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RECENT PROGRESS IN ELECTROMAGNETISM.

Much ingenuity has been wasted upon the problem of converting electricity into mechanical force; or, in other words, of constructing electromagnetic engines destined to drive machinery, to raise weights or to draw loads. Hundreds of such engines have been made, only to demonstrate the conclusion of scientific men, who have long ago given up the problem as incapable of a practical solution. It is not difficult, indeed, to show by a very simple calculation that, in the present state of science, the electromagnetic machine can never compete with the steam engine, because of its far greater cost. The force in the former is derived from the oxidation of zinc in the battery, while that of the latter is due to the oxidation of the carbon in the coal burned under the boiler. Now, 1 gramme of carbon burned will raise the temperature of 8,080 grammes of water 1° centigrade, while 1 gramme of zinc will only raise 1,300 grammes to the same extent. Thus carbon would seem to be 6·2 times as effective as zinc. After the oxidation of the zinc in the battery, the solution of the oxide in the sulphuric acid produces an additional quantity of force (or heat) capable of raising 335 grammes more, which must be added to the 1,300 grammes; from this, however, must be deducted the force wasted in decomposing the water in the battery, a force capable of raising 1,060 gramm es of water 1° centigrade. The balance, 575, is 14 times less than the effective force of coal, and yet even this comparatively small amount of force is only attainable in the theoretically perfect battery. Taking into account that coal is about 40 times cheaper than zinc, the odds are 40 times 14, or 560, to 1 against the electromagnetic machine.

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

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

In December, 1858, the electric light was employed for the first time in the illumination of lighthouses, at the South Foreland, England. The magneto-electric machine used was constructed by Professor Frederick H. Holmes. The following April a favorable report was made on the invention by Faraday, who thus had the satisfaction of seeing his discoveries productive of good to mankind. The first permanent electric light was not established, however, until June 6, 1862, at Dungeness. Holmes' machine consisted of 120 permanent magnets, each weighing 50 pounds, arranged on the periphery of two large wheels. A three horse power steam engine revolved 160 soft iron cores surrounded by coils of wire near the poles of the magnets about 100 times a minute. The negative and positive currents were thrown in one direction by means of a commutator, and then conducted through thick wires into the lighthouse tower where they terminated in carbon points, between which the electric arch was formed. The intensity of the electric light, as measured by Fizeau & Foucault, is only 2½ times less than that of the sun; while its cost as compared with the Fresnel lamp then in use was computed to be as 400 to 290.

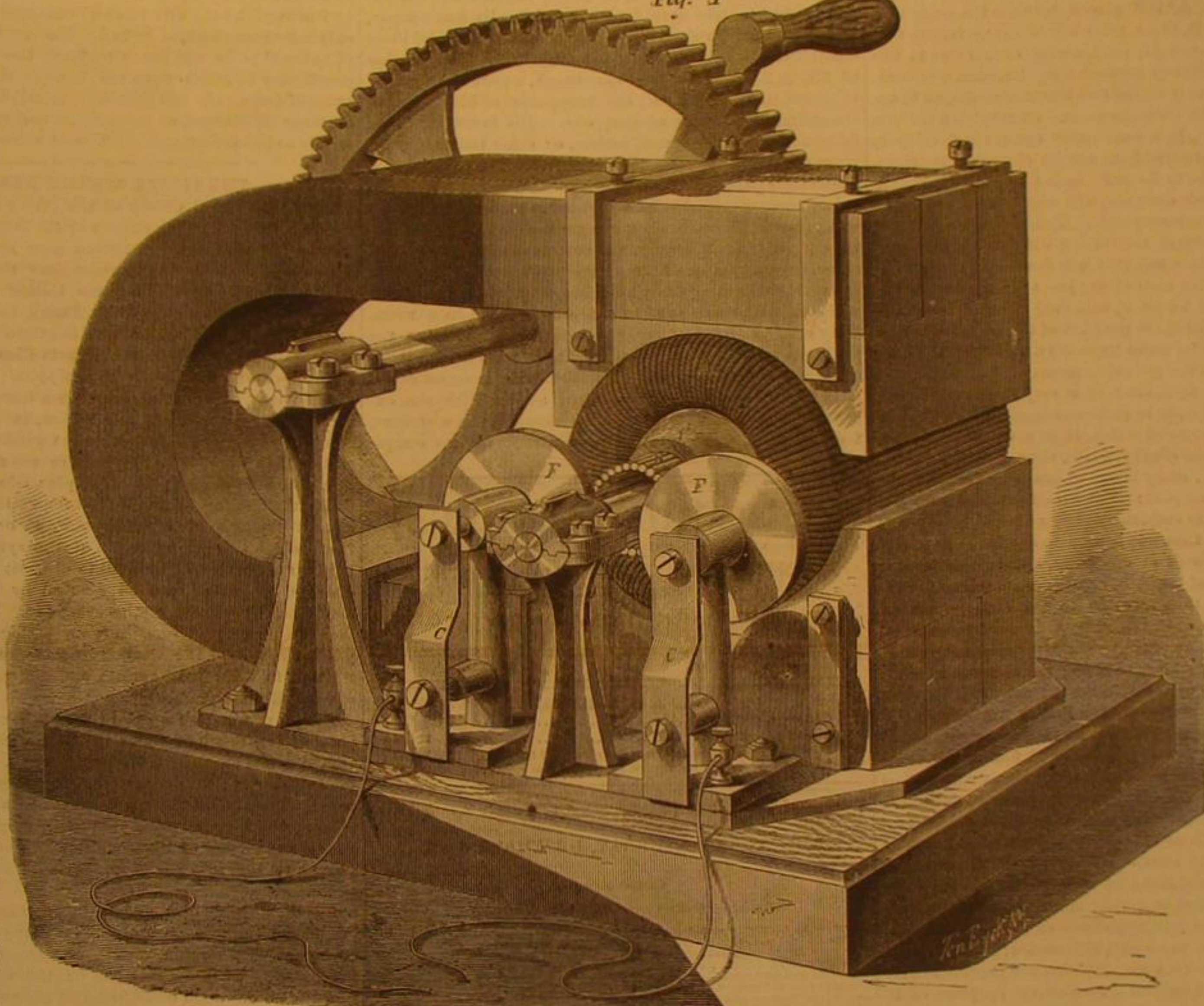
A considerable improvement was made by Wilde, who conceived the idea of causing the current induced in a coil of wire by a permanent magnet to produce a more powerful electromagnet, which in turn was to induce a new and greatly increased current. The current thus generated could be passed around a third magnet, and so on indefinitely, as far as theory was concerned. In practice, however, he found it most advantageous to limit himself to three magnets. When the three armatures of these magnets were driven with a velocity of 1,500 revolutions a minute, it melted a cylindrical iron rod 15 inches long and ½ of an inch in diameter, which was placed between its poles. With gas carbon points half an inch square, the light generated was equal to 4,000 wax candles. This machine weighed about 3 tuns, and required a seven horse power engine to drive it.

In his latest and most perfect form of machine, completed last June, Wilde employs two wheels of 16 electromagnets each, between which are situated two series, each of 16 soft iron armatures secured to a heavy cast iron disk. The ends of the cores are terminated with iron plates of circular form, which retain the helices in place and somewhat overlap the distance between the poles of the electromagnets. By having the magnetic circuits of the electromagnets and armatures closed for a short distance, and by likewise having the electric circuits closed for a brief interval at the point of no current, the magnetic intensity of the electromagnets is maintained during the rise and fall of the magneto-electric waves transmitted through the helices. These helices are divided into 8 groups of 4 each; one of these groups produces the minor current for the circle of electromagnets, and the rest are joined together for a quantity of 7 and an intensity of 4, to produce the major current of the machine.

This machine weighs only about one tun, while its power is double that of the 4 tun machine described. It may be run at a speed of 300 to 1,000 revolutions per minute.

