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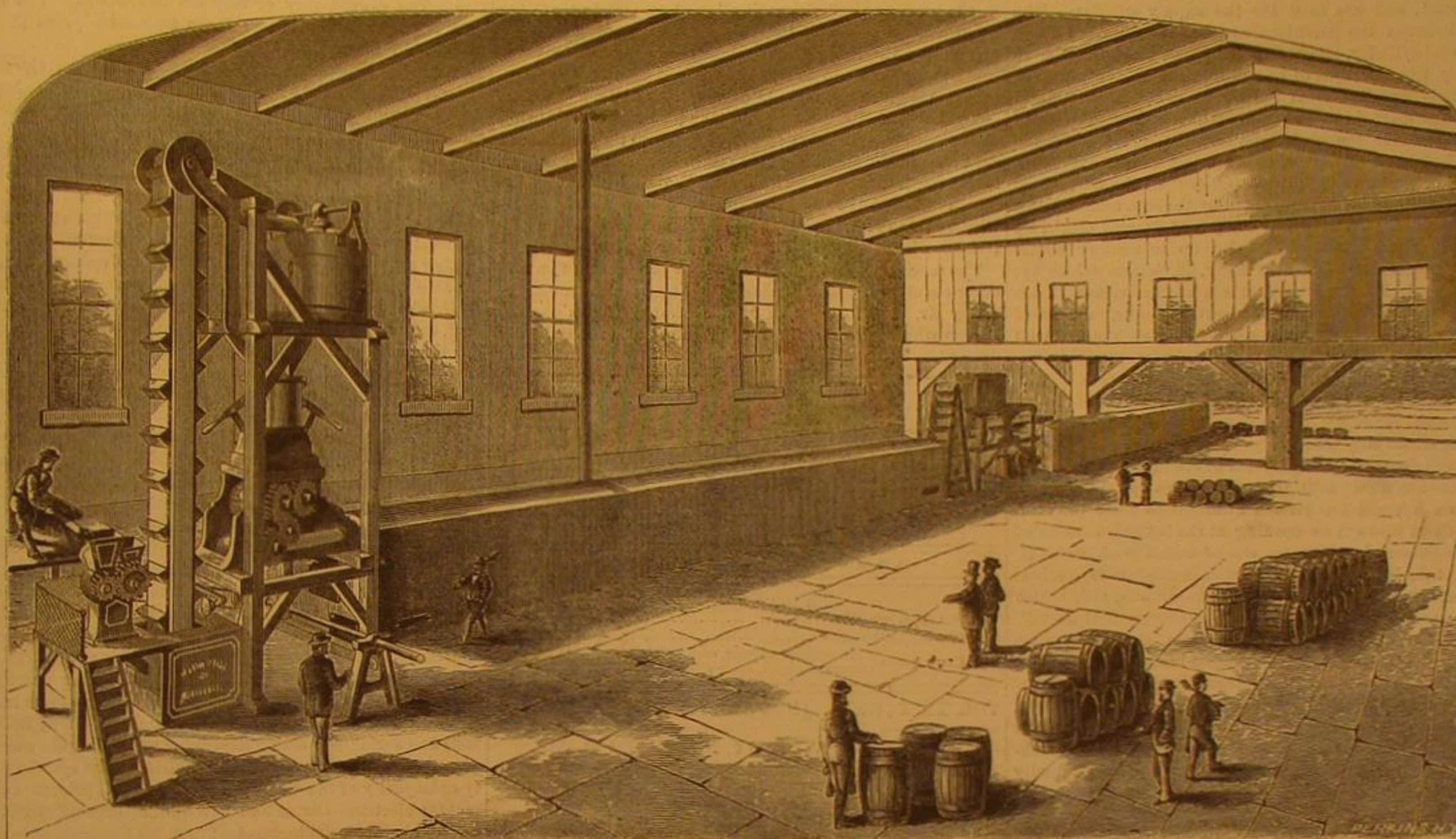


