checking the inflow of water. The speed of the wheel will, of course, diminish, when the balls will fall and the clutch above drop out of action. In case the speed should become too slow, then the further effort of the balls to reach the lowest possible point will cause the lower clutch to come into action with the pulley, E. This, however, as we have already explained, causes the shaft, F, to turn in the opposite direction, opening the gate wider and increasing the speed. It is evident that the supply of power will be so adjusted as to develop a speed of shaft that will keep the governor arms and balls between the two clutches, for, as a matter of course, the moment either clutch comes into action, the effect is either to increase or diminish the speed until the apparatus resumes its proper position.

For further particulars address the inventor, Mr. Joseph F. Terhune, Stockholm, N. J.

GAS BRACKET MATCH SAFE.

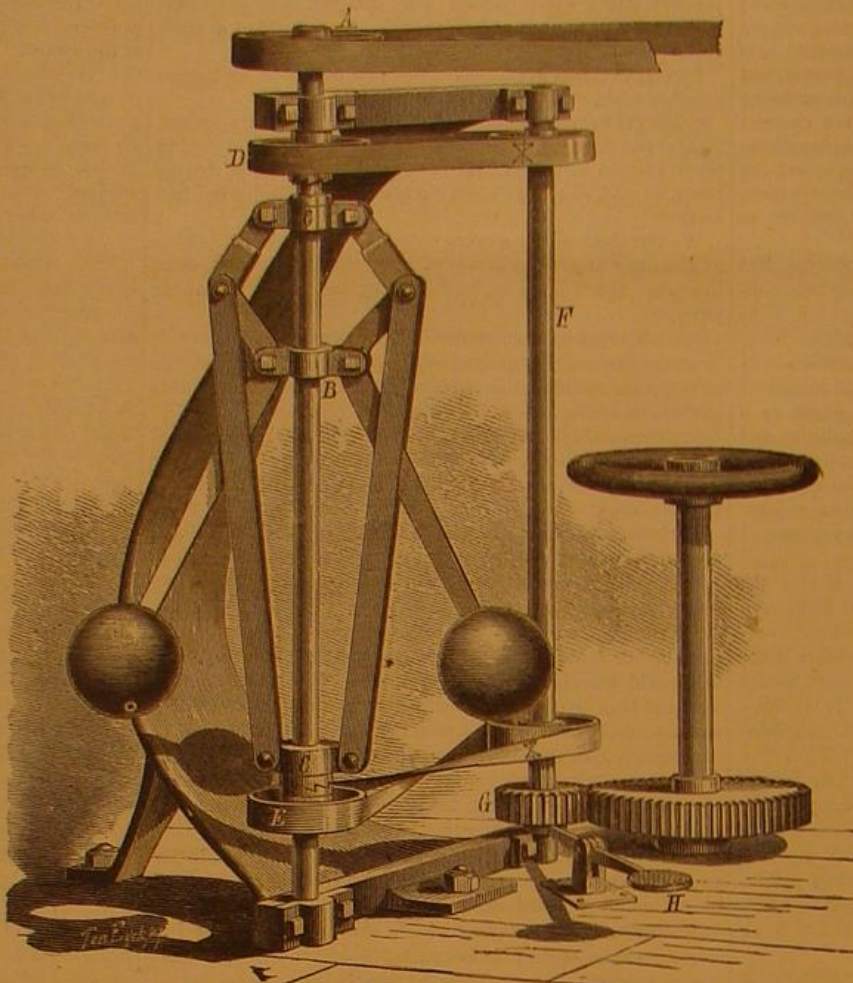
Everybody has experienced the annoyance of searching for matches in a dark room, doubtless to the no small detriment of temper as well as of such projecting portions of the body as are brought in sudden contact with vagrant rockers or sharp corners of tables and bureaus. Match safes, in fact, have the unpleasant peculiarity of apparently never remain-



ing in the spot where last placed, because every one using the contents leaves the box wherever about the room he may happen to be, so that the next person is obliged to hunt for it. Moreover, about nine tenths of the common match receptacles upset on the slightest provocation, strewing the floor with inflammable material, ready to take fire and burn holes in the carpet, and sometimes set dresses on fire, whenever accidentally stepped upon. We illustrate herewith a new form of safe, the invention of Mr. M. L. Orum, which can neither upset nor wander about a room, because it is fastened immovably to the wall by screwing the gas bracket against

it. The fixture is first removed, the hole in the device slipped over the pipe, and the bracket replaced, the whole being the work of a moment. Thus located, the box is always at hand when and where wanted, and, besides, is situated at the point where matches are usually scraped upon the wall, thus preventing injury to the paper or paint. It can be made with either one or two receptacles for matches, two being preferable, as one of the boxes may be employed to receive the burnt sticks. In material, style, and design, the attachment may correspond to the bracket to which it is screwed.

For hotels, where lodgers are apt to carry off the match



TERHUNE'S TURBINE WHEEL GOVERNOR.

boxes, the invention is excellently adapted, while its convenient and ornamental form will doubtless commend it as a necessary appendage to the gas fixture in every room.

For further particulars regarding rights to manufacture, application should be made to Messrs. Mellor & Orum, 448 North 12th street, Philadelphia, Pa.

The Opeloscope.

This is a new and simple instrument, suggested by Professor A. E. Dolbear, for the purpose of demonstrating the pulsations of sound. Take a tube of any material, from one to two inches in diameter, and anywhere from two inches to a foot or more in length. Over one end paste a piece of tissue paper or a thin piece of rubber or goldbeater's skin; either will do. In the center of the membrane, with a drop of mastic, fasten a bit of looking glass not more than an eighth of an inch square, with the reflecting side outward, of course. When dry, take it to the sunshine, and, with the open end of the tube at the mouth, hold the other end so that the beam of reflected light will fall upon the white wall or a sheet of paper held in the hand. Now speak, or sing, or toot in it. The regular movement of the beam of light with the persistence of vision presents very beautiful and regular patterns, that differ for each different pitch and intensity, but are quite uniform for given conditions. If a tune like "Auld Lang Syne" is tooted slowly in it, care being taken to give the sounds the same intensity, a series of curves will appear, one for each sound and alike for a given sound, whether reached by ascension or descension, so that it would be possible to indicate the tune by the curves; in other words, it is a true phonograph.

By trial one can find some tone which causes the membrane to vibrate in a single plane, and of course a straight line will appear upon the screen. If, while the sound is continued, the tube be swung back and forth at right angles to the line, the sinuous line will appear, which may be either simple, representing a pure and simple sound, or it may be compound sinuous, showing over tones, precisely as in König's manometric flames.

With the lecture room darkened and using the beam of light from a *porte lumière* or from a lantern, these may be projected of an immense size. There is no trouble in the world in making them eight or ten feet amplitude or more if needed. At a distance of but three or four feet, the curves will spread out to two or three feet in length when a tone is made to which the tube can reasonably respond.

The Water Supply of Rome.

In the course of a lecture on Roman antiquities, delivered at the Royal Institution, London, Mr. J. H. Parker said: The celebrated *Aqua Marcia* has recently been again brought

into Rome, and is rapidly coming into use, being considered the finest drinking water in the world, always cool even in the hottest weather. On the river Anio itself, where a fine cascade falls over the rock, there is a deep rocky gorge; and here great engineering works were made in the time of Claudius and Nero. A great wall, 12 feet thick, built of large blocks of stone, was erected across the river at the lower part of the gorge, forming a dam of 100 feet high and 12 feet thick, to enclose a portion, perhaps 100 yards long, between the dam and the natural cascade; the water was made to fall over the dam, which thus became the cascade; but at one end of it a specus was made below the level of the surface of the water, so that the water must always flow through that specus, and consequently through Rome, before any of it could fall over the cascade. This magnificent and most useful piece of engineering continued in use for centuries. It was destroyed in the fourteenth century by an ignorant monk, who was annoyed by a temporary flood in the upper country, which overflowed the meadows near his monastery, and, to relieve that, he made a hole at the bottom of the great dam. The force of the water soon carried all before it, and caused a great flood over all the lower country, even to the Tiber, and did immense mischief—even the walls of Rome were injured.

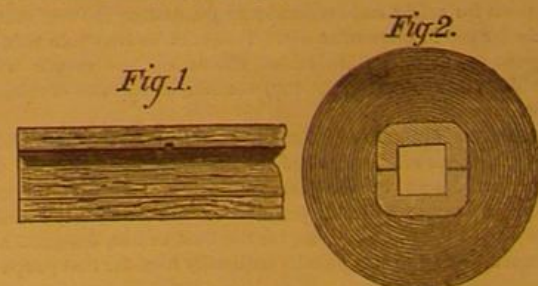
Mr. Parker said that he had not time to describe the *thermae*, or great public baths, to supply which most of the aqueducts were made, but he could not conclude without mentioning that the opinion, commonly entertained, that the ancient Romans were ignorant of the fact that water will rise to its level, is entirely a popular delusion. At every half mile of the aqueducts, on their course from the foot of the hills to Rome, each aqueduct forms an angle, to break the force of the water, and at that angle a great reservoir is made, with a *piscina* or filtering place at one end. Each *piscina* consists of four vaulted chambers, two above and two below. The water enters into the top of the first upper chamber; it then falls through a hole in the vault into the first lower chamber, then passes through small holes in the intermediate wall into the second lower chamber, then rises again through a hole in the vault into the second upper chamber, and then follows its course at the same level as it originally entered, depositing its mud in the lower chamber as it passed. Each *piscina* is therefore made upon the principle of water finding its level.

They used the large stone specus, or aqueducts, instead of ordinary pipes, because they could not depend either upon their leaden pipes or their *terra cotta* pipes to resist the force of such a stream of water. Nothing but the concrete stone was strong enough.

At the present time, the cast iron pipes of the new company are bursting every day in the streets of Rome to such an extent that the managers of the company fear that the expense will be ruinous to them. This seems to show that the old Romans were better engineers than we are.

A Trade Mark Decision.

The value of trade mark security to manufacturers and merchants is forcibly demonstrated in the following recent decision of the Supreme Court, rendered in the Circuit Court of the United States for the Eastern district of Pennsylvania, McKenna, judge, in the case of the Lowell Manufacturing Company against Larned and Starr, which is of interest as bearing on the law of trade marks. The complainants many years ago began to send their rolls of carpet to market with a hollow wooden shell in the center of each roll. The annexed engraving exhibits the construction. Fig. 1 is a plan view of the inside half of the shell. Fig. 2 is an end view of carpet, rolled, with shell in place. This shell can both be seen and felt. Becoming a distinguishing mark of the goods, they continued its use and adopted it as their trade mark, registering it as such in January, 1871,



under the act of July 8, 1870. Defendants copied it, and complainants having brought suit, pleaded that it was an unpatented mechanical contrivance for rolling the carpet and extracting the spindle. After full argument by Horace Barnard and Ludovic C. Cleeman for complainants, and Victor Guillon for defendants, Judge McKenna decided that the "shell" is a good and valid trade mark, and complainants are entitled to its exclusive use, further deciding that defendants have infringed. A perpetual injunction is granted, with reference to a master to compute and assess profits and damages.

BLACKSMITH'S MEASURING WHEEL.

Mr. Thomas R. Way, of Springfield, Ohio, is the inventor of the device herewith illustrated, for measuring the circumference of wheels and the length of the iron from which tyres therefor are to be made. The peculiarity of the apparatus consists in an extra pointer pivoted to the hand which indicates the wheel measure, for the purpose of deducting from the latter the amount to be allowed for expansion of the metal.

The wheel shown revolves freely on its axle, to which, however, the hand, A, is rigidly affixed. The pointer, B, is secured to the hand, A, by a screw, as shown in Fig. 2, so that its end may be set at any desired distance from that of its support. The device is applied and carried around the wheel to be measured, as represented in Fig. 1, where the hand, A, indicates the length of circumference passed over. The pointer, B, is then fastened with its end at a distance to one side of the hand equal to the amount of expansion of the iron. The apparatus is afterward carried over the tyre, which is cut at the point indicated by B.

The invention may also be employed by coopers for measuring hoops, in which case the extra pointer may be used to indicate the allowance for lap.

The Novel Steamer.

The saloon steamship designed by Mr. Bessemer, to make sea sickness impossible, is well under way at Hull, England. The framing is nearly complete, and a good part of the outer plating has been put on. The steamer is 350 feet long, 40 feet broad inside of her paddle boxes, and of 2,774 tons burthen. She will be driven by two sets of paddlewheel engines, acting upon a double set of paddlewheels, situated 100 feet apart, the aggregate power of the engines being no less than 4,600 horse power. The two ends of the ship are alike, and each will be furnished with a rudder. Her most characteristic feature is her saloon, which will be 70 feet long and 30 feet wide, and suspended upon massive pivots at the center and at the extremities. Thus supported, it will be brought under the control of powerful hydraulic gear, worked by the principal boilers of the ship. This gear will be so arranged that it is expected a man will be able to impart to the saloon a rolling motion in relation to the ship precisely the reverse of that which the ship herself receives. The engines, it is anticipated, will drive the vessel at a speed exceeding 20 miles an hour.

THE BLACK NECKED SWAN.

The swan, in one or another of its numerous varieties, is aboriginal in all parts of the globe. A large number are to be found in our beautiful Central Park. The proud and

placid white swan is probably the best known of all the species, and is certainly, when on the water, one of the most beautiful of birds. Virgil cited the black swan as a *rara avis*, and as the black variety is indigenous to Australia only, the Mantuan poet's acquaintance with it must have been ra-

Fig. 1

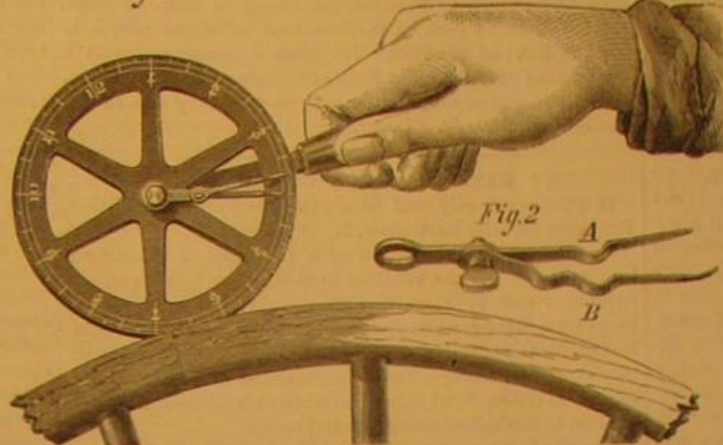


Fig. 2

**BLACKSMITH'S MEASURING WHEEL.**

ther mythical. The black necked swan (*cygnus nigricollis*), of which we present an illustration, is a native of South America, and it rivals the European white bird in the color of its body and wings, while its neck and head are of a splendid black color. In the red color of its bill it also resembles the white swan. A pair of these birds were taken to England and placed in the zoological garden of the late Earl Derby, at Knowsley, near Liverpool; and when the collection was dispersed, at Earl Derby's death, the Zoological Society, of London, became the possessors. Specimens of the variety are also to be found in the gardens at Amsterdam and Cologne.

As shown in our engraving, the young birds are singularly undeveloped, their necks being especially at variance with those of the grown birds. But time adds to them not only their singularly graceful form and beautiful plumage, but also the prodigious strength for which the whole species is remarkable, instances being on record wherein men's limbs have been broken by the blows of the wings of infuriated swans, whose pugnacity at breeding time is notorious. The females lay from five to eight eggs, the period of incubation being six weeks.

The Year's Business at the Patent Office.

A statement prepared by the Commissioner of Patents for the coming report of the Secretary of the Interior shows that, during the year ending September 30, 1873, there were

filed in the Patent Office 20,354 applications for patents, including reissues and designs; 283 applications for the extension of patents, and 519 applications for the registering of trade marks. Twelve thousand nine hundred and seventeen patents, including reissues and designs, were issued; 235 extended, and 955 allowed, but not issued by reason of non-payment of the final fee; 3,274 caveats were filed, and 476 trade marks registered. The fees received during the same period from all sources amounted to \$701,626.72, and the total expenditure to \$699,449.69, making the receipts \$2,177 in excess of the expenditures. The appropriation asked for the fiscal year ending June 30, 1875, is \$693,500. The expenditures included \$40,000 for the publication of the *Official Gazette*, \$40,000 for printing current drawings, and \$60,000 for the reproduction of old drawings. These items were unusual, and account for the absorption of most of the customary excess of receipts over expenditures. The cost of printing current drawings has heretofore been defrayed out of the government printing office appropriations. In regard to the reproduction of old drawings, the Commissioner considers the amount expended for that purpose a good investment, not only with reference to the intelligent advancement of the manufacturing interests of the country, but financially, as they are

now being sold at two or three times their actual cost. The Commissioner again invites earnest attention to the great want of additional room for the proper transaction of the business of the Office, stating that it is utterly impossible to properly classify the work of the Office, in order to insure its being economically and well done, in the present crowded state of the files, records, and exhibits.

Effect of Artificial Addition of Phosphates to the Food of Lambs.

V. Hofmeister states that two lots, each consisting of three eight weeks old wether lambs, were fed from May to December on hay and potatoes, with a little salt, this diet being selected as characteristically poor in phosphates. One lot received precipitated tricalcic phosphate with its food, the other lot none. During the last 77 days most phosphate was given, the phosphatic diet then containing one fourth more phosphate than was supplied by the vegetable food. The lambs gained about 18 lbs. per head in the six months. Those receiving phosphate showed a distinctly better appetite and drank more water than the others, but their greater increase in weight was insignificant. When slaughtered the only difference between the two lots was a slightly larger weight of stomach, intestines, and lungs, in the case of the lambs receiving phosphate. Five bones of two lambs in each lot were carefully examined. The fresh bones of the



SOUTH AMERICAN BLACK NECKED SWANS.

lamb fed with phosphate were on an average slightly heavier; they had a mean specific gravity of 1.384, the specific gravity of the other lot being 1.350. Analysis showed that there was generally more water and less fat in the bones of the lambs fed with phosphate; the dry bones of these lambs also generally contained a slightly larger proportion of incombustible matter; but looking at the absolute quantities found in the bones of the two lots, there was no increase of incombustible matter by feeding with phosphate, but a small increase of phosphoric acid, coupled with a diminution of lime. The amount of fat in most of the bones was very high, reaching to 40 per cent in the dry bone of the fore leg.

Experiments were made as to the digestibility of phosphates. The lambs fed on hay and potatoes (chiefly the latter) digested during six days 25.8 per cent of the phosphoric acid, and 46.0 per cent of the lime contained in their food; and in another experiment of four days, 40.9 per cent of phosphoric acid and 20.6 per cent of lime. In a further experiment of six days, with two year old sheep, on a similar diet, 43.3 per cent of the phosphoric acid and 43.0 per cent of lime in the food were digested. When the lambs received 6 grammes of precipitated phosphate per day, the whole of the extra phosphoric acid was taken up; but when the quantity was increased to 9 grammes, only about half the phosphoric acid was digested. In no case was all the lime of the phosphate taken up, but a greater proportion of the lime was taken up from the larger dose of phosphate. The old sheep received superphosphate. When 10 grammes were administered per day, the whole of the soluble phosphate was digested; but when the dose was increased to 20 grammes, only 64 per cent of the soluble phosphate was digested. As with the lambs, a greater proportion of lime was taken up from the larger dose of phosphate.—*Journal of Chemical Science.*

Photographs in Natural Colors.

After many unsuccessful attempts, I have at last been fortunate enough to discover a method of producing, with great ease and certainty, heliochromic prints whose colors are closely allied with those of nature. I have obtained by my method reproductions of colored glass and stamps. I can also obtain landscapes in the camera, but with colors rather weak in nature, the result, no doubt, being capable of improvement by having recourse to a better adapted apparatus.

My method of operating, at which I have arrived after numerous trials and experiments, I will now describe:

A sheet of paper, with as fine a grain as possible, is plunged into a silver bath made up as follows:

Nitrate of silver..... 20 parts.
Distilled water..... 20 "

are taken, and, as soon as a solution has been made, there is added:

Alcohol..... 100 parts.
Nitric acid..... 10 "

When the sheet has been thus treated and dried again, it is further plunged into a solution of

Hydrochloric acid..... 50 parts.
Alcohol..... 50 "
Nitrate of uranium..... 1 "

A little zinc white is dissolved into the hydrochloric acid beforehand.

After this double treatment, the sheet of paper is exposed to sunlight for a short time, until its surface has assumed a violet blue tint. It is then immersed again, after desiccation, in the silver, as also in the hydrochloric bath. These operations are repeated until a most intense blue has been obtained, this being the only way to secure very vigorous images.

Before the paper is altogether dry, it is put into another bath, made up by adding a few drops of a solution of mercury, dissolved in nitric acid, to some distilled water. The sheet is allowed to remain from five to ten minutes in this last named bath, and is then dried by contact with blotting paper.

The sheet thus sensitized is then exposed to light under colored glass—a colored magic lantern slide, for instance; and after a period of twenty to thirty seconds in the sunlight, an impression on a white ground is obtained, with all the colors of the model. The colors are more vivid, and the rapidity quite as great, if there is added, to the bath just mentioned,

Saturated solution of bichromate of potash or ammonia..... 2 parts.
Sulphuric acid..... 2 "
Chlorate of potash..... 1 "

To fix the prints in some degree, they are washed in plenty of water, and then immersed in

Ammonia..... 5 parts.
Alcohol..... 100 "

After again washing, the impression is put in a bath saturated with an alkaline chloride. Then, after a final washing, the image will be found to resist for a considerable time the action of diffused light.

ACTION OF COLORED GLASS.

1. Much greater rapidity is obtained if the chloride of silver paper is darkened under violet or blue glass.

2. If, on its exit from the nitrate of mercury bath, the sheet is exposed under a colored glass, and there are interspersed, between the sunlight and the glass, screens or glasses of different colors, it will be observed that the colors appear more rapidly under the yellow, green, and red screens, than under the blue and indigo ones.

COMPLEMENTARY COLORS.

The phenomenon of complementary colors, observed by M.

Bequerel when plunging the impressions in ammonia, is exceedingly easy to produce with paper. To effect this, it is only necessary to put the print, after it comes out of the frame, into a solution of carbonate of soda, and then plunge it, after washing, in a solution of nitrate of lead, and expose it to sunlight in a bath of an alkaline chloride. The phenomenon may also be produced in several other ways.

To reproduce landscapes in the camera, it is necessary to prevent, as much as possible, the action of diffused light, and to do this a cone of cardboard of sufficient length is fixed in front of the lens. The time of exposure with a Dargot lens of about eight inches focal length is from fifteen minutes to an hour, operating with an open stop and in full sunlight.—*M. De St. Florent.*

THE DEEP INJECTION OF CHLOROFORM.

In a paper recently read before the Academy of Medicine, Professor Roberts Bartholow, M. D., says:

It is true that the injection of a few drops of chloroform into the gums for the relief of toothache has been practiced by others, and by myself, with success; but hitherto, as far as I am aware, no one has used the deep injection of chloroform for the cure of *tic douloureux*. Indeed, the hypodermic injection of chloroform has been regarded as improper, owing to the violent local inflammation which follows its introduction to the subcutaneous areolar tissue.

The ill effects produced by the injection of chloroform into the areolar tissue are these: vaporization of the chloroform and consequent gaseous distention of the surrounding parts, painful swelling, inflammation, and the formation of an abscess. The pain experienced by the patient at the moment of injection is also considerable; and as the needle is withdrawn, the chloroform acts with energy on the wounded skin. These are very serious and almost insuperable objections to the hypodermic injection of this agent. The same objections do not hold against the deep injection of chloroform according to the method which I practice for the cure of *tic douloureux*. It is true considerable pain is experienced and swelling arises, but the pain quickly subsides, and no inflammation ensues and no abscess is produced.

The needle is inserted under the upper lip, which is raised, and passed so deeply that its point shall rest near the infra-orbital foramen. The chloroform is then slowly injected. When the needle is withdrawn, firm pressure from the cheek is made over the point of insertion of the needle, and is maintained for a time to insure the diffusion of the chloroform.

It is generally admitted that injection of the anodyne at the site of pain is not necessary to the relief of neuralgia. The curative effect is supposed to be due to the impression made by the anodyne on the center of consciousness. While this is undoubtedly true, there are many reasons for believing that the local influence of an anodyne on the end organs, the seat of a painful impression, is very serviceable, for pain of peripheral origin is made of two factors, an irritation of the sensory nerves, a realization of this irritation by the centers of conscious impressions. Furthermore, there are good reasons for believing that improvement in the condition of nerves, the seat of a painful sensation, reacts beneficially on the center with which they are physiologically and pathologically connected, although the peripheral pain may be the reflection outwardly of a centric lesion.

It is a singular anatomical fact that the facial vein communicates with the pterygoid plexus and the cavernous sinus; hence an injection of chloroform into the part I suggested and practiced in this operation must reach the brain more directly than by any other route. The effect, hence, may be much more decided than when injection is practiced into remote parts.

Case I.—Mr. M., aged about fifty years, married, and by occupation a book keeper; a tall, rather spare man, of nervous sanguine temperament. His hair and beard are freely sprinkled with gray. Although pursuing a sedentary occupation, he has had considerable outdoor exercise, and led a rather active life. Being in good circumstances, his hygienic surroundings have been favorable. He has lived freely and has always had a good appetite and vigorous digestion. He is accustomed to the daily use, in moderation, of whisky and tobacco.

About two years ago Mr. M. began to suffer with pain in the infra-orbital branch of the fifth nerve. The attacks appeared with more or less frequency during the ensuing eighteen months, and gradually increased in severity.

When he presented himself to me for treatment, he was in the following state: he was emaciated, and his countenance was anxious and worn. Owing to the extreme suffering which mastication induced, he had great difficulty in getting a sufficient supply of food. Every motion of the lip, the gentlest washing of the face, a touch of the cheek, induced a paroxysm of pain of horrible severity. The pain was on the right side of the face, and was experienced in the infra-orbital nerve and its terminal branches. During the paroxysm, the muscles of the face were convulsed, the eye injected, and profuse lachrymation occurred. There was great tenderness to pressure over the infra-orbital foramen, and a slight touch induced a paroxysm of pain. His teeth, although not very good, did not appear to be the seat of the irritation, for no pain was developed by pressure on or by striking them sharply. Raising of the upper lip always caused a severe paroxysm. In consequence of this, talking was painful, and the attempt to smile brought on an agony of suffering, so that he avoided seeing his friends. There were no evidences of intra-cranial disease except neuralgia, nor was there a history of specific infection.

I determined, as the patient was naturally most anxious to obtain relief, to inject chloroform. Charging the syringe

with half a drachm of Squibb's chloroform, I passed the needle deeply under the lip, according to the method which I have already described, and injected the chloroform in the neighborhood of the foramen. Mr. W. experienced a very severe paroxysm of pain at the moment: this was succeeded by burning pain at the site of the injection, numbness of the lip, giddiness and sopor, and swelling of the cheek. In rising to walk, he staggered and had difficulty in maintaining the vertical position. He went immediately home and laid down, in consequence of the continued vertigo and drowsiness. The giddiness did not entirely disappear for twenty-four hours or more. The pain ceased and has not since returned, a period of more than three months having now elapsed. The patient did not again present himself until three weeks, being desirous to ascertain, beyond peradventure, that his relief was permanent, a fact which he could scarcely realize after the protracted and agonizing suffering which he had endured. A remarkable improvement had occurred in general condition in this time. He had gained largely in weight, and his countenance wore a cheerful expression, instead of the anxious and suffering appearance which it had before presented.

Case 2.—Mr. E. V. W., farmer by occupation, aged about fifty-six, a man of medium height, compactly built, and of bilio-nervo-sanguineous temperament. He always had enjoyed good health and led an active outdoor life. About five years ago, he began to experience decided pain in the infra-orbital division of the right fifth nerve. The paroxysms occurred at first at long intervals; within the past year they have rapidly increased, and during the last three months have been almost continuous. During this time, the slightest touch on the surface of cheek, a current of air, washing the face, raising the lower lip, and especially the mastication of food, have given rise to horrible paroxysms. Lately he has found it necessary to eat alone. The frightful contortion of the muscles of the face, and the rolling of tears down his cheek during mastication, have excited so much apprehension in his family and friends as to render this isolation necessary.

As is usual in these cases of *tic douloureux*, the countenance of this patient expressed great suffering. He looked worn and anxious. When giving me his history, he had repeated paroxysms, during which the muscles on that side of the face became convulsed, the tears rolled down his cheeks, he ceased to speak, and his countenance wore an expression of great agony. He described the pains as of two kinds: a sensation of painful vibration in the face, eye, and forehead, and sudden darting pain, of intense severity, shooting up through the jaw to the eye and head. When I lifted up the lip to examine the mouth he had an atrocious attack, and begged me to desist until the paroxysm ceased. There was no disease of the teeth. Besides the neuralgia, he had no symptom of cerebral disease. His functions were otherwise normal. The loss of flesh was plainly due to the difficulty experienced in taking in a sufficient supply of food.

I injected, in the way already described, thirty minims of chloroform. This brought on a severe paroxysm of pain, which continued for a few minutes, but was succeeded by a feeling of relief, numbness of the face and lip, some drowsiness and swelling of the cheek. The relief to the pain lasted nearly twenty-four hours, when a light paroxysm ensued and the injection was repeated. In all, four injections were made in space of a week, but no pain was experienced after the second injection. At the expiration of two weeks, having had, meanwhile, no recurrence of his old malady, he called to say he was perfectly well. As he has not since presented himself, I have no doubt that he continues free from any return of the disease.

EMBALMING THE DEAD.—In the Vienna Exposition there were several specimens of the embalming of parts of the human body. Those exhibited by Dr. Marini, of Naples, were particularly to be noted. One of these was a large round table made of muscles, sinews, etc., of a dark brown color, with a handsome polish. Among his other exploits he petrified Thalberg, the deceased pianist, and the widow is said to keep the corpse in her drawing room. He also embalmed Mazzini, and so well that some of the more economical admirers of that statesman urged that the body should be set up in Rome as a statue, and thus save expense.

SAGACITY OF BIRDS.—Certain facts render it probable that birds, in some manner, become aware of cholera infection in the air. Recent European journals state that at Munich, where several cases of cholera have occurred, the rooks and crows, which flew about the steeples and through the trees of the public promenades, have all emigrated; and the same thing happened during the cholera seasons of 1836 and 1854. According to Sir Samuel W. Baker, the same phenomena occurred at Mauritius, where the martins, which exist in immense numbers the year round, wholly disappeared during the prevalence of the cholera.

QUALITATIVE ANALYSIS OF BENZINE.—Commercial benzine often contains quite a large proportion of petroleum, which leaves a disagreeable odor when the benzine is employed for the removal of grease. A small piece of pitch is placed in a test tube and the suspected liquid poured upon it. Pure benzine will readily dissolve the pitch, forming a tarry mass, while adulterated benzine will be less and less colored in proportion to the amount of petroleum contained in it. Coal tar will dissolve easily in pure benzine, but forms distinct layers when impure material is employed for the solution.

SCIENCE AND HEALTH.

The American Public Health Association, a body the objects of which are sufficiently indicated by its name, recently held its second annual meeting in this city. A number of interesting and valuable papers by eminent physicians and others were read, of the more important of which we give abstracts herewith.

Dr. Nathan Allen, speaking upon the laws of longevity, pointed out that a mind well cultivated and balanced, cheerful disposition, temperate and regular habits, are great promoters of long life. Hence longevity is found among civilized nations more than among savages. The prerequisites of prolonged life may be classed under the heads of constitution, inheritance, and obedience to laws. It was finally considered that physiology in its practical application is yet in its infancy; and when it is thoroughly understood in the family and the schoolhouse, the duration of life will be greatly increased.

THE HOUSEKEEPER'S RESPONSIBILITY

formed the subject of some excellent remarks by Dr. Edward James, of Dorchester, Mass., in which he said that man is more affected by the kind of food he eats than the lower animals, because he is of a more sensitive disposition. All measures of his life ought to depend on his digestion, and the methods of his housekeeper. The stomach is originally sound. It can digest and convert all proper food necessary for the support of the animal body, if it is suitably selected and prepared. If, after our meal, the stomach complains, we have headache, or are languid, nervous, depressed, have pains of neuralgia or indigestion, or our energies are overborne, it must be referred to the way in which we have treated the stomach by putting unsuitable burdens upon it. A large portion of these ills are due probably to our own fault, and to our love of what we call really good eating; but the cook and housekeeper are, more likely, to blame.

Dr. Hamlyn, of Bangor, referring to

DIET,

considered that, in the selection of meat for food, there is too little care. Flesh contains the elements of vicious poison. Butcher's meat contains but a small portion of nutriment, as shown by French physicians. It is now exposed to the air before serving it for the table. The exposure deprives it of a portion of its nutriment. Animals should be stalled and fed before being offered for food; but so far from that being the case, they are brought here by long travel in cars, worn and harassed. The meat should be prepared at the pastures of the cattle; and if necessary, the law of the nation should secure such a consummation.

THE SANITARY RELATION OF HEALTH AND ARCHITECTURE was considered by Mr. Carl Pfeiffer as of great importance, inasmuch as the architect furnishes the human body, by means of its dwelling place, its house, with the proper medicine wherewith to regulate its intercourse with what is its chief food and necessity—air. As this chief food exceeds in amount three thousand times that of all other kinds, so in proportion is the science of building a proper house of pre-eminence to the science of hygiene. One of the first principles of architecture is that the material of buildings should be dry and porous. The furniture can chill and produce rheumatic affections if it is damp or has been long in an unheated room. Cold bedrooms are breeders of disease unless they have ventilation besides their cold. People sleep in airtight cold rooms and believe they are doing a wondrous thing for their health, particularly if they have the bedroom aired in the morning. All night long the air stays unmoved and becomes slowly poisoned, while the evaporation of the body settles upon the walls and makes the room more and more airtight.

Referring to the

REFUSE OF CITIES,

Dr. C. A. Leas, of Baltimore, recommended great care and regularity in removing the ashes and garbage from the various sections. He urged that carts should be employed in this service, and that ashes and vegetable matter should be kept in separate receptacles, and emptied at regular and stated times.

Dr. Storer, of Boston, read a paper on the same subject, recommending a change in the method of disposing of the offal of slaughter houses. The most effectual way was to build chambers or ovens four or five feet square, where the gases and steam may be burned. Public health demanded that the offal and dead animals of a city should not be permitted to accumulate.

Dr. Russell's report on

YELLOW FEVER IN LOUISIANA

was read by Dr. White, of New Orleans. It was reported that the cases at Shreveport and Memphis were not more malignant than those found in New Orleans, and that the sprinkling of carbolic acid and hygienic measures are almost sure to moderate the disease. It is a strange fact that no single colored person took the yellow fever, and they rarely ever take it unless it is fiercely epidemic.

"For use in this city we have dead oil, and for streets carbolic acid. In applying these disinfectants, we applied 70 per cent of carbolic acid, and a chloride of zinc and iron, precipitated from scrap tin, which we used through water carts by a hose attachment, by which three men, going as fast as a horse could walk, could sprinkle each gutter; and by this means we have sprinkled 150 miles a week. No complaint of the smell of carbolic acid ever came to us. We were able, with dead oil and zinc solution, to disinfect about 120 outbuildings a day."

Dr. White said: In New Orleans they sprinkled carbolic acid on the velvets and silks in houses, as disinfectants, as it could not destroy colors.

General Francis A. Walker, superintendent of the United States census, followed in an interesting paper on

THE STATISTICS OF MORTALITY,

in which the proportion of deaths among all classes was shown, as follows:

	Share of population.	Share of deaths.
Colored.....	126 in 1,000	137 in 1,000
Irish.....	48 in 1,000	55 in 1,000
German.....	44 in 1,000	38 in 1,000
English and Welsh....	16 in 1,000	15 in 1,000

The large proportion of deaths from accidental causes among the latter class may be perhaps attributed to the fact that so large a number of the Welsh population are miners. From the severity of our climate, all foreign elements tend somewhat to consumption when on our shores. In the South the native colored furnish a less mortality from consumption than the average, while in the North it is much greater than the average.