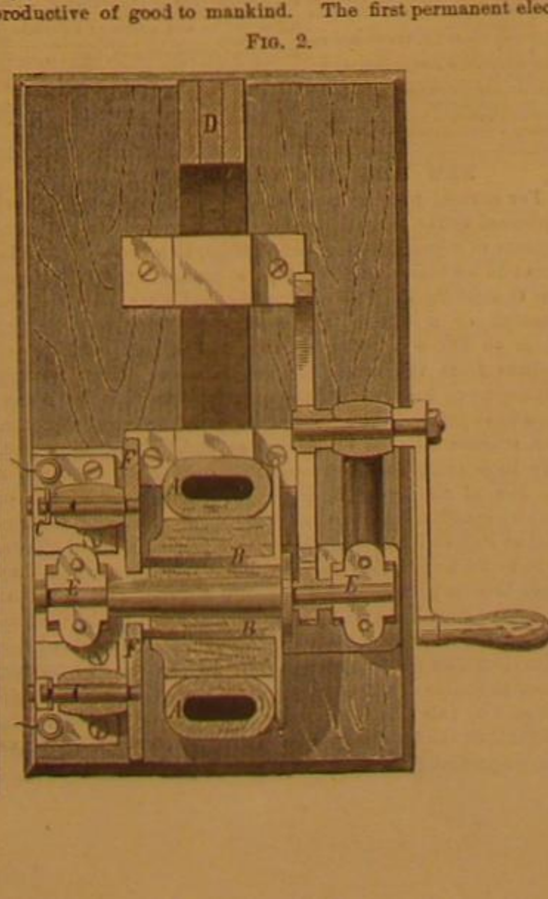
The Wilde machine is in operation in this city for plating purposes, at Frank Leslie's printing establishment. The machine runs with a velocity of 1,800 revolutions a minute, and will electrotype a number of plates as large as the Illustrated Newspaper in 20 minutes. Wires are also connected with the

Fig. 1



GRAMME'S NEW ELECTRIC LIGHT MACHINE.

FIG. 2.



machine, which lead to the photographic establishment across the street, and on cloudy days they print photographs by means of the electric light produced by the Wilde machine.

The results obtained by these machines and by subsequent modifications certainly leave little to be desired; but the machines themselves, unfortunately, have inherent defects. The currents produced are intermittent; at each revolution, two electrical pulses proceed in one, and two in another, direction. To collect these, a friction commutator is necessary, which wears away very fast. In Holmes' original machine it only lasted from 10 to 20 minutes; and in the later machines, in which over 1,800 revolutions per minute are obtained, there must necessarily be considerable wear and tear wherever there is a metallic contact of moving parts.

These difficulties have been overcome in a machine invented by M. Gramme, of Paris, and recently exhibited before the French Academy of Sciences by M. Jamin. Our engravings illustrate the invention. The principle is as follows: If the north pole of a permanent bar magnet be moved along a soft iron bar surrounded by an insulated wire, it will produce a south pole in the iron bar, which will gradually be displaced from one end of it to the other, following the motion of the bar magnet. The result is a continuous induced current in the surrounding wire. If, now, the soft iron bar be made into a ring, A, and placed between the poles of a horse shoe magnet, D, these poles will of course induce currents in opposite directions, neutralizing each other at two points of the ring, midway between the poles, exactly (according to Mr. Crookes) as if we had two batteries connected in opposition by joining their similar poles. On revolving the iron ring on the journals, E, a continuous current is developed, as in the case of a straight bar, but in opposite directions, because here we have to do with both poles of the exciting magnet. Both these currents will continually neutralize each other at the two mean points. To utilize them, all that is necessary is to connect conducting wires to the insulated wire at the mean points, and they will flow along these wires instead of neutralizing each other; just as in the two batteries above, connecting a disk, F, with each point of contact of the similar poles, will cause the force of the batteries to flow through the conducting wires "quantity-wise." M. Gramme accomplishes this in the following manner:

If the wire wound upon the ring is very thick and there is but a single layer of it, it is sufficient to remove the insulating covering at some point which, in its revolution, is made to touch fixed metallic conductors, F, situated at the neutral points. If, however, many layers of fine wire are used, the following device is adopted: The wire is divided into sections of, say, 300 turns each, there being no break, however, in the wire on passing from one section to another. Each section has its wire exposed at one point, and to this point is soldered a solid bar of brass, B, capable of considerable wear and tear. The bars thus attached to the sections are arranged radially; and when the ring, A, is revolved, several of them simultaneously touch two solid metallic rubbers, F, at the neutral points. More than one bar is made to touch at a time to prevent any break in the current.

The machine exhibited before the French Academy of Sciences derived its magnetism from an electromagnet instead of a permanent one. It was provided with four metallic rubbers, two of which supplied the electromagnet with a part of the current generated. The machine started with the feeble residual magnetism in the electromagnet, which rapidly gained in strength as the velocity increased. A machine of this kind, having 15·4 lbs. of copper wire 0·118 inch thick, decomposes water and fuses 1·04 inches of iron wire 0·036 inch thick when worked by hand. A large machine, driven by a 2½ horse power engine, which was exhibited in London, produced a light equal to about 8,000 candles; and still larger machines are being made, which Mr. Crookes expects to give a light equal to 25,000 candles. Besides the purposes of illumination, such machines, of the smaller sizes, will be of service in telegraphing, electroplating, gilding, medicine, military operations, and chemical decompositions. They are of especial value in electroplating, on account of the constancy of the current. In the galvanoplastic works of M. Christofle, of Paris, it is found that the best machine hitherto known, when moved with a velocity of 2,400 revolutions per minute, only deposits 5·465 ounces troy of silver per hour, while a smaller Gramme machine deposits 9·645 ounces troy of silver per hour with one eighth the velocity.

There will be two of these machines in this country before long, Professor Barker having ordered one for the Stevens Institute of Technology, and one for the University of Pennsylvania. At present electroplating is done in this city in several places by the Wilde machine.

It would be difficult indeed to foresee what further increase in power may yet be obtained in these machines; for investigators are constantly studying the properties of magnets and the means of augmenting their strength.

M. Ruhmkorff, to whom science already owes so much, still continues his experiments in electricity and magnetism. He has presented the following facts to the French Academy of Sciences:

If a bundle of iron wires, covered with thick copper wire giving passage to an intermittent current from a battery, is then wrapped with fine wire for the purpose of obtaining an induced current, that current will have more than double the usual intensity if we wrap the fine wire around the middle of the bundle, where there is no magnetization, instead of wrapping it near one of the poles. He concluded from these premises that he could get still more powerful effects by making a continuous ring of his iron wires, which would then present no poles; but in this he was disappointed, for the induced current gave a spark only 0·1 inch long. On cutting the ring, the spark at once increased to 0·2 inch, although the cut ends came together the moment they became magnetic.

On keeping the ends apart with a plug of wood 0·2 inch in thickness, the spark reached the length of 0·6 inch. With thicker plugs of wood, no further change was produced. It still remains to be seen what practical application can be made of this fact.

Jamin, in studying the magnetism of thin steel plates, found, by magnetizing plates of various dimensions and superposing a number of similarly magnetized ones, that he could construct magnets carrying twenty times their own weight. The thinner the superposed magnetized plates, the more powerful the resulting magnet. His researches will probably reveal the law according to which magnets, having a minimum weight and a maximum carrying force, may be constructed.

It seems, too, as if we were rapidly approaching the solution of the problem of an electrical illumination for our streets and houses. The difficulties hitherto have been: that it is impossible to regulate the intense brilliancy of the electric light, which would be blinding on the street, and of course utterly unfit for lighting our houses; that it is not continuous, but requires the frequent renewal and adjustment of the carbon points, involving expense and complicated apparatus for each lantern; and finally that a separate source of electricity is required for each lamp. All these difficulties are said to have been obviated by the invention of Mr. A. Ladiguin, of St. Petersburgh, which was recently exhibited by Kosloff & Co., the proprietors of his patent, in the Admiralty House of that city. His invention is as follows: Only one piece of carbon, or other bad conductor, connected with the magneto electric machine is placed in a glass tube exhausted of air, filled with some gas which will not combine with carbon at a high temperature and hermetically sealed. The carbon becomes gradually and equally heated, and emits a soft, steady, and continuous light. One machine, driven by a small three horse power engine, is said to be capable of lighting many hundreds of such lanterns, which will burn under water and in mines as well as in a room. They are free from any danger of explosion, and have the additional advantage, over gas, that they emit no poisonous evaporations detrimental to the health. The inventor calculates that these lamps can be lighted at one fifth the expense of coal gas. If this invention should prove a success, few consumers will mourn the disappearance of gas companies.