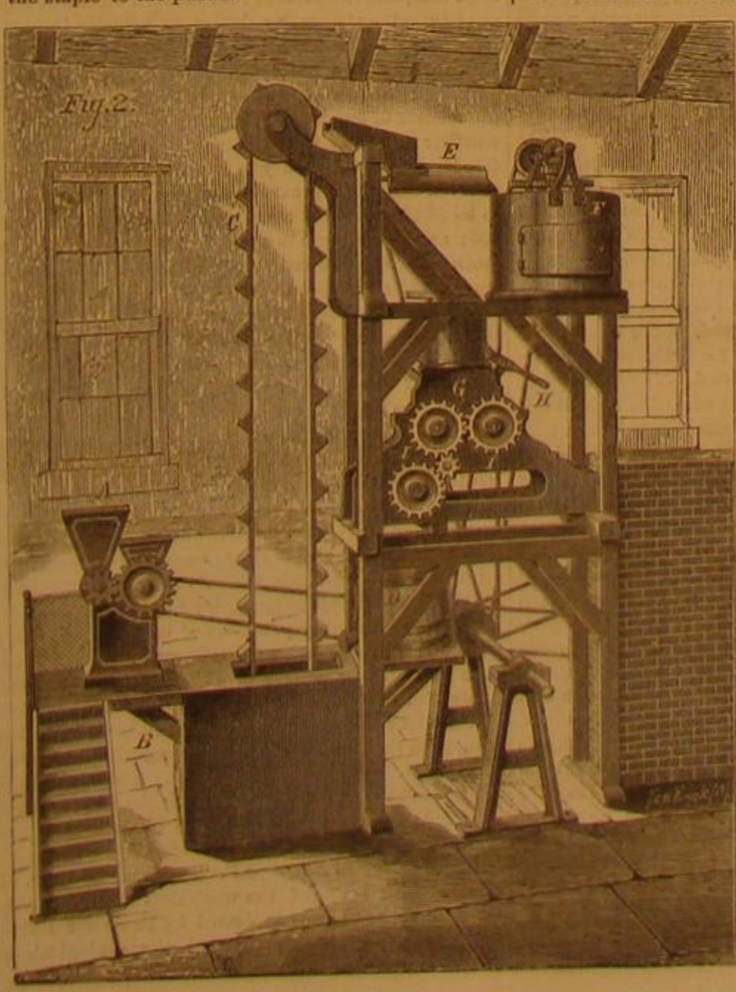
LOISEAU'S APPARATUS FOR THE MANUFACTURE OF ARTIFICIAL FUEL.

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 become 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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Contents.

(Illustrated articles are marked with an asterisk.)

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 topers. 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, meteoro 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 $\frac{1}{25}$ 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 spectroscope has proved that most of the nebulæ 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 tun, 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 tuns.

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 coöperate. 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, 10,042 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 hæmatodes*), or to microscopic vegetation (*oscillatoria rubescens*, *sphæroplea annulina*), and sometimes even to small insects, *entomostracæ* (*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 *medusæ*. Of these minute beings 64 have been found in a cubic inch, 110,392 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 coast 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 erythræum*. Pallas states that there exists in Russia a salt lake called Malinovoè 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 Montpelier, in France. The liquid 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 animalcule 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 access to the atmosphere, as is actually appears that respiration is absolutely necessary to their existence. Fig. 1 shows the monads (*monas Dunalii*) 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.

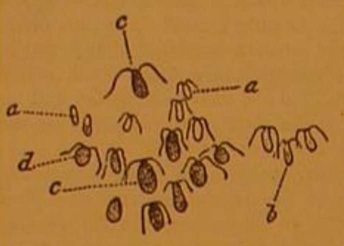


Fig. 1.

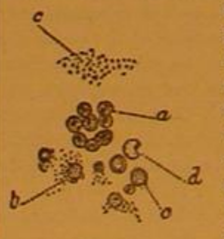


Fig. 2.

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

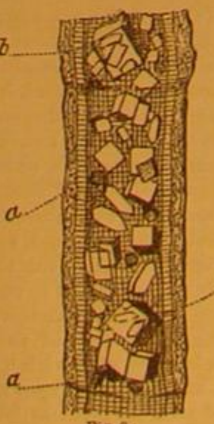


Fig. 3.