Dr. Lewis W. Leeds then read a paper on

THE SANITARY ELEMENTS IN DWELLINGS.

He thought it was a mistake to overhear all the fresh air as fast as it was admitted to our hospitals and public and private buildings. He had come to the conclusion that all artificially warmed air was injurious to animal life. Nature's method of warming was a warm floor, heated by the obstruction of the sun's rays, while the air above is cold.

A report upon the

HABITS OF YELLOW FEVER

was then read by J. M. Toner, M. D., of Washington. One question was whether elevation had had anything to do in the escape from yellow fever. Its favorite places were between the 45th and 100th degrees of longitude, and the 35th north and 35th south degrees of latitude. The strata of air in which yellow fever exists is heavier and lower than the surrounding air. From the facts gathered together, it would seem clear that this disease in the United States never exists above 500 feet. If it can be shown that the existence of yellow fever depends entirely upon the elevation, a great deal will have been done in the investigation.

ATMOSPHERIC ELECTRICITY AND OZONE

was the title of a paper read by Dr. George M. Beard of this city. He said that it has been shown that there are two daily tides of positive atmospheric electricity. In the morning between 6 and 9 o'clock, the atmospheric tide is at its height, falling somewhat between 2 and 5 P. M., rising again between 6 and 9 P. M., and falling to a minimum between 2 and 5 A. M. Similar variations are noticeable in the months, the tide of atmospheric electricity being highest through the months of January and February, gradually subsiding in the months of March, April, May, June, July, and August, when it is at its minimum, and gradually rising again through September, October, November, and December. It has been stated that there is a relation between ozone and intermittent and remittent fevers; that rheumatism is prevalent when ozone is deficient; and that when ozone is in excess, diphtheria, scarlet fever, small pox, measles, scarlatina, and other cutaneous affections become prevalent.

Comparative researches regarding atmospheric electricity, if conducted to a large extent under government supervision, would help to explain the extraordinary stimulative character of the climate of California, to explain the fact that sun-strokes are almost unknown on the Pacific coast, and perhaps elucidate some of the unknown causes of other wondrous effects of our climate.

Professor Chandler, in the course of remarks on

THE SANITARY CHEMISTRY OF WATER,

observed that the organic matter which is dangerous in water is sewage, and many diseases, especially cases of typhoid fever, have been developed by the presence of these impurities in water. Actual experiment shows that water which remains overnight in lead pipes in New York contains 1-10 of a grain of lead to the gallon. It seems to be well established now that rivers possess the power of self-purification, and the drainage of a great city can be received within an ordinary river without destruction of its wholesomeness. The Croton water brought to this city every day contains 22½ tons of mineral matter. To poison the Croton water for one day it would require 3½ tons of strychnin, and there is not, probably, a ton of strychnin in the world. It would take 114 tons of arsenic to serve the same purpose. So it may be seen that threats of poisoning the Croton supply during the war were ridiculous.

President White, of Cornell University, delivered an interesting address on

GENERAL SANITARY TOPICS

and proper education in hygiene. He said: "I would have simple text books in physiology introduced in our common schools; but, better still, I would have short courses of lectures by competent physicians. It thus becomes a study of living man by living man to living man. Physiology should be taught throughout a college course. The science of sanitary engineering is not so large that the main elements could not be given. I have great respect for the old curriculum, but the substitution of sanitary studies will well replace some of the now well worn classics."

THE GERM THEORY OF DISEASE IN ITS RELATION TO HYGIENE was the subject of an able discourse by President Barnard, in which the view was taken that the laws of health and disease were as well defined as those of the mathematics, and the only obstacle was the difficulty attending their discovery. No living organism enjoyed an existence prolonged to an indefinite length, and life began in the germ and ended in dissolution and disintegration. In the human race life was often shortened by ignorance, and in many cases by accident. After discussing the germ theory, the speaker concluded by

saying that drugs were already falling into disrepute, and he hoped to see the time when, through medical science, infectious diseases would be extirpated, and men would live out the time that Heaven intended they should.

SOAP SOLUBLE IN SEA WATER (M. Manin).—Oil or fat, 46 parts; resin, 10 parts; fish glue, 40 parts; soda or potash, 1 part; oxalate of potash, 1 part. The oil and resin are saponified as usual, but with an excess of alkali, the glue previously rendered gelatinous by solution in oxalate of potash with constant stirring to 50° or 60°.

ANOTHER newspaper concern is to attempt the passage of the Atlantic by balloon. This time it is the *Evening Herald* of Philadelphia. It is to be a hot air balloon, and is now in process of construction.

Recent American and Foreign Patents.

Improved Hydraulic Brake.

John F. Taylor, Charleston, S. C.—This invention consists in means whereby steam, water and air may be conjointly applied to operate car brakes with great certainty, efficiency and economy. Two steam cylinders and two water cylinders have an outlet tube, so connected with the rams that the introduction of steam in one cylinder results in the expulsion of water from the other. The steam valves and valves of the water outlet tube are connected by intermediate mechanism and operated by one and the same lever. The piston rod of the hydraulic engine is connected with brake bars. Provision is made for readily applying the brakes, in case of rupture or breakage of the connecting pipes.

Improved Apparatus for Cleansing Dyed Wool, etc.

James E. Ackroyd, Chester, Pa.—This invention consists of a trough attached to a tank for holding the wool and the scouring and cleansing mixture, having one side curved from bottom to top, and provided on the inside with fixed blocks or wire netting. Above there is a curved track, on which a carriage having blades projecting down to the curved bottoms is arranged to run forward and backward to force the wool up the sides of the tank and over the blocks. The latter are inclined on the sides against which the wool is forced, and the arms of the track are hinged so as to swing up and pass over any portion of the wool that may be under the points in going back, so as not to tear and injure the fiber.

Improved Map Holder.

Elon M. Naramore, Underhill, Vt.—This invention consists of a lateral head piece, attached to a map stick, between which and a wire clamp the map is tightly held. The wire clamp is provided with coiled springs, which swing sidewise on pivots of the head piece, with upward extending parts hooked to the sides of the handle.

Improved Wheel for Vehicles.

Michael B. White, McLean County, Ill.—The spoke is provided with a round, shouldered tenon, which enters a hole in the felly. The thimble fitting on said tenon is reduced and screw-threaded for one half its length, and on such reduced portion a nut is screwed, and also a jam nut. The thimble is applied to the spoke tenon with its larger end abutting against the shoulder thereof, and has ribs which take into notches on the spoke, for the purpose of preventing the thimble from turning. When the tyre requires to be tightened, or the felly adjusted, a wrench is applied to the larger nut, and it is turned or screwed back toward the felly until the distance between the spoke shoulder and the felly has been sufficiently increased to produce the desired effect.

Improved Pitman Rod.

Samuel N. Wate, Jr., Danville, Pa., assignor to himself and Peter J. Adams, of same place.—This invention consists in improving the pitman rod connection for which letters patent were granted to the same inventor, Nov. 19, 1872. The forward end of a screw, to which is attached a milled nut, rests against a block which is inserted in the inner end of the inner brass. The body of the screw passes through a washer, and its other end is inserted in the rod. This end of the screw is flat, to prevent the screw from turning when the nut is screwed down against the rod. Bolts, which pass through slotted holes in the straps, fit tight in the rod and brass, and are moved with the latter as they are pushed outward; but the hole through the long strap for one bolt, and the hole for the other in the short strap, are so arranged that, when the screw and nut push out the rod, block, and brass, the straps are drawn in just as much as the screw and nut push the rod and blocks apart, so that all the wear and lost motion is taken up without changing the length of the rod. The two cross bars described in the former patent are taken out, and the two bolts mentioned substituted.

Improved Jig Saw.

Martin E. Weller, Fort Plain, N. Y.—In the front of the frame is a vertical dovetail groove, in which a corresponding tongue on the adjusting plate fits to control said plate in adjusting it up and down and to hold it. For the latter purpose, an eccentric cam is arranged, provided with a weighted arm, which, when it falls, causes the eccentric to bear the tongue against the walls of the groove with sufficient force to bind it fast. There is suitable mechanism in order to lift the weighted lever and unfasten the plate by the hand used for adjusting said plate, and at or just before the time of adjusting it. Thus only one hand is employed for these two purposes, and the other is free to do other things necessary to be done at the same time. The upper cross head carries a couple of gripping jaws pivoted near their lower ends, and curved, outward and then backward, nearly together at their upper ends to provide room for a ball between them, to which a spring is connected. The upper end of the saw, having a slight head upset on it, is placed between the said jaws at the lower ends, and the spring is hitched to the ball, so as to pull it upward between the upper ends of the jaws, which forces the lower ends to gripe the saw and hold it with great force. The lower cross head has two sliding jaws between two inclined plates, and a double spring connected with said jaws, and extending down to an eccentric lever. The saw, also having a small head upset on the lower end, is placed between the jaws at their upper ends, and they are forced up by the two levers between the inclined plates, and thereby forced hard against the saw. These modes of fastening the saw are very simple, and allow of changing the saws with but very little labor and loss of time.

Improved Life Preserver.

George and Charles Palmer, Morris Run, Pa.—This invention consists in making a cape weatherproof, water repellent and indistinct, so that, while it affords the usual protection for sailors and seafaring people, it is also a life preserver.

Improved Bee Hive.

John H. Shook, Normal, Ill.—The feature of novelty in this hive is the arrangement of the honey frames on the comb frames proper, so that both may be supported by the same hinges, and removed from the hive together.

Improved Car Brake.

James B. Pelton, Mt. Pleasant, Md.—This invention relates to that class of brakes which are operated by steam from the locomotive. It consists in the mode of providing the cord with a take-up mechanism by means of a tube and pulley frame, jointed so as to fold up when the trucks come close together, and to unfold as they separate, thereby maintaining a constant tautness in the cord which connects the power with the brake mechanism, and preventing the brakes from being applied unintentionally.

Arms of the Law.

It is doubtful whether any similar weapon of offense, unless it be the sand club or slung shot, is more liable to cause severe injury or even death by a single well directed and heavy blow than the ordinary policeman's "loosest." For the preservation of order and peace, it is manifestly necessary to provide men with suitable weapons. A recent invention of Messrs. Simon Beery, of Ohio, and J. W. McDonald, of Texas, for which a patent has lately been granted, is an elastic baton, of gutta percha, India rubber or similar flexible material, which appears to be an improvement over the heavy wooden "billy."

Improved Wheel Cultivator.

James F. Matchet and Perry W. Smith, Paris, Mo.—The axes at the inner ends of the hubs of the wheels are bent forward at right angles, and after projecting a short distance are bent upward at right angles. The bow is made double, and the parts of its ends are horizontal, parallel with each other, and at such a distance apart as to receive the coupling between them. The ends of the double bow have holes formed through them to receive and work upon the upright parts of the axes. The middle parts of the bow are at such a distance apart as to receive the tongue between them and allow the said tongue and bow to work freely upon each other and upon the bolt that pivots them to each other. The intermediate parts of the double bow are close together, and are rigidly connected. To the rear end of the tongue is pivoted a cross bar, the ends of which are pivoted to arms the lower and forward ends of which are rigidly attached to the upper ends of the upright parts of the axle. The invention consists in the parts above mentioned all pivoted together and moving freely upon each other, in combination with the bent sectional axes.

Improved Manufacture of Iron and Steel.

Edgar Peckham, Antwerp, N. Y.—The object of this invention is to produce a thorough separation of the impure cluder from the metal, and in this manner purify the iron or steel. This method consists in drawing off and removing from the fire or furnace the impure cluder arising from the ore or pig iron as fast, or nearly as fast, as it is made, and supplying its place (by the use of a flux) with a pure cluder. If the impure cluder arising from the ore or pig iron should be thick, and not liquid enough to separate thoroughly from the metal (as is often the case with cluder arising from ores or pig iron containing silica), enough flux is added to it to make it liquid, so it will separate from the metal, when it is drawn off, and its place supplied with a pure cluder by adding more flux, and in this manner the impurities are separated from the iron or steel. Lime, flint, spar, or lean hematite or specular ore, or any other substance that will produce a liquid cluder free from impurities used as a flux, depending somewhat upon the character of the ore or pig iron employed.

Improved Tag Fastener.

John M. Goodridge, Norfolk, Va.—The improvement consists in the manner of attaching a hook to the card or label by means of a cross bar. The hook is made of flat sheet metal, and its upper part is in the form of the letter T reversed. The cross of the T is attached to the card. At the end of the vertical part is a double barb, which securely holds the hook in place when it is once attached.

Improved Churn.

Joseph L. Britt and Troy R. Britt, of Raleigh, N. C.—This invention consists of a peculiar and simple arrangement of supports for the dashers and operating mechanism, the said supports are mounted on the churn top, so that the dasher and driving gear are all removed when the cover is taken off, to afford unobstructed access to the churn case.

Improved Edge-Protecting Welt for Boots and Shoes.

John Green, Brooklyn, assignor to himself and Joseph Bach, New York City.—This invention is a welt for the protection of the shoe upper, formed of a long narrow strip of leather or other material rabbeted on the upper side to receive the upper, and bent or molded to conform to the shape or outline of the sole.

Improved Belt Clamp.

Eleazer Alsworth, Wilmington, Del.—Each clamp consists of a lower base piece and a top piece, which are connected by suitable thumb screws. Both pieces are provided at their inner sides, taking hold of the belt-like jaws to prevent its slipping. The top piece is rounded off at one side and straight at the other, so that it may be swung open on one screw, and be quickly attached to the belt. The hole for the other thumb screw in same piece is slotted for opening and closing the same on the belt. The ends of under piece are provided with recesses, and at their outer edges at the off-side of the belt ends with lugs. Bods extend longitudinally in recesses and connect the clamps, having right and left hand screw threads, with nuts working thereon. A ratchet is placed centrally on the rods for turning the same. After the clamps are applied, the rods connect them, as the lugs serve to retain the nuts in fixed position. Each turn of the ratchet produces then the gradual approach of clamps, and, consequently, the tightening of the belt for lacing, etc.

Improved Refrigerator.

William M. Baker, Fortville, Ind.—This invention relates to certain improvements upon the refrigerators patented by the same inventor December 21, 1871, and May 6, 1872, and consists mainly in providing, by a compact arrangement of the ice chamber, in combination with the cold water and air chambers, a larger space for the provision chambers, and a complete and uniform ventilation of the same.

Improved Copy Holder.

Walter R. Carter, Brooklyn, N. Y.—This invention consists of a couple of long thin bars, supported horizontally side by side in a stand of any suitable kind and material for holding written or printed papers to be copied between them, to expose the line directly above the edge of one of the bars which serves as a guide to the copyist, the paper being drawn up, as each line is copied, to expose the next.

Improved Refrigerator and Cooler.

Canada D. Hicks, Bowling Green, Ohio.—This invention consists in an outer box provided with doors in front, and at each end of its top, and is lined with galvanized iron. In the middle part of the case is placed a box also made of galvanized iron, and which is so supported as to leave a space between it and the lining upon its top, bottom, back, and sides. The inner box is designed to receive things to be cooled or preserved. In the spaces at the ends of the outer box are placed vessels to receive liquids to be cooled, and which are made of such a shape and size as to leave spaces between them and the lining and the box for ice. Pipes lead into the vessels through the bottom of the case, and are designed to extend to the cases or other receptacles in which the beer or other liquid is kept, so that the said liquid may be forced into the said vessels by force pumps.

Improved Picket Fence.

Robert H. McGinty, Moulton, Texas.—This fence is composed of two kinds of posts. Those forming the greater number rest upon the ground. The others are arranged at intervals, and are longer than the posts first mentioned. The distinguishing features of the fence are the zigzag base and straight top. The posts (both long and short) are arranged in panels which brace alternately in each direction, but the tops of some of the posts are brought to a line of wire. The wires are bound together between the posts by links which are so applied that the wires are drawn tightly against the sides of the posts, thus binding all of them together, and rendering the fence strong and substantial. A fence is thus made of short timber of the most durable kind, one well calculated to resist the currents of water as well as wind.

Improved Cosmetic Bottle.

Mary H. Huntington, Watertown, N. Y.—This invention consists of a cup on the top of the bottle or on the stopper, so arranged that some of the contents of the bottle will flow into it when the bottle is laid on one side, and be held conveniently to be taken up by a sponge, brush, or other article for use, and the remainder will flow back into the bottle again when it is placed upright. The object is to avoid the use of a separate cup and the waste attending it, as in the present mode of using cosmetics.

Improved Reel for Harvesters.

John Werner, Jr., Prairie Du Sac, Wis.—The journals of the reel revolve in bearings, which slide upon bars in which several holes are formed to receive pins or bolts, so that the bearings may be moved to adjust the reel forward and back. To the bars also are pivoted the upper ends of connecting rods, the lower ends of which are pivoted to the outer arms of bent levers, which are pivoted at their apices, and in a reversed position, with respect to each other, to a bar of the frame. To the inner arms of the bent levers are pivoted the ends of another connecting rod. By this arrangement the two bars will be made to move exactly together, so that the reel will always be raised and lowered squarely. The reel may also be raised and lowered by operating a suitable lever and held securely in any position into which it may be adjusted.

Improved Bolt and Rod Cutter.

Lewis H. Smith, Stryker, O.—This invention consists of a main cutter or lever or bar, to which is attached an eccentric lever, which bears on the revolving wheel of a sliding cutter acting on the bolts or rods. The opening of the cutters is produced by the action of the eccentric lever on a curved lever having its fulcrum on the main cutter piece, and acting also on the sliding cutter.

Improved Car Coupling.

Oscar Taylor, Grand Rapids, Wis.—The bumper head is made in two parts, upper and lower, divided horizontally and in the direction of their length. The upper part near its inner end has a rounded projection which fits and is pivoted in a corresponding recess in the lower part. At the forward end of both parts are shoulders. Between these enters the coupling bar, the end of which has corresponding projections which engage with said shoulders. To the inclined inner surface of the lower part is attached a spring which is held down against said inclined surface by projections of the upper part, and which, when said upper part is raised in uncoupling the cars, raises the shoulder of the coupling bar. The upper part is raised to uncouple the cars by a cord attached to its forward end, and which leads up to the platform or top of the car, or to both places.

Improved Scaffold Pole Clamp.

Henry Haering and Herman Alles, New York City.—For fastening the horizontal poles to the vertical poles of scaffolds, it is proposed to have a short lever pivoted at the middle in a yoke next to its bottom end, so that the lower end, which is curved to fit the side of a round pole, will embrace a horizontal pole and press it tight against the side of the vertical pole. The yoke embraces the vertical pole and is powerfully drawn against it by an eccentric lever pivoted in the bars at the open end on the side of the vertical pole opposite the lever. By this means the upper end of the lever is forced against the vertical pole above the yoke, so that points upon said extremity, as well as upon the face of the eccentric lever, will be driven into the pole and prevent the clamp from slipping down. The eccentric lever is fastened with a binding chain pressed around the pole and attached to it. The lever, which clamps the horizontal pole, is detachably connected to the yoke, so that the yoke and the eccentric lever may be used without the clamping lever for a splice clamp for clamping two poles together lengthwise, according to a method heretofore patented by same inventors.

Improved Piano Action.

Frederick L. Trayer, Maysville, Ky.—This invention consists of a combined repeating and back check attachment to the French grand action, by which it is designed to render said action equal to the most perfect repeating action. The attachment consists of a notched arm on the hammer rod and an adjustable headed screw on the jack, so contrived that, as the hammer drops from the string, it is caught by the head of the screw in the notch of the arm and held in check about a quarter of an inch from the string, to allow it to vibrate. The rebound is prevented by the heel of the arm below the notch bearing against the head of the rod. The arrangement of the jack, hammer butt, notched arm, and adjusting rod is such that, after the hammer is caught this way, the key being allowed to rise slowly, the jack will again fall into its notch as soon as the key has risen an eighth of an inch, so that a repetition can be made at any rise of the key above that amount.

Improved Children's Carriage.

John G. Kamphaus, Pittsburgh, Pa.—This invention relates to the construction of carriages for children; and consists in the mode of connecting the axle with the bolster, by means of which concussion and jolting are avoided.

Inventions Patented in England by Americans.

[Compiled from the Commissioners of Patents' Journal.]
From October 14 to October 27, 1873, inclusive.

BESSEMER CONVERTER.—J. E. Sherman (of Bucksport, Me.), Norbiton, Eng.
BOOT TACKS.—L. R. Blake, Brooklyn, N. Y.
DRIVING BOOT TACKS.—L. R. Blake, Brooklyn, N. Y.
FRICTION BEARING.—T. A. Weston, Ridgewood, N. J.
IRON MANUFACTURE.—J. E. Sherman (of Bucksport, Me.), Norbiton, Eng.
LIFT AND FORCE PUMP.—W. D. Baxter, New York City.
LOCK WARMER.—K. H. Loomis (of New York City), London, England.
LOOM.—G. Merrill, New York City.
PASSENGER REGISTER.—J. T. Parlour (of Brooklyn, N. Y.), London, Eng.
RAISING MACHINERY.—T. A. Weston, Ridgewood, N. J.
ROTARY ENGINE.—J. B. Bennett, Brooklyn, N. Y.

Value of Patents, AND HOW TO OBTAIN THEM. Practical Hints to Inventors.

PROBABLY no investment of a small sum of money brings a greater return than the expense incurred in obtaining a patent even when the invention is but a small one. Larger inventions are found to pay correspondingly well. The names of Blanchard, Morse, Bigelow, Colt, Ericsson, Howe, McCormick, Hoe, and others, who have amassed immense fortunes from their inventions, are well known. And there are thousands of others who have realized large sums from their patents.

More than FIFTY THOUSAND inventors have availed themselves of the services of MUNN & Co. during the TWENTY-SIX years they have acted as solicitors and publishers of the SCIENTIFIC AMERICAN. They stand at the head in this class of business; and their large corps of assistants, mostly selected from the ranks of the Patent Office; men capable of rendering the best service to the inventor, from the experience practically obtained while examiners in the Patent Office; enables MUNN & Co. to do everything pertaining to patents BETTER and CHEAPER than any other reliable agency.

HOW TO OBTAIN Patents.

This is the closing inquiry in nearly every letter describing some invention which comes to this office. A positive answer can only be had by presenting a complete application for a patent to the Commissioner of Patents. An application consists of a Model, Drawing, Petition, Oath, and full Specification. Various official rules and formalities must also be observed. The efforts of the inventor to do all this business himself are generally without success. After great perplexity and delay, he is usually glad to seek the aid of persons experienced in patent business, and have all the work done over again. The best plan is to solicit proper advice at the beginning. If the parties consulted are honorable men, the inventor may safely confide his ideas to them, they will advise whether the improvement is probably patentable, and will give him all the directions needful to protect his rights.

How Can I Best Secure my Invention?

This is an inquiry which an inventor naturally asks another, who has had some experience in obtaining patents. His answer generally is as follows:—and correct:

Construct a neat model, not over a foot in any dimension—smaller if possible—and send by express, prepaid, addressed to MUNN & Co., 37 Park Row New York, together with a description of its operation and merits. On receipt thereof, they will examine the invention carefully, and advise you as to its patentability, free of charge. Or, if you have not time, or the means

at hand, to construct a model, make as good a pen and ink sketch of the improvement as possible and send by mail. An answer as to the prospect of a patent will be received, usually, by return of mail. It is sometimes best to have a search made at the Patent Office. Such a measure often saves the cost of an application for a patent.

Preliminary Examination.

In order to have such search, make out a written description of the invention, in your own words, and a pencil, or pen and ink, sketch. Send these, with the fee of \$5, by mail, addressed to MUNN & Co., 37 Park Row, and in due time you will receive an acknowledgment thereof, followed by a written report in regard to the patentability of your improvement. This special search is made with great care, among the models and patents at Washington, to ascertain whether the improvement presented is patentable.

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Rejected cases, or defective papers, remodeled for parties who have made applications for themselves, or through other agents. Terms moderate. Address MUNN & Co., stating particulars.

To Make an Application for a Patent.

The applicant for a patent should furnish a model of his invention if susceptible of one, although sometimes it may be dispensed with; or if the invention be a chemical production, he must furnish samples of the ingredients of which his composition consists. These should be securely packed, the inventor's name marked on them, and sent by express, prepaid. Small models, from a distance, can often be sent cheaper by mail. The safest way to remit money is by a draft, or postal order, on New York, payable to the order of MUNN & Co. Persons who live in remote parts of the country can usually purchase drafts from their merchants on their New York correspondents.

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Persons desiring to file a caveat can have the papers prepared in the shortest time, by sending a sketch and description of the invention. The Government fee for a caveat is \$10. A pamphlet of advice regarding applications for patents and caveats is furnished gratis, on application by mail. Address MUNN & Co., 37 Park Row, New York.

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A reissue is granted to the original patentee, his heirs, or the assignees of the entire interest, when, by reason of an insufficient or defective specification, the original patent is invalid, provided the error has arisen from inadvertence, accident, or mistake, without any fraudulent or deceptive intention.

A patentee may, at his option, have in his reissue a separate patent for each distinct part of the invention comprehended in his original application by paying the required fee in each case, and complying with the other requirements of the law, as in original applications. Address MUNN & Co., 37 Park Row, for full particulars.

Design Patents.

Foreign designers and manufacturers, who send goods to this country may secure patents here upon their new patterns, and thus prevent others from fabricating or selling the same goods in this market.

A patent for a design may be granted to any person, whether citizen or alien, for any new and original design for a manufacture, bust, statue, alto relievo, or bas relief; any new and original design for the printing of woolen, silk, cotton, or other fabrics; any new and original impression, ornament, pattern, print, or picture, to be printed, painted, cast, or otherwise placed on or worked into any article of manufacture.

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The population of Great Britain is 31,000,000; of France, 37,000,000; Belgium, 5,000,000; Austria, 36,000,000; Prussia, 40,000,000; and Russia, 70,000,000. Patents may be secured by American citizens in all of these countries. Now is the time, while business is dull at home, to take advantage of these immense foreign fields. Mechanical improvements of all kinds are always in demand in Europe. There will never be a better time than the present to take patents abroad. We have reliable business connections with the principal capitals of Europe. A large share of all the patents secured in foreign countries by Americans are obtained through our Agency. Address MUNN & Co., 37 Park Row, New York. Circulars with full information on foreign patents, furnished free.

Value of Extended Patents.

Did patentees realize the fact that their inventions are likely to be more productive of profit during the seven years of extension than the first full term for which their patents were granted, we think more would avail themselves of the extension privilege. Patents granted prior to 1861 may be extended for seven years, for the benefit of the inventor, or of his heirs in case of the decease of the former, by due application to the Patent Office, ninety days before the termination of the patent. The extended time accrues to the benefit of the inventor, the assignees under the first term having no rights under the extension, except by special agreement. The Government fee for an extension is \$100, and it is necessary that good professional service be obtained to conduct the business before the Patent Office. Full information as to extensions may be had by addressing MUNN & Co., 37 Park Row.

Trademarks.

Any person or firm domiciled in the United States, or any firm or corporation residing in any foreign country where similar privileges are extended to citizens of the United States, may register their designs and obtain protection. This is very important to manufacturers in this country, and equally so to foreigners. For full particulars address MUNN & Co., 37 Park Row New York.

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On the first of September, 1872, the new patent law of Canada went into force, and patents are now granted to citizens of the United States on the same favorable terms as to citizens of the Dominion.

In order to apply for a patent in Canada, the applicant must furnish a model, specification and duplicate drawings, substantially the same as in applying for an American patent.

The patent may be taken out either for five years (government fee \$20) or for ten years (government fee \$40) or for fifteen years (government fee \$60). The five and ten year patents may be extended to the term of fifteen years. The formalities for extension are simple and not expensive.

American inventions, even if already patented in this country, can be patented in Canada provided the American patent is not more than one year old.

All persons who desire to take out patents in Canada are requested to communicate with MUNN & Co., 37 Park Row, N. Y., who will give prompt attention to the business and furnish full instruction.

Copies of Patents.

Persons desiring any patent issued from 1836 to November 26, 1867, can be supplied with official copies at a reasonable cost, the price depending upon the extent of drawings and length of specification.

Any patent issued since November 27, 1867, at which time the Patent Office commenced printing the drawings and specifications, may be had by remitting to this office \$1.

A copy of the claims of any patent issued since 1836 will be furnished for \$1.

When ordering copies, please to remit for the same as above, and state name of patentee, title of invention, and date of patent. Address MUNN & Co., Patent Solicitors, 37 Park Row, New York City.

MUNN & Co. will be happy to see inventors in person, at their office, or to advise them by letter. In all cases, they may expect an honest opinion. For such consultations, opinions, and advice, no charge is made. Write plainly do not use pencil, for pale ink; be brief.

All business committed to our care, and all consultations are kept secret and strictly confidential.

In all matters pertaining to patents, such as conducting interferences, procuring extensions, drawing assignments, examinations into the validity of patents, etc., special care and attention is given. For information, and for pamphlets of instruction and advice

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Wanted—Second handed photographic outfit in exchange for building lot. Address Box 227, Elizabeth, N. J.

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Small Tools and Gear Wheels for Models. List free. Goodnow & Wightman, 23 Cornhill, Boston, Ma.

Wanted—Set of Patterns for a Model Locomotive Engine; also, set for a Stationary Engine. Small size. Goodnow & Wightman, 23 Cornhill, Boston, Mass.

Bress Gear Wheel, for models, &c., made to order, by D. Gilbert & Son, 212 Chester St., Phila., Pa.

Notice of Removal—The American Photo Relief Printing Co. (Woodbury Process) have removed to No. 624 North 4th Street, Philadelphia, to which No. please address all orders, &c. I. Carbutt, Manager.

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Buy Steam Engines and Boilers of Gear, Boston, Mass.

Lathes, Planers, Drills, Milling and Index Machines. Geo. S. Lincoln & Co., Hartford, Conn.

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

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Five different sizes of Gatling Guns are now manufactured at Colt's Armory, Hartford, Conn. The larger sizes have a range of over two miles. These arms are indispensable in modern warfare.

Tool Chests, with best tools only. Send for circular. J. T. Pratt & Co., 53 Fulton St., New York.

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Notes & Queries.

J. W. C. asks: If a cone is 2 feet in diameter at the base, and 30 feet high, and a line is fastened at the top and then wound around the cone at every two feet perpendicular height, until it reaches the bottom, what is the length of the line?

M. W. asks: If two stakes of equal height stand 50 feet apart in a horizontal plane, what will be the dip or sag of a chain or cord connecting their tops, the cord being 100 feet long? What is the nature of the curve? Is it elliptic or parabolic?

R. R. asks: How can I restore the color of leather and cloth backs of books? They have suffered from the sun and from dust.

W. C. A. asks: How is the silvering prepared and applied in making glass reflectors?

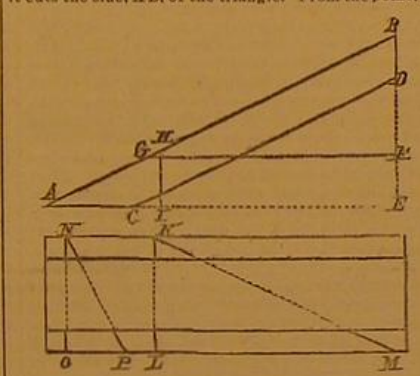
O. says: Astronomers tell us that the planet Neptune is 40,000 or 50,000 miles in diameter, and cannot be seen with the naked eye. Would it be reasonable to suppose that all the stars that we see (outside the orbit of Neptune) are over that magnitude?

T. F. de S. says: A friend says that if one takes a gun, and shoots straight up (no wind blowing), that the ball will not come down at the point whence it was discharged from the gun, but that the motion of the earth will move the gun from the ball. He says that one would have to hold the gun at an angle to correspond with the motion of the earth to let the ball come down at the spot whence it started. Is this so?



P. S. A. asks: How do lapidaries cut, grind and polish amethyst and other quartz and hard stones? Answer: The rough stones are first cut to a plane surface by means of a slitting mill. This consists of a thin circular piece of iron like a circular saw, without teeth, however, the periphery of which is covered with diamond dust. It is made to revolve rapidly, and the stone applied to its edge. The stone is then taken to the roughing mill where the surface is prepared for polishing. The roughing mill consists of a revolving leaden disk covered with emery. This gives a smooth surface to the stone, which is lastly polished at the polishing mill. The polishing mill is a revolving leaden disk kept covered with rottenstone and water.

E. R. G. asks: Can you give me directions for getting the bevels for a miter box to law the lower end of a rake or rafter molding? Answer: As we understand your question, you wish to find the bevels, A C and B D, of the ends of a rafter, A B C D, set at any pitch. Draw a triangle, A B E, making A B represent the inclination of a rafter. Construct a miter box in the usual manner. Draw a square line, K L, across the top of the box. On the side, B E, of the triangle, lay off a distance, B F, equal to K L, the extreme width of the box. Draw G F, perpendicular to B E, and note the point, G, in which it cuts the side, A B, of the triangle. From the point, L,



In the miter box, lay off on the outer edge a distance, L M, equal to G F. From the point, K, on the other outer edge, draw a line connecting K and M. This gives the bevel for A C, the lower end of the rafter. To find the bevel for B D, draw another square line, N O, across the miter box, and lay off, on the side A E of the triangle, a distance, A I, equal to K L or N O, the width of the miter box. From I draw I H perpendicular to A E; and from O, lay off a distance, O P, equal to I H. Then N P represents the bevel at which the upper end of the rafter is to be cut. These constructions are based on the principle that the angles of the miter box are the complements of the angles B A E and A B E.

S. Y. O. asks: 1. Is it a fact that the animal body, especially that of man, is heavier when asleep than when awake? In other words, is there a power to counteract gravitation in the living human body? 2. Is it an established fact that tables are moved by the mere act of the will by so-called mediums? Answers: 1. We think not. 2. No.

E. H. F. says: If I take a piece of plate looking glass and cut a fine line through the amalgam coating on the back, and then set this glass firmly on and perpendicular to the surface of a plane table, so that the line on the glass will be truly perpendicular to the table, and (turning the face of the glass northward, at the time of the transit of Alloth, and standing in front of the glass) adjust the table and glass so that the line on the glass shall bisect both the north star and Alloth, will a line drawn truly perpendicular to the plane of the glass, across the plane table, be a true meridian line, making allowance of 17 minutes after the transit to bisect the north star by the line? Or, in other words, would the star, the eye, and the line on the glass be all in the same vertical plane at such time? Could the star, as seen in the glass, be bisected by the line on the glass without bringing the eye into a plane perpendicular to that of the glass? If not, then by reversing the glass, with the table thus fixed with reference to the north star, could a shadow of the sun be bisected by the line on the glass, as seen by the eye, at any other time than when the sun is on the meridian of the place? The reflection of the eye, as well as the star, in the glass, must be bisected by the line on the glass, at the time of the transit. Answer: To ensure, with the arrangement you propose, the line drawn on the plane table being in the same vertical plane with the line of sight, it would be necessary to have two pieces of glass, and sight through both to the north star. We think there are better plans than this in use at present.

F. T. T. says: The feed pipe of a heater from tank enters the top. The pipe leading to force pump is 18 inches from bottom of heater. The glass water gage or tube is attached so that center of pipe is level with center of glass, that is, 6 inches above and 6 inches below the center of pipe. Pipe is 1 1/2 inches diameter. On starting engine after a few hours' stoppage, the water always leaves the glass tube, the lower end of which is 4 inches below the lower edge of feed pipe. In the course of 15 minutes all comes right again. Can you explain the reason? Answer: It may occur from the formation of a vacuum in the heater, when the engine is not running.