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(Illustrated articles are marked with an asterisk.)

NEW YORK AND THE CENTENNIAL.

For several months past extended advertisements have appeared in the journals of this city, announcing a projected scheme of a grand national exposition, to be permanently located in elaborate buildings, in a prominent locality near the Central Park. The originators, last year, obtained the passage of a bill in the State legislature, authorizing them to ask a subsidy of two and a half millions of dollars from the municipal government. After hearing argument on both sides of the question, the Board of Aldermen have refused the appropriation; and as a consequence, the scheme may be considered as indefinitely postponed. We have remarked, however, that during its existence a portion of the press have sought to engender a kind of rivalry between this plan and the coming National Centennial at Philadelphia. In view of the present state of affairs, it is to be hoped that any feeling of jealousy which may have become prevalent will speedily die out, and that the people of New York will render that support to the Centennial which the enterprise justly deserves. The quota of this State is $1,036,600, which it is proposed to raise by issuing stock in shares of $10 each, paying six per cent interest, and secured by sale of tickets, concessions for advertising, etc., and sale of the building—making the investment, as far as can be predicted, a safe and, probably, profitable one.

An immense amount of labor has been accomplished by the Centennial committee, and, from all accounts, the work is progressing rapidly and well. The people of the southern and western States are manifesting no small amount of interest in the scheme, and State and county associations are forming for the purpose not only of raising funds but of securing the most complete possible exhibit of resources and products. A very liberal appropriation has been made by Pennsylvania and the city of Philadelphia, and we understand that still further assistance is contemplated in order to add improvements to Fairmount Park, the site of the exposition buildings. In fact the country has abundant cause to congratulate itself on the favor with which the plan has been received abroad, and the enterprise with which it has thus far been conducted at home. Uniform and flattering success, we might say, has been encountered, were it not that several of the States have manifested a dilatoriness in affording support, which cannot but prejudice the general progress of the undertaking.

The citizens of New York should remember that the selection of the plan of buildings from drawings submitted by Messrs. Vaux & Bedford, a prominent architectural firm of the metropolis, is quite a compliment to the city, yet to be returned; and moreover that their local interests cannot but be furthered by the attraction of immense crowds to a point only four hours distant by rail. The matter is, besides, one of national pride, and hence we trust the patriotism of the people may be relied upon not to allow the Centennial, in point of magnitude and grandeur, to fall below previous exhibitions in Europe, or to prove so unfortunate a financial failure as the recently closed Vienna show.

THE SIGNAL SERVICE REPORT.

The Chief Signal Officer of the Army has recently submitted a very gratifying exhibit of the labors of his bureau during the past year. Thirteen new stations have been added, so that at the present time there are seventy-eight points of observation in the United States, eleven in Canada, and three in the West Indies, the latter being located at Havana, Kingston, and Santiago de Cuba. Three other stations, on the islands of Porto Rico, Guadaloupe and Barbadoes, will also shortly be equipped.

Some very excellent arrangements have been completed for securing to farmers and others, in communities not reached by telegraph, information as regards probable weather earlier than would be afforded were the reports delayed by publication in newspapers. The plan adopted has been to divide the territory of the United States into districts, each district having a distributing point, at or near the center, from which two printed copies of the synopsis and probabilities are forwarded by mail to all post offices within the districts, or which can be reached by sail, steamer, or mail coach by 4 P. M. of the same day. The bulletins are then conspicuously posted in the receiving offices, and 8,982 printed copies of the weather report are thus daily distributed to 4,491 post offices; and the plan thus far has worked admirably.

There are nineteen special river stations from which reports of the depth of water in the principal rivers of the United States are daily made by telegraph, at particular seasons during which danger from freshets may be anticipated. Twenty of the regular stations also furnish river reports, which are of great value as giving constant and accurate knowledge of the condition of channels, and thus adding to the safety and convenience of our river commerce.

For the purpose of studying the phenomena of the upper portions of the atmosphere, stations have been established on Mount Washington, N. H., on Mount Mitchell, N. C., and quite recently a third one on the summit of Pike's Peak, at an elevation of 14,216 feet above sea level.

One of the most valuable additions to the system, which has been made during the past year, is the establishment of a chain of life-saving stations along the Atlantic coast. Signals visible for some distance at sea, serving to warn vessels of probable bad weather, are to be displayed from points twenty-five miles apart from Sandy Hook to Cape May, and it is intended to continue the construction of suitable telegraphic communication along the dangerous coast of Virginia and North Carolina. Without doubt, these points of observation will be of great benefit. They will serve as meteorological stations from which information of the condition of the weather at the sea level can be transmitted; as sites for lighthouses and life boat deposits; as videttes in time of war, to give warning of the approach of an enemy's fleet; as a means of communication with vessels cruising along the coast; and as positions of display of cautionary signals, as already noted.

With reference to international exchanges of meteorological information, General Myer refers to the proceedings of the recent Weather Congress at Vienna. The proposition was adopted, by a unanimous vote of that body, that at least one uniform observation of such character as to be suitable for the preparation of synoptic charts should be taken, and recorded daily and simultaneously at as many stations as practicable throughout the world. It is also stated that arrangements have already been made with Prussia and Turkey to commence, on January, 1874, the exchange of one daily report, taken simultaneously throughout those countries and the United States; and the coöperation of other nations in the system is expected.

THE Chinese coal fields occupy an area of 400,000 square miles. Both bituminous and anthracite coal are found of good quality. In immediate proximity to the coal, large deposits of iron ore occur.

RECENT EXPERIMENTS WITH DIAMONDS.

Diamonds are rather costly objects to subject to destructive experiments on any extended scale, and not many investigators have been favored with the privilege of doing it. Thanks, however, to the liberality of the proprietor of a large diamond-cutting establishment in Amsterdam, a certain M. von Baumhauer has been permitted to make numerous studies of the behavior of these interesting gems when subjected to high temperature under various conditions, thus adding largely to our knowledge of the diamond's nature and properties.

The combustibility of the diamond in oxygen was demonstrated long ago; what the effect of pure heat upon it was remained a matter of doubt. Some experiments seemed to show that at extremely high temperatures the diamond is slowly converted into coke or graphite, an effect observed especially when the gem is subjected to the energetic action of a powerful galvanic battery. In certain experiments, in which Moren and Schrötter raised diamonds to the highest heat of a porcelain furnace, care being taken to prevent contact with air, a slight discoloration of the surface was observed, whether due to heat or imperfect protection against oxygen could not be decided positively. Inclosed in a bit of hard coke, and placed in a plumbago crucible packed with charcoal powder, diamonds operated on by Siemens and Rose withstood, without the least change, the temperature at which cast iron melts. A cut diamond, under similar conditions, subjected to the heat of molten wrought iron for a considerable period of time, was superficially blackened, but otherwise unaffected. By some this experiment has been interpreted as implying the slow conversion of the diamond to graphite at the temperature at which wrought iron melts. It is possible, on the other hand, that the change was due to air in the crucible: indeed probable, in view of the experiments more recently made by M. von Baumhauer.

By an ingenious device, the last named experimenter was able to subject diamonds, surrounded by an atmosphere of dry hydrogen, to a temperature at which both diamond and platinum holder became invisible; but with uncolored diamonds, their transparency and brilliancy were not in the least affected. Heated in contact with air, diamonds were not only blackened, but reduced in weight, showing positive combustion. In oxygen they burned with a vivid incandescence at a temperature below white heat. In a crucible which allowed the combustion to be observed through a sheet of mica, the burning diamond was seen to be surrounded by a white flame, less bright without and tinged with violet on the outer edge. Pure diamonds burned tranquilly, retaining their sharp edges even when so reduced as to be visible with difficulty. Impure specimens snapped and flew.