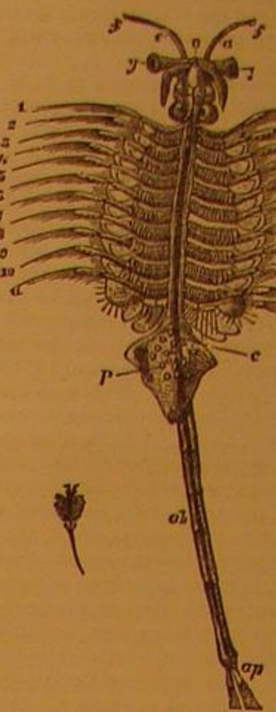


Fig. 4.

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 councilor, 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 burly 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.

POSTAL TELEGRAPH CARRIAGE.

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 machinery 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 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 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.

The Boiler Tests at Sandy Hook.

The experimental tests as to the cause of boiler explosions, made under the supervision of a government commission, the members of which we specified in our last week's issue, were inaugurated at Sandy Hook during the past week. Two marine boilers were used, one a small tubular, and the other a large low pressure generator, ordinarily known among engineers as a "lobster back."

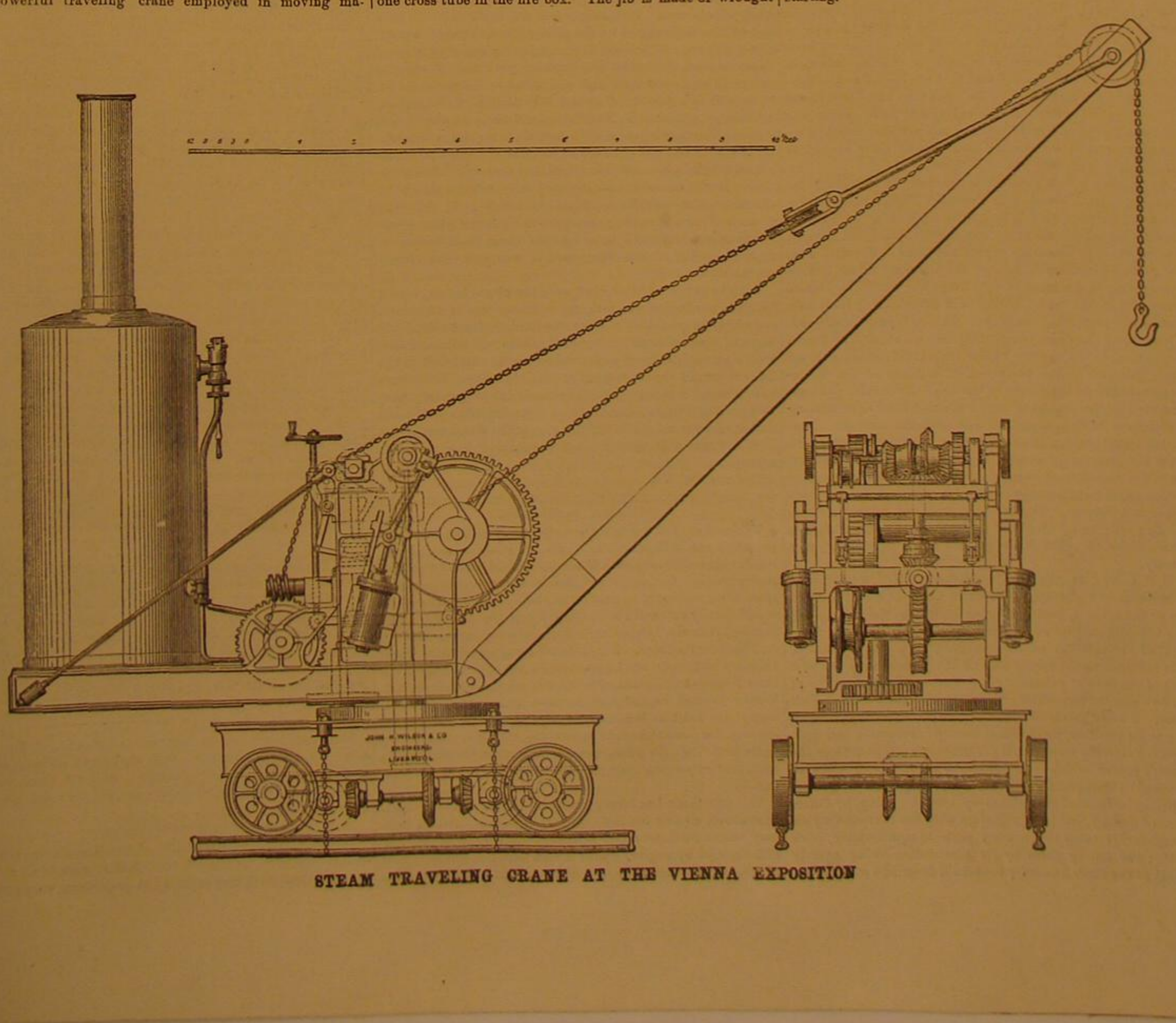
The small boiler was first tried, but, owing to leakage of the supply pump, there was a long delay which finally terminated in the collapsing of one of the tubes at a steam pressure of 54 pounds. The object of this experiment was to show that, with low water in the boilers, the plates become heated so that their strength of resistance is decreased. The pyrometer, placed below the boiler and near the fire box, showing that the steam in the upper portion of the vessel was superheated to 750° when the collapse occurred, 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.