E. C. H.'s calculations as to the rotundity of the earth per mile are correct; but he misunderstands the word rotundity in this connection. The question is: If a straight line tangential to the curve leaves the earth's surface at a particular point, how far will the earth's surface be from a point in the line one mile distant from the starting place? Answer: Eight inches.

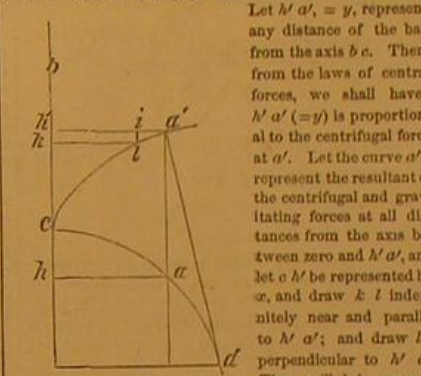
G. W. C. should consult Auchincloss on "Link and Valve Motions." See our advertising pages for booksellers' addresses.

P. asks: How can I preserve leaves? Answer: Press them between pieces of blotting paper, with a heavy weight, until all the juices are dried up.

G. W. F. asks: 1. Is spherical gearing illustrated in the Science Record for 1873? 2. Why is the pipe that connects to a steam gage bent into an S form? Answers: 1. Yes. 2. So as to retain water in the pipe.

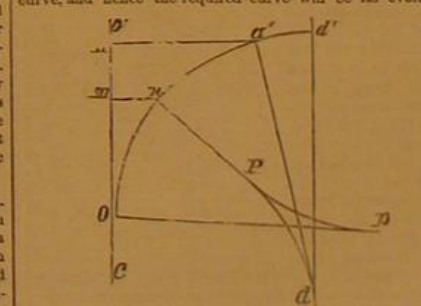
H. F. B. asks: What is the value of the skivings of sole leather as a fertilizer? The flesh part of the skin is steamed until it becomes a pulp, and then is dried and ground. Is the liquor valuable also? 2. Can bones be made soft so that they will crumble easily by steam pressure? If so, are they worth less or more, when ground, as a fertilizer? Answers: 1. We must ask some of our former readers to answer this question. 2. Ground bones are generally considered the best.

J. E. H. sends the following solution of C. H. A.'s question, on page 187, of our current volume: Let $h' a' = y$, represent any distance of the ball from the axis $b c$. Then, from the laws of Centrifugal force, we shall have—

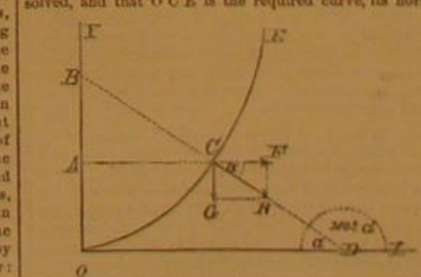


$h' a' (=y)$ is proportional to the centrifugal force at a' . Let the curve $a' c$ represent the resultant of the centrifugal and gravitating forces at all distances from the axis between zero and $h' a'$, and let $c h'$ be represented by x , and draw $k l$ indefinitely near and parallel to $h' a'$; and draw $l i$ perpendicular to $h' a'$. Then will $l i$ represent $d x$ and $a' i'$ will represent $d y$. Now because x may vary uniformly, $d x$ is constant; and because the differentials of x and y represent the components of the two forces at any point, $\therefore d x : d y :: 1 : y \therefore d x = \frac{d y}{y} \dots (1)$.

Integrating (1) we get: $x = \log y \dots (2)$. As (2) is a well known equation and represents the Napierian system of logarithms, and as the tangents to the required curve must be perpendicular to this curve, therefore the required curve is the evolute to the Napierian logarithmic curve. The equation to this curve I have not investigated; its tangent, however, which is perpendicular to and limited by the resultant curve, is $(\frac{1+y^2}{y})^{\frac{1}{2}}$. The question, as I understand it, may be definitely stated as follows: Suppose a ball to revolve in a horizontal plane, at variable distances, about a vertical axis, $b c$, making one revolution per second, and suppose the resultant of the force of gravity and the centrifugal force due the several distances from the axis to form a continuous curve from its greatest distance at d' to the axis at c : Can another curve be drawn whose tangents shall be perpendicular to the resultant curve and which shall also be continuous between the greatest and least distance of the ball from the axis? The answer to this latter question must be a negative; for, as I have shown in the solution, the resultant curve will be the Napierian logarithmic curve, and hence the required curve will be its evolute.



I have determined the equation to the evolute, and find it to be: $u = \log \{ (1 \pm \frac{1}{2} \sqrt{1+y^2}) - \frac{1}{2} y^2 \pm \frac{1}{2} \sqrt{1+y^2} - 1 \}$. The evolute may be constructed from this equation, and consists of the two branches of P and Pp as above. Answer: It is required to draw a curve, whose tangent shall be perpendicular to the resultant of the centrifugal force and force of gravity at any point, or whose normal shall coincide in direction with this resultant. Suppose the problem to be solved, and that O C E is the required curve, its normal—



B C, at any point, C, having the same direction as the resultant, C R, of the centrifugal force, C F, and the force of gravity, C G. Let $m =$ weight of ball, $m =$ mass of ball, $g =$ acceleration due to gravity, $\omega =$ angular velocity, $r =$ radius of rotation at any point, $F =$ centrifugal force, $G =$ force of gravity. $F = \frac{m \times \omega^2}{r} = 4\pi \times \omega^2 \times r$, since $\omega = 2\pi \times r$; $G = W = m \times g$; tangent of angle F C R = $\frac{C G}{C F} = \frac{m \times g}{4\pi \times \omega^2 \times r}$ $= \frac{g}{4\pi^2 \times r}$. The equation of the line B D is $y = -\frac{g x^2}{4\pi^2} + b$. To find O B, make $x = 0$, O B = b . To find A O, make $x = r$, A O = $-\frac{g}{4\pi^2} + b$. Hence subnormal of curve = O B - A O = $\frac{g}{4\pi^2}$ is a constant, and the curve is a parabola.

B. F. asks: Why is it that street cars are not run by compressed air? Could there not be enough air compressed in sheet iron vessels (say in the seats and a hollow or double floor) to run a small engine which would propel the car from station to station? To increase the efficiency, the compressed air might be heated in the cylinder of the engine with a suitable lamp. 2. Could not gas be generated out of water by electricity, with a sufficient force of expansion to run a small engine? 3. As the Nicholson pavement is apt to rot soon, would it not be better to lay a floor of boards, as in the Nicholson, then a thin layer of sand, and perhaps coal tar or cement, and on that basis (while the cement and sand or tar is yet soft) put common paving stone? Answers: 1. We have published accounts of the running of such cars. It is probably an expensive method. 2. Not economically. 3. The Nicholson pavement, as generally laid, does not have a good foundation. Were this attended to, and proper care used in the selection of the blocks, wooden pavements would be very durable.

W. T. H. asks: How can I put quicksilver on glass, to make a looking glass? Answer: Place a sheet of tin foil, the size of the glass, upon a perfectly smooth solid marble top table, and carefully rub down all the wrinkles in the metal with a brush, taking care not to break the foil. Then pour over it a small portion of mercury, and rub it over the tin foil gently with a clean piece of very soft woolen stuff. Then pour on as much mercury as it will hold, placing a strip of cloth around the edges to prevent waste, and slide a perfectly clean and dry sheet of glass over the surface of the liquid metal, beginning at one end and ending at the other. Some experience is necessary in sliding the glass, to make a perfect mirror. Afterwards the glass is placed under heavy weights, to remove superfluous mercury.

O. M. says, in reply to the question of E. C. M., p. 250, as to where a body sliding down the side of a hemisphere whose base is horizontal, will leave the side: I think it will not leave it at all; for after it starts, there will be, as it were, two forces acting on it, the original moving force accelerated by the force of gravity, acting in a line tangential to the sphere, and the force of gravity acting in a line perpendicular to the base. The tendency would then be to move in the diagonal of these two forces, which lies within the base of the hemisphere; hence it would never leave the side. Answer: When the body is at its starting point, the propelling force is applied tangentially, or in a horizontal direction. Hence the resultant motion will be that due to motion in a horizontal direction and vertically downward; and this resultant may fall without the base of the hemisphere.

F. H. M. asks: Is there any metal, or composition of metals, or any other known substance, that will break the attractive power of a magnet if placed between it and its armature? Answer: We think not.

C. W. C. asks: How can I plate polished steel with nickel? Answer: See page 298, current volume. Probably it will be cheaper and more satisfactory for you to send the articles to an establishment where they make a specialty of such business.

F. W. W. asks: 1. Is there any known chemical which, if contained in an airtight chamber, would make sufficient heat to boil water? 2. Is there any known combination of chemicals which will have the desired effect? 3. Is there any known chemical which, if confined in an airtight vessel, will burn and make considerable vapor? Answers: 1, 2. Yes. Lime and water. 3. Yes. Gunpowder.

E. W. asks: How can I make Russian shee iron? Answer: Russian iron, so called, is not made in Russia exclusively. If indeed any that we use comes from that country. Very pure iron is used in the manufacture of these sheets. The glossy appearance is produced by heating the sheets, moistening them with a solution of wood ashes, and passing them through polished steel rollers.

C. V. D. says: A vessel, 6 feet in diameter at the bottom and 3 1/2 feet at the top, 16 feet deep. How can I estimate the amount of outward pressure upon the hoops of said vessel? What is the least amount of common hoop iron that will resist the pressure, the vessel being filled with water, and where should the hoops be placed? Answer: If the vessel is filled with water the pressure on the base is equal to the weight of a prism of water whose base is equal to the base of the vessel, and whose height is equal to the height of the vessel. The pressure on the sides of the vessel is equal to the weight of a prism of water whose base is equal to the area of surface pressed, and whose height is equal to the distance of the center of gravity of the vessel below the surface of the water. Knowing the tensile strength of the hoops to be used, their size can readily be proportioned.

L. S. asks: How can I get rust, caused by salt water, off fine steel instruments? I cannot use emery, a file, or anything of the sort. Answer: If there are parts that you cannot reach with any rubbing instrument, you probably cannot remove the rust. We have an idea, however, that you can succeed in arranging a cloth or brush so that you can polish every part; and in this case, you can clean the instruments with oil and fine brick dust, afterwards applying some polishing powder.

D. L. S. asks: How can I remove deep scratches from a pianoforte case? Answer: This is work for an expert, and we hardly advise you to attempt it. The scratches, when very deep, are sometimes filled with a cement which is colored to match the wood, and then the whole is re-varnished. In ordinary cases, very fine sand paper is used. The wood then requires to be polished and varnished.

A. T. asks: What book gives, in the most condensed form, the relative strengths of metals and woods? I also want books on the workings of the different trades, as text books for a class in mechanics. Answer: We advise you to correspond with Professor R. H. Thurston, Professor of Mechanical Engineering in the Stevens Institute of Technology, Hoboken, N. J. We are sure that he will be glad to give you the desired information, while his experience and ability will make his reply of peculiar value.

P. P. H. asks: 1. What power is required to drive a sewing machine? 2. To what pressure can air be conveniently compressed in a suitable receiver by the air pump? Answers: 1. From 350 to 1,000 foot pounds per minute, varying with different machines. 2. The inventor of the Giffard injector states that he has compressed air, by the use of a piston of his own design, to more than 1,000 atmospheres, or till it attained a pressure of about 15,000 pounds per square inch.

W. L. C. says: We have occasion to use a large number of hard rubber balls for testing castings by water pressure, and we find that the balls get dry and hard, consequently soon crack and break. How can they be kept soft and pliable? Answer: Probably you cannot restore their former qualities. Your best plan will be to purchase a superior class of rubber.

S. H. D. says: 1. A safety plug to a steam boiler melted out when the boiler was being blown off; the fire was drawn and the steam gage indicated about 10 lbs. of steam; what was the cause? 2. Of what alloy or metal should a safety plug be composed? 3. How many years has the SCIENTIFIC AMERICAN been published? Answer: 1. It is quite probable that the iron was corroded around the plug, so that it was shaken out by the shock due to the contraction of the boiler. For a recipe for fusible metal, see p. 291, vol. 35. 2. The first number of the SCIENTIFIC AMERICAN was issued August, 1845.

J. F. W. says: I wish to watch the inside of a small thin copper cylinder. Can I cut a slit in it, and then cement a piece of glass over the aperture so that it will stand 200 lbs. to the square inch? I am afraid of unequal contraction and expansion. Could I cement it to any better advantage in a cast iron cylinder? Answer: The Committee of the Franklin Institute, who made experiments to determine the cause of boiler explosions, used a boiler having an opening covered with glass. We believe the glass was broken several times, under high pressures. Your best plan would probably be to make the joint with rubber.

E. J. C. asks: Will kerosene oil do in place of petroleum for steam boilers? Answer: We think not.

W. R. F. asks: 1. What is the best and cheapest way of making an exhaust air blower, to take the dust from a small emery grinder? 2. What is the cause of the clicking noise heard in cold steam pipes when steam is let on? 3. When does the Fair of the American Institute close? Answer: 1. It can be done by enclosing a shaft with vanes, in a box, having suitable openings. It will probably be more satisfactory for you to purchase a blower from an established manufacturer. 2. It is caused by the impulse of the condensed steam acting in a vacuum, and by the movement of the pipe as it expands. 3. On November 15, unless extended for one week by vote of the Board of Managers.

J. F. C. asks: 1. Could not drills be used with a rotary movement in boring rock, as is done in boring metals? 2. Could not some form of acid or solvent be used to facilitate the boring of rock? 3. What are the comparative advantages of the different forms of explosives for practical use in blasting? 4. In clearing fields of stone, would it save labor to use the more powerful explosives instead of ordinary blasting powder? Answer: 1. They would get dull too quickly. 2. Agents that would soften the rock might perform the same office for the drills, and in any case the process would probably be too expensive for general use. 3. Giant gunpowder is probably the most economical. 4. Yes.

J. R. Jr. asks: 1. What is the longest distance you have known steam to be conveyed from the boiler to the engine, as for steam pumps in shafts and mines? 2. How far do you think it could be conveyed to have an available working force, from a boiler of 125 lbs. pressure, if well boxed and packed? We wish to place a pump about 2,500 feet from the boiler. Answer: We think you can carry out this plan successfully if you use a large pipe, protect it carefully, arrange expansion joints at suitable intervals, and put in efficient traps to carry off the water. We advise you to have plans prepared by a competent engineer before putting up the pipe.

F. H. C. asks: What is the nominal horse power of the largest steamer on Long Island Sound, also what is the indicated horse power? Answer: Nominal horse power, by English Admiralty rule, 580. Indicated horse power, about 5,000.

C. J. H. asks: 1. At what surface speed should I run common emery wheels (wood covered with leather) to get the best result in grinding and polishing malleable cast iron? 2. Is there any better way to attach emery to leather, than with good glue? 3. Where is the best (sharpest) emery obtained from? 4. Can corundum be obtained in market, in grades like emery? Is it superior to emery in abrasive qualities, enough so to pay for the difference in cost? Answer: 1. About $\frac{1}{2}$ of a mile a minute. 2. We think so. 3 and 4. Where emery secured to leather is used, it stays on so short a time that the cheap grades of emery answer as well as the better qualities. Corundum can be obtained, but its use is not recommended in this case, for the reason given above.

M. W. says: By accident I got some zinc mixed with type metal. How can I separate them or can they be made to work together? There is only a small amount of zinc in it, just enough to give it the appearance of cold metal in the cast. Answer: The zinc can probably be separated by vaporizing it. This is, however, a rather difficult operation, and you will scarcely succeed unless you have had some experience in the method.

Y. E. asks: 1. In calculating the horse power of a boiler, do you count any of the breeching, or do you count nothing but the actual fire surface of the boiler? 2. What is the best dress to put on a circular saw when cutting pine timber? 3. How is naphtha oil manufactured? 4. What is benzine made from? 5. What horse power has an engine of the following dimensions: Cylinder 9 x 16 inches, working at 63 revolutions per minute, with a pressure of 70 lbs. to the square inch? 6. Did the great transatlantic balloon burst from the high pressure of gas, or did Professor Donaldson cut a hole in it? Answer: 1. Take only the effective heating surface. 2. It is hard to give a general rule, as much depends on the size and quality of the timber. 3. It is a natural product similar to petroleum. 4. It is ordinarily prepared from coal tar oil. 5. The data furnished are incomplete. Probably the mean pressure of steam is not 70 lbs., and there are some deductions to be made for back pressure and cushion. But using these figures, we have horse power = $63 \times 70 \times 2 \times 16 \div 33,000 \times 12 = 22.7$ nearly. 6. We expect no one but Mr. Donaldson could give a correct reply to this question.

C. D. M. asks: 1. What horse power would a propeller engine, 8 inches in diameter x 8 inches stroke, have? 2. Would you advise using a square water tube boiler to supply steam for the above engine? It is to be used in a small yacht, 40 feet keel x 10 feet beam. 3. How large ought a boiler to be for this engine? Answer: 1. It depends on piston speed and steam pressure. 2. We think you had better use a cylindrical boiler, of the same general character as those now used on ocean steamers. 3. Allow from 18 to 20 square feet of heating surface per horse power.

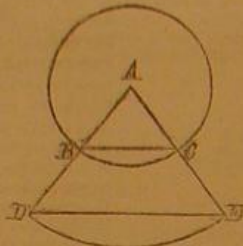
J. S. asks: In constructing a compound microscope, what are the focal distances and diameters of the glasses to be used, to produce a magnifying power of 30? What are the distances that the glasses should be placed from each other? Answer: Use for the object glass a plano-convex lens, $\frac{1}{4}$ inch focus, with its plane side towards the object and its aperture one-fifteenth of an inch. At the distance of about 6 inches from this glass, place the eye glass, which, in its simplest form, is a double convex lens. The magnifying power can be increased somewhat by increasing the distance by means

of a draw tube between the eye glass and the object glass, but this is at the sacrifice of distinctness.

G. K. M. asks: How can I make paint adhere to zinc? Answer: Dissolve 1 oz. nitrate of copper and 1 oz. sal ammoniac, in 64 oz. water. Then add 1 oz. hydrochloric acid. Apply this mixture to the zinc; and when it is dry, paint it, using mineral paint. M. M. M. should use this recipe for painting galvanized iron.

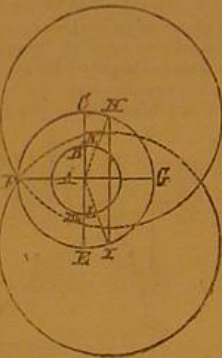
D. H. S. Jr. asks: 1. In fastening pulleys or straight gear to vertical shafting, ought the keys to be driven up or down? In securing bevel gear, ought the keys to be driven with or contrary to the thrust? By thrust I mean the tendency of the wheel to push out of mesh. 2. What scale of measurement is used in expressing the gage of a saw? Answer: 1. Drive the key so that the thrust of the wheel tends to tighten it. 2. There is a great lack of uniformity on the gage question, in the practice of different manufacturers. In ordering a saw, it is best to write to the maker and request him to send a cut of the gage he uses.

J. O. R. asks: Will you please give a formula for finding the length of a lever for working a roll valve, diameter of steam chest, travel of valve and throw of eccentric being known? Answer: Let the circle described with A B as a radius represent the steam chest. Knowing the travel of the valve, the chord B C can be found. Then the chord D E, which represents the throw of the eccentric, being given, A E, the length of



lever can be found by a simple proportion. Example: Diameter of steam chest = 6 inches. Travel of valve = 5 inches. Throw of eccentric = 11 inches. Angle B A C = $5 \times 860 \div 18 \times 5496 = 95^\circ 30'$ nearly. Chord B C = $6 \times 0.672 = 4.032$ inches. Lever A E = $8 \times 11 \div 4.032 = 8.18$ inches.

H. R., S. H., and H. C. say: Locomotive eccentrics sometimes slip round upon the shaft. Bourne, in his "Catechism of the Steam Engine," gives the following rule: "Draw upon a board two straight lines at right angles to one another, and from their point of intersection as a center describe two circles, one representing the circle of the eccentric, the other the crank shaft; draw a straight line parallel to one of the diameters, and distant from it the amount of the lap and lead; the points in which this parallel intersects the circle of the eccentric are the positions of the forward and back eccentrics. Through these points draw straight lines from the center of the circle and mark the intersection of these lines with the circle of the crank shaft, measure with a pair of compasses the chord of the arc intercepted between either of these points, and the diameter which is at right angles with the crank, and the diameters being first marked on the shaft itself, then by transferring with the compasses the distances found in the diagram and marking the point, the eccentric may at any time be adjusted without difficulty." Can you make this a little clearer for us? Answer: In the accompanying diagram, let F G and E C be the two straight lines at right angles to each other, the circle described with A B as a radius be the end view of the shaft, the circle described with A C as a radius be the circle described by the center of the eccentric, and H I the line parallel to E C, and distant from it the amount of the lap and lead. Then if F G represents the direction of the crank when on the center, H and I will be the positions of the centers of the eccentrics, according to the rule. If, then, the points K and L, in which the lines A H and A I intersect the circle representing the shaft, be transferred to the shaft, by laying off on its end the two diameters, and the chords B K and L M, the eccentrics can readily be set.



E. S. asks: Is hard rubber expansive in its nature when subjected to steam under pressure? Will an India rubber conical plug placed in a hole in the shell of a boiler, so that the steam pressure would make it faster in the plate, expand as fast as the hole increases in size by the expansion of the boiler? Answer: We think the proposed arrangement will answer the purpose very well.

R. asks: How can I take 4 or 5 copies of a letter written in copying ink? Answer: There are several varieties of copying ink in the market, which, their makers state, will take 5 or more copies; but you can probably make the ink you use at present effective by adding a little more sugar.

L. Z. R. says: I have a head of water of 7 1/2 feet. During 3 months of winter, we cannot run, and I have tried means to use the water over again. Below me is a lake reservoir always full of water above is the lake which supplies my stream. My idea is to run a penstock, 4 feet deep and 3 feet wide, level with the lower lake, through and under my dam; and thence a penstock at right angles to this, 200 feet long, parallel to my dam. This admits the water of the lower lake in said penstock right into the water of the upper lake, whence it must be raised by power into the upper lake for use the second time. On this 200 feet (or longer if needed) penstock 12 or more large cheap windmills with 12 feet arms can be easily erected by simply driving 4 piles to form a frame; wood arms and sails would do, cheapness and strength being the only requisites. What kind of pump will discharge the most water, under 6 1/2 feet head? I want simply a pump to raise the water from the penstock, discharging directly in the water above the penstock, the power being furnished by said windmills. Answer: Your plan is practicable, provided you can depend upon the wind. Probably simple piston pumps, double acting, will answer as well as anything.

H. says: I notice your answer to H. in reference to heating a room by gas. If a gas stove is put up properly, having not less than 1/4 inch connecting

pipe, you can use it without any objectionable smell. There is, however, a great difference in gas stoves. In some, the combustion is more perfect than in others. The only secret is to have oxygen enough to mingle with the carbon to produce perfect combustion, free from odor.

R. A. M. says, in reply to C. M. N., who asked how to read the superscriptions on coins: Lay your coins upon a piece of hot iron; the dates will be so visible as to be plainly read. The iron must be red hot, and the coins must be read while hot.

H. says, in answer to S. W. G., who asked as to elevating water: A hydraulic ram is the most economical for your purpose. In order to elevate water 115 feet, you must have a fall of 12 feet from the spring or fountain head. You should excavate, at the exit of the springs, to a depth of 10 feet, and group together as many outlets of the springs as possible. Box the sides of the excavation with 2 inch plank and cover the same. Make a hole six inches square at the lower end of the box, in the trench or excavation. Cover this hole with a coarse wire gauze, conduct the water from this through a wooden box 4 inches square into a square box in which the ram should set, at the foot of the hill. Close the end of the wood supply pipe, and in this insert a piece of iron pipe 2 inches in diameter to connect with the ram. The supply or wood pipe should be from 25 to 50 feet long. This will take a No. 5 ram, which will receive from 6 to 14 gallons water per minute. The iron discharge pipe that runs up the hill to the reservoir should not be less than 1 inch. The end of this 1 inch pipe at the top of the hill should be inserted in a close, heavy, iron bound 10 gallon cask, at the lowest point. At the opposite point of the cask, insert another piece of pipe 1 inch in diameter, and continue to the fountain or reservoir. The cask is to equalize pressure. The ram will discharge one seventh of the water it receives into the reservoir. For every foot descent in the supply or drive pipe, you have a raising power of 10 feet in the discharge pipe. The object in having the discharge pipe large is to avoid friction; for when the pipes are smaller, there is more friction, the ram labors heavily and is more liable to get out of order. The box in which the ram sets should be made double, with a space of 10 inches, filled with sawdust, to prevent freezing. The discharge pipe and cask should be buried in the ground below a freezing point. Avoid sharp angles.

T. L. M. says, in reply to several enquiries as to leaf printing: The bichromate of potash photographic process spoken of by your correspondent J. N. Q. gives but a faint picture, even after lengthened exposure to the sun. The image may be reddened by a dilute solution of nitrate of silver. Blue leaf prints are obtained by floating paper on a strong solution of ferricyanide of potassium, commercially called the red prussiate of potash. They are fixed by simple washing. By Obernetter's process, using salts of copper, pictures may be obtained in different tints of deep red and violet, with intermediate shades; but five different solutions are required, and the process, though not difficult, is rather tedious. Leaf prints of the greatest beauty and delicacy may easily be made by amateurs by the ordinary processes of photography on paper, scarcely any utensils being needed besides those found in any household. Make a solution of sixty grains of nitrate of silver and sixty grains nitrate of ammonia to the ounce of water. Float pieces of albumen paper, obtainable at any photographic supply store, on this solution for half a minute or a minute; pin up to dry in the dark. When dry, lay the paper on a thin board, the leaf on the albumen surface, and upon this a pane of glass. Fasten all together with spring clothes pins, and expose to the sun till the darkened albumen paper begins to show a metallic marbling; then remove from the glass, wash, immerse in a solution of chloride of gold. For a ten cent sheet of albumen paper, 18 by 22 inches, a grain and a half of chloride of gold is needful. Dissolve in a pint of warm water, add a teaspoonful of salt and a little chalk to remove the acidity; leave the washed leaf prints in this till they have assumed a pleasing shade (ten or fifteen minutes will be sufficient); then immerse ten minutes in a solution of hyposulphite of soda, two ounces in ten of water, remove and wash thoroughly; if possible, leave over night in running water. These prints are very pretty. In experimenting with them, I obtained beautiful results by soaking them in aniline dyes; the color does not show on the black ground, but the leaves shine out like exquisite paintings on ebony. The entire expense for chemicals (excepting the aniline colors) is \$2.50, for this process; this will be enough for twenty square feet of pictures.

COMMUNICATIONS RECEIVED.

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

- On Electricity vs. Yellow Fever. By O.
- On a New Theory of the Universe. By D. L. S.
- On Cement Water Pipes. By M. S.
- On Richmond, Va. By H. E. C.
- On Compressed Air Cars. By J. P.
- On Propylamin. By C. D. D.

Also enquiries from the following: J. T. T., J. M. S. Jr., H. Z. T., M. F., C. W., J. P. L., F. D. B., F. C. D., J. M., P. L., S. N., A. L. E.

Correspondents who write to ask the address of certain manufacturers, or where specified articles are to be had, also those having goods for sale, or who want to find partners, should send with their communications an amount sufficient to cover the cost of publication under the head of "Business and Personal" which is specially devoted to such enquiries.

[OFFICIAL.]

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October 28, 1873,

AND EACH BEARING THAT DATE.

(Those marked (r) are reissued patents.)

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RECENT PROGRESS IN ELECTROMAGNETISM.

Much ingenuity has been wasted upon the problem of converting electricity into mechanical force; or, in other words, of constructing electromagnetic engines destined to drive machinery, to raise weights or to draw loads. Hundreds of such engines have been made, only to demonstrate the conclusion of scientific men, who have long ago given up the problem as incapable of a practical solution. It is not difficult, indeed, to show by a very simple calculation that, in the present state of science, the electromagnetic machine can never compete with the steam engine, because of its far greater cost. The force in the former is derived from the oxidation of zinc in the battery, while that of the latter is due to the oxidation of the carbon in the coal burned under the boiler. Now, 1 gramme of carbon burned will raise the temperature of 8,080 grammes of water 1° centigrade, while 1 gramme of zinc will only raise 1,300 grammes to the same extent. Thus carbon would seem to be 6.2 times as effective as zinc. After the oxidation of the zinc in the battery, the solution of the oxide in the sulphuric acid produces an additional quantity of force (or heat) capable of raising 335 grammes more, which must be added to the 1,300 grammes; from this, however, must be deducted the force wasted in decomposing the water in the battery, a force capable of raising 1,080 grammes of water 1° centigrade. The balance, 575, is 14 times less than the effective force of coal, and yet even this comparatively small amount of force is only attainable in the theoretically perfect battery. Taking into account that coal is about 40 times cheaper than zinc, the odds are 40 times 14, or 560, to 1 against the electromagnetic machine.

While thus any effort to convert electricity into the grosser form of mechanical force must fail, until zinc can be manufactured about 600 times more cheaply than coal can be mined (which it probably never will be) or until some other source of electricity be discovered, physicists have been eminently successful in reversing the problem: that is to say, converting mechanical force into electricity, and they have utilized the electricity so obtained in the production of the most intense artificial light known. Before describing the immense improvements made very recently in this department of science, it may be well to study the apparatus hitherto employed.

When a piece of soft iron surrounded by insulated copper wire is presented to the poles of a magnet, a momentary electrical current is formed in the wire; and on removing the soft iron from the magnet, another current is formed in the opposite direction. Now, these currents may be made to succeed each other with extreme rapidity by revolving the insulated iron bar before the poles of the magnet, and they may also be made to flow in one direction. The former may be done by steam, and the latter is accomplished by a device called a commutator. Thus a powerful current is produced, capable of showing all the phenomena of the battery in an exalted degree. Machines constructed on these principles have been

extensively used to produce the electric light and in electroplating.

In December, 1858, the electric light was employed for the first time in the illumination of lighthouses, at the South Foreland, England. The magneto-electric machine used was constructed by Professor Frederick H. Holmes. The following April a favorable report was made on the invention by Fara-

tric light was not established, however, until June 6, 1862, at Dungeness. Holmes' machine consisted of 120 permanent magnets, each weighing 50 pounds, arranged on the periphery of two large wheels. A three horse power steam engine revolved 160 soft iron cores surrounded by coils of wire near the poles of the magnets about 100 times a minute. The negative and positive currents were thrown in one direction

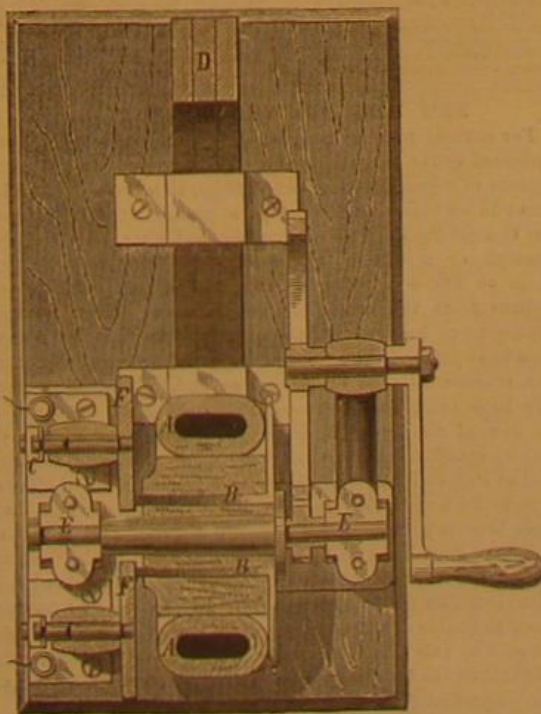
by means of a commutator, and then conducted through thick wires into the lighthouse tower where they terminated in carbon points, between which the electric arch was formed. The intensity of the electric light, as measured by Fizeau & Foucault, is only 2½ times less than that of the sun; while its cost as compared with the Fresnel lamp then in use was computed to be as 400 to 290.

A considerable improvement was made by Wilde, who conceived the idea of causing the current induced in a coil of wire by a permanent magnet to produce a more powerful electromagnet, which in turn was to induce a new and greatly increased current. The current thus generated could be passed around a third magnet, and so on indefinitely, as far as theory was concerned. In practice, however, he found it most ad-

GRAMME'S NEW ELECTRIC LIGHT MACHINE.

day, who thus had the satisfaction of seeing his discoveries productive of good to mankind. The first permanent elec-

FIG. 2.



vantageous to limit himself to three magnets. When the three armatures of these magnets were driven with a velocity of 1,500 revolutions a minute, it melted a cylindrical iron rod 15 inches long and ½ of an inch in diameter, which was placed between its poles. With gas carbon points half an inch square, the light generated was equal to 4,000 wax candles. This machine weighed about 3 tons, and required a seven horse power engine to drive it.

In his latest and most perfect form of machine, completed last June, Wilde employs two wheels of 16 electromagnets each, between which are situated two series, each of 16 soft iron armatures secured to a heavy cast iron disk. The ends of the cores are terminated with iron plates of circular form, which retain the helices in place and somewhat overlap the distance between the poles of the electromagnets. By having the magnetic circuits of the electromagnets and armatures closed for a short distance, and by likewise having the electric circuits closed for a brief interval at the point of no current, the magnetic intensity of the electromagnets is maintained during the rise and fall of the magneto-electric waves transmitted through the helices. These helices are divided into 8 groups of 4 each; one of these groups produces the minor current for the circle of electromagnets, and the rest are joined together for a quantity of 7 and an intensity of 4, to produce the major current of the machine.

This machine weighs only about one ton, while its power is double that of the 4 ton machine described. It may be run at a speed of 300 to 1,000 revolutions per minute.

The Wilde machine is in operation in this city for plating purposes, at Frank Leslie's printing establishment. The machine runs with a velocity of 1,800 revolutions a minute, and will electrotype a number of plates as large as the Illustrated Newspaper in 20 minutes. Wires are also connected with the

machine, which lead to the photographic establishment across the street, and on cloudy days they print photographs by means of the electric light produced by the Wilde machine.

The results obtained by these machines and by subsequent modifications certainly leave little to be desired; but the machines themselves, unfortunately, have inherent defects. The currents produced are intermittent; at each revolution, two electrical pulses proceed in one, and two in another, direction. To collect these, a friction commutator is necessary, which wears away very fast. In Holmes' original machine it only lasted from 10 to 20 minutes; and in the later machines, in which over 1,800 revolutions per minute are obtained, there must necessarily be considerable wear and tear wherever there is a metallic contact of moving parts.

These difficulties have been overcome in a machine invented by M. Gramme, of Paris, and recently exhibited before the French Academy of Sciences by M. Jamin. Our engravings illustrate the invention. The principle is as follows: If the north pole of a permanent bar magnet be moved along a soft iron bar surrounded by an insulated wire, it will produce a south pole in the iron bar, which will gradually be displaced from one end of it to the other, following the motion of the bar magnet. The result is a continuous induced current in the surrounding wire. If, now, the soft iron bar be made into a ring, A, and placed between the poles of a horse shoe magnet, D, these poles will of course induce currents in opposite directions, neutralizing each other at two points of the ring, midway between the poles, exactly (according to Mr. Crookes) as if we had two batteries connected in opposition by joining their similar poles. On revolving the iron ring on the journals, E, a continuous current is developed, as in the case of a straight bar, but in opposite directions, because here we have to do with both poles of the exciting magnet. Both these currents will continually neutralize each other at the two mean points. To utilize them, all that is necessary is to connect conducting wires to the insulated wire at the mean points, and they will flow along these wires instead of neutralizing each other; just as in the two batteries above, connecting a disk, F, with each point of contact of the similar poles, will cause the force of the batteries to flow through the conducting wires "quantity-wise." M. Gramme accomplishes this in the following manner:

If the wire wound upon the ring is very thick and there is but a single layer of it, it is sufficient to remove the insulating covering at some point which, in its revolution, is made to touch fixed metallic conductors, F, situated at the neutral points. If, however, many layers of fine wire are used, the following device is adopted: The wire is divided into sections of, say, 300 turns each, there being no break, however, in the wire on passing from one section to another. Each section has its wire exposed at one point, and to this point is soldered a solid bar of brass, B, capable of considerable wear and tear. The bars thus attached to the sections are arranged radially; and when the ring, A, is revolved, several of them simultaneously touch two solid metallic rubbers, F, at the neutral points. More than one bar is made to touch at a time to prevent any break in the current.