Burned in an oxyhydrogen flame, capable of melting platinum, diamonds emitted a brilliant light and wasted rapidly, but did not blacken. Heated to a high temperature in an atmosphere of carbonic acid, they were slowly consumed, decomposing the carbonic acid, and combining with its oxygen with loss of weight. Similarly treated in superheated steam, no effect was produced, showing that at white heat the diamond does not decompose water, as might be expected from its affinity for oxygen. In regard to the supposed transformation of the diamond into coke or graphite by means of pure heat, especially by that of a battery of 100 Bunsen elements, M. von Baumhauer is very doubtful. It should not be admitted, he holds, until the effects observed are proved to be not the result of chemical action, produced by foreign matter, or by the transmission of particles of carbon from the charcoal poles to the surface of the diamond.

The effect of heat on colored diamonds is more pronounced, with the exception, perhaps, of gray and yellow gems, which appear to resist such action, the same as the colorless ones. Green diamonds are variously affected. One of a dirty green tint was changed to pale yellow, with a slight increase of its transparency; but its brightness remained the same. Another, so green as to be almost black, likewise retained its brilliancy, but gained in clearness, while its color was changed to violet. A light green gem lost its color entirely, but was otherwise unaffected. Brown diamonds lost most of their color, showing under the microscope a limpid field, scattered with black spots. A diamond almost colorless assumed, under the influence of heat (out of contact with air), a deep rose color, which it retained some time when kept in the dark. In the light its color faded, but always returned again with heating. A naturally rose colored diamond reversed the phenomena, losing its hue with heating, and afterwards gradually regaining it.

PHOTOGRAPHY OF THE INVISIBLE.

The grand moral idea which science continually seeks to impress upon her votaries is, humility of mind; that inestimable virtue whence spring the noblest pleasures of the soul. But how rare it is to find this beautiful quality, even in persons of culture and learning! The great doctors looked upon Galileo with contempt, confined him in prison as a dangerous man, and subjected him to the most ignominious treatment, simply because he presented, for their acceptance, the light from a new idea, which their dull perceptions were unable to appreciate. He affirmed that the sun did not really rise or set; that it was the rotation of the earth that brought day and night alternately upon the earth. But the doctors, like many in our day, proud in their own conceit of knowledge, knew better. "The scriptures tell us," they said, "of the rising and the setting sun; therefore it moves; our own eyes assure us of the fact; the diurnal experience of mankind confirms the truth. Your doctrine, Galileo, is false and dangerous."

It is in this style that some persons, very knowing in their own esteem, reason upon certain subjects. Take "spirit photography" for an example. They allege that spirits are invisible; that an invisible thing cannot be photographed; therefore the so-called spirit photographs are base impostures.

It is not our purpose to dissent from the conclusion here assumed; but we take exception to the premises, which are not in agreement with science. Photographs of some objects that are invisible to the human eye may undoubtedly be produced. The spectrum of solar light is an example, portions of which, totally invisible to the eye, are brought out upon the photographer's plate; and their presence is also demonstrated by other instruments.

The mental effect which we term light is supposed to be produced by the beating of waves of ether against the retina of the eye. These waves enter the eye with an average velocity of about 186,000 miles in a second, the length of the waves being variable, from the one twenty-seven thousandth part of an inch, to one seventy-five thousandth part of an inch. The retina therefore receives many billions of impressions in a second, and it is supposed that it is the difference in the number and velocity of these impressions that produces in the mind the sensations of the colors. If the waves which enter the eye have a much greater or a much less velocity than the limits above stated, they do not, it is supposed, produce the sensation of light; and the objects from which such rays come, although they may really stand before the eye, are, as we say, invisible. But although they do not effect the eye, they may impress the photographic plate, which has no such constitution as the eye.

One of the most successful methods of producing "spirit" photographs is to place, in front of the sensitive plate, within the plate shield, a clear sheet of glass having nothing upon it except a thin positive of the "spirit" that is to be produced on the negative. The portrait of the sitter is taken in the usual manner. The light which enters the camera lens prints the sitter and also the "spirit" which is on the thin positive upon the negative. This is a very convenient method, as it requires no manipulations likely to be detected; and is, we think, the favorite plan practiced by the best spirit photographers. Prints made in this manner pass current among the believers for genuine ghosts of the departed, directly descended from heaven.

But a more new, interesting, and scientific method of producing "spirit" photographs, is as follows: the plain background screen, before which the sitter is placed in order to have his portrait taken, is to be painted beforehand with the form of the desired "spirit," the paint being composed of some fluorescent substance, such as a solution of sulphate of quinine. When this painting dries on the screen, it is invisible to the eye; but it sends out rays that have power to impress the photo plate; and thus the image of the person together with the quinine ghost are simultaneously developed upon the negative. This is a very beautiful and remarkable method.

SCIENCE IN THE KITCHEN.

The student of the social economy of this country will encounter no more remarkable anomaly in the habits of our people than that, while we exhaust every possibility achieved by the progress of modern science toward the augmenting of our pecuniary welfare, we as sedulously neglect the teachings derived from the same source and pointing to one of the most important causes of physical health and comfort. When a man undertakes to build himself a house, it is the general rule that he exercises the closest care that every portion of the structure shall be, in design and material, the best. He employs a capable architect, a thorough builder, selects stone, brick, mortar and other components of his fabric with a rigid scrutiny which leaves no doubt in his mind but that his dwelling will be a strong and lasting shelter. Then he decorates, furnishes, searches for ingenious devices of household convenience, and finally enters his new habitation secure in his belief of its excellence. Is it not strange that all his labor is done for a roof which may cover its owner but until to-morrow: for a home which the vicissitudes of fortune may wrest from him in a day, or which of his own choice he may abandon before the mortar is perfectly dry: while to the structure in which Providence has ordained he shall exist for a lifetime, but secondary consideration is given?

Our food has been compared to the fuel which heats a boiler, makes steam, and so drives the machinery. The simile is not only trite but unjust. The substances that we eat play even a greater part. It is as if the fuel, besides heating the water, contributed by its combustion to the existence of the boiler—in other words, we are made of the materials we consume. Clearly then, although we may subsist for a time on substances unsuitable and comparatively non-nutritious, in the end our physical system will suffer, if not break down, from the improper nature of the components with which it is supplied.

Cooking is the proper preparation of food for human consumption. We do not consider that the term means applying heat until the substance assumes any form which is edible, but the causing of the material to undergo certain changes, chemical or otherwise, in its condition, which render it in the most suitable state for the nourishment of the body. Articles for the table, then, are either cooked or ruined—necessarily one or the other. Bad cooking, like bad grammar, is non-existent *ex vi termini*; but as to where the dividing line happens to be between these very opposite conditions, it is odd that few persons can agree. Perhaps it may be safely drawn from the sanitary point of view, as above noted; for a single material, like the common potato, for example, may be nutritious and healthy when properly cooked; while if it be boiled until it be waterlogged and waxlike, its beneficial nature is lost. Theoretically, then, the gage of cookery should be the healthfulness of its results; practically, however, the standard is simply and purely one of individual taste; and that in this country, where the majority are educated to relish compounds indigestible and worthless as brain and muscle producers, is fallible in the extreme. Hence, while this sense is gratified, we give no thought to the means; in other words, so long as the builder of the fabric is satisfied with the exterior appearance of his stone, mortar, or brick, no matter, if when they are made into a wall, they prove bad within, and weak and insufficient as supports.

Dr. James, in an excellent paper recently read before the American Health Association, upon a topic kindred to that to which we are referring, points out with much clearness many of the abuses into which the preparation of our food has fallen, and inveighs with special vigor against the general assumption that women are natural cooks. Perhaps it is to the invariable inaccuracy which (our feminine readers will pardon us) is inherent to the gentler sex, more than to any other cause, that the science of cookery has descended to the level of a rule of thumb pursuit. Do we ever need a medicine, we watch the druggist, that he compounds it with scrupulous exactitude. Do we build a machine, we hire talent that will execute the work to hair breadth accuracy; in fact, we employ skilled labor to supply us with knowledge, to house us, to dress us, and even to shave us, everything but to feed us. It takes an artist to make our coats but the most foolish of Hibernian virgins may be installed in our kitchen to prepare the food that makes our body.