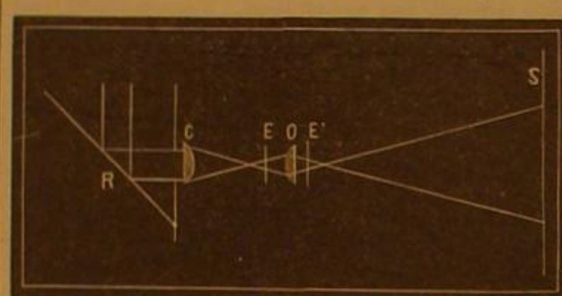
The Projection of Diffraction Phenomena.

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 eidotrope 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 eidotrope 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 eidotrope 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 eidotrope 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 of 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 develope 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 gage, 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 gage; 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 wi'l carry three tuns, 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 tunnage is considerable, it will be preferable to adopt a light engine of six or seven tuns, 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 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 tun 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 tun, the angle of friction would be forty-eight feet to the mile. And a horse exerting a power of 150 lbs. at 2¼ 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 tuns, giving 6 tuns 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 tun, as against $10 per tun 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-tyred 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 280°, 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 Munroe, 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 nebulæ 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 spectroscope 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 spectroscope, 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 spectroscope, 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 spectroscope, 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 spectroscope 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 spectroscope. 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 spectroscope 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 spectroscope. 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 experiments 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 spectroscope 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 spectroscope, solves the problem of quantitative analysis of bodies giving an absorption spectrum in the following way: The slit of the spectroscope, 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 spectroscope, 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 $\frac{1}{75000}$ of an inch in length; that of violet light, $\frac{1}{57500}$; that of blue, $\frac{1}{49500}$; red, $\frac{1}{39000}$; yellow, $\frac{1}{27500}$. 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 699,000,000,000 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 homœopathic; '*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 retouching, 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 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.

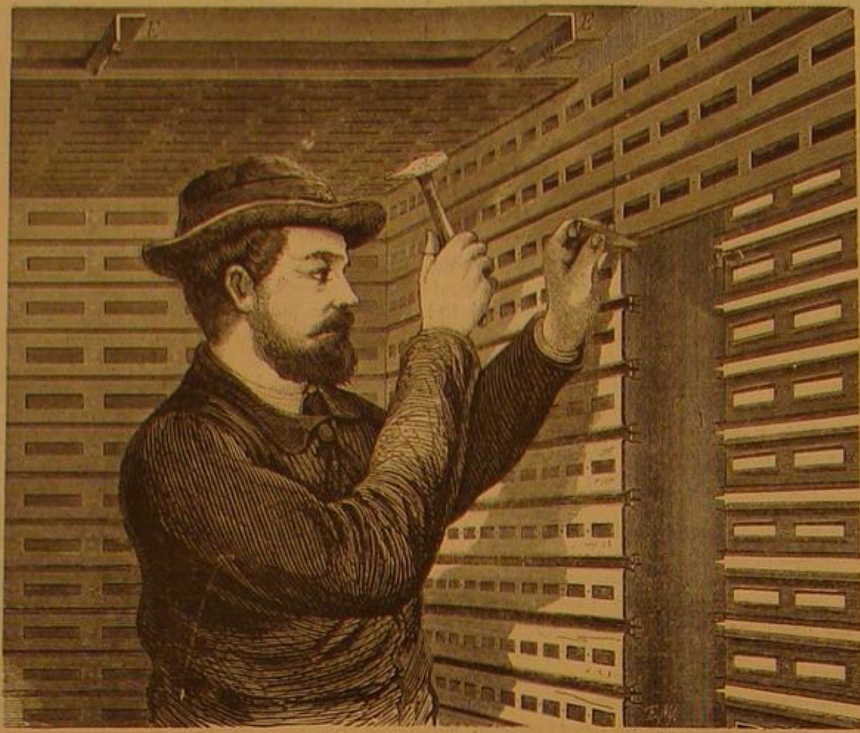
After the sixty thousand are printed, orders from advertisers and others will be executed, for any number of copies of the paper desired, at reduced rates. When writing for terms, state the number of papers wanted. The larger the order, the less will be the price per hundred or thousand.