The machine exhibited before the French Academy of Sciences derived its magnetism from an electromagnet instead of a permanent one. It was provided with four metallic rubbers, two of which supplied the electromagnet with a part of the current generated. The machine started with the feeble residual magnetism in the electromagnet, which rapidly gained in strength as the velocity increased. A machine of this kind, having 15-4 lbs. of copper wire 0.118 inch thick, decomposes water and fuses 1.04 inches of iron wire 0.036 inch thick when worked by hand. A large machine, driven by a 24 horse power engine, which was exhibited in London, produced a light equal to about 8,000 candles; and still larger machines are being made, which Mr. Crookes expects to give a light equal to 25,000 candles. Besides the purposes of illumination, such machines, of the smaller size, will be of service in telegraphing, electroplating, gilding, medicine, military operations, and chemical decompositions. They are of especial value in electroplating, on account of the constancy of the current. In the galvanoplastic works of M. Christoffe, of Paris, it is found that the best machine hitherto known, when moved with a velocity of 2,400 revolutions per minute, only deposits 5.465 ounces troy of silver per hour, while a smaller Gramme machine deposits 9.645 ounces troy of silver per hour with one eighth the velocity.

There will be two of these machines in this country before long, Professor Barker having ordered one for the Stevens Institute of Technology, and one for the University of Pennsylvania. At present electroplating is done in this city in several places by the Wilde machine.

It would be difficult indeed to foresee what further increase in power may yet be obtained in these machines; for investigators are constantly studying the properties of magnets and the means of augmenting their strength.

M. Ruhmkorff, to whom science already owes so much, still continues his experiments in electricity and magnetism. He has presented the following facts to the French Academy of Sciences:

If a bundle of iron wires, covered with thick copper wire giving passage to an intermittent current from a battery, is then wrapped with fine wire for the purpose of obtaining an induced current, that current will have more than double the usual intensity if we wrap the fine wire around the middle of the bundle, where there is no magnetization, instead of wrapping it near one of the poles. He concluded from these premises that he could get still more powerful effects by making a continuous ring of his iron wires, which would then present no poles; but in this he was disappointed, for the induced current gave a spark only 0.1 inch long. On cutting the ring, the spark at once increased to 0.2 inch,

although the cut ends came together the moment they became magnetic.

On keeping the ends apart with a plug of wood 0.2 inch in thickness, the spark reached the length of 0.6 inch. With thicker plugs of wood, no further change was produced. It still remains to be seen what practical application can be made of this fact.

Jamin, in studying the magnetism of thin steel plates, found, by magnetizing plates of various dimensions and superposing a number of similarly magnetized ones, that he could construct magnets carrying twenty times their own weight. The thinner the superposed magnetized plates, the more powerful the resulting magnet. His researches will probably reveal the law according to which magnets, having a minimum weight and a maximum carrying force, may be constructed.

It seems, too, as if we were rapidly approaching the solution of the problem of an electrical illumination for our streets and houses. The difficulties hitherto have been: that it is impossible to regulate the intense brilliancy of the electric light, which would be blinding on the street, and of course utterly unfit for lighting our houses; that it is not continuous, but requires the frequent renewal and adjustment of the carbon points, involving expense and complicated apparatus for each lantern; and finally that a separate source of electricity is required for each lamp. All these difficulties are said to have been obviated by the invention of Mr. A. Ladiguin, of St. Petersburg, which was recently exhibited by Kosloff & Co., the proprietors of his patent, in the Admiralty House of that city. His invention is as follows: Only one piece of carbon, or other bad conductor, connected with the magneto-electric machine is placed in a glass tube exhausted of air, filled with some gas which will not combine with carbon at a high temperature and hermetically sealed. The carbon becomes gradually and equally heated, and emits a soft, steady, and continuous light. One machine, driven by a small three horse power engine, is said to be capable of lighting many hundreds of such lanterns, which will burn under water and in mines as well as in a room. They are free from any danger of explosion, and have the additional advantage, over gas, that they emit no poisonous evaporations detrimental to the health. The inventor calculates that these lamps can be lighted at one fifth the expense of coal gas. If this invention should prove a success, few consumers will mourn the disappearance of gas companies.

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NEW YORK AND THE CENTENNIAL.

For several months past extended advertisements have appeared in the journals of this city, announcing a projected scheme of a grand national exposition, to be permanently located in elaborate buildings, in a prominent locality near the Central Park. The originators, last year, obtained the passage of a bill in the State legislature, authorizing them to ask a subsidy of two and a half millions of dollars from the municipal government. After hearing argument on both sides of the question, the Board of Aldermen have refused the appropriation; and as a consequence, the scheme may be considered as indefinitely postponed. We have remarked, however, that during its existence a portion of the press have sought to engender a kind of rivalry between this plan and the coming National Centennial at Philadelphia. In view of the present state of affairs, it is to be hoped that any feeling of jealousy which may have become prevalent will speedily die out, and that the people of New York will render that support to the Centennial which the enterprise justly deserves. The quota of this State is \$1,036,600, which it is proposed to raise by issuing stock in shares of \$10 each, paying six per cent interest, and secured by sale of tickets, concessions for advertising, etc., and sale of the building—making the investment, as far as can be predicted, a safe and, probably, profitable one.

An immense amount of labor has been accomplished by the Centennial committee, and, from all accounts, the work is progressing rapidly and well. The people of the southern and western States are manifesting no small amount of interest in the scheme, and State and county associations are forming for the purpose not only of raising funds but of securing the most complete possible exhibit of resources and products. A very liberal appropriation has been made by Pennsylvania and the city of Philadelphia, and we understand that still further assistance is contemplated in order to add improvements to Fairmount Park, the site of the exposition buildings. In fact the country has abundant cause to congratulate itself on the favor with which the plan has been received abroad, and the enterprise with which it has thus far been conducted at home. Uniform and flattering success, we might say, has been encountered, were it not that several of the States have manifested a dilatoriness in affording support, which cannot but prejudice the general progress of the undertaking.

The citizens of New York should remember that the selection of the plan of buildings from drawings submitted by Messrs. Vaux & Bedford, a prominent architectural firm of the metropolis, is quite a compliment to the city, yet to be returned; and moreover that their local interests cannot but be furthered by the attraction of immense crowds to a point only four hours distant by rail. The matter is, besides, one of national pride, and hence we trust the patriotism of the people may be relied upon not to allow the Centennial, in point of magnitude and grandeur, to fall below previous exhibitions in Europe, or to prove so unfortunate a financial failure as the recently closed Vienna show.

THE SIGNAL SERVICE REPORT.

The Chief Signal Officer of the Army has recently submitted a very gratifying exhibit of the labors of his bureau during the past year. Thirteen new stations have been added, so that at the present time there are seventy-eight points of observation in the United States, eleven in Canada, and three in the West Indies, the latter being located at Havana, Kingston, and Santiago de Cuba. Three other stations, on the islands of Porto Rico, Guadalupe and Barbadoes, will also shortly be equipped.

Some very excellent arrangements have been completed for securing to farmers and others, in communities not reached by telegraph, information as regards probable weather earlier than would be afforded were the reports delayed by publication in newspapers. The plan adopted has been to divide the territory of the United States into districts, each district having a distributing point, at or near the center, from which two printed copies of the synopsis and probabilities are forwarded by mail to all post offices within the districts, or which can be reached by rail, steamer, or mail coach by 4 P. M. of the same day. The bulletins are then conspicuously posted in the receiving offices, and 8,982 printed copies of the weather report are thus daily distributed to 4,491 post offices; and the plan thus far has worked admirably.

There are nineteen special river stations from which reports of the depth of water in the principal rivers of the United States are daily made by telegraph, at particular seasons during which danger from freshets may be anticipated. Twenty of the regular stations also furnish river reports, which are of great value as giving constant and accurate knowledge of the condition of channels, and thus adding to the safety and convenience of our river commerce.

For the purpose of studying the phenomena of the upper portions of the atmosphere, stations have been established on Mount Washington, N. H., on Mount Mitchell, N. C., and quite recently a third one on the summit of Pike's Peak, at an elevation of 14,216 feet above sea level.

One of the most valuable additions to the system, which has been made during the past year, is the establishment of a chain of life-saving stations along the Atlantic coast. Signals visible for some distance at sea, serving to warn vessels of probable bad weather, are to be displayed from points twenty-five miles apart from Sandy Hook to Cape May, and it is intended to continue the construction of suitable telegraphic communication along the dangerous coast of Virginia and North Carolina. Without doubt, these points of observation will be of great benefit. They will serve as meteorological stations from which information of the condition of the weather at the sea level can be transmitted; as sites for lighthouses and life boat deposits; as videttes in time of war, to give warning of the approach of an enemy's fleet; as a means of communication with vessels cruising along the coast; and as positions of display of cautionary signals, as already noted.

With reference to international exchanges of meteorological information, General Myer refers to the proceedings of the recent Weather Congress at Vienna. The proposition was adopted, by a unanimous vote of that body, that at least one uniform observation of such character as to be suitable for the preparation of synoptic charts should be taken, and recorded daily and simultaneously at as many stations as practicable throughout the world. It is also stated that arrangements have already been made with Prussia and Turkey to commence, on January, 1874, the exchange of one daily report, taken simultaneously throughout those countries and the United States; and the cooperation of other nations in the system is expected.

The Chinese coal fields occupy an area of 400,000 square miles. Both bituminous and anthracite coal are found of good quality. In immediate proximity to the coal, large deposits of iron ore occur.

RECENT EXPERIMENTS WITH DIAMONDS.

Diamonds are rather costly objects to subject to destructive experiments on any extended scale, and not many investigators have been favored with the privilege of doing it. Thanks, however, to the liberality of the proprietor of a large diamond-cutting establishment in Amsterdam, a certain M. von Baumhauer has been permitted to make numerous studies of the behavior of these interesting gems when subjected to high temperature under various conditions, thus adding largely to our knowledge of the diamond's nature and properties.

The combustibility of the diamond in oxygen was demonstrated long ago; what the effect of pure heat upon it was remained a matter of doubt. Some experiments seemed to show that at extremely high temperatures the diamond is slowly converted into coke or graphite, an effect observed especially when the gem is subjected to the energetic action of a powerful galvanic battery. In certain experiments, in which Moren and Schrötter raised diamonds to the highest heat of a porcelain furnace, care being taken to prevent contact with air, a slight discoloration of the surface was observed, whether due to heat or imperfect protection against oxygen could not be decided positively. Inclosed in a bit of hard coke, and placed in a plumbago crucible packed with charcoal powder, diamonds operated on by Siemens and Rose withstood, without the least change, the temperature at which cast iron melts. A cut diamond, under similar conditions, subjected to the heat of molten wrought iron for a considerable period of time, was superficially blackened, but otherwise unaffected. By some this experiment has been interpreted as implying the slow conversion of the diamond to graphite at the temperature at which wrought iron melts. It is possible, on the other hand, that the change was due to air in the crucible: indeed probable, in view of the experiments more recently made by M. von Baumhauer.

By an ingenious device, the last named experimenter was able to subject diamonds, surrounded by an atmosphere of dry hydrogen, to a temperature at which both diamond and platinum holder became invisible; but with uncolored diamonds, their transparency and brilliancy were not in the least affected. Heated in contact with air, diamonds were not only blackened, but reduced in weight, showing positive combustion. In oxygen they burned with a vivid incandescence at a temperature below white heat. In a crucible which allowed the combustion to be observed through a sheet of mica, the burning diamond was seen to be surrounded by a white flame, less bright without and tinged with violet on the outer edge. Pure diamonds burned tranquilly, retaining their sharp edges even when so reduced as to be visible with difficulty. Impure specimens snapped and flew.

Burned in an oxyhydrogen flame, capable of melting platinum, diamonds emitted a brilliant light and wasted rapidly, but did not blacken. Heated to a high temperature in an atmosphere of carbonic acid, they were slowly consumed, decomposing the carbonic acid, and combining with its oxygen with loss of weight. Similarly treated in superheated steam, no effect was produced, showing that at white heat the diamond does not decompose water, as might be expected from its affinity for oxygen. In regard to the supposed transformation of the diamond into coke or graphite by means of pure heat, especially by that of a battery of 100 Bunsen elements, M. von Baumhauer is very doubtful. It should not be admitted, he holds, until the effects observed are proved to be not the result of chemical action, produced by foreign matter, or by the transmission of particles of carbon from the charcoal poles to the surface of the diamond.

The effect of heat on colored diamonds is more pronounced, with the exception, perhaps, of gray and yellow gems, which appear to resist such action, the same as the colorless ones. Green diamonds are variously affected. One of a dirty green tint was changed to pale yellow, with a slight increase of its transparency; but its brightness remained the same. Another, so green as to be almost black, likewise retained its brilliancy, but gained in clearness, while its color was changed to violet. A light green gem lost its color entirely, but was otherwise unaffected. Brown diamonds lost most of their color, showing under the microscope a limpid field, scattered with black spots. A diamond almost colorless assumed, under the influence of heat (out of contact with air), a deep rose color, which it retained some time when kept in the dark. In the light its color faded, but always returned again with heating. A naturally rose colored diamond reversed the phenomena, losing its hue with heating, and afterwards gradually regaining it.

PHOTOGRAPHY OF THE INVISIBLE.

The grand moral idea which science continually seeks to impress upon her votaries is, humility of mind; that inestimable virtue whence spring the noblest pleasures of the soul. But how rare it is to find this beautiful quality, even in persons of culture and learning! The great doctors looked upon Galileo with contempt, confined him in prison as a dangerous man, and subjected him to the most ignominious treatment, simply because he presented, for their acceptance, the light from a new idea, which their dull perceptions were unable to appreciate. He affirmed that the sun did not really rise or set; that it was the rotation of the earth that brought day and night alternately upon the earth. But the doctors, like many in our day, proud in their own conceit of knowledge, knew better. "The scriptures tell us," they said, "of the rising and the setting sun; therefore it moves; our own eyes assure us of the fact; the diurnal experience of mankind confirms the truth. Your doctrine, Galileo, is false and dangerous."

It is in this style that some persons, very knowing in their own esteem, reason upon certain subjects. Take "spirit photography" for an example. They allege that spirits are invisible; that an invisible thing cannot be photographed; therefore the so-called spirit photographs are base impostures.

It is not our purpose to dissent from the conclusion here assumed; but we take exception to the premises, which are not in agreement with science. Photographs of some objects that are invisible to the human eye may undoubtedly be produced. The spectrum of solar light is an example, portions of which, totally invisible to the eye, are brought out upon the photographer's plate; and their presence is also demonstrated by other instruments.

The mental effect which we term light is supposed to be produced by the beating of waves of ether against the retina of the eye. These waves enter the eye with an average velocity of about 186,000 miles in a second, the length of the waves being variable, from the one twenty-seven thousandth part of an inch, to one seventy-five thousandth part of an inch. The retina therefore receives many billions of impressions in a second, and it is supposed that it is the difference in the number and velocity of these impressions that produces in the mind the sensations of the colors. If the waves which enter the eye have a much greater or a much less velocity than the limits above stated, they do not, it is supposed, produce the sensation of light; and the objects from which such rays come, although they may really stand before the eye, are, as we say, invisible. But although they do not effect the eye, they may impress the photographic plate, which has no such constitution as the eye.

One of the most successful methods of producing "spirit" photographs is to place, in front of the sensitive plate, within the plate shield, a clear sheet of glass having nothing upon it except a thin positive of the "spirit" that is to be produced on the negative. The portrait of the sitter is taken in the usual manner. The light which enters the camera lens prints the sitter and also the "spirit" which is on the thin positive upon the negative. This is a very convenient method, as it requires no manipulations likely to be detected; and is, we think, the favorite plan practiced by the best spirit photographers. Prints made in this manner pass current among the believers for genuine ghosts of the departed, directly descended from heaven.

But a more new, interesting, and scientific method of producing "spirit" photographs, is as follows: the plain background screen, before which the sitter is placed in order to have his portrait taken, is to be painted beforehand with the form of the desired "spirit," the paint being composed of some fluorescent substance, such as a solution of sulphate of quinine. When this painting dries on the screen, it is invisible to the eye; but it sends out rays that have power to impress the photo plate; and thus the image of the person together with the quinine ghost are simultaneously developed upon the negative. This is a very beautiful and remarkable method.

SCIENCE IN THE KITCHEN.

The student of the social economy of this country will encounter no more remarkable anomaly in the habits of our people than that, while we exhaust every possibility achieved by the progress of modern science toward the augmenting of our pecuniary welfare, we as sedulously neglect the teachings derived from the same source and pointing to one of the most important causes of physical health and comfort. When a man undertakes to build himself a house, it is the general rule that he exercises the closest care that every portion of the structure shall be, in design and material, the best. He employs a capable architect, a thorough builder, selects stone, brick, mortar and other components of his fabric with a rigid scrutiny which leaves no doubt in his mind but that his dwelling will be a strong and lasting shelter. Then he decorates, furnishes, searches for ingenious devices of household convenience, and finally enters his new habitation secure in his belief of its excellence. Is it not strange that all his labor is done for a roof which may cover its owner but until to-morrow: for a home which the vicissitudes of fortune may wrest from him in a day, or which of his own choice he may abandon before the mortar is perfectly dry; while to the structure in which Providence has ordained he shall exist for a lifetime, but secondary consideration is given?

Our food has been compared to the fuel which heats a boiler, makes steam, and so drives the machinery. The simile is not only trite but unjust. The substances that we eat play even a greater part. It is as if the fuel, besides heating the water, contributed by its combustion to the existence of the boiler—in other words, we are made of the materials we consume. Clearly then, although we may subsist for a time on substances unsuitable and comparatively non-nutritious, in the end our physical system will suffer, if not break down, from the improper nature of the components with which it is supplied.

Cooking is the proper preparation of food for human consumption. We do not consider that the term means applying heat until the substance assumes any form which is edible, but the causing of the material to undergo certain changes, chemical or otherwise, in its condition, which render it in the most suitable state for the nourishment of the body. Articles for the table, then, are either cooked or ruined—necessarily one or the other. Bad cooking, like bad grammar, is non-existent *ex vi termini*; but as to where the dividing line happens to be between these very opposite conditions, it is odd that few persons can agree. Perhaps it may be safely drawn from the sanitary point of view, as above noted; for a single material, like the common potato,

for example, may be nutritious and healthy when properly cooked; while if it be boiled until it be waterlogged and wax-like, its beneficial nature is lost. Theoretically, then, the gage of cookery should be the healthfulness of its results; practically, however, the standard is simply and purely one of individual taste; and that in this country, where the majority are educated to relish compounds indigestible and worthless as brain and muscle producers, is fallible in the extreme. Hence, while this sense is gratified, we give no thought to the means; in other words, so long as the builder of the fabric is satisfied with the exterior appearance of his stone, mortar, or brick, no matter, if when they are made into a wall, they prove bad within, and weak and insufficient as supports.

Dr. James, in an excellent paper recently read before the American Health Association, upon a topic kindred to that to which we are referring, points out with much clearness many of the abuses into which the preparation of our food has fallen, and inveighs with special vigor against the general assumption that women are natural cooks. Perhaps it is to the invariable inaccuracy which (our feminine readers will pardon us) is inherent to the gentler sex, more than to any other cause, that the science of cookery has descended to the level of a rule of thumb pursuit. Do we ever need a medicine, we watch the druggist, that he compounds it with scrupulous exactitude. Do we build a machine, we hire talent that will execute the work to hair breadth accuracy; in fact, we employ skilled labor to supply us with knowledge, to house us, to dress us, and even to shave us, everything but to feed us. It takes an artist to make our coats; but the most foolish of Hibernian virgins may be installed in our kitchen to prepare the food that makes our body.

If cookery were reduced down to rule, so that a person could follow recipes with the same certainty of success, due to accuracy, with which the student pursues the instructions laid down in his text book of chemical analysis, it is presumable that any individual could produce eatable and healthy dishes; but nothing is further from the truth. Let the reader ask any successful cook how he or she made such or such a compound, the chances are strongly that no satisfactory explanation can be given. "Practice" is probably stated as the reason, or "experience," or "luck." Let him turn to any so-called cookery book, and we would be willing to wager that in nine cases out of ten the recipes for the most delicate cake and pastry contain greater margins of inaccuracy than any formula extant for mixing mud concrete. What does a teaspoonful mean, heaped up or level with the rim? Or a teaspoonful? What size of teaspoon? How much is a pinch, or a handful, or a pennyworth? There is absolutely no standard system of measures conscientiously followed; and hence a woman will gage her ingredients by the grab with the same unquestioning faith in the accuracy of the combination that she reposes in the fact that the distance from the tip of her nose to the end of her fingers is precisely and infallibly one yard.

The practical solution of the important question, whether the masses can be educated properly to prepare their food, is yet to be determined. It is surely possible that cookery can be taught as a science, as other necessary branches of knowledge, not after the fashion of child's play, as have been most of the previous attempts in this direction, but as a serious study. We do not expect every man's wife to become a *cordon bleu*, or our servants to prepare *entrées* which would not disgrace Delmonico; but we do believe that means might be found of imparting information sufficient to relieve the people of many of the nightmare-breeding compounds of daily consumption. Make practical cookery a part of every woman's education, and the principles of the same a portion of that of every man. Let us, for recipes, have formulae and instructions, clearly couched but as accurate as the physician's prescription, and deduced by scientific investigation. Then with the materials and means which we now have, better than which the world cannot produce, the answer to our petition for daily bread will not be food destructive to our health as individuals and as a people.

SCIENTIFIC AND PRACTICAL INFORMATION.

SWEDISH IRON.

The superior quality of Swedish iron is still maintained. The price for charcoal pig, in 1873, has been about \$45 a ton. Ten years ago the same article sold at \$19 per ton. It is supposed that the excellence of Swedish iron is due to the presence of tephrite, a silicate of manganese and iron. This is a discovery by M. Ingelstrom.

AN IMPERIAL THERMOMETER.

Professor Palmieri, of Naples, has recently completed a very ingenious and elaborate registering thermometer for the private use of the Empress of Russia. The instrument is of metal and is provided with bells, which give a signal whenever any considerable change of the surrounding temperature occurs. It is said to be so sensitive that the indicator is in a state of almost perpetual motion. Suitable devices show the extreme range of temperature during given periods of time. The apparatus is placed in the imperial traveling carriage.

THE CORINTH SHIP CANAL.

The Italian Consul at the Piræus, Greece, communicates to this government the news that the contract for opening a canal through the Isthmus of Corinth has been awarded to M. Tavini, an Athenian banker. The conditions of the agreement are that the canal shall have a minimum depth of 28 feet and a breadth of 137 feet at the base. A basin and docks, with storerooms, etc., covering an area of 71 acres,

are to be constructed, at half the distance, and the basin is to have a sufficient depth of water to float the largest vessels.

The work is to be completed in 6 years under a penalty of \$60,000, and M. Tuvini has obtained the entire grant for 99 years. It is estimated that the expense of the undertaking will reach about \$1,000,000. The advantage to be gained are the avoidance of the *détour* of the Morea and the doubling of Cape Matapan, a dangerous coast in stormy weather, thus materially lessening the journey between Greece and the western countries of Europe.

BISULPHIDE OF POTASH A REVEALING AGENT FOR GALENA.

M. Jannetot, in *Les Mondes*, says that, on throwing a fragment of a crystal of bisulphate of potash, $\text{HO} \cdot \text{K} \cdot 2\text{SO}_3$, on roughly ground galena, a very sensible disengagement of sulphuretted hydrogen ensues. If the two substances be ground together, the odor becomes almost insupportable. It is well known that sulphuric acid, mixed or even warmed with galena, does not give any sensible disengagement of sulphuretted hydrogen, nor do the sulphurets of antimony, of iron, of mercury, of silver, or even those in which the lead and sulphur do not form an isolated combination, give such results with the bi-sulphate. But if, to any mixture whatever, a fragment of pure sulphuret of lead be added, at the moment when the rubbing or grinding of the whole with bisulphate of potash takes place, sulphydric acid is given off.

DIRECT DETERMINATION OF THE ELEMENTS OF ORGANIC SUBSTANCES BY A SINGLE COMBUSTION.

Mitscherlich has recently discovered a new mode by which, by direct analysis, not only the carbon, oxygen, and hydrogen in an organic substance can be determined, but also the chlorine, bromine, sulphur, iodine, phosphorus, and probably also the nitrogen therein contained. The organic material is brought to combustion with oxide of mercury, the results of which process are water, carbonic acid, and mercury. The two former are weighed in the ordinary manner. The weight of the mercury formed serves to determine the quantity of oxygen due to combustion, by subtracting which from that contained in the carbonic acid and the water, the total amount of oxygen existing in the substance submitted to elementary analysis is found. If, however, the body under examination contains chlorine, bromine, or iodine, these elements combine with the mercury set free, and are determined by weighing. Sulphur and phosphorus combine in the state of sulphate and of phosphate of oxide of mercury.

PREPARING AMMONIA SALTS.

Bobrownicki, of Paris, proposes to prepare ammonia salts from the ammonia liquor of gas works by acidifying and then treating it with fluoride of silicon, chloride of silicon, hydrofluor-silicic acid, or an alkaline silicate. The silicon compounds carry down the suspended bodies, and those in solution, and hold them in a solid or half solid form. Bobrownicki calls the precipitate a silicoid. It furnishes the crude material for preparing ammonia salts in the usual manner.

NEW REMEDIES FOR CHOLERA.

French physicians, as a rule, hold to the fungoid theory of cholera, and one of their number has been experimenting with the carbolate of ammonia in cases of cholera, so far, we learn, with encouraging success. One physician (Dr. Déclat) looks upon carbolic acid as a prophylactic, to be used in the ordinary way of diet during epidemics. It is taken in the form of sirup. When a patient is attacked with cholera, the sirup should be administered, and a dilute solution of the acid injected. In severe cases, the doctor employs a sirup of carbolate of ammonia, with subcutaneous injections of the same; and he is so confident as to the efficacy of his remedy that, in cases where dissolution is impending, he injects a solution of the carbolate of ammonia directly into the veins.

A Phenomenon of Capillarity.

A curious experiment, due to capillary attraction, was described at a recent session of the French Academy of Sciences. It consists in placing in a flask a small quantity of bisulphide of carbon, and inserting into the liquid a small tight roll of filtering paper, which passes up through a hole in the cork. Owing to the porosity of the paper, the bisulphide ascends; and on coming in contact with the atmosphere, evaporates very rapidly. A temperature is thus produced of very nearly 0° Fah., under ordinary circumstances. The water held in a vaporous condition in the air is consequently condensed and precipitated in the state of hoar frost, which, with the bisulphide, forms, it is said, a peculiar hydrate, which is deposited on paper in a white layer. As new quantities of the bisulphide are continually supplied, the phenomenon continues until a mushroom-shaped excrescence perhaps an inch in height and broad in proportion, surmounts the flask.

MM. Dumas and Chevreul suggest that this may point to the explanation of certain geological phenomena, such as ferruginous and calcareous concretions, of which the forms are identical with that of the artificial stalagmite described.

For the convenience of those dandies who are unequal to the effort required to carry a cane and an eye glass at the same time, C. E. Pevey, of Worcester, Mass., has combined these two articles in one, the glass being set in a bow formed in the handle.

A MODEL of a safety watch pocket in the Patent Office has the following inscription:

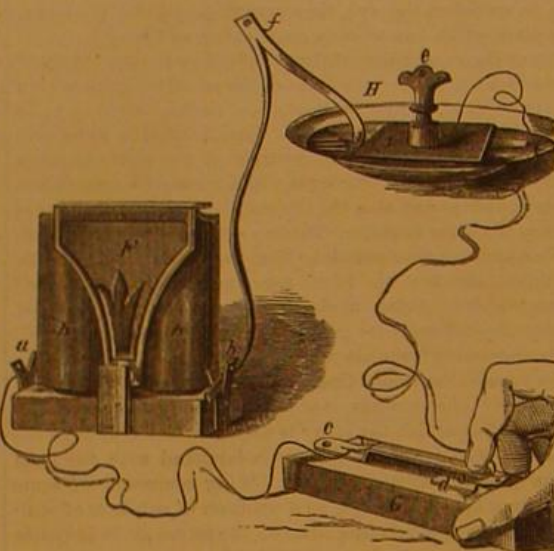
"He that hath a watch, two things must do,
Pocket his watch, and watch his pocket, too."

THE TOM THUMB TELEGRAPH.

There is nothing equal to experiment in impressing the facts of science upon the mind. Faraday used to say, with emphasis, to his pupils, that it was not sufficient to read about magnets and electricity. He advised them to make the magnets, use the electrical machines, and thus become, step by step, positively acquainted with the whole subject. As a means to such ends, we take especial pleasure in calling the attention of our readers to the Tom Thumb Telegraph. It affords the means of illustrating the phenomena of electricity at a cost so small as to be within reach of almost everybody.

The Tom Thumb Telegraph consists of an electro magnet, sounding armature, a galvanic battery, telegraph key, connecting wires, and chemicals, all complete for working, which, with excellent directions for use, are furnished for \$3: neatly packed, and sent to all parts of the world, on receipt of the price, by the makers, F. C. Beach & Co., 260 Broadway, corner Warren street, New York.

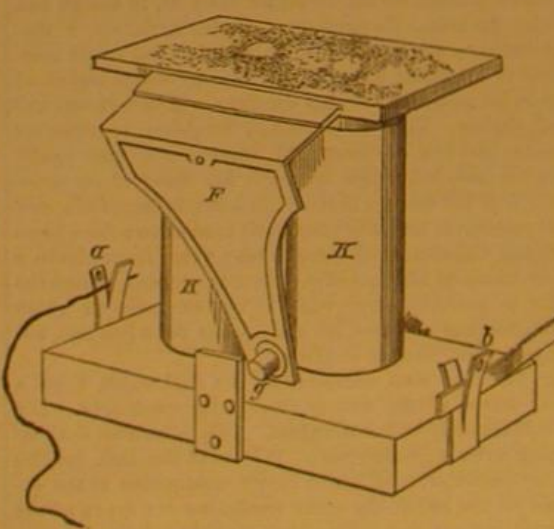
One of these little instruments is now in operation upon our table as we write. We had some curiosity to see what could be done with it, and will here give some of the results: First, as to the battery. It is composed of two small plates, one of lead, one of zinc, the latter covered with paper as a septum, both plates set in a common saucer, in water in which a few grains of sulphate of copper are dissolved. This little battery we found, on trial, to run for two days and a half. The water solution needs to be then renewed, which requires, perhaps, a couple of minutes to do.



THE TOM THUMB TELEGRAPH. FIG. 1.

Next, as to the instrument. It makes a first rate click signal, and is, we think, just as useful for learning the manipulation of the Morse alphabet, and for sending and receiving messages by sound, as any of the larger and more expensive instruments.

In addition to its office as a signal telegraph, this little device may be used for experimenting in many ways, and with it all the principal phenomena connected with electricity and magnetism may be exhibited. Its employment for telegraphing is illustrated in Fig. 1. In Fig. 2 the armature is removed and a slip of glass, with iron filings, placed on the poles of the magnet, K. When the key is pressed, and the glass gently tapped, the filings assume the beautiful positions of the magnetic curves. Removing the glass, needles



THE TOM THUMB TELEGRAPH.—SHOWING THE MAGNETIC CURVES. FIG. 2.

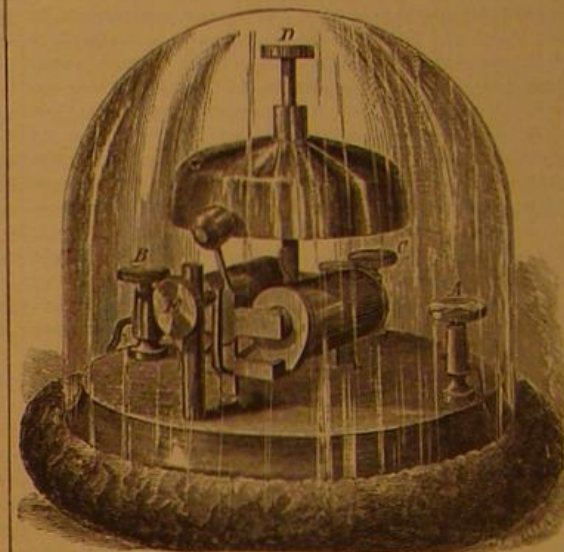
may be magnetized by rubbing on the poles, permanent magnet made, weights lifted, etc. By connecting one wire with a file and drawing the other wire over the teeth, the electric light, in the form of a sparkling luminosity, may be produced. This is a pretty evening experiment. The electrolysis or decomposition of water into oxygen and hydrogen may be done with the battery, and it may also be used for electro-plating. For these, and other interesting experiments, printed directions are given by the makers. For schools, large or small, the device will be found very useful in the hands of the intelligent teacher, as a means of interesting instruction.

We should find it difficult to select an article of more interest and usefulness for a Christmas gift for young persons than this Tom Thumb Telegraph. It supplies the means

for easy self-instruction in one of the most interesting branches of science, with which everybody, old or young, ought to make themselves familiar. These little devices may also be used for office telegraphing as well as for home use and amusement. Any intelligent lad may put up the lines and set them in operation. For further information, and free illustrated catalogues, address the makers as above.

THE MINIATURE TELEGRAPH.

For about a year past we have had in use here, in the office of the SCIENTIFIC AMERICAN, a very simple and convenient little electrical device, termed as above, the Miniature Telegraph, the invention of Mr. Lawrence Duerden, telegraph engineer of the Broadway Underground Railway, in this city. It consists of a pretty little electric bell, shown in its full size in the accompanying engraving, Fig. 1.



THE MINIATURE TELEGRAPH. FIG. 1.

As used in our office, these instruments are placed upon the desks in the various departments of our establishment, and from them wires extend to the desks of the managers, on which buttons are fixed, which connect with the wires. When the manager wishes to communicate with any particular person on the premises, he touches the button corresponding to the wire leading to the bell where the individual is at work. The touch sounds the bell, and, as a variety of signals may be sent, one bell may serve to signalize different persons who are within its hearing. It is surprising how many steps the use of this little contrivance saves, and how greatly it facilitates the transaction of our office business. Previous to its introduction, it was necessary for us to employ messengers, who did little else than run from one part of the premises to another, consuming time and making mistakes. This miniature telegraph saves all such



THE MINIATURE TELEGRAPH. FIG. 2.