If cookery were reduced down to rule, so that a person could follow recipes with the same certainty of success, due to accuracy, with which the student pursues the instructions laid down in his text book of chemical analysis, it is presumable that any individual could produce eatable and healthy dishes; but nothing is further from the truth. Let the reader ask any successful cook how he or she made such or such a compound, the chances are strongly that no satisfactory explanation can be given. "Practice" is probably stated as the reason, or "experience," or "luck." Let him turn to any so-called cookery book, and we would be willing to wager that in nine cases out of ten the recipes for the most delicate cake and pastry contain greater margins of inaccuracy than any formula extant for mixing mud concrete. What does a teaspoonful mean, heaped up or level with the rim? Or a teacupful? What size of teacup? How much is a pinch, or a handful, or a pennyworth? There is absolutely no standard system of measures conscientiously followed; and hence a woman will gage her ingredients by the grab with the same unquestioning faith in the accuracy of the combination that she reposes in the fact that the distance from the tip of her nose to the end of her fingers is precisely and infallibly one yard.

The practical solution of the important question, whether the masses can be educated properly to prepare their food, is yet to be determined. It is surely possible that cookery can be taught as a science, as other necessary branches of knowledge, not after the fashion of child's play, as have been most of the previous attempts in this direction, but as a serious study. We do not expect every man's wife to become a *cordon bleu*, or our servants to prepare *entrées* which would not disgrace Delmonico; but we do believe that means might be found of imparting information sufficient to relieve the people of many of the nightmare-breeding compounds of daily consumption. Make practical cookery a part of every woman's education, and the principles of the same a portion of that of every man. Let us, for recipes, have formulæ and instructions, clearly couched but as accurate as the physician's prescription, and deduced by scientific investigation. Then with the materials and means which we now have, better than which the world cannot produce, the answer to our petition for daily bread will not be food destructive to our health as individuals and as a people.

SCIENTIFIC AND PRACTICAL INFORMATION.

SWEDISH IRON.

The superior quality of Swedish iron is still maintained. The price for charcoal pig, in 1873, has been about $45 a tun. Ten years ago the same article sold at $19 per tun. It is supposed that the excellence of Swedish iron is due to the presence of tephrite, a silicate of manganese and iron. This is a discovery by M. Ingelstroem.

AN IMPERIAL THERMOMETER.

Professor Palmieri, of Naples, has recently completed a very ingenious and elaborate registering thermometer for the private use of the Empress of Russia. The instrument is of metal and is provided with bells, which give a signal whenever any considerable change of the surrounding temperature occurs. It is said to be so sensitive that the indicator is in a state of almost perpetual motion. Suitable devices show the extreme range of temperature during given periods of time. The apparatus is placed in the imperial traveling carriage.

THE CORINTH SHIP CANAL.

The Italian Consul at the Piræus, Greece, communicates to this government the news that the contract for opening a canal through the Isthmus of Corinth has been awarded to M. Tuvini, an Athenian banker. The conditions of the agreement are that the canal shall have a minimum depth of 28 feet and a breadth of 137 feet at the base. A basin and docks, with storehouses, etc., covering an area of 71 acres, are to be constructed, at half the distance, and the basin is to have a sufficient depth of water to float the largest vessels.

The work is to be completed in 6 years under a penalty of $60,000, and M. Tuvini has obtained the entire grant for 99 years. It is estimated that the expense of the undertaking will reach about $1,000,000. The advantage to be gained are the avoidance of the *détour* of the Morea and the doubling of Cape Matapan, a dangerous coast in stormy weather, thus materially lessening the journey between Greece and the western countries of Europe.

BISULPHIDE OF POTASH A REVEALING AGENT FOR GALENA.

M. Jannettoz, in *Les Mondes*, says that, on throwing a fragment or a crystal of bisulphate of potash, $\left.\begin{matrix}HO\\KO\end{matrix}\right\}$ $2SO_3$, on roughly ground galena, a very sensible disengagement of sulphuretted hydrogen ensues. If the two substances be ground together, the odor becomes almost unsupportable. It is well known that sulphuric acid, mixed or even warmed with galena, does not give any sensible disengagement of sulphuretted hydrogen, nor do the sulphurets of antimony, of iron, of mercury, of silver, or even those in which the lead and sulphur do not form an isolated combination, give such results with the bisulphate. But if, to any mixture whatever, a fragment of pure sulphuret of lead be added, at the moment when the rubbing or grinding of the whole with bisulphate of potash takes place, sulphydric acid is given off.

DIRECT DETERMINATION OF THE ELEMENTS OF ORGANIC SUBSTANCES BY A SINGLE COMBUSTION.

Mitscherlich has recently discovered a new mode by which, by direct analysis, not only the carbon, oxygen, and hydrogen in an organic substance can be determined, but also the chlorine, bromine, sulphur, iodine, phosphorus, and probably also the nitrogen therein contained. The organic material is brought to combustion with oxide of mercury, the results of which process are water, carbonic acid, and mercury. The two former are weighed in the ordinary manner. The weight of the mercury formed serves to determine the quantity of oxygen due to combustion, by subtracting which from that contained in the carbonic acid and the water, the total amount of oxygen existing in the substance submitted to elementary analysis is found. If, however, the body under examination contains chlorine, bromine, or iodine, these elements combine with the mercury set free, and are determined by weighing. Sulphur and phosphorus combine in the state of sulphate and of phosphate of oxide of mercury.

PREPARING AMMONIA SALTS.

Bobrownicki, of Paris, proposes to prepare ammonia salts from the ammonia liquor of gas works by acidifying and then treating it with fluoride of silicon, chloride of silicon, hydrofluor-silicic acid, or an alkaline silicate. The silicon compounds carry down the suspended bodies, and those in solution, and hold them in a solid or half solid form. Bobrownicki calls the precipitate a silicoid. It furnishes the crude material for preparing ammonia salts in the usual manner.

NEW REMEDIES FOR CHOLERA.

French physicians, as a rule, hold to the fungoid theory of cholera, and one of their number has been experimenting with the carbolate of ammonia in cases of cholera, so far, we learn, with encouraging success. One physician (Dr. Déclat) looks upon carbolic acid as a prophylactic, to be used in the ordinary way of diet during epidemics. It is taken in the form of sirup. When a patient is attacked with cholera, the sirup should be administered, and a dilute solution of the acid injected. In severe cases, the doctor employs a sirup of carbolate of ammonia, with subcutaneous injections of the same; and he is so confident as to the efficacy of his remedy that, in cases where dissolution is impending, he injects a solution of the carbolate of ammonia directly into the veins.

A Phenomenon of Capillarity.

A curious experiment, due to capillary attraction, was described at a recent session of the French Academy of Sciences. It consists in placing in a flask a small quantity of bisulphide of carbon, and inserting into the liquid a small tight roll of filtering paper, which passes up through a hole in the cork. Owing to the porosity of the paper, the bisulphide ascends; and on coming in contact with the atmosphere, evaporates very rapidly. A temperature is thus produced of very nearly 0° Fah., under ordinary circumstances. The water held in a vaporous condition in the air is consequently condensed and precipitated in the state of hoar frost, which, with the bisulphide, forms, it is said, a peculiar hydrate, which is deposited on paper in a white layer. As new quantities of the bisulphide are continually supplied, the phenomenon continues until a mushroom shaped excrescence perhaps an inch in hight and broad in proportion, surmounts the flask.

MM. Dumas and Chevreul suggest that this may point to the explanation of certain geological phenomena, such as ferruginous and calcareous concretions, of which the forms are identical with that of the artificial stalagmite described.

FOR the convenience of those dandies who are unequal to the effort required to carry a cane and an eye glass at the same time, C. K. Pevey, of Worcester, Mass., has combined these two articles in one, the glass being set in a bow formed in the handle.