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.



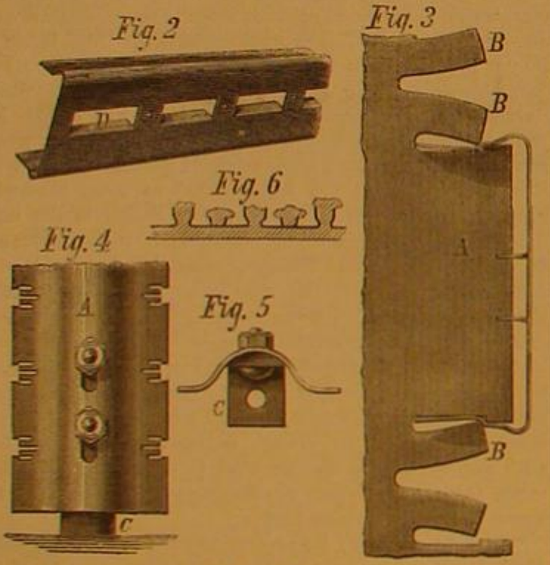
HOLMES' IMPROVED FIREPROOF CONSTRUCTION.—Fig. 1.

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.

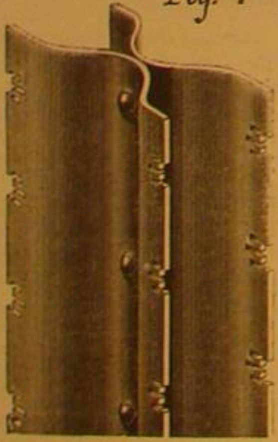
Fig. 3 is a full sized section of lath in position, with a side view of the perforated edge of the stud, A, showing the two tongues, B, by means of which the laths are fastened. A wedge-shaped tool is driven between the two tongues, so that they are bent outward, locking the edges of the laths firmly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



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.

Fig. 7



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.

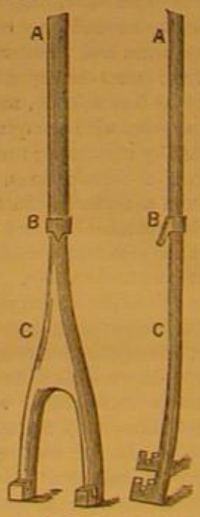
Further information, circulars, prices, samples, etc., can be obtained by addressing the inventor, Isaac V. Holmes, or The John Cooper Engine Manufacturing Company, at Mount Vernon, Ohio.

The Estimation of Phosphorus in Fatty Mixtures.

In order to separate phosphorus from articles of food, vomits, and other matters containing fatty substances, in 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 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 Monteratsch 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 hight (just beneath the surface), which serves as the vestibule to the caverns. At its extremity there is an opening about the hight of a man, within which there is a sharp descent over blocks of ice. From this point ropes and lights are needful. 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 hight. 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.

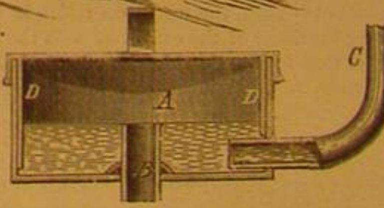
ANTHON'S SEWER GAS TRAP.

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, D, 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. GRUNER, 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 2,331° to 2,874° Fah. The heat of a hot blast iron furnace, for cast iron, is ordinarily reckoned at 3,002° Fah. Bessemer steel, according to M. Grüner, melts at 2,912° Fah. Siemens estimates the heat necessary in a furnace to melt steel as 3,600 Fah.