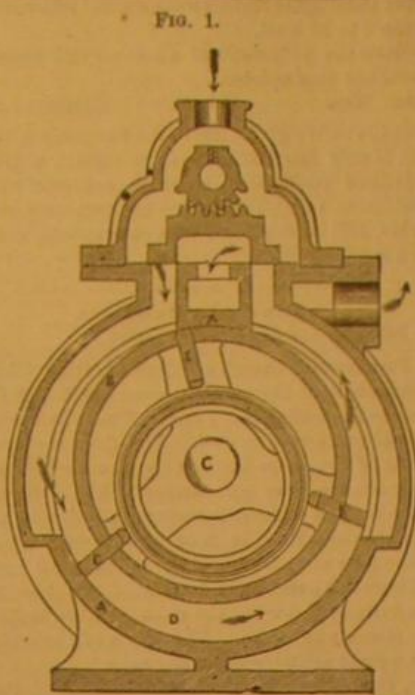
troubles, and enables the manager, without leaving his seat, to communicate instantly with all the principal persons employed in the concern. (See Fig. 2.) We have seven of these little instruments in use in our office, which serve us in signalizing a large number of persons. For factories, stores, shops and offices, for dwellings, in lieu of the ordinary bells, for signaling from house to barn, and for all the thousand and one purposes of business and domestic communication, this improvement is very useful. The makers fit up offices and buildings with them when desired. The device is so simple that any person of ordinary intelligence may put up the wire and set into use. It is so made that by shifting a wire from one screw into another it may be used as a telegraph, giving single signals, or as a burglar alarm, making a continuous ringing. The cost is only \$5. For this sum, the manufacturers supply one of the bells, like those we use in our office, pictured above, together with connecting wires, chemicals, and a small battery, all complete for working the instrument, with directions for use: neatly put up and sent on receipt of price to all parts of the world by the manufacturers, F. C. Beach & Co., No. 260 Broadway, corner Warren street, New York. At a slight additional cost, the makers supply a larger battery, such as we use in our office, which runs six or eight months without renewal.

THE CHALLENGE REVERSIBLE ROTARY HOISTING MACHINE.

A novel application of the rotary engine to purposes of hoisting or elevating has recently been brought to our notice, which in some particulars appears to be, in point of simplicity, compactness, portability, and usefulness, an improvement of considerable merit. It is claimed that the engine runs the same number of piston feet per minute as a reciprocating, and, from its construction, at a higher speed than the latter. Hence, and for other reasons to be noted as we proceed, it is believed that the ground of the objection generally true to rotary engines as a class, namely, lack of economy, is here materially decreased, and in some forms of the machine perhaps obviated altogether.

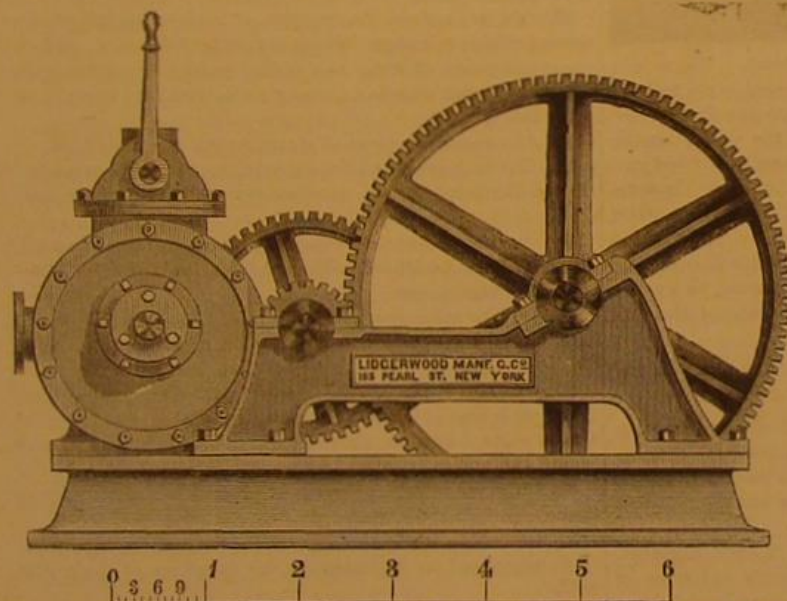
In justice to the apparatus it may be stated that, so far as our investigation has extended, it has given general satisfaction; and although from our individual knowledge we are of course unable to make confident assertions as to its merits as compared with devices of like nature, we nevertheless have been informed by credible engineers, and others by whom it has been actually employed over a sufficient period for reasonable tests, that it is, in point of relative advantage, superior to many other well known machines with which they are familiar.

In order clearly to comprehend the operation of the apparatus, an explanation of the interior working mechanism of the engine is necessary, and this will be rendered plain by a reference to the sectional view represented in Fig. 1. B is the spider which is keyed fast to the shaft, C, and set eccentrically to the outer cylinder, A, forming an abutment at the top and leaving a steam space, D, which is traversed by the three pistons, E. The latter are held out by a loose interior ring and a spring ring, and can move with the inner cylinder or remain at rest. A regular and steady power, it is claimed, is gained at all points from the fact that each piston acts for one third of the circumference of the outer cylinder, and the steam expands by increase of area until cut off by another piston. The point, however, to which we desire to call more direct attention, is the valve, which, of the usual D shape, slides over the steam ports of the engine and by its position allows the entrance of steam into one or the other side. At the



tional Line, the apparatus is used for hoisting in and out cargo, coal and freight. An apparatus rated at fifteen horse power by the manufacturers, we were told, under a pressure of 60 lbs. of steam, easily lifted 4,800 lbs. 200 feet per minute, raising, lowering, or holding its load at any point with equal facility. The same machine also elevated 460 tons of coal to a height of 20 feet in eleven hours. At a warehouse in Washington street in this city, where the handling of heavy goods is often necessitated, an engine rated at

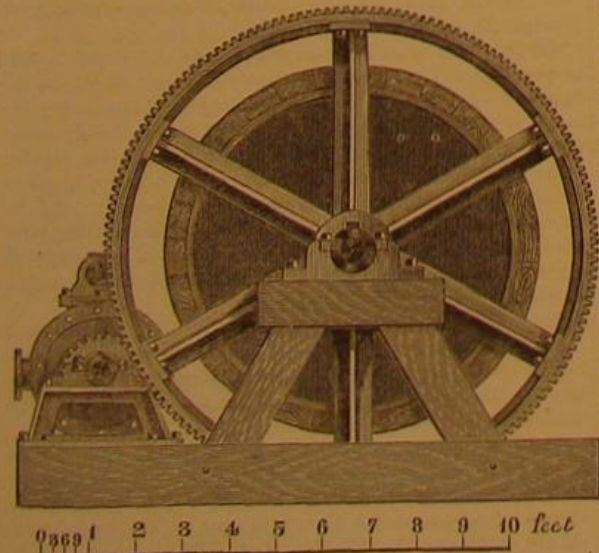
FIG. 2.



THE CHALLENGE REVERSIBLE HOISTING ENGINE AS APPLIED TO MINING PURPOSES.

upper part of this valve is a rack into which work the cogs of a segment pinion, which is vibrated by means of a hand lever extending upward. It is clear that by this mechanism the valve can be readily moved so as to admit steam as above noted, causing the engine to travel in either direction or

FIG. 3.



to stop. The motor thus constructed is, by a simple arrangement of cog gearing, connected with a large spur wheel on the hoisting drum, so that the movement imparted to the latter may be either rapid or slow.

We were quite recently afforded an opportunity of inspecting several of these machines in actual employment, and from conversations with engineers the following information was obtained. At the pier of the steamers of the Na-

seven horse power, we were informed, would hoist one ton 150 feet per minute. The boiler in this case was of the type supplied with the machine, and of the upright tubular pattern, containing 56 two inch tubes, each 4 feet long. The diameter was 34 inches. We understood from the owner that six tons of coal lasted on an average three months, using the machine almost continuously.

Various other illustrations of the capabilities of the apparatus were submitted to us, but the above are sufficient to give a general idea of its working. The smaller forms may be mounted on trucks and thus readily transported from point to point wherever any hoisting is to be done, it being merely necessary to secure the machine to the ground, attach a hose conducting steam from the boiler, and it is ready to operate. The lever is easily governed by the hand of the engineer, or may be arranged with cords to be regulated from a distance.

One of the most important applications of the apparatus is in connection with mines, and its arrangement for such purpose is represented in the engravings hereto annexed.

The first operations in the excavation are designed to be accomplished by the machine shown in elevation and plan in Figs. 2 and 3. This is a single powerful engine geared to a drum so as to lift heavy weights at a low speed. The dimensions of the various parts may be judged from the scale of feet and inches accompanying. Figs. 3 and 4 are similar views of an arrangement of two engines of equal capacity, in connection with a single drum geared for more rapid

hoisting, and intended for use in the regular removal of coal from the mines. One or both engines may be employed, the valves being so arranged that a single lever governs both. From the engravings a general idea may be gained of the mechanism of the hoisting engines above referred to.

Not the smallest merit in the invention is its freedom from clutches, brakes, complicated reversing gear, etc., necessitating the frequent stoppage of the machine, and the constant supervision of the engineer. The load is held suspended at any point, by shutting off steam entirely, excepting from a very minute hair space, so that just sufficient is admitted to maintain the necessary opposing pressure. This is quickly and easily accomplished without jarring or racking. A natural inference, from the facility with which the motion of the device is controlled, is that it may be advantageously applied to steering gear on vessels. This we find has already been done, and the steamboat Rhode Island, of the Stonington line, is now thus fitted. A simple device throws the main steering wheel out of action. The rudder is then governed by a small hand wheel in the pilot house, which, by a simple rack and pinion, communicates with the governing lever of the engine. We were assured that the helm is easily managed by a single pilot, even in the roughest weather, and that there is no wrenching of the mechanism due to heavy seas striking the rudder. We may add that this application of the device appears one of much value and to be superior to the more complicated arrangements usually employed.

Many other uses to which the apparatus is applicable will at once suggest themselves. Its portability and compactness render it a convenient device for elevating stone and other material in the construction of buildings. It can be permanently placed on the decks of steam vessels as a substitute for the ordinary form of winch, and will doubtless prove of

FIG. 4.

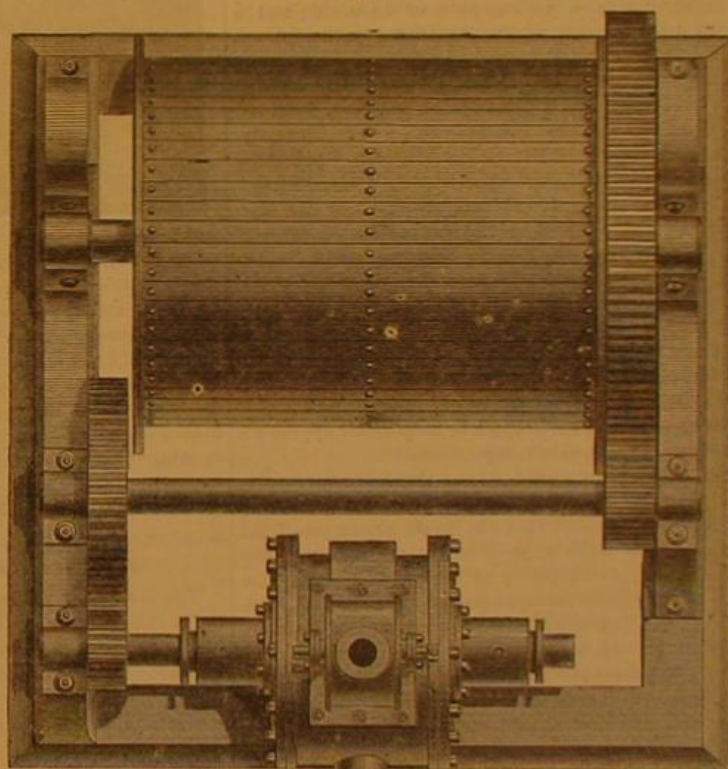
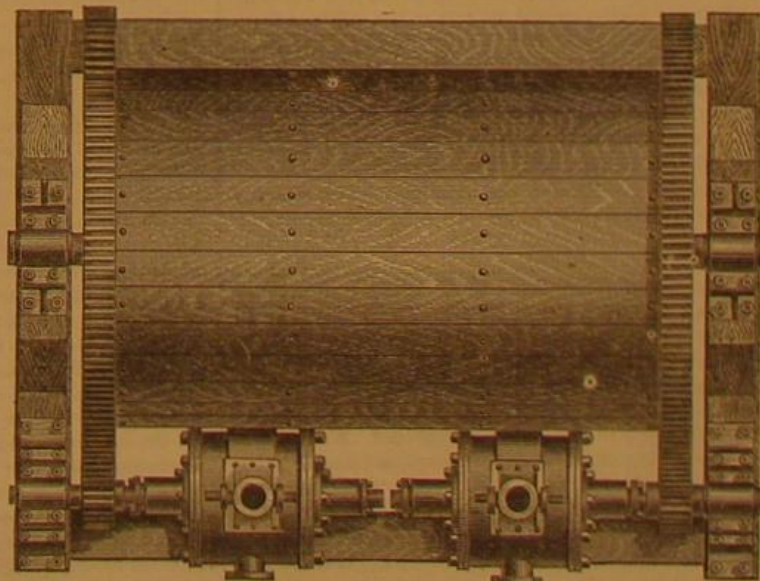


FIG. 5.



exclusive of bolts; and finally that it rarely requires repairs, and then but such as are easily and inexpensively effected. For further particulars, address the Lidgerwood Manufacturing Company, No. 165 Pearl street, New York city.

COAL has been discovered in the diamond fields of South Africa, and is sold there at \$11 per bag of 200 lbs.

Correspondence.

The Vienna Patent Congress.

To the Editor of the Scientific American:

Upon my return from Vienna, I have been shown an article in your paper, of September 27, 1873, in regard to the Patent Congress in that city, stating that "it adopted as its final resolution the absurd proposition that inventors ought not to be allowed to sell their patent rights, except at such rates as government officers might dictate."

Accepting this extraordinary statement at second hand as a fact, you naturally characterize those who are said to have supported it as "incompetent." As you have taken the liberty of using my name as one of these, I beg the opportunity of making a brief statement of the objects and course of the Patent Congress, whose work, moreover, cannot fail to be a matter of interest to your readers; and if my action there seems objectionable, you will then, at least, have the facts at first hand, on which to make criticism.

No one knows better than you that the condition of patents in Continental Europe is very unsatisfactory, and that the present practice is wholly opposed to the interest of inventors. To bring about a better condition of things was the great object of those who devised the Patent Congress. It was felt that the first thing to be done was to get together experts, so to speak, from different countries, leading manufacturers, scientific men, and patent authorities, who should produce a concise and forcible argument in favor of patent protection, and should also prepare a brief statement of the fundamental principles upon which such protection should be founded; so that in asking of the continental governments a change in the patent laws, those applying should be able to say precisely what they desired. In the Patent Congress such a set of men were brought together. It included leading authorities from various parts of the world; and in spite of the determination of the Austrian government not to recognize it officially, it comprised unaccredited, but regularly appointed, delegates from nearly all the leading nations. In this way, the United States, England, Belgium, Bavaria, Sweden, Prussia, Switzerland, Greece, Hungary, Italy, Roumania, and even Austria herself, were represented by regular delegates sent for the purpose. A declaration and argument of the strongest kind, was presented by Mr. Barnard Siemens, and adopted by the convention in favor of patent protection as a stimulus to invention and to manufacturing industry; and the Congress then proceeded to the preparation of a statement of the fundamental principles upon which such patent protection should rest. This work proceeded most harmoniously till a clause was reached, which, as nearly as it can be translated, reads thus:

"It is desirable to devise regulations under which a patentee shall be held to grant licenses to responsible applicants in consideration of adequate compensation."

Upon this a great discussion arose; the Germans represented that it was vital to their prospects that something like this should be passed, that the great argument of the conservatives, who were opposed to patents, was that they were monopolists, giving power to individuals to shut up inventions which should be made public. The English, with Mr. Webster, the distinguished patent lawyer, at the head, took the same ground, representing that they were laboring for a reform in patent law in England, and that a cardinal point in any reformed code must be something which would protect the public against the growing tendency of rich and powerful combinations to control valuable patents in an unreasonable oppressive manner. The Americans, on the other hand, took strong ground in favor of the free control by inventors of their own inventions, and the undersigned stood with them. The matter was debated for a day and a half. At last it became evident that some mean must be found on which differing interests could combine, and the writer proposed that, as the conditions varied in different countries, the clause in question should be replaced by one which declared that the matter should be left to the different States to decide for themselves. This was rejected by the Germans and English. However, on the morning of the next day, they proposed that the objectionable clause should be amended so that it should declare that it would be desirable that patentees should be held to grant licenses for an adequate consideration when the public interest demands it.

The Congress was tired of the question. Those who sustained the original proposition had a large majority, and nothing but their feeling that they needed the moral support of the Americans had prevented them from passing the clause long before. It seemed to me that (as in practice, it must rest with each nation to determine when, if at all, the public interest demanded interference between the inventor and the public) it came to the same point as the proposition made by me the day before; and I stated to the convention that this was my view, and, with this understanding, I would agree to the clause as modified. No objection was made to this, and the clause was passed with this understanding by a nearly unanimous vote, including many Americans. The convention went on to a harmonious conclusion, and, at its end, there was a general feeling expressed that it had done all, and more than all, that could be expected of it.

In conclusion, the writer was in a position to know the sentiments of our official representatives, and of the liberal members of the Austrian Government, and also of prominent persons among the German liberal party; and in their opinion the harmonious and united action of the Patent Congress was worth a thousandfold to the interest of Americans beyond anything which could have been gained by

carrying the dispute further upon a point which, as modified, had ceased to be vital.

I believe the judgment of all sober and reasonable men will bear out this opinion.

Boston, Mass.

HAMILTON A. HILL.

REMARKS:—We give place to the foregoing with pleasure, since it is only fair that both sides should be heard. The unprejudiced reader will, we think, conclude with us that the statement published in the SCIENTIFIC AMERICAN, to which Mr. Hill takes exception, is substantially confirmed by his own showing.

Echoes in Buildings.

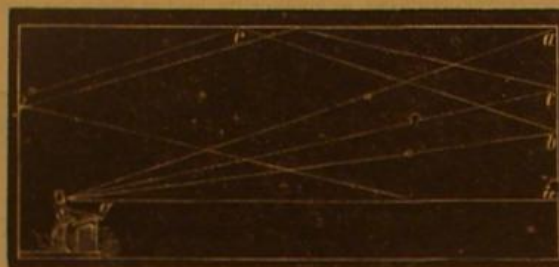
To the Editor of the Scientific American:

The Presbyterian church building of Tiffin, Ohio, echoes. The dimensions of the audience room are 63 x 50 feet; from the floor to the ceiling is 27½ feet. The minister's desk or stand is 12 feet from the wall. The floor is carpeted, with exception of the space beneath the pews, which is not covered, nor are the pews upholstered. The ceiling and side walls are flat and without interruption. There are no galleries in the church. The floor of the pulpit is 20 inches above the floor of church, and the speaker is 5 feet 7 inches tall. There is a great modification of the echo when the room is full: indeed when the room is filled to its capacity, there is scarcely any echo. The angle of the ceiling to the sides is a right angle, without any cove.

Tiffin, O.

J. T. POLLOCK.

REMARKS BY THE EDITOR.—The echo is probably caused by the rebound of the waves of sound from the front wall, as shown in the sketch. All the vibrations of air that strike on said wall above the line, *g d*, are reflected to the ceiling



and to the rear wall above the speaker's head. Those that strike between the points, *a b*, are reflected to the ceiling, thence to the rear wall, and then back into the ears of the auditors, arriving a moment later than the direct sound, and thus producing confusion. The erection of a front gallery would have a tendency to prevent the echo. In some late experiments in England, it has been found that wires stretched across the space, at about 6 inches apart, have broken the vibrations. This might be tried in this case by running them horizontally, at that distance apart, in a series extending from *a* to *b*. Painting them the color of the wall would conceal them.—Eds.

SUBJECTS FOR ENGINEERING PAPERS.

The Council of the Institution of Civil Engineers, London, invite communications dealing in a complete and comprehensive manner with any of the subjects included in the following list, and other papers treating on analogous questions:

- Account of the progress of any work in civil engineering, as far as absolutely executed (Smeaton's narrative of the building of the Eddystone Lighthouse may be taken as an example).
- Descriptions of distinct classes of engines and machines of various kinds.
- Practical essays on subjects allied to engineering, as for instance, metallurgy; and
- Particulars of experiments and observations connected with engineering science and practice.

List.

- On the application of graphic methods in the solution of engineering problems, and in the reduction of experimental observations.
- On the elasticity, or resistance to deflection, of masonry, brickwork and concrete, with observations on the deflection of bridge piers, caused by the unequal loading of the arches abutting on them.
- On the use of concrete, or *béton*, in large masses, for harbour works and for monolithic structures.
- On the manufacture of iron and steel as now practised; on the effect on the strength and tenacity of the metal by the admixture of substances with the ore; on the various experimental tests by which the quality may be ascertained; and on the effects of low temperature on metals.
- On the results of experience in the recently extended use of steel in mechanism and in works of engineering.
- On the theory and practical design of retaining walls for sustaining earth or water, and on experimental tests of the accuracy of the various theories.
- On modern methods of constructing the foundations of bridges, and on bridges of large span, considered with reference to examples; including an account of the testing, and of the effects produced by variations of temperature.
- On the different systems of swing, lifting and other opening bridges, with existing examples; and on the application of machinery in working them.
- On the proportions and details of construction of lock gates, and on the application of machinery for moving them.
- On the appliances and methods for rock-boring and

blasting in this country and abroad, and on the results obtained.

- On the systems of signaling on railways, and on the comparative advantages of the absolute or permissive use of the block system.
- On the constant use of water supply, with special reference to its introduction into the metropolis in substitution for the intermittent system; and on the waste of water and the best apparatus for its prevention.
- On the various modes of dealing with sewage, either for its disposal or its utilization.
- On the separate system of sewerage towns, with a detailed description of the works in a town to which this system has been wholly or partially applied, and particulars as to its results.
- On the ventilation of sewers, with a *résumé* of the experiments as to the motion, pressure, etc., of gas in the sewers.
- On the relative value of upland and of tidal waters in maintaining rivers, estuaries, and harbors.
- On the construction of sluices for the expeditious filling and emptying of locks of large size on navigable canals.
- On the maintenance by sluices of the harbors on the coasts of France, Belgium and Holland.
- On the sea works at the mouths of the rivers Adour and Maas, and on the effects produced thereby.
- On recent improvements in the construction of steam boilers adapted for very high pressures.
- On the best practical use of steam in steam engines, and on the effects of the various modes of producing condensation.
- On the modern construction of marine engines, having reference to economy of the working expenses, by superheating, surface condensing, high pressure, great expansion, etc.
- On modern locomotive engines, designed with a view to economy, durability, and facility of repair, including particulars of the duty performed, of the cost of repairs, etc.
- On the application of steam as a motive power for pumping water or sewage, with a comparison of the advantages of the different classes of engines, and details of the cost of working for long periods.
- On the various descriptions of pumps employed for raising water or sewage, and their relative efficiency; and on the employment of water as a motive power for pumping by means of water wheels, turbines, water pressure engines, or other machines.
- On the employment of steam power in agriculture.
- On the methods of transmitting force to distant points; and on the details of the existing system of rope transmission.
- On the present state of science in regard to the manufacture of gas for illumination; and on the materials most suited for the purpose.
- On the manufacture of mineral oils and the lamps best adapted for their consumption in dwellings and light-houses.
- On the output of coal in the United Kingdom, as compared with that of other countries, illustrated by statistical tables, plans, diagrams, showing where coal is produced, and where and how it is consumed.
- On mechanical apparatus at present in use in getting coal.
- On modifications necessary in future coal-mining operations, suggested (or indicated) by the working of deep coal fields.
- On turf (or peat) cutting, macerating, and pressing machinery, with experiments as to its heating power and expense as a fuel, as compared with coal.
- On the various methods of draining distant isolated sections of mines.
- On compressed air as a motive power for machinery in mines, with some account of its application on the continent.
- On the use of diving apparatus in mines, especially in Westphalia and in Germany.

For approved original communications, the Council will be prepared to award the premiums arising out of special funds devoted for the purpose. They will not, however, consider themselves bound to make any award should there not be any communication of adequate merit; but, on the other hand, more than one premium will be given, if there are several deserving memoirs on the same subject. It is to be understood that, in this matter, no distinction will be made between essays received from a member or an associate of the Institution, or from any other person, whether a native or a foreigner.

The communication should be written in the impersonal pronoun, and be legibly transcribed on foolscap paper, on the one side only, having a sufficient margin on the left side in order that the sheets may be bound. A concise abstract must accompany every paper.

The drawings should be on mounted paper, and with as many details as may be necessary to illustrate the subject. Enlarged diagrams, to such a scale that they may be clearly visible when suspended in the theater of the Institution, should be sent for the illustration of particular portions.

Papers which have been read at the meetings of other societies, or have been published in any form, cannot be read at a meeting of the Institution, nor be admitted to competition for the premiums.

The communications must be forwarded on or before the 31st of January, 1874, to the house of the Institution, 23 Great George street, Westminster, S. W., London, where any further information may be obtained.

THE GERM THEORY AND ITS RELATIONS TO HYGIENE.

BY PRESIDENT F. A. P. BARNARD, LL.D., OF COLUMBIA COLLEGE.

The following very interesting paper, by F. A. P. Barnard, LL.D., President of Columbia College, on the germ theory of disease in its relations to hygiene, was read before the American Public Health Association, on November 13. After a few excellent remarks on the general recognition, among educated men, of the universal reign of law and order, Professor Barnard said:

The germ theory of disease is not, as is commonly supposed, a theory which has originated in very recent years. More than 200 years ago it was brought forward, at least as a hypothesis, by the celebrated Father Kircher, in his *Scrutinium physico-medicum contagiosum luis quæ pestis dicitur*, to account for the infectious propagation of the plague. However plausible this theory might at the time have seemed, it could then, nevertheless, claim no higher rank than that of a bare hypothesis; and it has only been in times comparatively recent that observation has brought to light a sufficient number of facts apparently favoring it to justify our advancing it in the arena of scientific discussion to the higher dignity of a theory.

Before proceeding to consider the evidence bearing on the truth of this theory, for or against, a few observations of a general nature may properly here find place. No living organism enjoys an existence of unlimited duration. Every such organism, under favorable circumstances, passes through three distinct stages, which are those of growth, vigorous maturity, and decline. The organism commences as a germ, and ends in dissolution and disintegration. Since the laws of life, as well as those of physics, are fixed and definite, there is reason to believe that all organisms of the same species, if placed in conditions equally favorable to their development, would be equally long-lived; yet, in point of fact, those which pass through the regular stages constituting their normal life are comparatively few. In the large majority, the vital functions are, earlier or later, more or less disturbed, if not arrested, by an endless variety of causes tending to produce disease and premature death. In the human race, life is often shortened by ignorant or wilful disregard of the conditions necessary to the preservation of health. Accident, also, often exposes individuals to deleterious influences. Thus, in many cases, diseases arise from exposure to extremes of temperature or from excesses in eating and drinking, persisted in until the organs of digestion become debilitated and fail to fulfil their proper functions. But beside these causes of disease, which may be classed under the head of "injurious conditions," there are other influences directly morbid, which, whenever they come into play, cut short the duration of life. Poisons belong to this class, but the effects of these are felt only in occasional and accidental instances. Other noxious influences, of which the pernicious consequences are more widely spread, are those which produce the diseases called zymotic. Such are malaria, contagion, and infection, instrumentalities to which are owing the widespread ravages of epidemic.

It may be remarked that there are many cases of disease in which the cause is not traceable directly to any of the sources above mentioned, but in which the disease has been transmitted by inheritance from a parent similarly affected. In such cases there is nevertheless every reason to believe that the disease in its first appearance was produced in a healthy organism by causes belonging to one or the other of the classes above named.

The diseases which it is the object of the present paper to consider are only those which belong to the epidemic or contagious class.

THE EPIDEMIC OR CONTAGIOUS CLASS OF DISEASES.

No subject has occupied more the careful attention of physicians, or has been a subject of more elaborate observation and experiment, or has led to more marked difference of opinion or more animated controversy, than that of the nature of the influences by which these diseases are transmitted from individual to individual. That many epidemics arise from peculiar conditions of the atmosphere, not in the least as yet understood, can hardly be doubted; and in this case the influence which excites disease simultaneously in many is not dissimilar to that by which contagious diseases are transmitted from individual to individuals. Two theories, distinctly opposed to each other, have long been held on the subject. These may be distinguished as the chemical theory of infection and the germ theory. The chemical theory is founded on a presumed analogy between the propagation of disease in living organisms and the process of fermentation in certain forms of organic matter without life. This theory assumes a ferment to be an organized substance in a certain state of decay, which possesses the property of exciting the same decay in other organic substance with which it is in contact. Applying this theory to disease, it supposes that infection is communicated by the instrumentality of particles thrown from the person, or from substances proceeding from the person diseased, and borne by the air to other persons in full health, in whom they excite, probably by contact with the membranous linings of the lungs, the same diseased condition which exists in the patient. The opposing theory presumes that the diseased person is suffering from an invasion of his system by microscopic alga or fungoid vegetative forms having the property of rapid self-multiplication, and that the spores which proceed from these fungi or the cells of the algae are wafted in like manner by the air from person to person, penetrating the systems of the healthy, and establishing new colonies to generate disease in them.

A *prima facie* evidence, which so far as it goes is favor-

able to the germ theory, is found in the well known fact that all the forms of cryptogamic vegetation are propagated by spores, which they shed freely abroad in all directions, and that these are borne in infinite numbers through the atmosphere, which they pervade near the surface of the earth in all places. The fact of their universal presence is made manifest by the promptitude with which fungoid growths spring up in all circumstances in which the conditions favor their development. We know that the numbers of spores which all fungi produce are incalculable. The larger fungi give us evidence of this. The spores of a single puff ball have been estimated to be more numerous than the entire human population of the globe. It is true that to ordinary observation the presence of foreign matters in the atmosphere is not perceptible, except when such foreign matters take the gross form of clouds of smoke or dust; but particles of smoke or dust, and in general of all inorganic substances, are so heavy that they soon subside; yet when the air is thus left apparently free from all foreign admixture, it is demonstrably full of organic particles so extremely light as not to subside for many hours or even days of perfect rest. The chemist, it is true, is unable to detect them by his tests, delicate as they are; for being organic, and composed in general of but two or three elements—which elements are in great part those of the atmosphere itself—they produce no distinctive reactions under the ordinary processes of analysis. But there is a mode of analysis much more delicate than even that of the chemist. It is that which has been applied incidentally to this question by Professor Tyndall, in his interesting investigation into the chemical effects of light upon vapors. Professor Tyndall discovered that there are many substances of great volatility which, when in the state of vapor, are easily decomposed by light. He found that a perfectly transparent vapor-like steam, when traversed by a luminous beam, is absolutely invisible; while we all know that if we admit a beam of sunlight into a darkened room, through an aperture in the shutter, the path of the beam through the apartment is as distinctly marked as if it were a solid bar. That this visibility of a beam of light in the air is not owing to the power of the aerial particles themselves to reflect light, is demonstrated by him by proofs entirely conclusive. A beam of light from an electric lamp was made in his experiments to pass through a large glass tube closed at both ends by plates of glass, ground on. No light was permitted to escape into the room; and, accordingly, when the tube was exhausted of air altogether, and no light from its interior was reflected to the eye, it was perfectly invisible. But if the air of the room were allowed to re-enter it, it immediately became brilliantly luminous, as in the case of a sunbeam admitted through a window shutter. He showed, however, that a filter of rather closely compacted cotton will shut off entirely, or almost entirely, the organic matters which the air contains; and he showed, finally, that absolute rest for a long period of time will cause these particles completely to subside. He constructed a closed space, cubical in form and several feet in linear dimensions, glazed so as to permit him to pass through it a beam of light, and to observe the path of the beam. This small apartment was made absolutely airtight, and left to itself. On each succeeding day the brilliancy of the transmitted beam grew less and less; and at length, at the end of a week, it could no longer be perceived at all. The apartment was optically empty.

THE AIR FILLED WITH ORGANIC MATTER.

It is not necessary to suppose that all particles of organic matter are living germs of vegetable or animal organisms; but when we see how constantly such organisms spring up wherever the conditions favor germination, it is impossible to doubt that a vast many of them have this character; and that these are the source of those growths of minute cryptogams which thus seem to spring up spontaneously. There is no mode of accounting for such growths, except to suppose that they are actually spontaneous; and accordingly the view has been taken by some physiologists, perhaps I should say many, that the true mode of accounting for the appearance of microscopic forms of life is to suppose that they originate without organic antecedents, or as they expressed it, *de novo*. No question at the present day is more sharply debated than that which relates to the origin of life. There is no subject which has been pursued experimentally with more zeal, more earnest solicitude to reach the truth, and with more singularly discordant results than this. The notion of spontaneous generation, is not, by any means, of modern origin. It has been entertained by naturalists in every age since the dawn of scientific history. But the earlier naturalists, Aristotle and Lucretius, for instance, conceived that organisms of a high order of complexity, such as insects, or fishes, or reptiles, might be directly produced out of the moist earth softened by showers, or out of the slime and mud of rivers; whereas those of our time have long since abandoned any such extravagant notions, and confine themselves to the assertion that life in its spontaneous origin is manifested only under the simplest forms.

Less than three centuries ago the belief that living things may originate without eggs, or germs, or living parents from which to proceed, may be said to have been universal in Europe. Of the truth of this belief there was supposed to be visible evidence in the invariable occurrence of maggots in putrefying flesh. The doctrine was held as matter of faith, and those who first assailed it were naturally accused of impiety and irreverence. Prominent and perhaps first among these was Francis Redi, an Italian philosopher, scholar and poet, born in 1626. He presented a conclusive disproof of the spontaneous generation of maggots in putrefying flesh, by simply inclosing, in an open mouthed jar cov-

ered with gauze, pieces of flesh still sound, and leaving them in the sun to putrefy. Putrefaction occurred as before, but no maggots made their appearance. The maggots, nevertheless, did appear on the gauze, and a little observation made their origin manifest. The flies, of which they are the progeny in the larval state, being attracted by the odor of the flesh, but unable to reach it, laid their eggs upon the covering of the jar, and out of these the larvae were presently developed. Having demonstrated the falsity of the popular belief on this subject in a case so conspicuous, Redi naturally generalized his conclusion, and took the ground that no living thing comes into existence without deriving its life from something previously living. He did not say, as it has been said later, "*omne vivum ex ovo*," but "*omne vivum ex vivo*." He still believed that out of a living plant may arise a living animal as the insect within the gall of the oak, or the worm within the fruit which presents no external puncture. His doctrine was, therefore, that which Huxley has named *biogenesis*, in contradistinction to spontaneous generation, called by him *abiogenesis*, and by Bastian *archegensis*. But *archegensis* had been put aside only to return again under a new form. Among the earliest revelations of the microscope was the remarkable fact that, whenever a dead organic substance is infused in water, myriads of minute creatures presently make their appearance in the infusion, all possessing most extraordinary and many of them very varied powers of reproduction. They multiply by means of *ova*, by means of buds, or gemmation, and by means of self-division, or fission. All this was strongly favorable to the doctrine of *biogenesis*. Where so many means of reproduction existed, every one of them so effectual and sufficient, to provide that the same forms of life should be produced without any organic antecedents, seemed "wasteful and ridiculous excess." This view, however, met here and there with a dissentient. About a century and a quarter ago, John Thurberville Needham, an English naturalist, resorted to an experiment which, with various modifications, has been since repeated many hundreds, possibly many thousands, of times, with the view thoroughly to test the question whether, in its application to infusorial life, the doctrine of *biogenesis* is universally true. He prepared an infusion, thoroughly boiled it in a flask, corked it tight, sealed the cork with mastic, and covered the whole with hot ashes, designing to destroy by heat any germs which might be in the infusion, in the substance infused, or in the air above the liquid in the flask. After some days or weeks, he found that, notwithstanding all these precautions, living organisms did make their appearance in the flask, precisely such as, in freely exposed infusions, habitually appeared earlier. This experiment was immediately repeated by Spallanzani, an Italian ecclesiastic and naturalist; but Spallanzani, instead of corking his flask and cementing his corks, sealed the vessels by fusing the glass; and having thus completely cut off communication with the outward air, kept them at the boiling temperature for three quarters of an hour. No life appeared in the infusions of Spallanzani, and the doctrine of *biogenesis* was again apparently triumphant.