A MODEL of a safety watch pocket in the Patent Office has the following inscription:

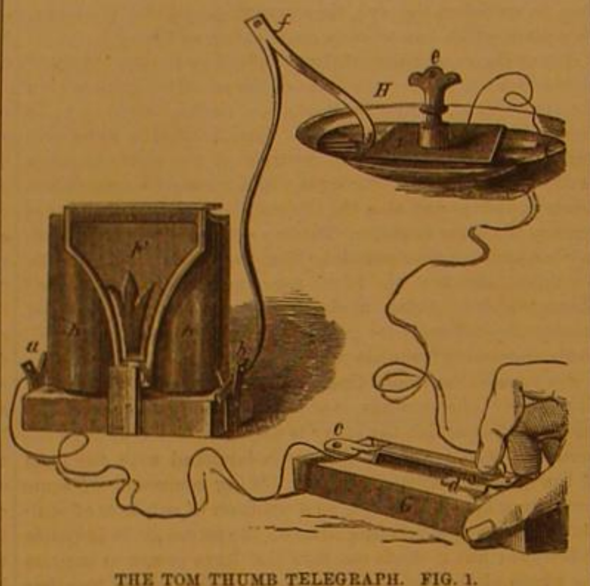
"He that hath a watch, two things must do,
Pocket his watch, and watch his pocket, too."

THE TOM THUMB TELEGRAPH.

There is nothing equal to experiment in impressing the facts of science upon the mind. Faraday used to say, with emphasis, to his pupils, that it was not sufficient to read about magnets and electricity. He advised them to make the magnets, use the electrical machines, and thus become, step by step, positively acquainted with the whole subject. As a means to such ends, we take especial pleasure in calling the attention of our readers to the Tom Thumb Telegraph. It affords the means of illustrating the phenomena of electricity, at a cost so small as to be within reach of almost everybody.

The Tom Thumb Telegraph consists of an electro magnet, sounding armature, a galvanic battery, telegraph key, connecting wires, and chemicals, all complete for working, which, with excellent directions for use, are furnished for $3: neatly packed, and sent to all parts of the world, on receipt of the price, by the makers, F. C. Beach & Co., 260 Broadway, corner Warren street, New York.

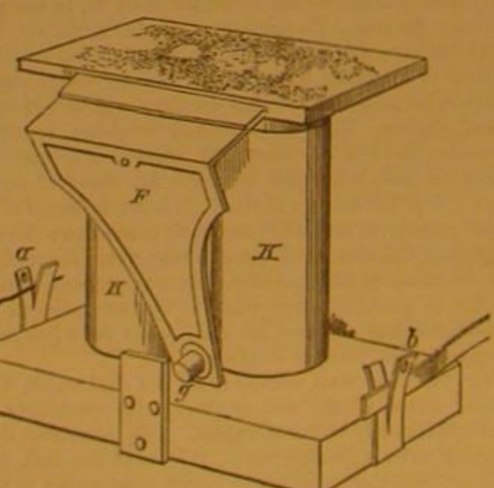
One of these little instruments is now in operation upon our table as we write. We had some curiosity to see what could be done with it, and will here give some of the results: First, as to the battery. It is composed of two small plates, one of lead, one of zinc, the latter covered with paper as a septum, both plates set in a common saucer, in water in which a few grains of sulphate of copper are dissolved. This little battery we found, on trial, to run for two days and a half. The water solution needs to be then renewed, which requires, perhaps, a couple of minutes to do.



THE TOM THUMB TELEGRAPH. FIG. 1.

Next, as to the instrument. It makes a first rate click signal, and is, we think, just as useful for learning the manipulation of the Morse alphabet, and for sending and receiving messages by sound, as any of the larger and more expensive instruments.

In addition to its office as a signal telegraph, this little device may be used for experimenting in many ways, and with it all the principal phenomena connected with electricity and magnetism may be exhibited. Its employment for telegraphing is illustrated in Fig. 1. In Fig. 2 the armature is removed and a slip of glass, with iron filings, placed on the poles of the magnet, K. When the key is pressed, and the glass gently tapped, the filings assume the beautiful positions of the magnetic curves. Removing the glass, needles



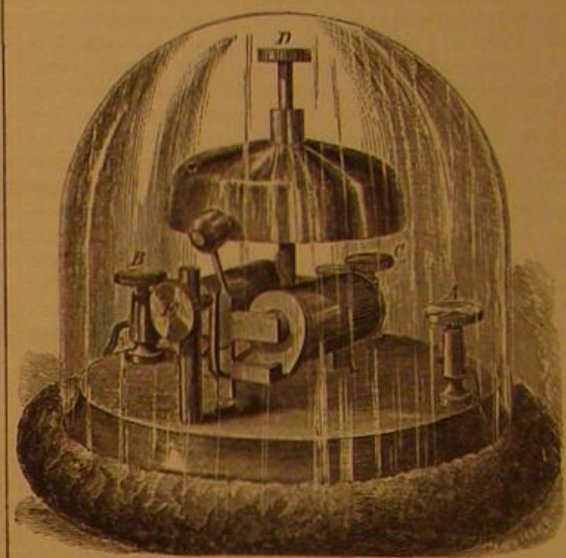
THE TOM THUMB TELEGRAPH.—SHOWING THE MAGNETIC CURVES. FIG 2.

may be magnetized by rubbing on the poles, permanent magnets made, weights lifted, etc. By connecting one wire with a file and drawing the other wire over the teeth, the electric light, in the form of a sparkling luminosity, may be produced. This is a pretty evening experiment. The electrolysis or decomposition of water into oxygen and hydrogen may be done with the battery, and it may also be used for electro-plating. For these, and other interesting experiments, printed directions are given by the makers. For schools, large or small, the device will be found very useful in the hands of the intelligent teacher, as a means of interesting instruction.

We should find it difficult to select an article of more interest and usefulness for a Christmas gift for young persons than this Tom Thumb Telegraph. It supplies the means for easy self-instruction in one of the most interesting branches of science, with which everybody, old or young, ought to make themselves familiar. These little devices may also be used for office telegraphing as well as for home use and amusement. Any intelligent lad may put up the lines and set them in operation. For further information, and free illustrated catalogues, address the makers as above.

THE MINIATURE TELEGRAPH.

For about a year past we have had in use here, in the office of the SCIENTIFIC AMERICAN, a very simple and convenient little electrical device, termed as above, the Miniature Telegraph, the invention of Mr. Lawrence Duerden, telegraph engineer of the Broadway Underground Railway, in this city. It consists of a pretty little electric bell, shown in its full size in the accompanying engraving, Fig. 1.



THE MINIATURE TELEGRAPH FIG. 1.

As used in our office, these instruments are placed upon the desks in the various departments of our establishment, and from them wires extend to the desks of the managers, on which buttons are fixed, which connect with the wires. When the manager wishes to communicate with any particular person on the premises, he touches the button corresponding to the wire leading to the bell where the individual is at work. The touch sounds the bell, and, as a variety of signals may be sent, one bell may serve to signalize different persons who are within its hearing. It is surprising how many steps the use of this little contrivance saves, and how greatly it facilitates the transaction of our office business. Previous to its introduction, it was necessary for us to employ messengers, who did little else than run from one part of the premises to another, consuming time and making mistakes. This miniature telegraph saves all such

THE MINIATURE TELEGRAPH. FIG. 2.

troubles, and enables the manager, without leaving his seat, to communicate instantly with all the principal persons employed in the concern. (See Fig. 2.) We have seven of these little instruments in use in our office, which serve us in signalizing a large number of persons. For factories, stores, shops and offices, for dwellings, in lieu of the ordinary bells, for signaling from house to barn, and for all the thousand and one purposes of business and domestic communication, this improvement is very useful. The makers fit up offices and buildings with them when desired. The device is so simple that any person of ordinary intelligence may put up the wire and set into use. It is so made that by shifting a wire from one screw into another it may be used as a telegraph, giving single signals, or as a burglar alarm, making a continuous ringing. The cost is only $5. For this sum, the manufacturers supply one of the bells, like those we use in our office, pictured above, together with connecting wires, chemicals, and a small battery, all complete for working the instrument, with directions for use: neatly put up and sent on receipt of price to all parts of the world by the manufacturers, F. C. Beach & Co., No. 260 Broadway, corner Warren street, New York. At a slight additional cost, the makers supply a larger battery, such as we use in our office, which runs six or eight months without renewal.