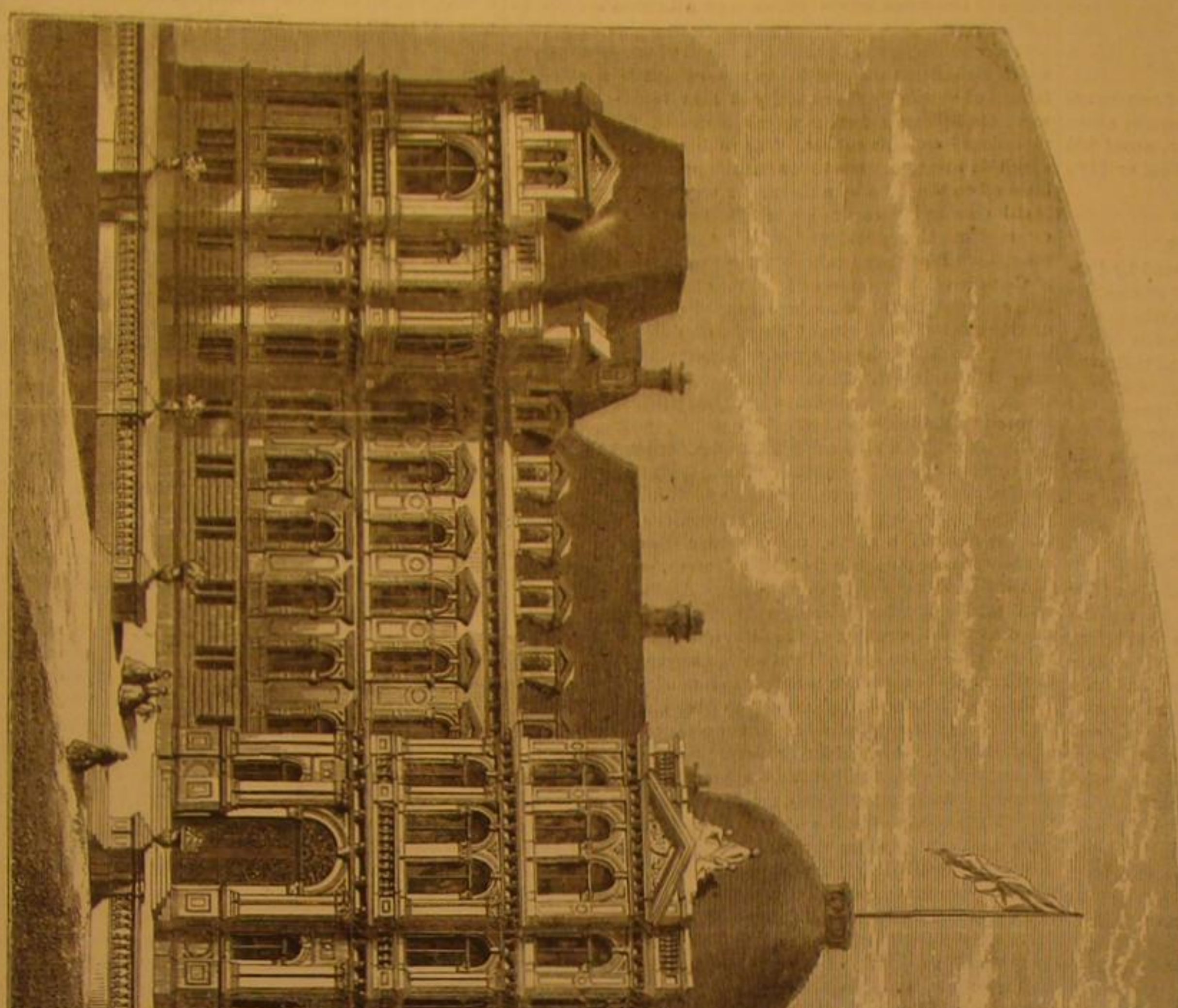
A MANSION AND MUSEUM COMBINED.

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 ground floor, in the center pavilion, is the entrance hall, 48 feet 6 inches by 40 feet, and 30 feet in hight, 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 fireproof.