Marbled Paper.

This, much used by bookbinders, is produced in a very curious way. The name is not exactly suitable, seeing that few of the specimens are imitations of real marble; but it has gradually become applied to sheets of paper of which one surface is made to imitate any kind of stone or wood. Small brown spots on a light ground, marble veining on a shaded ground, curled patterns and wavy patterns, all are produced in great diversity. The colors are of the usual kind, such as Naples yellow, yellow ochre, yellow lake, orpiment, verdigris, rose pink, red lead, carmine, *terra di Siena*, Dutch pink, indigo, Prussian blue, verditer, umber, ivory black, etc.; they are ground up very fine with prepared wax and water and a few drops of alcohol. A solution of gum is made of gum tragacanth, alum, gall, and water, and placed in a trough or shallow flat vessel. Color is thrown on the surface of this gum water, usually by striking a brush against a stick, so as to produce a shower of sprinkles. Pigments of different tints and different thicknesses or degrees of consistency are thrown on; some spread more than others, and thus a diversity of patterns is produced. Sometimes the color is thrown on by means of a pencil of very long bristles; it is diversified by means of a rod, held upright and carried along amongst the colors in a wavy or spiral course; and it is further cut up into tortuous lines by passing a kind of comb along it. All this takes place on the surface of the gum solution in the vat. When the vat is prepared, a sheet of paper is laid down flat on the solution, care being taken that every part of the surface shall be wetted; the paper takes up a layer of paint, fancifully disposed in a pattern or device, and is hung up to dry. In order that one color may not be blended or confused with another, they are ground up with different liquids, some watery, some gummy, some oily. The imitations of marble, gray and red granite, and fancy woods, are certainly not very faithful; but the paper is lively in appearance, and remains clean and bright a long time when polished. This polishing is effected by moistening the colored surface of the paper with a little soap, and rubbing it with a piece of smooth marble, an ivory knob, a glass ball, or an agate burnisher. Beautiful products have been produced within the last few years under the names of iridescent and opalescent paper. Like the commoner kinds, these receive colored devices on one surface; but great delicacy and care are called for in the processes to produce the exquisite play of light and shade which suggests the names given to these varieties. *Practical Magazine.*

IMPROVED BOX CORNER GROOVING MACHINE.

We illustrate in the accompanying engraving an improved machine for box makers' use, the object of which is to cut, in an expeditious and accurate manner, the tenons or grooves by which the corners of wooden boxes are matched together. This operation is effected by bringing the edge of the slab in contact with a set of circular toothed blades arranged in cylindrical form, and rotated at a speed of some 3,000 revolutions per minute. The principal points of advantage claimed are the simplicity and fewness of parts, compact form, adjustability of table and blades, besides others of more detailed nature, which will be found referred to below.

A is the set of cutters arranged in succession upon a horizontal shaft, the pulley of which is rotated by a belt communicating with the driving pulley, as shown. Between each blade is placed a collar, so that a space between the cutting portions is left, which forms the tenons between the grooves of the board operated upon. As the cutters are easily removable for adjustment, it is evident that all may be made of a gage equal to the narrowest groove which might be required; because, in case a wider cut is required, blades may be placed in groups of two or even three directly side by side, so as to form a less number of cutters, but of greater thickness. In front of the cutting cylinder is placed the table, B, which is arranged with suitable arms so as to vibrate on a pivot at C, and to be swung nearer or further from the cylinder by a pressure of the foot upon the spring treadle beneath the machine. To this table there are three adjustments; first, by a screw at D, by means of which its angle of inclination to the horizontal is altered. Second, by set screws at E, which are inclosed in spiral springs, and the object of which is to regulate the distance of the inner edge of the table from the cutting cylinder, so that, as the latter wears away, said edge may be brought in the closest possible proximity to the teeth. Third, by another pair of screws at F, which regulate the outward swing of the table or its movement in a direction away from the cutters. On the inner edge of the table and placed at an angle, cutting edge up, is a blade, H, and near the same will be noticed two projections, G, resembling teeth. The latter are attached to carriers which project from and are secured under the table, and, besides, connect with adjusting screws, one of which is shown at I. By means of these screws the distance of the teeth, H, from the edge of the table may be increased or diminished, so that they may enter more or less into the space left between the cutting blades. Lastly, the table is provided with suitable detachable guiding pieces, and there is a swinging cover, which fits over the top of the cutting cylinder.

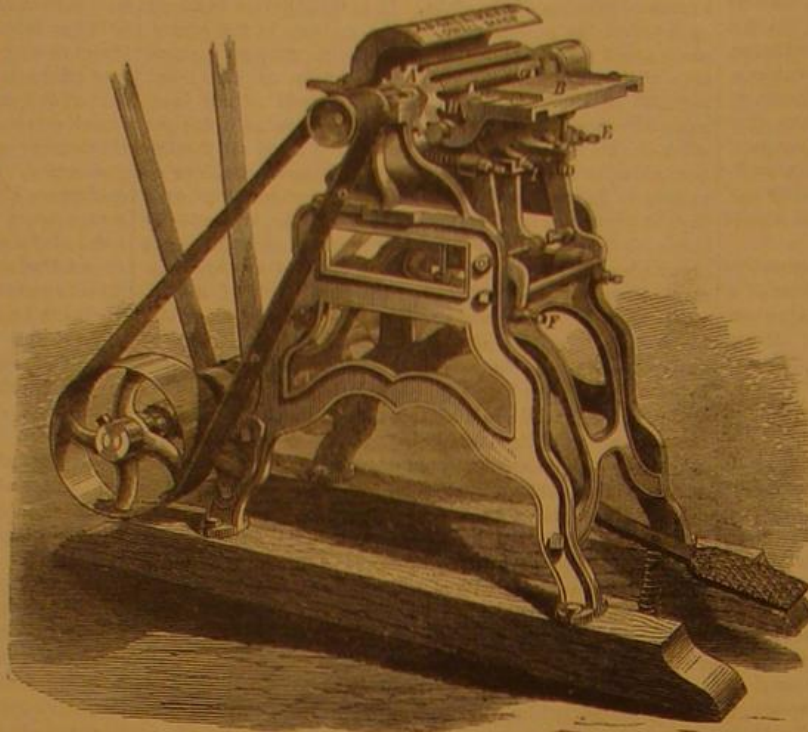
The mechanism thus far understood, the operation of the device is readily followed. For rough work, the slab is simply laid upon the table, the latter being previously brought as close as possible to (without touching) the cutting cylinder. The board is then fed by hand against the blades which, rotating from left to right, rapidly cut the grooves into the wood, until the motion of the latter is arrested by its coming into contact with the projections, G. These projections, as before remarked, enter between the blades when the table is close to the cylinder, consequently their distance from the periphery of the cutters inward governs the depth to which the latter are enabled to penetrate. This depth, depending on the position of the projections, is consequently easily regulated by moving the latter in or out by the screws, I.

It is a common defect, of rotary blades acting as above noted, that, although the upper side of the groove in the board is cleanly cut, the under portion is apt to be ragged or to have small fragments split off inward from the edge. To obviate this difficulty the inventor employs the fixed blade, H, which, bearing directly against the under surface of the slab, ensures the smooth division of the wood, as the portions which are to be cut away to form the groove are forced directly against its edge by the teeth of the revolving cutters. This is a point claimed as of especial advantage and stated to ensure increased neatness and accuracy of work.

In case greater care is necessitated in cutting the grooves, in thin or short boards, for instance, the stuff is not fed by hand to the cutters, but by the motion of the table. It is laid upon the table and there firmly held by the operator, while the latter with his foot presses down the treadle, bringing the table slowly toward the cylinder. The slab is thus carefully brought to the cutters, which gradually form the grooves, thus avoiding the sudden impact and probable tilting of the delicate work, as might be the case were hand guidance alone relied upon. It will be noticed that no bolting in forms is required, nor indeed is there any operation needed for securing the board, at expense of considerable time and trouble. Another merit claimed lies in the fact that boards of any width may be grooved. This is done by removing one of the guides from the table, leaving the other in place. Against the latter the edge of the board is laid and in this position brought to the cutters. These, of course, groove the board for the length of the cylinder. The fixed guide is next removed and the opposite one returned to place. Against this the other edge of the slab is adjusted, and the grooves on that extremity cut, thus completing the

width of the board, care being previously taken to have the second set of indentations follow those first made in proper succession.

The apparatus is the invention of Mr. Asahel Davis, of Lowell, Mass. The same inventor has also devised some novel machines of equally compact form for planing and dovetailing purposes, so that the present apparatus completes a very useful set of box makers' tools, to the perfection of which much time and care has been devoted. Further particulars may be had by addressing the patentee as above, and the devices themselves may be seen at the ware-



DAVIS' BOX CORNERING AND GROOVING MACHINE.

rooms of John B. Schenck's Sons, No. 118 Liberty street, New York city.

THE YUCCA PENDULA.

This is one of the very best species of a beautiful genus, and its graceful and noble habit makes it simply invaluable in every garden. It grows about six and a half feet high, the leaves being at first erect, and of sea green color, after-



wards becoming reflexed, and changing to a deep green. Old and well established plants of it, standing alone on the grass, are pictures of grace and symmetry, from the lower leaves which sweep the ground to the central ones that point up as straight as a needle. It is amusing to think of people putting tender plants in the open air, and running with sheets to protect them from the cold and rain of early summer and autumn, while perhaps not a good specimen of this fine plant is to be seen in the place. There is nothing more suited for planting between and associating with flower beds, for isolation and small groups, on the turf of the pleasure ground, for large vases, and for bold rocky banks.—*The Garden.*

Simple Ornaments.

A pretty mantlepiece ornament may be obtained by suspending an acorn, by a piece of thread tied around it, within half an inch of the surface of some water contained in a vase, tumbler, or saucer, and allowing it to remain undisturbed for several weeks. It will soon burst open, and

small roots will seek the water; a straight and tapering stem, with beautiful glossy green leaves, will shoot upward, and present a very pleasing appearance. Chestnut trees may be grown in the same manner, but their leaves are not so beautiful as those of the oak. The water should be changed once a month, taking care to supply water of the same warmth; bits of charcoal added to it will prevent the water from souring. If the little leaves turn yellow, add one drop of ammonia into the utensil which holds the water, and they will renew their luxuriance.

Another pretty ornament is made by wetting a sponge and sprinkling it with canary, hemp, grass and other seeds. The sponge should be refreshed with water daily so as to be kept moist. In a few days the seeds will germinate, and the sponge will soon be covered with a mass of green foliage.

Temperature Indicator for Petroleum Oils.

Petroleum oils, as is well known, contain various volatile oils, which, in being disengaged in a state of vapor and mixed with atmospheric air, form an explosive mixture that has been the cause of numerous accidents. It is consequently important to ascertain, by a simple method, as quick and exact as possible, the temperature of ignition. M. Granier has arranged an apparatus for the purpose which he has exhibited before the Société d'Encouragement.

A small receptacle, of a cylindrical form and made of metal, is closed by a movable cover, furnished, in the center, with a circular opening. This vessel is about two thirds filled with the oil that has to be tested, so that there may be a chamber of air between the surface of the oil and the top of the cover, in which may be received the inflammable gases disengaged by the oil. A tube, soldered to the bottom of the vessel, holds a wick, the extremity of which ends in the middle of the opening of the cover. A thermometer is inserted in the oil to indicate successive and minute changes of temperature.

For the purpose of testing any oil, it is poured into the vessel to the height already stated. The wick absorbing the oil is then lighted and thus gradually heats that in the vessel. This is hastened by the presence of some fine copper wire, which extends from the burning wick into the oil, thus spreading the heat through it. When the temperature is sufficiently elevated, the vapors are disengaged, and an explosive mixture is produced, which, on catching fire, causes a slight explosion. The temperature is noted at this moment, and the point of ignition thus ascertained.

Necessity the Mother of Invention.

Young men are retrenching in these dull times, and making strong efforts to appear well dressed and at the same time save their money. Two young gentlemen of Oil City, says the *Derrick*, have invented a novel plan to attain these two points. The two are nearly of the same size and build, and what one wears fits the other. By putting their money together, they were able to buy one good suit, and now take turns in wearing it, changing about, one week off and one on. Of course the man who has a week off is unable to accept invitations out to tea, hops, and balls; but then his suit or his half of the suit will be there as a representative.

A Mammoth Cheese.

The Painesville (O.) *Telegraph* describes a mammoth cheese which lately passed through that town on its way East. It was mounted on a substantial platform to which were attached small cast iron wheels, so that it easily moved, and the platform in turn was mounted on a heavy lumber wagon, drawn by two span of horses. The cheese was cased in a tight fitting cheese box which was firmly secured to the platform to prevent sliding. Its measurement is: Height, 3 feet 2 inches; diameter, 5 feet 4 inches, and circumference 16 feet. Its net weight is four thousand and fifty pounds. In quality, it is said to be fully equal to any of the Carter cheese, which stands so prominent in every market. It was manufactured for Messrs. Gass, Doe & Chapin, of Boston, and will be cut for the holidays.

Fish Way in the Connecticut River.

The Holyoke (Mass.) Water Power Company have just built, under the mandate of the Supreme Court at Washington, a fish way on their big dam, against which they had long held out. It is described as a sort of covered ladder, 450 feet long, and divided by short zigzag "locks" or checks, to break the force of the cataract, and permit shad and salmon to get over the big fall at the dam. It has cost about \$25,000. The State of Massachusetts, four years ago, appropriated half that amount, but the company declined to touch it; and now the latter must bear all the expense, as the courts have so decided. The Fish Commissioners of Connecticut, Massachusetts, and other New England States will meet this month to examine this work.

THE FIRELESS LOCOMOTIVE IN NEW YORK STREETS.—The Fireless Engine Company, whose locomotive we illustrated and described some time ago, have obtained the permission of the Board of Aldermen to run their machines on any of the city railroads above 14th street. This is a most important concession, and must be taken as an admission by the city authorities that the system can safely be worked without danger on our street rails. The want of some better mode of propulsion than that of horses is painfully obvious.

How to Make Money Honestly.

Professor R. W. Raymond, in his recent address at the dedication of Pardee Scientific Hall, Easton, Pa., said: Lesoinne, a distinguished French writer, defines metallurgy as "the art of making money in the treatment of metals." This definition may be applied to almost all occupations of life. The practical art of each is not only to achieve certain results, but to do so profitably, to make money in doing so; that is to say, to increase the value of the raw materials, whether wood, or cotton, or ores, or time, or ideas, by the use we make of them and the transformation to which we submit them, so as thereby to really elevate the condition of humanity: to leave the world better than we found it. This is, in its last analysis, the meaning of honestly making money. Men are put into this world with limited powers and with limited time to provide for their own sustenance and comfort, and to improve their condition. A certain portion of these powers and this time is required for the support of life in a greater or less degree of comfort, and more or less multiplied means and avenues of enjoyment, activity, and influence. Whatever their labor produces more than this is represented by wealth, and, for purposes of exchange, by money. To make money honestly is to do something for other men better or cheaper than they can do it for themselves; to save time and labor for them; in a word, to elevate their condition. It is in this sense, greatly as we Americans are supposed to be devoted to making money, that we need to learn how to make more money; how to make our labor fruitful; how to assail more successfully with our few hands the natural obstacles and the natural resources of a mighty continent; how to build up on the area of that continent a prosperous nation, united in varied, fruitful, and harmonious industries, glowing with patriotism and inspired by religion.

In this work we need specially the basis of a more thorough technical education, applying principles of science to the material and economical problems involved. This education is necessary to supply the directing forces for the great agricultural, manufacturing, and engineering improvements of the country. It is also needed as a solvent and remedy for the antagonism between labor and capital. The true protection of labor will be found in its higher education, and in opening to the individual laborer, for himself and for his children, by means of that education, a prospect of indefinite improvement and advancement.

In the realm of metallurgical and engineering operations the difference between theoretical and practical training is, perhaps, still more striking. The student of chemistry in the laboratory cannot be made acquainted with many of the conditions which obtain in chemical and metallurgical operations upon a larger scale. All the chemists of the world failed to comprehend or describe correctly the apparently simple reactions involved in the manufacture of pig iron, until, by the genius and enterprise of such men as Bell, Tanner and Akerman, the blast furnace itself, in the conditions of actual practice, was penetrated and minutely

studied. Moreover, in all the experimental inquiries of the laboratory, the question of economy plays no part. It is the art of separating and combining substances which the student follows there, not the art of making money. That education of judgment and decision, of choice of means for ends which the exigencies of daily practice give, cannot be imparted in the school.

In mechanical engineering the same principle is illustrated. The highest department in this art is that of construction, and in this department the highest function is the designing of machinery. Now, the most perfect knowledge of the theory of a machine and its mathematical relations, of the strength of materials, or the economical use of power, will not suffice to qualify a man to design a machine or a system of machines, for the reason that in this work an element must be considered not at all included in theoretical knowledge, namely, the element of economy in the manufacture, as well as in the operation of the machine. A machine, any part of which requires for its manufacture a tool (such, for instance, as a peculiar lathe) which is not already possessed by the manufacturer, and which, after the construction of this one part, would not be necessary or useful for other work—such a machine could not be profitably built. In other words, machines must be so designed, in a large majority of cases, as not to necessitate the construction of other machines to make them; and the planning of machinery, so that it shall be at once economical and durable in operation and simple and cheap in construction, is not merely an important incidental duty; it is absolutely the chief and most difficult duty of the mechanical engineer.

THE PASHIUBA PALM OF BRAZIL.

Among the many wonders of the region of the Amazon river (now being traversed by Professor James Orton, and described by him in the series of letters in the course of publication in our pages), there is none more marvelous than the vegetation, of which the singularity of the species is as remarkable as their prodigious fecundity.

We present herewith an engraving of the *pashiuba* or *pashiuba* palm tree of Brazil (*Irartea exorrhiza*), which certainly "bears off the palm" for eccentricity of growth. The first sight of this tree, says *The Garden*, suggests the idea that some careful hand has been at the trouble of placing round its base a tree guard to protect the stem, somewhat after the manner in which the trees in our parks are railed and fenced in from cattle. A nearer approach, however, discloses the fact that the supposed tree guard is neither more nor less than the roots of the tree itself, which are disposed in this strange fashion. These roots are of the kind known as aerial, and spring from the trunk above the ground, new ones being successively produced from a higher point than the last. They take an oblique or diagonal direction until they reach the ground, into which they descend and root themselves. As fresh ones appear, those underneath decay and die off, leaving the tree supported by a hollow cone of roots, which is sometimes so high that a man may stand in the center, with the stem of the tree, 60 or 70 feet

in length, immediately over his head. These roots are densely covered with small, hard, tubercular prickles, and are used by the natives as graters for reducing the inside of the cocoa nut to a pulpy mass, to be boiled with rice and water. The same peculiar mode of growth is exhibited by *Irartea ventricosa*, and several alliee species.

A Quick Change of Gage.

The Grand Trunk Railway Company of Canada have lately been changing the gage of a considerable portion of their lines from 5 feet 6 inches to the standard of 4 feet 8½ inches.

On the main line from Stratford, Ontario, to Montreal, a distance of 421 miles—or, including sidings, 500 miles—1510 men were employed to do the work, the staff thus averaging 3¼ men per mile of main line. The engineer of the Grand Trunk line, Mr. E. P. Hannaford, laid out the work personally by going over the road by hand car, arranging each gang in position, and laying out the details of working. To each 15 miles of main line an overseer was appointed, and these overseers reported progress to the engineer. Each gang of men had their allotted work, and, when they had completed it, reported to their overseer.

After the passing of the last train, it took each overseer from 3¼ to 5 hours to narrow his district of 15 miles; so that had the main line been cleared of cars so that all these overseers could have commenced at the same time, a maximum of 6 hours would have completed the work of 500 miles of main line and sidings. As it was, some of the main line was taken possession of on a Friday noon, and the balance, on Saturday at daybreak. The whole was completed and trains running on the afternoon of the second day from commencement.

A Novel and Simple Electric Light.

Dr. Geissler, of Bonn, Germany, whose name is inseparably associated with some of the most beautiful experiments that can be performed by the agency of electricity, makes an electrical vacuum tube that may be lighted without either induction coil or frictional machine. It consists of a tube an inch or so in diameter, filled with air as dry as can be obtained, and hermetically sealed after the introduction of a smaller exhausted tube. If this outward tube be rubbed with a piece of flannel, or any of the furs generally used in exciting the electrophorus, the inner tube will be illumined with flashes of mellow light. The light is faint at first, but gradually becomes brighter and softer. It is momentary in duration; but if the tube be rapidly frictioned, an optical delusion will render it continuous. If the operator have at his disposal a piece of vulcanite, previously excited, he may, after educing signs of electrical excitement within the tube, entirely dispense with the use of his flannel or fur. This will be found to minister very much to his personal ease and comfort. He may continue the experiments, and with enhanced effect, by moving the sheet of vulcanite rapidly up and down at a slight distance from the tube. This beautiful phenomenon is an effect of induction.



THE PASHIUBA PALM OF BRAZIL.

ASTRONOMICAL NOTES.

OBSERVATORY OF Vassar College.

For the computations (which are approximate only) and for most of the observations contained in the following notes, I am indebted to students.

Positions of Planets for December, 1873.

Mercury.

Mercury rises on the 1st at 6h. 57m. A. M., and sets at 4h. 25m. P. M. On the 31st it rises at 6h. 8m. A. M., and sets at 3h. 14m. P. M.

On the 10th, Mercury and Venus will be in conjunction, the latter being two degrees south of Mercury. They should be looked for in the morning before sunrise.

Venus.

At this time (November 15) Venus is very brilliant before sunrise. On the 10th Mercury will be near it, and Jupiter will precede them and come to the meridian four hours in advance of them; all three should be observed in the early morning.

December 1, Venus rises at 5h. 28m. A. M., and sets at 3h. 26m. P. M. December 31, Venus rises at 6h. 37m. A. M., and sets at 3h. 37m. P. M.

Mars.

Mars is at this time (November 15) approaching Saturn, Saturn's apparent motion being much slower than that of Mars, and both being eastward. They can be seen well only in the early evening hours. After the 20th of November Mars will be east of Saturn, and will steadily diminish in its apparent diameter.

Mars rises December 1 at 11h. 10m. A. M., and sets at 8h. 39m. P. M. On the 31st, Mars rises at 10h. 13m. A. M., and sets at 8h. 42m. P. M.

Jupiter.

Jupiter rises December 1 at 1h. 9m. A. M., and sets at 1h. 21m. P. M. Jupiter rises December 31 at 11h. 22m. P. M., and sets at 11h. 30m. A. M., its diurnal path being for the whole month nearly in the celestial equator. This planet is becoming more and more favorably situated for observation, and its apparent diameter steadily increases until the last of March.

Saturn.

Although Saturn is not in a good position for observation, being far south in declination, and therefore low in altitude, yet with a telescope of moderate power its ring can be seen and perhaps one of its moons. With a large telescope, the ring can be seen to be divided, belts are observed on the body of the planet, and five or more moons circling around.

December 1 Saturn rises at 10h. 41m. A. M., and sets at 8h. 4m. P. M. December 31 Saturn rises at 8h. 54m. A. M., and sets at 6h. 21m. P. M.

Uranus.

Uranus having set on the 1st of December at 11h. 20m. in the morning, rises again at 8h. 59m. in the evening. On the 31st it sets at 9h. 19m. in the morning, and rises at 6h. 37m. in the evening. It is among the small stars of the constellation Cancer.

Neptune.

Neptune rises December 1 at 2h. 25m. P. M., and sets at 3h. 30m. A. M. On the 31st it rises 27m. after noon, and sets at 1h. 29m. after midnight. It is very near the star α Pegasus.

Meteors.

A lookout for meteors was kept up on the morning of November 14 from midnight until 6h. 30m., eight students being employed, who divided into sets of two, each set being relieved after half an hour's watch. The night was remarkably fine, but not more than 200 meteors were seen, and of these not more than three fourths seemed to radiate from Leo, the point of departure for the meteors of the 13th and 14th of November.

Sun Spots.

Daily photography of the sun at noon, the record extending from October 23 to November 14, shows that the disturbances of spots and faculae have been comparatively slight. From the 23d the spots, then being very few and small, increased slightly in number, but on November 1 there was only one exceedingly small spot near the center of the disk, which, by its position, could not have come from any of those which appeared on the 30th (the 31st being cloudy). From November 4 to November 5, there was a marked change, a pair of spots of equal size uniting, while the resultant spot was larger than the sum of the original two. On the 10th, a group of fourteen small spots was scattered over an area a third of the diameter of the disk in length, and in breadth about one half its own length. On the 11th this group had begun to pass from view, owing to the revolution of the sun on its axis; and by the 14th, cloudy days intervening, it had disappeared entirely. Faculae have been visible nearly every day, and were of considerable extent on October 28th and 29th.

Barometer and Thermometer.

The meteorological journal from October 15 to November 15 gives the highest barometer, October 15 and November 7, 30.5; the lowest barometer, October 30, 29.43; the highest thermometer, October 19, at 2 o'clock P. M., 71°; the lowest thermometer, November 7, at 7 o'clock A. M., 20°.

Amount of Rain.

The rain which fell between the night of October 26 and the afternoon of October 27 amounted to 0.91 inch.

The rain which fell between the evening of November 7 and the evening of November 8 amounted to 0.65 inch.

Dr. HUGGINS has discovered, by the movement of the lines in the spectrum, that the star Arcturus is approaching the earth at the rate of about 50 miles per second.

THE NEBULAE.

BY PROFESSOR C. A. YOUNG.

Scattered here and there through the sky are thousands of little luminous clouds, for the most part so faint as to be visible only with powerful telescopes. These are the nebulae, which to the modern astronomer are objects of great and increasing interest. A few of them, perhaps a dozen, can be discerned by the naked eye; of those visible in our northern hemisphere, the brightest, situated in the girdle of *Andromeda*, is favorably placed for observation in the autumnal months; while the second in order adorns the winter sky as the most beautiful, if not the most conspicuous, of the celestial gems which form the wonderful constellation of *Orion*.

The total number at present known is not quite 8,000, but every new investigation increases the catalogue. Many of them consist of separate stars divided by dark spaces, and are known as clusters; others exhibit starry points on a bright back ground; these are said to be resolvable; the majority, however, show no structure, but even under the highest telescopic power remain mere blotches of hazy light; and among those which thus defy all attempts to resolve them are some of the brightest. In form they are most commonly oval, and somewhat brighter in the middle. Sometimes the condensation is so great that the central point appears like a star surrounded by a nebulous atmosphere. In many instances, they are nearly circular and of uniform brightness throughout, and these are called planetary nebulae. There are also a few annular nebulae, which are darker at the center, and seem to be rings of the shining mist; and there are double nebulae, which, like the double stars, probably revolve around each other in elliptic orbits; and spiral nebulae, whose filaments are so arranged as to suggest almost irresistibly the idea of a whirlpool-like movement of the whole mass. Besides these, there are a multitude in which the nebulous matter is distributed in streaks and patches of most fantastic and unaccountable formation. To this class belongs the nebula of *Orion*.

Unless nearer to us than the stars (which there is no reason to suppose), even the smallest of these objects must greatly exceed the dimensions of our whole solar system; and yet our outside planet Neptune is so distant from the sun that the swiftest express train would require nearly 8,000 years to make the journey. And the great nebulae exceed the small by many thousand times in bulk.

But what are they? The elder Herschel, who was the first to make a careful study of the subject, concluded that many of them at least are masses of a peculiar cloud-like substance, mainly gaseous,—the material out of which worlds are formed,—and falling in with Laplace's theory, he thought that in these objects we have instances of stars-making. But when some thirty years ago it appeared that every increase of telescopic power resolved more and more of them into stars, a different theory prevailed, urged especially by certain astronomers who considered the hypothesis of Laplace to be hostile to revealed religion. They jumped to the conclusion that all the nebulae are merely clusters of stars, the component stars themselves being as large as the other suns which constitute our stellar system, and separated from each other by intervals as vast, but so remote from us that even such suns and such abysses are confounded into these little whiffs of haziness.

This is the view of the matter presented by many of the popular astronomical works still current, and even in some of our text books; but fascinating as it is, it is demonstrably incorrect, and Herschel's original doctrine is much nearer to the truth. Time would fail to indicate the many facts which prove that the nebulae (and star clusters too) really belong to our stellar system, and are no farther from us than the stars, but are scattered through the star depths, and that not without pretty well marked laws of distribution. For this we must refer to the works of Struve, Abbe, Proctor, and others who have discussed the subject.

But though such evidences are really conclusive, they would probably have produced but slow conviction had not the spectroscopic intervened, and by a single observation so settled the main fact of the gaseous nature of certain nebulae as to render contradiction impossible. It was in 1864 that Huggins first applied the new instrument to the study of these objects, and the very first he examined gave him a spectrum of three bright lines. This of course is absolute demonstration that the nebula in question is mainly a gaseous mass of no great density; and could the lines be identified with those of terrestrial substances, its chemical constitution would be known. In fact, one of the lines apparently coincides with the so called F line in the spectrum of hydrogen, and a fourth, since observed in some of the brighter nebulae, also coincides with another line in the spectrum of the same gas. The brightest line of the whole is in the green, and very near the principal double line of nitrogen; so near indeed that at first Mr. Huggins supposed it to indicate the presence of that gas. At present, however, he thinks it certain that the coincidence is only approximate and accidental, and that the line is due to some other element, as yet unrecognized. The remaining line is also of unknown origin.

Not all the nebulae give a bright line spectrum. Those which the telescope resolves into stars present a continuous spectrum like that of the sun; those which are classed as resolvable usually show bright lines upon a faint continuous background; and some of the brighter irresolvable nebulae (notably the great nebula in *Andromeda*) give a simple continuous spectrum like the clusters. It must be remembered, however, that such a spectrum may come from gas under strong compression, as well as from incandescent solids or liquids. It may be added that all the nebulae which give a

spectrum of bright lines show the same lines, so far as yet observed, and that the appearance of the lines indicates that the gaseous matter is but slightly compressed, and at a temperature much lower than that of the sun and stars.

It would seem, therefore, that we are to consider the nebulae as great clouds of gas, probably sprinkled throughout with minute solid and liquid particles. Whether they are luminous from simple elevation of temperature, as ordinarily understood, or in some other way more analogous to phosphorescence, is not certain. They are in various stages of lecting themselves around a single center to form a single sun; condensation; some granulating into star dust, and some col-

The distance and dimensions of a nebula have never yet been determined. A year or two ago, indeed, it was announced by an English observer that he had detected a parallax of nearly two seconds of arc in a nebula situated in the constellation of *Ursa Major*. This would correspond to a distance about one half as great as that of α Centauri, our nearest neighbor among the stars. But the observation has not been confirmed, and deserves but little confidence.

Of course, if the nebulae are such bodies as have been described, they ought continually to change in form and appearance; and in fact the best observations upon those in *Orion's* sword and near η Argus seem to indicate actual alterations within the last fifty years. Yet the observations are so difficult, and what is seen depends so much on the observer, his instrument, and the purity of his atmosphere that great caution must be used in coming to any conclusion.

From what has been said it is easy to understand the interest with which astronomers regard these objects. It almost seems as if in studying them we might come to witness for ourselves the building of suns and systems.—*Boston Journal of Chemistry*.

A Whale Caught by a Telegraph Cable.

We published some time ago a drawing of a portion of the Singapore ocean telegraph cable, which had been pierced and injured by the lance of a saw fish. We have here to chronicle an accident of a still more extraordinary nature, by which the Persian Gulf cable was broken. The particulars are given in *Engineering*:

"The cable between Kurrachee and Gwadar (a distance of about 300 miles) suddenly failed on the evening of the 4th of October. The telegraph steamer, *Amber Witch*, under the command of Captain Bishop, with the electrical and engineering staff under Mr. Henry Mance, proceeded on the following day to repair the damage, which, by tests taken at either end, appeared to be 118 miles from Kurrachee. The cable was successfully grappled within a quarter of a mile of the fault.

"The soundings at the fault were very irregular, with overfalls from 30 to 70 fathoms. On winding in the cable unusual resistance was experienced, as if it were foul of rocks; but after persevering for some time, the body of an immense whale, entangled in the cable, was brought to the surface, where it was found to be firmly secured by two and a half turns of the cable immediately above the tail. Sharks and other fish had partially eaten the body, which was rapidly decomposing, the jaws falling away on reaching the surface. The tail, which measured fully 12 feet across, was perfect, and covered with barnacles at the extremities.

"Apparently the whale was, at the time of entanglement, using the cable to free himself from parasites, such as barnacles, which annoy whales very much; and the cable hanging in a deep loop over a submarine precipice, he probably, with a flip of his tail, twisted it round him, and then came to an untimely end."

This is, without exception, the most extraordinary accident that has happened to any submarine cable which has come within our knowledge, although many strange accidents have arisen. In one case the cable across the river Yar, in the Isle of Wight, was broken by a bullock, which, falling overboard, got entangled in the cable, finally breaking it.

A Novel Contest Between Horseshoers.

The horseshoers of New York and Brooklyn have been excited for a month past over a wager made between John Burns and George Boyle as to which of them could make a greater number of shoes in a specified time. Both men work in Brooklyn. Burns bet Boyle \$50 that the latter could not turn out as many shoes as he could in eight hours. A day was assigned for the contest. Several hundred horseshoers from New York and New Jersey were attracted to Brooklyn to witness the contest, and considerable money was staked in outside bets on the result. Work was begun at eight o'clock, Burns being at Slavin's shop in Atlantic avenue, and Boyle at his brother's shop in Livingston street. Burns was watched by Pat. Boyle, and his opponent by Slavin. Each of the contestants had a "helper" and used the following described material: Two dozen and a half pieces of iron, an inch and an eighth wide by nine sixteenths of an inch thick; two dozen and a half, an inch by nine sixteenths; two dozen and a half, an inch by half an inch; two dozen and a half, an inch by seven eighths. Each piece of iron was 13 inches in length.

Both shops were crowded throughout the day, the spectators going from one to the other to watch the progress of the work. In seven hours Boyle made 10 dozen shoes, and at the expiration of the eighth hour he had turned out just 11 dozen and 10 shoes to his opponent's 11 dozen. Boyle was accordingly declared the winner. His was the fastest work that has ever been performed.

THE largest bar of gold ever produced was lately made up for exhibition at Helena, Montana. Its value was \$50,000; weight, about 172 pounds; fineness, 900.

DECISIONS OF THE COURTS.

United States Circuit Court—District of Massachusetts.

L. C. CHASE vs. EDWARD WESSON et al.—PATENT MATTER.

The complainant having been long in the enjoyment of his patent, a preliminary injunction was ordered restraining the defendants from infringing it, notwithstanding affidavits were filed showing that articles embodying the alleged invention had been in use before the complainant made it, there being evidence to the contrary, and none of the articles being produced.

SHEPLEY, J.:
Limiting the first claim in this patent to that only which was invented by the patentee—i. e., his device, as described in his specification, of such a mode of attaching a halter or other harness ring to a halter or harness strap by means of rivets, in the described mode, passing through holes in the described flanges of the dec or ring without the necessity of sewing, and dispensing with the use of any other material to form the "lap," in the mode and for the purpose described—the patent is for a device of the kind described in the patent to Samuel C. Hawkins, No. 21,674, granted October 5, 1858, which is relied upon to prove want of novelty in complainant's invention.

No exhibit is produced of any such harness ring with two flanges as some of the affidavits on the part of respondents testify were in use before the date of the complainant's invention. The affidavits introduced by the complainant throw very grave doubt upon the question of the existence of any such device at the dates indicated. These doubts are greatly confirmed by the omission to produce as exhibits in the case any such harness rings as the witnesses describe, which could easily have been produced if they had existed and been in use for so long a time. It is not, therefore, at this stage of the case, necessary to decide what effect they would have upon the plaintiff's patent if the court were satisfied of their prior use.