THE CHALLENGE REVERSIBLE ROTARY HOISTING MACHINE.

A novel application of the rotary engine to purposes of hoisting or elevating has recently been brought to our notice, which in some particulars appears to be, in point of simplicity, compactness, portability, and usefulness, an improvement of considerable merit. It is claimed that the engine runs the same number of piston feet per minute as a reciprocating, and, from its construction, at a higher speed than the latter. Hence, and for other reasons to be noted as we proceed, it is believed that the ground of the objection generally true to rotary engines as a class, namely, lack of economy, is here materially decreased, and in some forms of the machine perhaps obviated altogether.

In justice to the apparatus it may be stated that, so far as our investigation has extended, it has given general satisfaction; and although from our individual knowledge we are of course unable to make confident assertions as to its merits as compared with devices of like nature, we nevertheless have been informed by credible engineers, and others by whom it has been actually employed over a sufficient period for reasonable tests, that it is, in point of relative advantage, superior to many other well known machines with which they are familiar.

In order clearly to comprehend the operation of the apparatus, an explanation of the interior working mechanism of the engine is necessary, and this will be rendered plain by a reference to the sectional view represented in Fig. 1. B is the spider which is keyed fast to the shaft, C, and set eccentrically to the outer cylinder, A, forming an abutment at the top and leaving a steam space, D, which is traversed by the three pistons, E. The latter are held out by a loose interior ring and a spring ring, and can move with the inner cylinder or remain at rest. A regular and steady power, it is claimed, is gained at all points from the fact that each piston acts for one third of the circumference of the outer cylinder, and the steam expands by increase of area until cut off by another piston. The point, however, to which we desire to call more direct attention, is the valve, which, of the usual D shape, slides over the steam ports of the engine and by its position allows the entrance of steam into one or the other side. At the upper part of this valve is a rack into which work the cogs of a segment pinion, which is vibrated by means of a hand lever extending upward. It is clear that by this mechanism the valve can be readily moved so as to admit steam as above noted, causing the engine to travel in either direction or to stop. The motor thus constructed is, by a simple arrangement of cog gearing, connected with a large spur wheel on the hoisting drum, so that the movement imparted to the latter may be either rapid or slow.

FIG. 1.

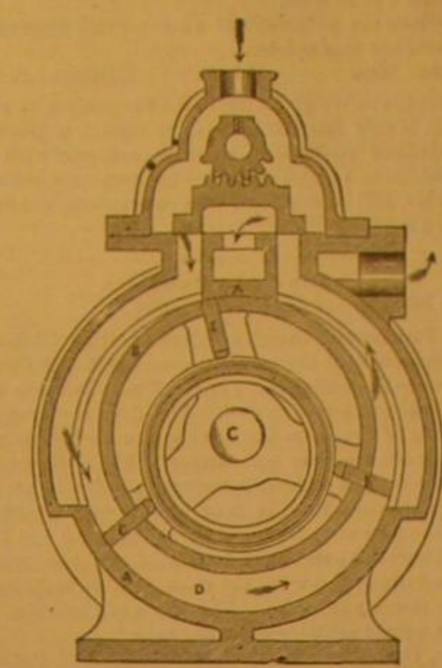


FIG. 2.

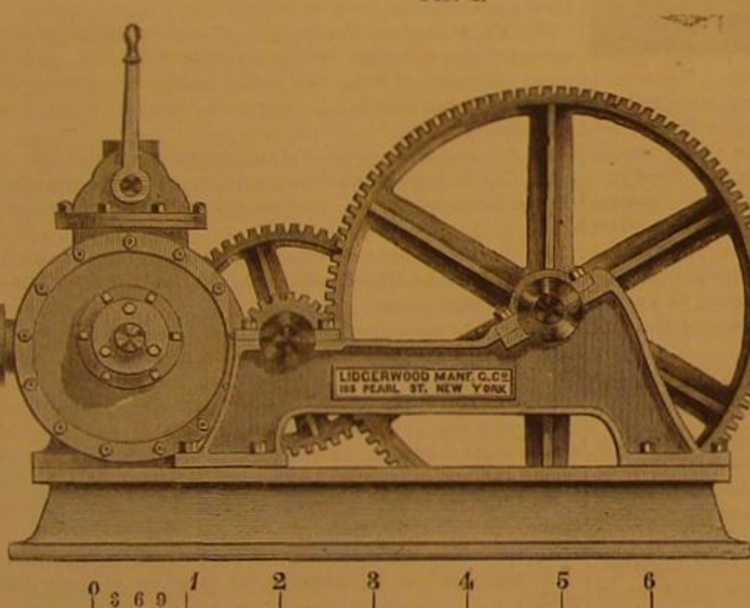
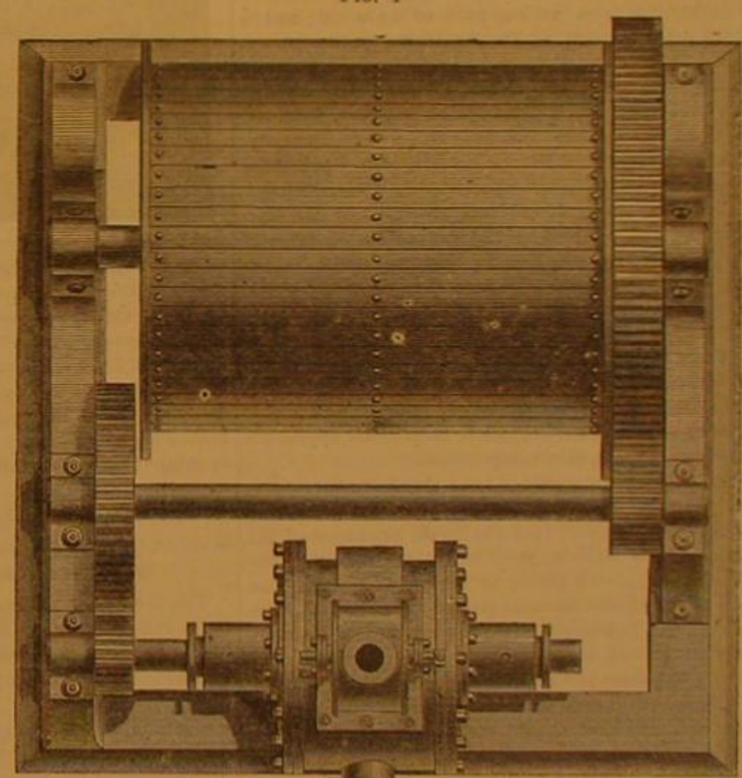


FIG. 4



THE CHALLENGE REVERSIBLE HOISTING ENGINE AS APPLIED TO MINING PURPOSES.

FIG. 3.

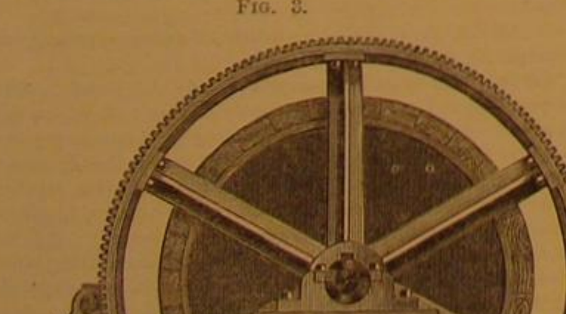
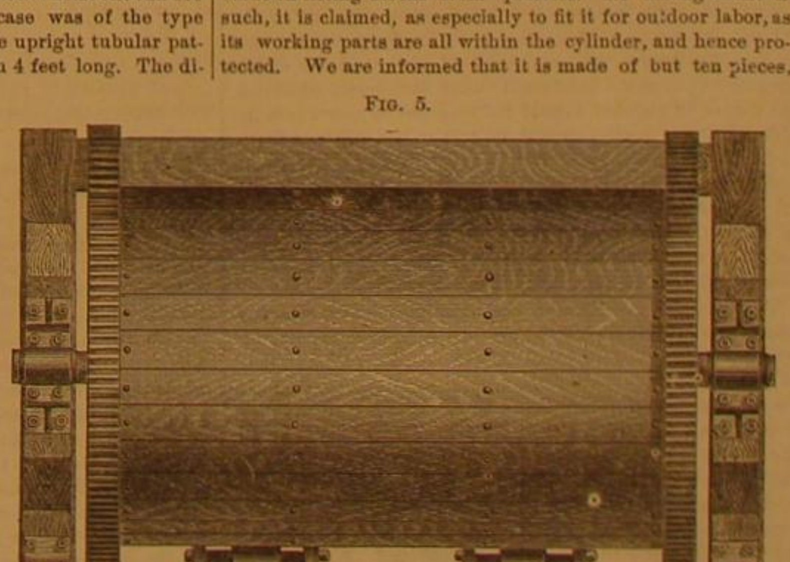


FIG. 5.