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, 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.



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

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 $33,000,000, 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.

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 tun 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 tun 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 3,000 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 copper 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 tun 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

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 tuns of 5½ per cent ores, $76.96, equal to 3⅔ 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 sinusoidal 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 ampulæ 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 l, $\frac{1}{2}l$, $\frac{1}{3}l$, $\frac{1}{4}l$, 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 mammalia, 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 Professer 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 antennæ 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 antennæ 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 antennæ 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 antennæ 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 antennæ 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.

President Morton next explained his researches on the

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 petrolucene, 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. Dammer 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 Scio 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 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 tuns Bessemer steel rails,30,000 tuns railroad iron,and 50,000 tuns 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.
$1\frac{1}{4}$ inch	American	101,750
	English	76,500
$\frac{5}{8}$ inch	American	28,875
	English	19,000
$\frac{3}{4}$ inch	American	38,000
	English	26,000
$\frac{1}{2}$ 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 to have obviated 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 Defilement 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 defilement, 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 defiled 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 defilement 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 manufactured 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 defile 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. 6 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 whereby the runners of corn planters may be cheaply, conveniently and effectually bent into the desired shape; 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 salt 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 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 devices 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 Danforth H. Ainsworth, 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.

Hillery 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 cutting, 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 hight 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 home 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, Johnstown, 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 binding 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 gage 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 gage 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 fingers. As the machine moves forward the former is thrown into place and the fingers 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, confining 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 fingers. 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 Sheplar and Daniel Sheplar, Murraysville, 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 Cyclopædia 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., 202 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. Loiseau, Mauch Chunk, Pa.
BOAT TENT.—J. R. Adams, Oakland, Cal.
CUTTING CARDS.—V. E. Mauger, 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.
STOVE 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. Cockroft *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, 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 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 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 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 Vises to upset by hand. J. R. Abbe, Manchester, N. H.

Manufacturers of Flour Machinery, send circulars to E. C. Campbel, Millhiem, Center Co., Pa.

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

Sharps Rifles, $8; Box 1268, 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 $5.00. 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 Matcher and Planer on hand will please send a description of it with price to the subscriber, 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, 23 Cornhill, Boston, Ms.

Wanted—Set of Patterns for a Model Locomotive Engine; also, set for a Stationary Engine. Small size. Goodnow & Wightman, 23 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. Chalmers Spence Company, foot East 9th St., N. Y.

Brass Gear Wheels, 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. 621 North 24th Street, Philadelphia, to which No. please address all orders, &c. I. Carbutt, Manager.

Superior to all others—Limet & 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, 20 Platt Street, New York.

The New Elastic Truss presses uniformly all around the body, and holds the Rupture easy, night and day, till cured. Sold cheap by the Elastic Truss Co., 683 Broadway, New York.

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

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

Brown's Coalyard Quarry & Contractors' Apparatus for hoisting and conveying material by iron cable. W.D. Andrews & Bro. 414 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 paints as Boiled Linseed Oil. Price only 50cts. 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.

Belting—Best Philadelphia Oak Tanned. C. W. Arny, 301 and 303 Cherry Street, Philadelphia, Pa.

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

For patent Electric Watch-clocks, address Jerome Redding & Co. 30 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, 470 Grand Street, New York.

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

Just Published—"Workshop Receipts" for Manufacturers, Mechanics, and Scientific Amateurs. $2, mail free. E. & F. N. Spon, 446 Broome Street, N. Y.

Damper Regulators and Gage Cocks—For the best, address Murrill & Keizer, Baltimore, Md.

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

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

At American Institute and Chicago Exposition—Bentel's Unrivaled 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, Finishers, &c., 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 photometrical 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.

Answers to Correspondents

P. W. should read Noad's "Student's Manual of Electricity." See our advertising columns for books on mechanism.—A. D. W. will find a recipe for paste on p. 170, vol. 24.—B. J. will find directions for repairing rubber garments or boots on p. 155, vol. 26.—C. S. will find a recipe for glue impervious to moisture on p. 232, vol 29.—O. A. D. can mold India rubber by the method described on p. 232, vol. 29. Wood can be fastened to rubber with glue.—R. L. W. and J. E. R. should refer to p. 229, vol. 28, for a blackboard composition.—C. A. K. will find instructions for bleaching sponge on p. 279, vol. 28.—J. R. W. should read the article on p. 258, vol. 29, 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. 283, vol. 29.—J. C. should try the recipe for cement for meerschaum on p. 232, vol. 27, on his broken ivory. Read Lyall's "Manual of Geology."—C. H. S. should consult our advertising columns for books on mechanism.