As the plaintiff has been long in the enjoyment of his rights under the patent, and there is no doubt upon the question of infringement, the injunction will issue as prayed for in the bill, until the further order of the court.

George E. Bolton, for complainant.
George L. Roberts, for defendants.

Recent American and Foreign Patents.

Improved Pen and Pencil Case.

Charles H. Straight, New York city.—This invention has for its object to furnish an improved pencil case which shall be so constructed as to form a longer handle when the pencil is extended than when constructed in the ordinary manner, and a still longer handle when the pencil is drawn in and a pen extended. The invention consists of the slot of the inner sliding tube, made with an offset in the middle part of said tube, and with its rear part parallel to but not in line with its forward part.

Improved Harness Mounting.

Thomas Fawcett, New York city.—This invention consists in the improvement of taffet rings which are covered with leather, the edges of the leather being sewed together on the inner side of the ring. A metallic band is then slipped into the ring to cover the sewing and receive the wear. In putting the coverings on the mountings, the edges of the leather are received into grooves or rabbets in the ring, which hold the edges in place when an inner ring is introduced. By this improvement these mountings, it is stated, are greatly improved in appearance, rendered more durable, and can be produced at less expense than by the old method of manufacture.

Improved Ferry Boat for Trains of Cars.

Frank Cass, New Orleans, La.—This invention consists of a truck on a railway car ferry boat, mounted on a series of screws on each side and arranged with vertical guide posts. The screws of each side are geared to a line shaft running the whole length of the truck. At one end, the two line shafts are geared together and connected with a power mechanism, so that the railway track can at any time be adjusted up or down to coincide with the shore tracks, so that the rising and falling of the tide will not interfere with the running of the cars on and off the boat.

Improved Lightning Rod.

Joseph J. White, Jullustown, N. J.—The object of this invention is to improve lightning rods, by rendering them more durable and easily made and more permanently joined together; and it consists in the joint, and in such a construction of the rod that the pieces slip together, and the ends lap past each other and form the joint. Two rivets pass through the joint at right angles to each other, thus securely binding the parts together, and making the joint the strongest part of the rod.

Improved Measuring Faucet.

Jacob Schalk, Jr., Guttentberg, N. J.—This self-measuring faucet consists of two faucets combined and a measuring cup. When a hollow plug is turned so that two orifices correspond in position, in whole or in part, the liquid in the can will run down into and fill the cup. When the orifice is closed, the orifice in the plug is brought in communication with an air tube, which subjects the contents of the cup to atmospheric pressure, and allows a free discharge thereof. The plugs of the faucets are connected by means of a gear wheel on each. The receptacle is placed beneath the discharge tube and the plug turned, which, by virtue of the gear wheel, turns the inner plug and closes an aperture. The liquid in the cup (and no more) is consequently discharged. When that quantity is drawn off, the faucet is turned back and the cup immediately fills, and it is ready to be again discharged.

Improved Children's Carriage.

Thomas Galt, of Rock Island, Ill.—This invention consists of the body of a child's perambulator mounted on the frame with rockers, so that it can be used as a cradle as well as a perambulator when it may be required to do so. Hooks are attached to fasten the body, so that it will not rock when it is not desired.

Improved Evaporating Pan.

David Watson, of Mexico, Mexico.—The invention consists in providing the evaporating pan or vessel with a channel or canal surrounding the same at the top, and leading at the ends into a filter, which is in communication with said pan or vessel near the bottom, the object of such arrangement being to receive the overflow caused by ebullition of the saccharine juice and filter or strain the same before it again enters the vessel.

Improved Street Sweeping Machine.

Leslie J. O'Connor, of Chicago, Ill.—This invention is an improvement in street sweeping machines of the class in which a fan is employed to draw the dust away from the rotary brush and into a suitable receptacle. The improvement relates to the arrangement of a train of driving gears for communicating motion from one of the truck wheels to the brush, in combination with vertically adjustable supports for said brush, whereby the raising and lowering of the same does not in any way obstruct or interfere with the train. The invention also relates to the arrangement of a curved sheet metal hood directly over the front upper portion of the rotary brush, and having a pipe leading from the center thereof to carry off the dust. The machine is designed for removing snow from street railways as well as dust, and the broom is extended each side beyond the truck wheels as much as it is desired to remove the snow from each side of the track.

Improved Car Starter.

Benjamin F. Oakes, of Milford, Me.—The object of this invention is to provide means for moving railroad cars by hand and by one man power; and it consists in a lever having a head adapted to be pivoted directly or indirectly to the drawhead of a car at its middle, and provided at each end with an arm, having a gripe so that the lever may be vibrated horizontally to each clamp arm, acting alternately to hold the rail and give purchase to the operator.

Improved Oil Can.

William G. Cowell, of Wallingford, Conn.—The invention consists in using a can to hold oil, a heater pipe to keep it in a melted state, and a pump to discharge it from the can, all being combined to operate together. The pipe may connect at the upper end with the exhaust pipe of a steam engine, or with the hot feed water pipe of a hot air reservoir, so that it can be readily attached at any time to be heated. It may be coiled within or around outside of the can, or a jacket may surround the can wholly or in part, with pipe connections to conduct the heating medium into and out of it. This plan is preferable to the ordinary method of setting the can on a stove to heat the oil.

Improved Seed Planter and Fertilizer Distributor.

Richardson Montfort, of Butler, Ga.—This invention relates to an arrangement of vertically adjustable shoes or supplementary seed distributing hoppers with stationary receiving hoppers, whereby the delivery of seed from the latter to the former may be conveniently and perfectly controlled or stopped altogether, as required.

Improved Flour Bolt.

William Goshorn, of Waterloo, Pa.—The object of this invention is to improve the old reel bolt in such a manner that the flour is cooled in bolting, so as to be fit for immediate packing; that it bolts faster and cleaner, and requires less cloth, which lasts longer time, as no middlings or bran remains in the bolt, offering thereby less opportunity for injury or destruction by insects. The invention consists in arranging the flour bolt in upright position, with stationary cloth, and a fan with straight and curved partitions.

Improved Stove Pipe Thimble.

Thomas D. Slauson, of Havana, N. Y.—The object of the invention is to furnish an improved casing for conducting stove pipes through wooden partitions, which is easily fastened in position, protects the lathing fully against any danger by fire, and leaves no communicating holes between the rooms, being fully covered by the plastering. It consists in a double casting, which is attached suitably to the wooden partition, being provided with bent up face pieces and side perforations, through which the circulation of the air around the inner casing is kept up.

Improved Automatic Gate.

George W. Olbert and William Young, of Barr's Store, Ill.—The improvement consists in a pendulum swinging gate, connected by means of cranks and rods with pivoted levers, which are arranged horizontally and parallel to the roadway, so that, when a vehicle wheel is run on to one of said levers, the gate will be thrown by the superior weight of the vehicle into a nearly vertical position, leaving the passage way unobstructed.

Improved Children's Carriage.

Albert F. E. Aradt, of Detroit, Mich., assignor to himself and W. Doeltz, of same place.—The object of the invention is to improve the child's carriage in common use that the handle part may be detached and applied at pleasure either to the front or rear of the body. For storage during the winter months, space is saved by the disconnection of the handle, which is, in many cases, a great convenience. The invention consists in attaching, to the front and rear ends of the carriage, sockets for the handle ends, into which the latter lock by means of suitable spring catches.

Improved Check Rein.

George J. Townley, of Parma, Mich.—This invention consists in a check rein attached to the head stall on each side of the horse's head. A pulley is fastened by a frame to this rein. One end of a strap is passed around the pulley coupled with the ordinary check rein, and extends back within reach of the driver. This rein gives the driver complete control of the horse, as, by the purchase which he obtains by means of the pulley, he can draw the check just as tight as he pleases, and stop him or check his speed if he is disposed to be unruly, or attempts to run away.

Improved Mode of Securing Wheel Hubs to Shafts.

Edwin Sanford, of Hartford, Conn.—For fastening pulleys, cog wheels, etc., on the shafts in a way to save the expense of boring the hubs, turning the shafts, and fitting the wheels to the shafts, it is proposed to cast the wheels with their holes a little larger than the shafts, and with three or more grooves in said holes, in which gibs or keys are fitted. On the latter the wheels are secured and trued to the shafts by set screws, screwing through the hubs and clamping the gibs on the shafts.

Improved Apparatus for Cleaning Cesspools, Sinks, etc.

J. P. Florimond Datichey, Brooklyn, N. Y.—The object of this invention is to improve the machines for emptying and cleaning sinks, privies, cesspools, sewers, marshy lands, etc., in a perfectly odorless manner, so that the work can be done in the day time without the least discomfort and annoyance to the occupants of the dwellings, and without the use of separate machines by which the vacuum in the tank is created. The invention consists of a tank of suitable capacity, which is provided with double acting pneumatic pumps and all necessary appurtenances to insure the efficient working of all the parts. The tank is carried on a four wheeled truck of suitable strength, and the vacuum is created by the blind wheels working the air pumps by eccentrics, said action to be discontinued by the application of a regulating gear, which frees the piston from its shaft, according to a gage placed on a cupola connected with the tank, which assists, also, the perfect working of the machine.

Improved Toy Device for Making Soap Bubbles.

Samuel B. Bliss, New York city.—The object of this invention is to furnish, for the amusement of children, a toy instrument by which soap bubbles may be easily and quickly produced, without the spilling of soap water and other inconveniences. The invention consists, mainly, in the arrangement of a double tubular casing for soap and soap water, with an air pipe and exit tube, in which latter the quantity required is regulated by a suitably constructed valve arrangement.

Improved Internal Spring Coupling and Brake.

Léandre Mégy, José De Echeverría and Félix Baran, Paris, France.—This coupling system is based on the use of one or several blade springs suitably curved, inclosed within a hollow drum or pulley, and working by their own expansive force, which keeps them pressing more or less closely against the internal cylindrical face of the said drum or pulley. This expansive force, independent of any exterior action, causes a close adhesion of the said spring to the hollow pulley, which makes them, as it were, a single piece by preventing their sliding on one another, and this adhesion can only be destroyed by an impulse from the exterior. It follows, therefore, that, if one of the two mentioned pieces, either the spring or the pulley, is set in motion, it naturally carries along the other one, so long as the resistances which the latter has to overcome are insufficient to produce the sliding of the said pieces on each other, or so long as the adhesion between the spring and drum is not destroyed, either completely or partially, by any exterior action. The self-acting brake is claimed to afford security for the handling of the heaviest loads. The ascending movement being caused by the effect of the adhesion of the spring to the pulley, then if this adhesive force was able to raise the load it will, of course, be able to maintain it in suspension at any period of its ascent. The workman has no ratchet to lift up, no kind of operation to perform in which he could make a mistake; he has only to turn the crank round to cause the load to ascend, to weigh lightly on the same crank in a contrary direction in order to cause the said load to descend; he may, at pleasure, regulate the descending speed and stop it at any moment by only letting go the handle, having no effort to make, no danger to run, since the crank does not revolve when the load moves down, so that he has nothing to preoccupy his mind. The almost instantaneous stoppage which takes place when suddenly letting loose the handle cannot have any hurtful effect on the chain, for the active impulse is employed only to cause the spring to slide till that impulse is annulled by the friction of the latter on the pulley.

Improved Oscillating Gland for Flowing Oil Wells.

George Flintou, Meadville, Pa.—This invention relates to an apparatus which is fastened to the top of the casing to prevent the escape of oil or gas during the process of drilling oil wells; and it consists in a ball and socket gland which permits the rope from which the iron tool is suspended to pass through the gland oil and gas tight, and to move up and down in the act of drilling without permitting either oil or gas to escape, except through proper orifices. If oil escapes, it may be conveyed to an oil tank, and if gas escapes it may be conducted off to a distance, so as to avoid danger.

Improved Method of Propelling Boats.

Abram Beckman, New York city.—To the bar or lever of the paddle are hinged two blades in such a way that when moving forward through the water the pressure of the water will close them. These are kept from closing against each other by one or more stops, interposed between them and attached to the bar, so that as the paddle begins to make the stroke the pressure of the water may open or spread the blades so as to present the greatest possible surface. The upper ends of the bar are designed to be attached to the shafts, which are arranged so as to be operated independently of each other. The shafts are placed in line with each other, and a pintle may be attached to the end of one shaft to enter a socket in the end of the other shaft. Levers are attached to the inner parts of the shafts, extending above and below said shafts, and having handles attached to their upper ends and foot rests attached to their lower ends, so that the operator can apply hand and foot power.

Improved Fastening for Bedsteads.

James M. Baird, Wheeling, W. Va.—The object of this invention is to produce a simple and reliable means for connecting converging rails, boards, or pieces of articles of furniture, so that such converging or joining pieces may be firmly held together, but so that they can be readily taken apart. The invention consists in the application, to such converging pieces, of wedge-shaped or oblique edged blocks, of which one is attached to each piece in such position that the two blocks, when overlapping each other with their oblique faces, hold the pieces to which they are attached properly together.

Improved Shears.

Allen Lapham, Paterson, N. J., assignor to himself and Orville W. Leonard of same place.—This invention consists of a compound lever arrangement of one of the arms or handles of the shears, to increase the leverage. The handle or arm is in two sections, of which one is a part of the blade, terminating a little beyond the pivot by which the two blades are connected together, and is pivoted at said end to the other section a short distance above its lower end. The latter is connected by a link to the handle for a fulcrum. It extends from the pivot which connects the two sections along with the other handle to its end. A wider sweep and more power is thus given to the blades. The improvement is designed more particularly for the "snip" shears used by tanners and others for cutting sheet metal.

Improved Picture Frame.

Felix Helfschneider, New York city.—This invention consists of a round or oval frame, of wood, metal, or other material, covered with velvet or other cloth, and the cover secured at the edges by ornamental spun metal bands, in addition to being glued to the surface of the metal or wood portions.

Improved Mordant for Dyeing.

Gustav A. Hageman, Copenhagen, Denmark.—This invention relates to the mordant chemically known as acetate of alumina. Acetate of soda is calcined to an anhydrous or a monohydrous state, and then pulverized by means of a fine sieve. The finest powder is removed and mixed with a fresh charge of hydrous acetate to be calcined. The coarser powder of average fineness is separated by another sieve, and forms the part prepared for use. Sulphate of alumina is ground and then sifted in a similar manner. The two coarse grained powders thus obtained are then mixed with each other, preferably by sifting both at the same time through an open sieve, and the mixed powder is ready for packing. The sulphate of alumina may be used in the form of crystal alum, concentrated alum, aluminous cake, etc.

Improved Elastic Seat for Railway Rail Joints.

Lewis Scofield, Jr., Atlanta, Ga.—This invention is an improvement in cushioning the joints of railroad rails; and relates more particularly to a socket plate for the rubber cushion, which is provided with end flanges to adapt the cushion for use with wooden sleepers or cross ties.

Improved Boiler Feeder.

Rafael Rafael, Havana, Cuba.—The object of this invention is to furnish an automatic water feeder for steam boilers. There is a many chambered cylinder, the periphery of which is provided with cogs, which engage with a perpetual screw of the driving shaft, by means of which the cylinder is slowly revolved. The cylinder is placed between two plates, which are secured together by bolts. The cylinder revolves watertight between these plates, the contact surfaces being ground so as to make tight joints, and still allow the cylinder to revolve. The feed water descends through a pipe and fills one of the chambers, the air contained in the chamber being forced out through an upper pipe, in which the water rises to a level with that in the tank. Power being applied to the pulley on the worm shaft, the cylinder is slowly revolved, and the full chamber is carried round to the discharge pipe, while other chambers are filling and being moved in the same manner. When the chamber reaches the discharge pipe, the water is subjected to boiler pressure of steam by means of the steam pipe; and if there is a deficiency of water in the boiler, the water in the chamber will fall by its own gravity, and the chamber will move along filled with steam until it reaches orifices in the upper plate, when the steam will be discharged. The cylinder thus keeps revolving, and the chambers constantly discharge water in sufficient quantity to keep the water in the boiler up to the desired level.

Improved Water Wheel.

Elli Overton, Utica, N. Y.—The gages for regulating the capacity of the buckets according to the volume of water to be used consist of horizontal plates, constructed in the form of the cross section of the space between the upper or vertical portions of the buckets. They are attached to the lower end of the curb surrounding the upper portion of the wheel, and extend above it and the upper wall of the chutes as high as the gages may require to be lowered. The gages for the chutes are attached to the curb, which is the gate to be raised and lowered by it, and thus be adjusted as readily as the gate is. The gate being connected by its sleeve with the sleeve to which the wheel gages are connected, both the wheel and the chute gages will be adjusted together and alike, and at the same time that the gate is opened, so that the labor of adjusting the wheel gages separately to the different heights as the stream varies, or as the labor to be performed by the wheel varies, will be avoided.

Improved Ice Cream Freezer.

Miller F. Graves, Sunbury, Pa.—In the bucket is made a stationary tube of perforated sheet metal. This is placed at the center, and extends nearly as high as the top of the pail, and is large enough to receive the cream can, which has a non-conducting cover lined with charcoal. The ice is packed in the space between the tube and the shell of the pail, and is, by the curb, prevented from filling up the center of the pail when the cream can is taken out, so that as many cans can be put in and taken out as may be desired, without repacking the ice.

Improved Safety Platform for Railroad Car.

Richard Strode, of Coatesville, Pa.—The invention is designed to prevent persons from falling between the platforms of cars, and fracturing their limbs, or otherwise more seriously injuring themselves. It consists in a relative construction of the platform ends which enables them to come into contact, yet allows the lateral motion required in the attachment to each car of a projection which passes under the opposite one (and this prevents them from telescoping with one another), and finally in pendulous ops which are placed on the sides of platform and outside of the rail to prevent cars from readily upsetting and falling over embankments.

Improved Reversible Plow Point.

Robert M. Pattillo, of Cartersville, Ga.—This invention relates to the plow iron now generally used in the cultivation of cotton upon a one horse frame, and attached only to the foot of standard by a bolt, which passes through the plow, and which holds it in a notch upon an inclined surface. These are known through the South as twister plows, the share and mold board being in one piece, somewhat spirally concaved. The invention consists in the peculiar relative construction of the two parts of these twister plow irons, so that the mold board and point become interchangeable, and, wearing at different parts, enable nearly or quite double the service to be obtained out of the same quantity of metal.

Improved Bee Hive.

Joseph R. East, Fincastle, Tenn.—The hive is so constructed that honey can be removed with perfect safety, yet without injury to the bees, and the swarm can be divided, or entirely removed from the hive, with equal facility. The hive is also well ventilated, is provided with means of protection against moths, and adapted for use of a ventilating attachment in the form of a wire gauze basket which allows admission and circulation of air, and forms practically an extension of the hive, which the bees may enter at any time whenever the heat is too great within the hive.

Improved Car Coupling.

Wille D. Pope, Gadsden, Ala.—The bumper heads are alike and made of the usual hopper shape. Pivoted within at its angle, by a transverse pin, is a two armed lever—one arm of which projects toward the mouth of the bumper, and has a hook on its extremity, and the other extends up through a slot in the upper part of the drawhead. The link, entering, is guided by a spring so as to catch under the hook. A cord may be attached to the forward end of the upper arm of the hooks and carried up to the top of the car, so that the hook may be raised for uncoupling from that point.

Improved Plow.

John S. Hall, Pittsburgh, Pa.—This invention relates to plows, and consists in a projection plate applied to the rear of the mold board so as to serve several useful purposes; in a novel mode of splitting the beam so that the landside is formed out of the same piece of metal; also in placing the hook which connects the mold board and beam at the rear end of an extension of the beam and enabling it to hold by the rear end of the mold board.

Improved Artificial Teeth.

William C. Tracy, Brooklyn, N. Y.—This invention has for its object to furnish artificial teeth, single and in blocks, so that they may be more conveniently and firmly secured to the various plates or bases upon which they are set or mounted. It consists in a platinum lining upon the back of the teeth, with or without pins. When the teeth are to be applied singly, or in blocks, to a rubber or vulcanite base or plate, the platinum lining will be covered up and concealed by said plate.

Improved Wood Fence.

Robert F. Ward, Seneca, Miss.—The stakes are used in pairs, set at such an inclination toward each other that they intersect or cross, and are placed at the usual distance apart to form a panel of fence. A rider is supported in the angles formed by the intersection, and an upright is placed centrally between each pair of stakes. These uprights extend to near the intersection of the stakes, with a rider extending across the top ends thereof. Braces are attached to the stakes at one end, while the other end rests, beneath the lower angle of the latter, on the rider. The uprights are connected with the stakes by slats, and placed at an angle of fifteen degrees with the surface of the ground. Rails rest on these slats, and their ends lap past each other or placing them on opposite sides of the uprights. The fence is said to be straight, and proof against unruly stock as well as high winds.

Improved Grave Covering.

Joseph R. Abrams, Greenville, Ala.—This invention relates to mounds erected over graves, and consists in three arches of stone sunk in the ground so that their upper faces are about level with the surface. On these rest four inwardly inclined plates, which support another plate with an oval opening and an angular recess.

Improved Device for Changing the Speed of Machinery.

Alfred Betts, Wilmington, Del.—This invention consists in a mechanical movement by which the velocity of a drive shaft may be quickly lessened to give greater power, or the reverse, a portion of the former being converted into the latter, or vice versa, as may be desired.

Improved Explosive Engine.

Joseph M. Welbourn, Caledonia, Ohio.—The object of this invention is to construct an engine which is driven by the explosive force of powder charges. The invention consists in the introduction and explosion of powder charges into chambers, which are alternately discharged to act on pistons, which turn the driving wheels, and are regulated by suitable mechanism. The base frame on which the engine is placed is of oblong shape, and contains two powder chambers arranged parallel to each other in longitudinal direction at both sides. The driving wheels produce, by alternately completing one half of a revolution on each wheel, rotary motion of a shaft from the reciprocating motion of the pistons. Each powder chamber is closed by an adjustable breech piece, which may be detached for cleaning out the chamber. The closely fitting piston moves in the chamber, its piston rod connecting, by a cross pin, with a strong spiral spring, which is also applied by cross head and pitman, to the side of a driving wheel. The required quantity of powder is introduced, in cartridge form, into the chamber by means of a vertical casing, which is arranged on guide rails placed on the top of the chamber. A brush of casing serves to secure the cartridge in recess of the sliding piece, which is carried forward and backward in guide rails. On the forward motion of the slide the cartridge drops into a chamber, to be carried back toward the breech piece by the returning piston, and be discharged by the concussion against the breech block. The piston is, by the explosion, forced forward again, and causes, by its action on the pitman, the rotation of the wheel. The smoke and gases escape through side apertures, admitting the immediate recharging of the chambers.

Improved Butter Print Press.

Lewis Costes and Joel T. Criswell, Collierville, Pa.—The object of this invention is to furnish to farmers and dairymen an improved butter print or press, by which the butter may be quickly and evenly formed into cakes of required weight, with so table print marks thereon, without previous weighing. It consists in a sliding box, into which the butter is introduced and pressed on a printing block, by a follower block and lever, into suitable shape and weight.

Improved Painted Cloth Cover.

William D. Richardson, Pawtucket, R. I.—The cloth or other material used for ornamenting, is backed before painting on with any stiff material, whether of pasteboard, wood, metal, rubber, or any combination of the same, provided it is thick and strong enough to fasten permanently and securely thereon. It is cut of the exact size required, and bound with metallic edges to protect the edges and prevent a disconnection of the cloth from the board. The metallic edges serve also as an ornamental finish. If used as a table cover, it may be glued, tacked, or screwed down, or it may also be used as a movable cover, and be made with leather and cloth hinges to be folded up, which, in the case of chess boards and other games is very desirable.

Improved Armpit Shield.

James Sibley, New York city.—The object of this invention is to provide means for protecting the dresses of ladies from the ruinous effects of perspiration under the arms; and it consists in a shield or protector made of what is known as chamois skin or equivalent material and oiled silk or equivalent material in combination.

Improved Life-Preserving Mattress.

John J. Woodfine, Hoboken, N. J.—This invention is a life-preserving mattress, made of cork strips or similar buoyant material, having end sections connected with a middle section by straps that interlock, one sliding upon the other and both together, allowing the said end sections to turn up on either side of the middle one, so that they can swing up edgewise when the mattress sinks by the weight of a person. Cords are arranged on the edges of the middle and end sections for grasping the float by one floating in the water, and they are provided with the loops, also, for grasping hold of and for making temporary rowlocks, in which to use paddles for propelling the raft.

Improved Taper-Turning Attachment to Lathes.

Michael Neekermann, Pittsburgh, Pa.—This invention consists of a toothed rack on a lathe frame, and a system of gears on the tool slide, which moves lengthwise of the lathe, combined with the screw which works the tool slide crosswise in such manner that the tool is fed crosswise of the lathe at the same time that it is fed lengthwise, so as to turn tapers. The wheels are graduated and the supports contrived so that, by the use of interchangeable wheels of different sizes and numbers of teeth, tapers of various predetermined angles can be produced, and they can be turned either way—that is to say, from the large to the small end, or vice versa.

Improved Car Coupling.

James Griffith and William F. M. Her, Adamsburg, Pa., assignors to themselves and C. D. B. Eisman, of same place.—The entering coupling bar passes back in such a direction as to strike the pivoted block below its pivoting point, swinging the same back and continuing on beneath its lower edge. An enlargement is formed in the upper part of the drawhead, to give room for the pivoted block to swing in. The coupling bar is made with a joint in its middle part, to adapt it for use in coupling cars of unequal height. This joint is made with almost straight shoulders, to guard it from dropping down too far. The ends of the coupling bar are rounded off, and have shoulders formed upon their upper sides near their ends, to receive the lower ends of the pivoted blocks, and thus sustain the draft strain. With this construction, the lower end of the block is free to swing inward, to allow the cars to be coupled by the entrance of the coupling bar. To uncouple the cars a key is drawn out, which allows the block to swing freely in either direction.

Improved Vehicle Axle Box.

Oliver P. Rice, New York city.—This invention has for its object to diminish the wear and friction of axle journals and boxes, particularly those of rail car trucks; and it consists in a chambered axle box provided with a flange in which the lubricating material is contained, and from which it is discharged to the frictional surfaces, and on a perforated journal sleeve, which is also provided with discharge orifices by means of which the axle is lubricated. There is a cap nut on the end of the axle, which incloses the ends of the box and sleeve, and comes in contact with the hub of the wheel.

Improved Wheel for Vehicles.

Peter C. Hirston, Crawfordsville, Miss.—The object of this invention is to construct an improved metallic wheel for wagons, carriages, etc. It consists of a hub with projecting central piece and two detachable collars, into which the two dovetailed ends of the spokes are mortised and held by lateral screw connections. The curved spokes bear against the tyre, and are, with their conical outer ends, screwed therein.

Improved Railway Switch.

Joseph J. Rockwell, Shell Rock, Iowa, assignor to himself and Peter C. Wette, of same place.—This invention consists of apparatus arranged in connection with the switch to be actuated by a shaft or wheel on the locomotive coming in contact with a lever alongside of the rail, and caused to unlock the switch and change it, and shift the target before the locomotive runs on to the switch, the said apparatus being arranged so that a locomotive approaching from either direction will shift it.

Improved Miner's Pick.

Richard K. Walton, Clarington, Ohio.—This invention consists in a movable bit attached to an ordinary pick, provided with two triangular points and prevented from turning by a clamp screw.

Automatic Lubricating Water and Gas Cock.

Edwin F. Brooks, Baltimore, Md.—This invention consists in a water or gas cock provided with a valve having an oil reservoir in one or both ends and connected with the outer surface of the valve by a suitable aperture; also in a spring piston, applied in connection with the screw cap so as to expel the oil.

Improved Children's Carriage.

Lucius Havasy, Hoboken, N. J.—The body is constructed mainly in the form of a covered chair with inclosed sides, and suspended by arms from a rod, which is mounted at the top standards, extending up from the lower portion of the frame about as high as the top of the body, so that it can be swung forward and back whenever it may be desired to do so to quiet the child. For this purpose the wheels are made small and arranged wide apart, to suspend the body as low as possible, and afford a substantial support for the body when swinging. It is proposed to mount the frame on the middle cross bar of the wheel frame by light, flat, semi-elliptical springs, bolted to said bar at the middle, and connected at the ends to the side pieces of the frame by their turned up flanges, which are notched and fitted in notches in the frame.

Improved Sash Fastener.

Edward Burdett, Horsham, Sussex county, England.—This invention relates to the ordinary sash fastener, which prevents the window from being opened, and consists in means whereby the introduction of a blade or instrument between the sashes in order to unlock them may be effectually prevented.

Inventions Patented in England by Americans.

(Compiled from the Commissioners of Patents' Journal.)

From October 30 to November 3, 1873, inclusive.

BOILER FURNACE.—L. Stevens, Washington, D. C.
BOOT LASTING MACHINE.—G. McKay, Boston, Mass.
EXCAVATOR.—T. FitzRandolph, Morristown, N. J.
FURNACE FOR IRON, ETC.—S. Danks (of Cincinnati, Ohio), London, England.
HORSESHOE MACHINERY.—M. E. Hayes, Somerville, Mass.
MAKING CANS, ETC.—T. J. Powers, New York city.
METAL TUBING, ETC.—S. W. Wood, Cornwall, N. Y.
NAILS AND SPIKES.—B. T. Nichols, Roselle, N. J.
PEN FINGER GUARD.—S. T. Pomeroy (of New York city), London, England.
PRESERVING TEETH.—G. H. Chance, Salem, Oregon.
PUDDLING FURNACE.—S. Danks (of Cincinnati, Ohio), London, England.
RAILWAY CARRIAGE.—W. B. Rogers, Paterson, N. J.
SLIDE REST, ETC.—S. W. Wilson (of Philadelphia, Pa.), London, England.

Value of Patents, AND HOW TO OBTAIN THEM. Practical Hints to Inventors.

PROBABLY no investment of a small sum of money brings a greater return than the expense incurred in obtaining a patent even when the invention is but a small one. Larger inventions are found to pay correspondingly well. The names of Blanchard, Morse, Bigelow, Colt, Ericsson, Howe, McCormick, Hoe, and others, who have amassed immense fortunes from their inventions, are well known. And there are thousands of others who have realized large sums from their patents.

More than FIFTY THOUSAND inventors have availed themselves of the services of MUNN & Co. during the TWENTY-SIX years they have acted as solicitors and Publishers of the SCIENTIFIC AMERICAN. They stand at the head in this class of business; and their large corps of assistants, mostly selected from the ranks of the Patent Office: men capable of rendering the best service to the inventor, from the experience practically obtained while examiners in the Patent Office: enables MUNN & Co. to do everything appertaining to patents BETTER and CHEAPER than any other reliable agency.

HOW TO OBTAIN Patents. This is the closing inquiry in nearly every letter, describing some invention which comes to this office. A positive answer can only be had by presenting a complete application for a patent to the Commissioner of Patents. An application consists of a Model, Drawing, Petition, Oath, and full Specification. Various official rules and formalities must also be observed. The efforts of the inventor to do all this business himself are generally without success. After great perplexity and delay, he is usually glad to seek the aid of persons experienced in patent business, and have all the work done over again. The best plan is to solicit proper advice at the beginning. If the parties consulted are honorable men, the inventor may safely confide his ideas to them, they will advise whether the improvement is probably patentable, and will give him all the directions needed to protect his rights.

How Can I Best Secure my Invention?

This is an inquiry which one inventor naturally asks another, who has had some experience in obtaining patents. His answer generally is as follows:—and correct:

Construct a neat model, not over a foot in any dimension—smaller if possible—and send by express, prepaid, addressed to MUNN & Co., 37 Park Row, New York, together with a description of its operation and merits. On receipt thereof, they will examine the invention carefully, and advise you as to its patentability, free of charge. Or, if you have not time, or the means at hand, to construct a model, make as good a pen and ink sketch of the improvement as possible and send by mail. An answer as to the prospect of a patent will be received, usually, by return of mail. It is sometimes

best to have a search made at the Patent Office. Such a measure often saves the cost of an application for a patent.

Preliminary Examination.

In order to have such search, make out a written description of the invention, in your own words, and a pencil, or pen and ink, sketch. Send these, with the fee of \$5, by mail, addressed to MUNN & Co., 37 Park Row, and in due time you will receive an acknowledgment thereof, followed by a written report in regard to the patentability of your improvement. This special search is made with great care, among the models and patents at Washington, to ascertain whether the improvement presented is patentable.

Rejected Cases.

Rejected cases, or defective papers, remodeled for parties who have made applications for themselves, or through other agents. Terms moderate. Address MUNN & Co., stating particulars.

To Make an Application for a Patent.

The applicant for a patent should furnish a model of his invention if susceptible of one, although sometimes it may be dispensed with; or if the invention be a chemical production, he must furnish samples of the ingredients of which his composition consists. These should be securely packed, the inventor's name marked on them, and sent by express, prepaid. Small models, from a distance, can often be sent cheaper by mail. The safest way to remit money is by a draft, or post order, on New York, payable to the order of MUNN & Co. Persons who live in remote parts of the country can usually purchase drafts from their merchants on their New York correspondents.

Caveats.

Persons desiring to file a caveat can have the papers prepared in the shortest time, by sending a sketch and description of the invention. The Government fee for a caveat is \$10. A pamphlet of advice regarding applications for patents and caveats is furnished gratis, on application by mail. Address MUNN & Co., 37 Park Row, New York.

Reissues.

A reissue is granted to the original patentee, his heirs, or the assignees of the entire interest, when, by reason of an insufficient or defective specification, the original patent is invalid, provided the error has arisen from inadvertence, accident, or mistake, without any fraudulent or deceptive intention.

A patentee may, at his option, have in his reissue a separate patent for each distinct part of the invention comprehended in his original application by paying the required fee in each case, and complying with the other requirements of the law, as in original applications. Address MUNN & Co., 37 Park Row, for full particulars.

Design Patents.

Foreign designers and manufacturers, who send goods to this country may secure patents here upon their new patterns, and thus prevent others from fabricating or selling the same goods in this market.

A patent for a design may be granted to any person, whether citizen or alien, for any new and original design for a manufacture, bust, statue, alto relievo, or bas relief; any new and original design for the printing of woolen, silk, cotton, or other fabrics; any new and original impression, ornament, pattern, print, or picture, to be printed, painted, cast, or otherwise placed on or worked into any article of manufacture.

Design patents are equally as important to citizens as to foreigners. For full particulars send for pamphlet to MUNN & Co., 37 Park Row, New York.

Foreign Patents.

The population of Great Britain is 31,000,000; of France, 37,000,000; Belgium, 5,000,000; Austria, 35,000,000; Prussia, 40,000,000; and Russia, 70,000,000. Patents may be secured by American citizens in all of these countries. Now is the time, while business is dull at home, to take advantage of these immense foreign fields. Mechanical improvements of all kinds are always in demand in Europe. There will never be a better time than the present to take patents abroad. We have reliable business connections with the principal capitals of Europe. A large share of all the patents secured in foreign countries by Americans are obtained through our Agency. Address MUNN & Co., 37 Park Row, New York. Circulars with full information of foreign patents, furnished free.

Value of Extended Patents.

Did patentees realize the fact that their inventions are likely to be more productive of profit during the seven years of extension than the first full term for which their patents were granted, we think more would avail themselves of the extension privilege. Patents granted prior to 1861 may be extended for seven years, for the benefit of the inventor, or of his heirs in case of the decease of the former, by due application to the Patent Office, ninety days before the termination of the patent. The extended time inures to the benefit of the inventor, the assignees under the first term having no rights under the extension, except by special agreement. The Government fee for an extension is \$100, and it is necessary that good professional service be obtained to conduct the business before the Patent Office. Full information as to extensions may be had by addressing MUNN & Co., 37 Park Row.

Trademarks.

Any person or firm domiciled in the United States, or any firm or corporation residing in any foreign country where similar privileges are extended to citizens of the United States, may register their designs and obtain protection. This is very important to manufacturers in this country, and equally so to foreigners. For full particulars address MUNN & Co., 37 Park Row, New York.

Canadian Patents.

On the first of September, 1872, the new patent law of Canada went into force, and patents are now granted to citizens of the United States on the same favorable terms as to citizens of the Dominion.

In order to apply for a patent in Canada, the applicant must furnish a model, specification and duplicate drawings, substantially the same as in applying for an American patent.

The patent may be taken out either for five years (government fee \$20) or for ten years (government fee \$40) or for fifteen years (government fee \$60). The five and ten year patents may be extended to the term of fifteen years. The formalities for extension are simple and not expensive.

American inventions, even if already patented in this country, can be patented in Canada provided the American patent is not more than one year old.

All persons who desire to take out patents in Canada are requested to communicate with MUNN & Co., 37 Park Row, N. Y., who will give prompt attention to the business and furnish full instruction.

Copies of Patents.

Persons desiring any patent issued from 1836 to November 25, 1871, can be supplied with official copies at a reasonable cost, the price depending upon the extent of drawings and length of specification.

Any patent issued since November 27, 1871, at which time the Patent Office commenced printing the drawings and specifications, may be had by remitting to this office \$1.

A copy of the claims of any patent issued since 1836 will be furnished for \$1.

When ordering copies, please to remit for the same as above, and state name of patentee, title of invention, and date of patent. Address MUNN & Co., Patent Solicitors, 37 Park Row, New York city.

MUNN & Co. will be happy to see inventors in person, at their office, or to advise them by letter. In all cases, they may expect an honest opinion. For such consultations, opinions, and advice, no charge is made. Write plainly: do not use pencil, for pale ink is brief.

All business committed to our care, and all consultations are kept secret and strictly confidential.

In all matters pertaining to patents, such as conducting interferences, procuring extensions, drawing assignments, examinations into the validity of patents, etc., special care and attention is given. For information, and for pamphlets of instruction and advice

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The Antiquities of Mexico, 9 Vol. imp. folio, elegantly bound, for \$125. Dr. Ditson, Albany, N. Y.

Wanted, a 2d hand foot lathe. J. H. S., Box 5345. Manf. of Match, Bobbin & Clothes Pin Machinery, address T. R. Bailey & Vall, Lockport, N. Y.

Iron Steam Boxes for Stave Bolts & Veneer Cutting Machines. T. R. Bailey & Vall, Lockport, N. Y.

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For Solid Wrought-iron Beams, etc., see advertisement. Address Union Iron Mills, Pittsburgh, Pa., or lithograph, etc.

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Wanted—To manufacture, under contract, heavy Machinery, Steam Engines, Ore Crushers, &c., &c. Address Herrman & Hercheirode M'g Co., Dayton, Ohio.

For Bolt Forging Machines, Bolt Holding Vices to upset by hand. J. R. Abbe, Manchester, N. H.

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The New Remedy retains the Rupture in case and comfort, night and day, till cured. Sold cheap. Fitted without charge, by the Elastic Truss Co., 683 Broadway.

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For patent Electric Watch-clocks, address Jerome Heddling & Co., 30 Hanover Street, Boston, Mass.

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

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Hydraulic Presses and Jacks, new and second hand. E. Lyon, 470 Grand Street, New York.

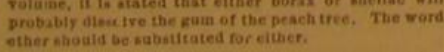
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Dickinson's Patent Shaped Diamond Carbon Polite and adjustable hold-r for working Stone, dress- ing Emery Wheels, Grindstones, &c., 64 Nassau St., N. Y.



In our answer to T. C. E., page 331, current volume, it is stated that either borax or shellac will probably dissolve the gum of the peach tree. The word ether should be substituted for either.

P. G. W. asks: Is it practicable to raise water 14 or 15 feet with a steam ejector through a 3 inch pipe? How many cubic feet of steam at a given pressure to 100 cubic feet of water raised will be required? Will it be as economical as to use a steam pump for the work? Answer: The ejector will work very well under the circumstances mentioned; but probably it will not be as economical as a good steam pump.

T. asks: 1. Has there ever been discovered, and if so what is it, a geometric rule for trisecting any angle save a right angle? 2. Is there any known way by which a hyperbola or parabola may be trisected? Answer: 1. An equation of the third degree is involved in the solution of this problem. 2. We do not understand what you mean by this question.

A. M. asks: How can I get iron out of dipping acid (nitric and sulphuric) which has accidentally been dissolved in it? It gives the brass articles a dull color when dipped in it. Answer: If the mixed acids are not too strong, you can precipitate the iron as prussiate of potash (ferrocyanide of potassium). Add the yellow prussiate solution by degrees, stirring well until a blue color ceases to be formed, and then allow to settle. Pour off the acid from the precipitate.

C. A. asks: How can I remove and prevent rust on a cooking stove? Answer: Remove as much of the rust as possible by scraping and brushing, and then rub with plumbago, ordinarily called black lead. The ordinary stove polish is this substance prepared for the purpose.

J. A. M. asks: What is the best material for a bake oven? Answer: A brick oven will probably be the most serviceable, but you can make one of mud or clay.

F. W. D. asks: If a current of electricity be passed through a telegraph wire, always in one direction, how can I find the direction it takes, knowing nothing of its connections with the battery, yet having access to the wire? Answer: If the wire runs approximately north and south, you might be able to tell the direction of the current by placing a magnetic needle beneath it, and observing the deflection. If the wire runs nearly east and west, it would probably be necessary to attach a compensating magnet, so as to annul the influence of the earth's polarity. In case the intensity of the current is not sufficient to deflect the needle, you might be obliged to employ a delicate galvanometer, and also to cut the wire and attach the ends to the instrument. You will find directions in regard to the use of galvanometers in any good text book on electric city.

J. H. M. says: 1. I have two boilers, 4 feet diameter, 16 feet long, with two 16 inch flues. The fire is under front end of boilers; it passes under boiler and returns through the flues and up the chimney. Will some one tell me how large and how high a round iron chimney should be to have a good draft? Fuel is wet sawdust. I want to carry 90 lbs. steam and burn as much sawdust as possible. 2. Will some one describe a furnace and give its capacity for burning sawdust and making steam? 3. Is there a tightening pulley in use with a rubber tyre? Would such a thing not be preferable to wood or iron, being a saving of belts? Answer: 1, 2. It is quite common to use sawdust for fuel, in many localities. If you will write to any good builder of stationary engines and boilers, he will probably send you an engraving illustrating the arrangement of furnace. Perhaps some of our readers who have had experience with this fuel will be kind enough to send descriptions. 3. We scarcely think that such a pulley would be desirable.

D. T. T. asks: 1. What attractive or lifting force has the most powerful magnet ever known? 2. Is there any magnet that will lift an object upward to any distance? Answer: 1. About 5½ tons. 2. No.

R. B. says: While at breakfast this morning a drop or two of coffee was by accident spilt on my plate, and came in contact with some sirup I had been eating. The peculiar shade assumed by the mixture raised my suspicions that all was not right with the sirup. On further trial, I found that the coffee and sirup, when mixed, turned very dark, while coffee and molasses did not change color. I afterwards tested the sirup with tannin, and found, as I expected, that I had a pretty fair article of ink from the mixture. I presume the sirup was made from a starch. I would be glad to have your opinion as to the healthfulness of such sirup, and whether coffee may be considered a fair test for glucose? If so, it certainly is a very simple test, which can be made at any time, and should be better known. Answer: The reaction of which you speak indicates the presence of iron in the sirup. Tannic acid, it is well known, as well as its salts, are characterized by striking a deep black color with the persalts of iron. There is sufficient tannin in coffee to effect this reaction, and the iron in the sirup is probably due to the iron vessels used in its manufacture. We have ourselves noticed the reaction of tea with iron.

J. A. C. asks: 1. Would rubber dissolved in bisulphide of carbon be of any use on the inside of a gum belt from which the rubber has been worn off? Would it adhere well, or would the solvent injure the cotton of the belt? 2. Would this solution do for waterproofing boots and shoes? 3. We are using a locomotive boiler with 66 two inch flues; we have had great trouble with their leaking; we have had them reset, but they were no better. Then we stopped using the water from our well, and took it from a dam on a small stream, since which we have had no trouble. Now the tubes are clean, or very nearly so. Do you think that any kind of clear water would cause them to leak, at once? From appearances, it was the water that caused it, but we are surprised that any water should cause it at once, and thought that they must become coated so as to overheat first. Answer: 1. We do not think that you can repair the belt in the manner mentioned. 2. There is a solution made for this purpose, which answers very well. 3. Fresh water sometimes cuts out scale or mud at once, causing leaks.

S. A. T. says: I had about \$10 worth of postage stamps, torn apart, in a tin box on my desk; and somebody upset ink on them, which has dissolved the gum on them and soiled nearly all of them. The gum has dried and they are all stuck together and soiled with ink. What can I do with them? I can soak them apart, but now about the ink? Answer: After carefully soaking the stamps apart, you can remove the ink stains by brushing them over with a fine camel's hair brush dipped in a dilute solution of oxalic acid. Oxalic acid is poisonous, so that care must be exercised in using it.

J. T. A. asks: 1. Can buckshot be fired from a swivel boat gun, so as to kill large birds at 1,000 yards? 2. What would be the length and caliber of such a gun, and the proper charges of powder and buckshot? Answer: 1. No. 2. Your best plan would be to copy as nearly as possible the 12 pound mountain howitzer, used in the army. The weight of this gun is 230 pounds. You might place your buckshot in canisters, and thus obtain a range of perhaps 500 yards; but the deviation of the balls at the end of their path would be over a space of fully fifty feet in diameter. The proper charge of powder is ¼ lb. to the above mentioned weight of projectile. If you have facilities for making shells and understand the arrangement of time fuses, you can do good execution at 1,000 yards range, elevating your piece to 5° and cutting your fuse at 3 seconds. For further information, consult any standard work on gunnery, or the Army Ordnance Manual, whence you can obtain full particulars as to caliber, material, length, etc.

W. P. asks: In heating a greenhouse by hot water, would it not do to carry the smoke along the floor in an ordinary heating flue, and thus utilize its heat instead of carrying it directly up the chimney as is usually done? Answer: A very common method of heating greenhouses is to carry the smoke flue along the floor, as you suggest.

R. asks: Which locomotive engine has the most power to start a heavy freight train, one with large drive wheels or one with small? Answer: The engine with small wheels has more tractive force, other things being equal, because the difference between length of crank and radius of wheel is less than in the case of an engine with larger drivers.

H. D. asks for a formula for bay rum. Answer: Tincture bay leaves 5 ozs., otto of bay 1 dram, bi carbonate of ammonia 1 oz., borax 1 oz., rose water 1 quart. Mix and filter. Bay rum is said to be made in the West Indies by distilling rum with the leaves of the bay tree.

P. asks: What is the exact difference in time between New York and Washington? Answer: Twelve minutes, fifteen and forty-seven hundredths seconds, (12 min. 15.47 sec.).

S. E. asks: What is a horse power of an engine? Answer: A horse power, when used in reference to a machine, is a unit for expressing the amount of work that it is capable of performing in a given time, being the power required to raise 33,000 pounds one foot high in a minute.

F. O. W. says: What is the requisite education for entering the United States navy as engineer? Also, what experience, influence, money, etc., are needed? In what text books would one be examined? Answer: We believe that it is necessary for all those who wish to join the engineer corps of the United States Navy to enter the Naval Academy as cadet engineer. If you will write to the chief of the Bureau of Steam Engineering, Navy Department at Washington, we think you can obtain a circular giving full particulars.

F. P. B. says: Why does a barometer show the same pressure of atmosphere inside a room as it does outside? Answer: Because the atmosphere of the inside of an apartment communicates, through the cracks of the doors, windows and other parts, with the outside atmosphere. If the room in which the barometer is placed is airtight and rigid, the barometer will not be affected by changes in the exterior atmosphere.

A. B. K. asks: 1. What is used to give imported pickles their agreeable flavor? 2. Is there anything that will prevent the icing of cakes from rapidly turning yellow? 3. What is used to prepare the sugar for molding for ornamenting? Answer: Wash your vegetables and fruit in cold spring water, and steep for some days in strong brine; drain, dry, and put in jars; add the spice, if required, and fill up with hot, strong, pickling vinegar; cork up tight, and tie over with bladder. When the jars are cold, seal over the corks with sealing wax. The ordinary difficulty is with the vinegar. It is useless to try to make good pickles with sour cider. Use a malt vinegar, if you can get it. 2 and 3. Beat the white of eggs to a full froth, with a little rose water; add, gradually, as much finely powdered sugar as will make it thick enough, beating it all the time. Use vegetable coloring matter for the ornaments. This ought not to become rapidly discolored, if the sugar is pure.

C. S. K. asks: Why does a hair out of the tail of a horse, thrown into warm water, become animated in a few days, with apparently some of the characteristics of the snake? Answer: It does not.

J. A. asks: What is the law in regard to joint interests of employer and employee in case of patentable improvements on machinery? For instance, employer, A, is using new and peculiar machinery of his own device and construction; employee, B, is at work for A, for per diem wages, and he proposes changes and improvements which, with A's advice and consent, are put in at A's expense of time, material, and risk, some of which improvements in their details A requests to have tried; the improvements operate successfully; A proposes to have a patent, and orders a model constructed, which B goes on and builds, employing the assistance of other workmen of A. Now to whom belongs the right of the patent? Can either party claim it for himself? Or does it belong to both? If B may claim it, what becomes of A's right and interest, the improvement being devised expressly for him at his expense and under his order and knowledge? Answer: The rule is that when an employer directs an employee to make a thing, giving him general instructions what to make, the invention belongs to the employer, the other party having merely exercised his mechanical skill in carrying out orders. But where an employee gets up a new improvement without such instruction, the invention belongs to him though made while at work for another party. Where the invention of an employee is put into use with his knowledge and consent, the employers have the right to continue the use of the specific machine thus made, after a patent has been granted to the inventor.

J. P. says: I have observed the following phenomenon which I cannot satisfactorily account for. I placed a lamp in a room some twelve feet distance from the wall, and held a plano-convex lens in the rays of light near the wall, and observed the focus to be a small speck; I then removed the lens into close proximity with the lamp, and found the focus to be many times greater than in the former case. I also noticed that these were the only two points where a lens could be placed to form a focus or image upon the wall. What I wish to know is this: 1. Why does not the lens in the second case produce the same sized focus or image as in the first? 2. Is it because the lens in the second case intercepts a greater number of rays and is incapable of converging to a small focus? 3. How may I clean a specimen which has become covered with dirt without injuring the face? Answer: 1 and 2. There is only one position of the lens (with respect to the light of the wall) where a true focus can be obtained. This is where the diverging rays of light from the candle are refracted to a focus by the plano-convex lens. The nearer this lens is moved to the source of light, the more divergent the incident rays become; and consequently the less convergent are the rays after refraction, and the farther the true focus is from the lens. 3. Rub gently with soap and water, using a soft woolen cloth, and then rub with camellia oil.

A. H. says: We have a breast wheel 25 feet diameter by 12 feet face. The wheel gears into a pinion 3 feet in diameter; on same shaft with pinion is an intermediate gear 5 feet in diameter, which gears into another pinion 2½ feet in diameter; on the shaft with last named pinion is the main drum, 8 feet in diameter, from which we belt to different parts of the mill. Recently we have added machinery so that the buckets of the wheel fill full and a small quantity of water spurts out at each side of the apron; at the same time we fall short of our regular speed about 4 revolutions on loom shaft, or about ¼ of one revolution of the water wheel, which runs 7½ feet per second on the rim. Can I lag the main drum sufficiently to gain the right speed as the wheel now runs, or would it be better to lag up more and run the wheel slower? Would it be any gain in power, or effect any saving of water, to throw out the 5 feet intermediate and the 2½ feet pinion gear, put a larger drum on the jack shaft, and so get power and speed direct from wheel? Answer: There will probably be a little gain if you throw out the intermediate gear; but lagging up the wheel will have no effect if the water wheel is not sufficiently powerful, as we judge, from your statement, is the case.

W. E. says: 1. It has been the practice, in building up a wagon spring, to punch a slot in one iron, and a rib on the other, so that the rib will enter the slot and keep the leaves straight. Where these slots and ribs are made, about one third of the strength has been destroyed; and the strain is thrown on the weakest point and they soon break. If I make a spring without these slots and ribs, but, in the place of them, with an ear on two inside corners of each leaf to rest against the inside edge of the next longer leaf, and thus, in connection with the bolts in the center, keep them straight, would it not be an improvement and patentable? Answer: Probably the value of this method would depend upon the cost of manufacture. As to your water wheel query correspond with a manufacturer.

J. K. W. says: I have difficulty with my boilers on account of want of draft. I have 2 boilers, set side by side, 12 feet long, 42 inches in diameter, with 38 flues each. They are connected with a breeching. The smoke stack enters at top of breeching, runs back about 4 feet, then turns at a right angle and runs 10 feet, thence upwards 75 feet. Stack is 18 inches in diameter all the way from boilers. Is there any way to increase the draft except by enlarging the smoke stack? If not, how large should the smoke stack be to give sufficient draft? I very seldom have enough draft, except in very cold weather, and not always then; sometimes one boiler will have a fair draft and the other none at all. I tried a blower last winter, first in the smoke stack and afterwards under the grate bars, but failed to receive any benefit. I have since tried a jet of steam in smoke stack, taken from another boiler, running with 40 pounds of steam, but still fail to improve the draft. I burn anthracite coal. Answer: Possibly the chimney is not properly proportioned. You do not send enough data to enable us to determine.

O. A. F. says: In your issue of October 26, 1872, in answer to E., query 19, page 216, A. H. G., of Mo. says: "Make a mixture of sal soda 40 pounds; gum catechu 5 pounds, and sal ammoniac 5 pounds, and use one pound of the mixture to each barrel of water used, and it will take the scale off the boiler." 1. Will this mixture injure a boiler in any way; and will it take the scale off which is formed by different kinds of water? He also states that, after the scale is once removed, sal soda will prevent any more forming on the boiler: is that true? 2. I also wish to know how copper is deposited on iron wire, such as is used for pall balls. Answer: 1. We know nothing of the merits of this mixture, and would hardly recommend the use of sal ammoniac in a boiler. 2. We believe it is done by dipping them into a solution of sulphate of copper.

C. R. M. asks: 1. What is the best length of lead to give the valve of a steam engine? The cylinder is 14 inches by 20, making about 110 or 120 strokes per minute. The present lead is hardly one sixteenth of an inch. Many years ago, I had an engine of 2 feet stroke. The motion had to be reversed; and in doing so, the length of lead was changed from almost nothing to about one fourth of an inch. The engine ran much faster with the same steam. Would it improve my engine to give it more than one sixteenth of an inch lead? 2. I wish to case my boiler. Ought I to use anything besides the planking; and if so, what is best? Will the boards alone do? The boiler is on the locomotive set. Answer: 1. We think you should give the valve, if wet cold, about three eighths of an inch lead. Possibly you may have to try it at several points, before hitting upon the best position. 2. See our advertising columns for boiler covering.

J. S. M. asks: 1. What is the best way to filter the water after it has passed through a surface condenser? The steam goes in on the outside of the tubes, and water is pumped through the tubes by a circulating pump. The air pump is a fresh water pump, which pumps the water overboard; there are two plunger pumps, which take the water from the bottom of an air chamber on the air pump. There is a delivery on the air chamber close to the top. 2. Why is the delivery at the top of the air chamber? 3. How do pumps draw the water when it is so hot? 4. Does this condenser have tube heads besides the outside heads? 5. If there is a cut-off on an engine, is there any need of the main valve to do more than just cover the ports? Answer: 1. We do not think that it is necessary to filter the water. 2. Probably for convenience. 3. The pump will draw water unless the tension of the vapor is sufficient to overcome the vacuum that would otherwise be produced. Some pumps are fitted with relief valves, to allow the escape of the vapor when it exceeds a given pressure. 4. Yes. 5. It is not absolutely necessary, but it is sometimes convenient. You might find Auchincloss's "Link and Valve Motions," and Molesworth's "Pocket Book," useful. Much of the information you want can only be acquired by practice.

C. W. D. asks: 1. What is the difference in velocity of a body, for instance iron or lead, falling through air or through a vacuum; and is the rule for computing the velocity the same? 2. Can air be used as fuel? 3. You say in your answer to A. M.: "The specifications and drawings issued at the Patent Office are divided into classes, and those of any class are sent for ten cents," but you do not say who sends them, yourselves or the Patent Office. Answer: 1. In this calculation, the resistance of the air must be considered. 2. We think not. 3. In our answer to A. M., we said that the price of the specifications of any class was ten cents each. You must send to the Patent Office at Washington for them.

M. E. J. asks: 1. What is the rule for finding the number of pounds weight to hang on a safety valve lever, and the proper distance from the valve or fulcrum when the area of valve and number of pounds pounds pressure per square inch is known? 2. Will the number of pounds indicated by steam gage show the number of pounds per square inch in the boiler? Answer: 1. Box's rule is: If we have a 3 inch valve for 45 lbs. steam, and the effective weight (of valve and lever) on the center of the valve is 12 lbs., the distances from fulcrum to center of valve, and from fulcrum to position of the weight, being 3.25 and 19.5 inches respectively, or 1 to 6; then, the area of a 3 inch valve being 7.06, we have $(7.06 \times 45) - 12 \times 3.25 = 19.5$, or $(7.06 \times 45) - 12 \times 6 = 51$ lbs. 2. The steam gage, if in good order and properly set, shows the pressure per square inch in the boiler above the atmospheric pressure.

G. A. H. asks: Can sheet zinc be tinned? If so, what is the process? Answer: We presume it could be tinned by being placed in a bath of molten tin.

T. F. de S. asks: How can I anneal lamp chimneys? 2. What are carbon diamonds? Answer: 1. Place them in cold water, and heat it slowly to boiling point. Then allow it to cool gradually. 2. Carbon is supposed to be an element. It exists in crystallized and amorphous states. Soot or lampblack is a good example of amorphous carbon. Diamond is one form of crystallized carbon.

F. L. G. asks: What should be the dimensions of a pleasure boat, to use an engine and boiler of 4 horse power? What size and pitch should the wheel have? Answer: About 25 feet long by 5 feet beam; diameter of propeller 20 inches, pitch 2 feet.

V. G. says: A friend says that he has a common suction pump that on some days draws water 4 feet and upwards, perpendicularly. Isay that no such pump ever did or will do it. Answer: You are right.

W. E. says: I have a wash pipe 1 inch in diameter leading from a wash basin, having a common plug, and protected by the usual cross bars. The pipe is lead, and has become stopped by some object, I think a mouse. How can I clear it out without taking it down? Would oil of vitriol do it, without destroying the pipes? Answer: Use a solution of caustic potash.

W. B. G. asks: Are not conical bullets for Minié and other rifles made by punching, and how fast can they be made by the machines now in use? Answer: The machine in use at our arsenal was invented by a workman named Snyder, in the arsenal at Watervliet, N. Y. We think it makes about 40 bullets a minute, but are not quite certain. Some of our readers will doubtless correct us, if we are in error.

F. L. O. says: I have a 2 horse power engine working under 15 lbs. steam. The water in our hydrant pipe indicates 20 lbs. pressure; the engine is used only for 2 hours per day. Could I use the hydrant water instead of steam in my engine? I think the amount of water used is cheaper than coal. Answer: Probably you could not make the change, with the present arrangement of valves.

J. L. C. asks: What will produce a very bright permanent red color on leather, to be polished with a hot iron? Answer: Scarlet moroccoes and roans are dyed with cochineal.

G. B. G. asks: 1. How can I give a fine blue or rich brown color to small articles made from sheet steel? 2. How, also, can articles made from sheet brass be bronzed? Answer: 1. After the articles are tempered, polish them, and heat to color, over a spirit lamp, in a charcoal fire, or a lead bath. 2. See p. 331, current volume.

F. E. B. asks: What is the lifting power of a kite, the shape of which is an inverted isosceles triangle of 10 feet perpendicular, surmounted by half a circle of 6 feet diameter? Answer: We published on p. 331, current volume, a table of the force of the wind, at different velocities. Knowing the weight of the kite, and the direction which the wind has, you can calculate the lifting power.

M. F. asks: How can I make Babbitt metal? Answer: Melt 4 lbs. copper, add by degrees 12 lbs. best tin, 5 lbs. regulus of antimony, and then 12 lbs. more tin. After 4 or 5 lbs. of the last quantity of tin have been added, reduce the heat to a dull red and add the remainder.

C. S. A. asks: 1. How much power will it take to cut a plate of iron 1 1/2 inches thick? 2. What will be the effect of expansion and contraction on the bridge at St. Louis, Mo.? Answer: 1. The resistance of wrought iron to shearing is about 45,000 pounds per square inch, on an average. 2. The effect will probably be to raise and lower the crown of the arch a little, if the whole structure is rigid.

H. H. asks: What is the difference in cotton (between ordinary and middling, for instance), and how is it detected? Answer: The classification of different grades of cotton is made according to length and quality of fiber, and is expert work.

J. G. D. T. asks: Why is it that the sun and moon, when first appearing over the horizon, seem larger than when in the zenith? Is it owing to the peculiar condition of the atmosphere near the earth? Answer: Yes.

J. S. says: Chemistry teaches that, when a mixture of hydrogen and oxygen contains common air (probably nitrogen) it will explode when ignited. Therefore if the water for charging boilers were drawn from the bottom of a deep tank, the superincumbent column of water would weigh more than the air (or more than 15 pounds to the square inch) and all air would be expressed. I think that all surface ground water contains explosives in solution. In the tank containing water, there should be arranged some flat vessels containing alumina or the like combustible substance; then the explosives would be neutralized, the water being purified for that purpose. Answer: We believe that a committee of the Franklin Institute made experiments on this subject in 1837, and determined that explosive compounds, other than steam, were not formed in steam boilers.

P. T. R. asks: What is oil of citronella? Answer: Citronella is an oil procured by distilling the leaves of *Andropogon schenanthus*, which grows wild and very abundantly in Ceylon, whence this oil is chiefly imported.

P. P. says: In Culpepper's "Complete Herbal" there is mention made of a plant called Christ's eye, which of course is the vulgar or local name. What is the botanical name of that plant? Answer: You probably refer to the flower of the bush known as Christ's thorn, or *palmaria aculeatus*.

R. R. asks: Is the ocean level? How much higher is the city of New York than Liverpool? Answer: A level line is one that coincides with the general form of the surface of the earth, which is that of an oblate spheroid. The surface of the ocean would be level at mean low tide, were it not for the wind. As it is, the level varies in different locations. The difference between the level of New York and Liverpool, if any, is very slight.

A. G. P. asks: 1. What is carbon disulphide? 2. Can I make a liquid of transparent color to apply to the hands when bruised, so as to form a false skin? Answer: 1. Carbon disulphide is a compound of carbon and sulphur, made by passing the vapor of sulphur over fragments of red hot charcoal in a porcelain tube and condensing the gaseous product. It is also called sulphide of carbon, and sulphuretted of carbon, and bisulphuret of carbon. 2. Collodion is used for the purpose you mention. This is made by dissolving gun cotton, or pyroxylin, in a mixture of ether and alcohol. It will be better for you to purchase the collodion already made from a druggist, as its preparation involves skill and care, especially in making the pyroxylin, which, when dry, is an explosive substance.

L. S. Jr., asks: 1. Have the Bessemer steel rails given the satisfaction to railroad managers anticipated, cost considered, over a first class iron rail? 2. How does the silicon rail compare with the Bessemer in wear? Answer: 1. Yes. 2. So far as we know, very few rails made of the silicon steel have been laid down, and there has not been enough time to enable a comparison to be made.

D. B. P. says: I wish to run a woven iron wire cylinder in water, and to protect it from corrosion. Tinning does not answer the purpose, and galvanizing fills up the meshes. Can you suggest a remedy? The cylinder will be subjected to some wear. Answer: You might overcome the difficulty by constructing the cylinder of wire cloth with a larger mesh than you require, so that, when it is galvanized, it will be of the proper size. Or you might have the cloth made of galvanized wire in the first place.

B. and P. say: We have to use swamp water for our boiler; it forms a soft muddy scale, easily scraped off, but it has to be done often. What is the best thing to hold it in solution that it may be blown off? 2. Water collects in our steam heating pipe and, freezing, bursts, or cracks it. What is a good cement for the cracks? Answer: 1. Probably your best plan will be to filter the water, before it enters the boiler. There are feed water heaters in the market that are said to remove all impurities which are held in solution. 2. We expect the best plan will be to renew the pipe. But you might try a cement made of red and white lead and fine iron borings. Put this over the crack, cover with a piece of tin, and wrap strongly.

F. N. says, in reply to A. R.'s query in regard to the locomotive, that air can be pumped in the boiler to almost any pressure where there is power sufficient to draw the engine; of course the engine is reversed. I have frequently seen engineers oil their throttle valves by reversing their engines for a few seconds while rolling down hill just after tailowing the cylinders, when there was, perhaps, a pressure of 140 pounds of steam on the boiler. A. R. seems to think that the air would escape by the way it entered. The throttle valve prevents this by acting as a check.

T. B. J. says, in reply to L. W.: Brass can be stained a permanent dark brown by placing it in a mixture of iron scales 1 lb., arsenic 1 oz., muriatic acid 1 lb., and holding a piece of sheet zinc near it in the solution.

G. M. says, in reply to A. D., who asked for a remedy for snails other than salt: Put ashes with the seeds into the ground, or outside of them, wherever the snails may be found.

F. V. F. says, in reply to G. W. C.'s question as to two locomotives: If the wheels were of the same size on the two locomotives, it is evident that they would both reach the foot of the incline at exactly the same instant; but the wheels being of different diameters, it is equally evident that nothing can influence the relative motions of the locomotives on the incline except the friction of the two sets of wheels, which friction is found by experiment to be inversely proportional to their radii. Hence, since the radii of the two sets of wheels are to each other as 1/2 to 1, the friction being inversely proportional to the radii, we have S : L :: 1 : 1/2, in which L and S indicate the large and small wheels respectively. Also, in the case of the smaller wheels, in consequence of their making a greater number of revolutions during the descent than the larger wheels, the rods, shafts, links, etc., attached to them would move faster, and hence increase the friction. I conclude from these facts that, since the locomotive with the four foot wheels has a little more than 1/2 as much friction as the other locomotive, the last mentioned locomotive will arrive at the foot of the incline in a little less than 1/2 of the time that it takes the other to arrive there.

A. G. Jr. says, in reply to J. N. Q.'s query as to coloring photographs: An exact representation of any transparent leaf or plant of any color or shade can easily be made by obtaining direct from the leaf a carbon negative, then using tissue, of the color desired, for positives. You can obtain, from the following solutions and their admixtures, almost any shade of blue, green, yellow, and brown. Solution No. 1, to be used as a bath: Dissolve 2 ozs. lead in nitric acid, and evaporate to dryness. Then dissolve 2 ozs. of the resulting nitrate of lead in rain or distilled water, in a glass or porcelain vessel. In another, dissolve 2 ozs. of the ferricyanide of potassium (red prussiate of potash), mix the solutions, and filter into a suitable bath. Then float, upon this, either plain or albumen paper, and dry in the dark. Then use a paper, or carbon, or ordinary photographic negatives as J. N. Q. describes. After finding the proper time to expose (and a few experimental failures will soon do it), immerse in the following solution to make a dark green leaf: bichromate of potash 1/2 oz., perchloride of iron 1/2 oz., water about one pint. For red: sulphate of copper 1 oz., water 1 pint. For brown: weak solution perchloride of iron and a little sulphate of copper. For dark brown, more iron and less copper.

E. J. O. says, in reply to J. N. N.'s query as to a common house fly, surrounded by a kind of opaque vapor, after death: It is a mold or fungus, and is caused by the bite or sting of the mosquito. I have watched the combat, and the mold or fungus is deposited during and immediately following the death struggles of the fly.

W. E. H. says, in answer to W.'s question as to mensuration of circles: I use rules that are not given in school arithmetic books: To find the circumference of any circle: Multiply the diameter by 3 1/4 and divide by 2. To find the area of the same circle: Take 1/4 of the square of the diameter. Having the circumference, to find the diameter: Divide the circumference by 3 1/4 and multiply the quotient by 2.

J. C. S. says: "When our belts slip, we pour castor oil on them just in front of the pulley, and the effect is always satisfactory; we also use tanner's or neat's foot oil on the outside of the belts. We run the grain side of our belts next the pulley, preferring always to use, for our own purposes, large pulleys and long belts, keeping them soft and pliable, and having them loose as possible."

C. H. R. says, in reply to C. C.'s question on page 250, current volume: The answer is: 12,533 lbs. less friction, which in this case would be over 1/2, and also less an amount in proportion to the distance the pin for the sheaves is placed from the ends of the lines.

C. M. N. says that A. M. can solder brass to brass by taking a piece of the brass to be soldered and adding a little silver while melted in a crucible. One eighth part of silver will do, and it will melt just as the piece to be soldered begins to flow. Two parts brass and one of silver is a good solder for brass, iron or steel.

J. E. E. says, in reply to C. C.'s question on page 250, current volume: Disregarding friction (which will be about 1/2), the pressure on W will be 72,838 lbs., four times the power (less friction) given by the use of the four pulleys.

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

R. W. H.—Your specimen is tripoli, of value as a polishing material.

H. S.—The black material is carbonate of iron.

J. J. T.—Galena or sulphide of lead, a valuable ore of lead, consisting of lead 83 and sulphur 17 parts, the remainder being oxide of iron or other impurity, with sometimes a little silver. Lead is obtained from it by roasting in a reverberatory furnace, and smelting the residue with coal and lime.

M. E. B.—Nos. 1 and 2 are trap rock, of no value. No. 3 is trap with spangles of plumbago, and perhaps some galena, disseminated through it.

J. T. C.—No. 1 is a vein of trap, of igneous or eruptive origin. No. 2, hornblende. No. 3. This is possibly metalliciferous at some depth.

COMMUNICATIONS RECEIVED.

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

On River Navigation. By G. W. L.
On Sexadigitism. By W. T. R.
On Ecclesiastical Bickerings. By J. R. P.
On Insect Nests. By A. B.
On Snake Poisons. By T. J.
On Flying Spiders. By E. F.
On Water Gas. By A. A. H.
On the Proposed Great Telescope. By W. M.

Also enquiries from the following:

W. A. B.—S. E. N.—S. B. H.—J. P.—B. W. W.—J. C.—T. C. C.—O. S.—C. E. B.—J. W. P.—S. N.—A. L. B.—P. L.—J. M.—F. C. D.—J. A. V.—F. D. B.—J. P. L.—C. W.—M. F.—H. Z. T.—D. T. T.—J. M. S. Jr.

Correspondents who write to ask the address of certain manufacturers, or where specified articles are to be had, also those having goods for sale, or who want to find partners, should send with their communications an amount sufficient to cover the cost of publication under the head of "Business and Personal" which is specially devoted to such enquiries.

[OFFICIAL.]

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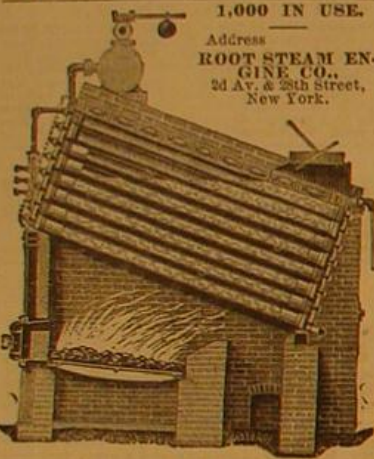


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