C. A. T. asks: Which do you consider the most efficient wheel to be used for a flat bottomed boat with a sharp bow and a scow 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 ¼ inch internal diameter and exhaust pipe ⅜ inch internal diameter be large enough? 2. Would a boiler 20 inches long x 12 inches diameter x ⅛ 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? Answers: 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	0·025 area of piston.	0·040 area of piston.
250	0·032 " "	0·047 " "
300	0·039 " "	0·055 " "
350	0·046 " "	0·062 " "
400	0·053 " "	0·070 " "
450	0·060 " "	0·077 " "
500	0·067 " "	0·085 " "
550	0·074 " "	0·092 " "
600	0·080 " "	0·100 " "

The engine of our correspondent is to have a piston speed of $150 \times 4 \times 2 \div 12 = 100$ 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, then 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, 1873 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? Answers: 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 formulæ 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 agones, 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 426° Fah., 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 gearing, 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? Answers: 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 100 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 100 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 Bain'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? Answers: 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 subterraneous 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? Answers: 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, Schweinfurt 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 ocher 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? Answers: 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 Seidlitz powders? Answers: 1. Clean the bolt, heat it, apply nitric acid, and rub it on the solder. 2. Seidlitz powders are generally put up in different colored papers, white and blue. The blue paper contains 2 drams of the double tartrate of potassa and soda, and 2 scruples of bicarbonate of soda; and the white paper, 35 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? Answers: 1. Dissolve 2 drams of sal ammoniac and ¼ 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? 3. 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 hight, what proportion of applied power does a centrifugal pump require, as compared with any other pump? 6. How can I temper brass springs? Answers: 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 113, current volume. 4. We do not understand what you mean. 5. It depends on the hight to which the water is to be raised. Within certain limits, the centrifugal pump is 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 windmill is 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 oftener 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 is, 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? Answers: 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
4	0·079
5	0·123
10	0·492
15	1·107
20	1·968
25	3·075
30	4·429
35	6·027
40	7·873
50	12·300
60	17·715
80	31·490
100	49·200

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 6 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? Answers: 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? Answers: 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, crystaline 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 proportion? Answer: Vulcanization of rubber is effected by combining it with sulphur or the mineral sulphurets. The process is differently conducted in different manufactories. Caoutchouc combines with from 12 to 15 per cent of sulphur, and vulcanization can be affected 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 120° Fah.

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. says: 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 and 3. Professor Page, in 1850, constructed an electro-magnetic engine, of between 4 and 5 horse power, which was exhibited at the Smithsonian Institute. 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 subnitrate 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 hight 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 180° 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 x 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 *mucor mucedo*. It belongs to the same family of parasitic plants as *penicillium glaucum*, *puccina graminis*, *cephalo-sporium* 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 present 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 alnifolia* of Linnæus. 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 whereat to study architecture? Who makes heavy spiral springs? Where can I get headstocks for lathes? Makers of the above articles will probably promote their interests by advertising, in reply, in the SCIENTIFIC AMERICAN.

[OFFICIAL.]

Index of Inventions

FOR WHICH

Letters Patent of the United States

WERE GRANTED FOR THE WEEK ENDING

October 21, 1873,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

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Bag holder, N. A. Geisinger	143,897
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Dental instrument, I. A. Salmon (r)	5,623
Desk, school, C. J. Higgins	143,760
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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.—PLANING MACHINE.—S. S. Gray. January 7.
26,906.—STITCHES.—A. F. Johnson. January 7.
26,911.—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.

25,871.—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.

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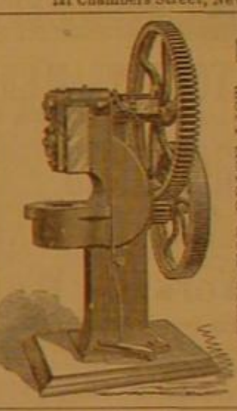

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