We were quite recently afforded an opportunity of inspecting several of these machines in actual employment, and from conversations with engineers the following information was obtained. At the pier of the steamers of the National Line, the apparatus is used for hoisting in and out cargo, coal and freight. An apparatus rated at fifteen horse power by the manufacturers, we were told, under a pressure of 60 lbs. of steam, easily lifted 4,800 lbs. 200 feet per minute, raising, lowering, or holding its load at any point with equal facility. The same machine also elevated 460 tuns of coal to a hight of 20 feet in eleven hours. At a warehouse in Washington street in this city, where the handling of heavy goods is often necessitated, an engine rated at seven horse power, we were informed, would hoist one tun 150 feet per minute. The boiler in this case was of the type supplied with the machine, and of the upright tubular pattern, containing 56 two inch tubes, each 4 feet long. The diameter was 34 inches. We understood from the owner that six tuns of coal lasted on an average three months, using the machine almost continuously.

Various other illustrations of the capabilities of the apparatus were submitted to us, but the above are sufficient to give a general idea of its working. The smaller forms may be mounted on trucks and thus readily transported from point to point wherever any hoisting is to be done, it being merely necessary to secure the machine to the ground, attach a hose conducting steam from the boiler, and it is ready to operate. The lever is easily governed by the hand of the engineer, or may be arranged with cords to be regulated from a distance.

One of the most important applications of the apparatus is in connection with mines, and its arrangement for such purpose is represented in the engravings hereto annexed. The first operations in the excavation are designed to be accomplished by the machine shown in elevation and plan in Figs. 2 and 3. This is a single powerful engine geared to a drum so as to lift heavy weights at a low speed. The dimensions of the various parts may be judged from the scale of feet and inches accompanying. Figs. 3 and 4 are similar views of an arrangement of two engines of equal capacity, in connection with a single drum geared for more rapid hoisting, and intended for use in the regular removal of coal from the mines. One or both engines may be employed, the valves being so arranged that a single lever governs both. From the engravings a general idea may be gained of the mechanism of the hoisting engines above referred to.

Not the smallest merit in the invention is its freedom from clutches, brakes, complicated reversing gear, etc., necessitating the frequent stoppage of the machine, and the constant supervision of the engineer. The load is held suspended at any point, by shutting off steam entirely, excepting from a very minute hair space, so that just sufficient is admitted to maintain the necessary opposing pressure. This is quickly and easily accomplished without jarring or racking. A natural inference, from the facility with which the motion of the device is controlled, is that it may be advantageously applied to steering gear on vessels. This we find has already been done, and the steamboat Rhode Island, of the Stonington line, is now thus fitted. A simple device throws the main steering wheel out of action. The rudder is then governed by a small hand wheel in the pilot house, which, by a simple rack and pinion, communicates with the governing lever of the engine. We were assured that the helm is easily managed by a single pilot, even in the roughest weather, and that there is no wrenching of the mechanism due to heavy seas striking the rudder. We may add that this application of the device appears one of much value and to be superior to the more complicated arrangements usually employed.

Many other uses to which the apparatus is applicable will at once suggest themselves. Its portability and compactness render it a convenient device for elevating stone and other material in the construction of buildings. It can be permanently placed on the decks of steam vessels as a substitute for the ordinary form of winch, and will doubtless prove of value in lifting blocks from quarries. Its arrangement is such, it is claimed, as especially to fit it for outdoor labor, as its working parts are all within the cylinder, and hence protected. We are informed that it is made of but ten pieces, exclusive of bolts; and finally that it rarely requires repairs, and then but such as are easily and inexpensively effected. For further particulars, address the Lidgerwood Manufacturing Company, No. 165 Pearl street, New York city.

COAL has been discovered in the diamond fields of South Africa, and is sold there at $11 per bag of 200 lbs.

Correspondence.

The Vienna Patent Congress.

To the Editor of the Scientific American:

Upon my return from Vienna, I have been shown an article in your paper, of September 27, 1873, in regard to the Patent Congress in that city, stating that "it adopted as its final resolution the absurd proposition that inventors ought not to be allowed to sell their patent rights, except at such rates as government officers might dictate."

Accepting this extraordinary statement at second hand as a fact, you naturally characterize those who are said to have supported it as "incompetent." As you have taken the liberty of using my name as one of these, I beg the opportunity of making a brief statement of the objects and course of the Patent Congress, whose work, moreover, cannot fail to be a matter of interest to your readers; and if my action there seems objectionable, you will then, at least, have the facts at first hand, on which to make criticism.

No one knows better than you that the condition of patents in Continental Europe is very unsatisfactory, and that the present practice is wholly opposed to the interest of inventors. To bring about a better condition of things was the great object of those who devised the Patent Congress. It was felt that the first thing to be done was to get together experts, so to speak, from different countries, leading manufacturers, scientific men, and patent authorities, who should produce a concise and forcible argument in favor of patent protection, and should also prepare a brief statement of the fundamental principles upon which such protection should be founded; so that in asking of the continental governments a change in the patent laws, those applying should be able to say precisely what they desired. In the Patent Congress such a set of men were brought together. It included leading authorities from various parts of the world; and in spite of the determination of the Austrian government not to recognize it officially, it comprised unaccredited, but regularly appointed, delegates from nearly all the leading nations. In this way, the United States, England, Belgium, Bavaria, Sweden, Prussia, Switzerland, Greece, Hungary, Italy, Roumania, and even Austria herself, were represented by regular delegates sent for the purpose. A declaration and argument of the strongest kind, was presented by Mr. Barnard Siemens, and adopted by the convention in favor of patent protection as a stimulus to invention and to manufacturing industry; and the Congress then proceeded to the preparation of a statement of the fundamental principles upon which such patent protection should rest. This work proceeded most harmoniously till a clause was reached, which, as nearly as it can be translated, reads thus:

"It is desirable to devise regulations under which a patentee shall be held to grant licenses to responsible applicants in consideration of adequate compensation."

Upon this a great discussion arose; the Germans represented that it was vital to their prospects that something like this should be passed, that the great argument of the conservatives, who were opposed to patents, was that they were monopolists, giving power to individuals to shut up inventions which should be made public. The English, with Mr. Webster, the distinguished patent lawyer, at the head, took the same ground, representing that they were laboring for a reform in patent law in England, and that a cardinal point in any reformed code must be something which would protect the public against the growing tendency of rich and powerful combinations to control valuable patents in an unreasonable oppressive manner. The Americans, on the other hand, took strong ground in favor of the free control by inventors of their own inventions, and the undersigned stood with these. The matter was debated for a day and a half. At last it became evident that some mean must be found on which differing interests could combine, and the writer proposed that, as the conditions varied in different countries, the clause in question should be replaced by one which declared that the matter should be left to the different States to decide for themselves. This was rejected by the Germans and English. However, on the morning of the next day, they proposed that the objectionable clause should be amended so that it should declare that it would be desirable that patentees should be held to grant licenses for an adequate consideration *when the public interest demands it.*

The Congress was tired of the question. Those who sustained the original proposition had a large majority, and nothing but their feeling that they needed the moral support of the Americans had prevented them from passing the clause long before. It seemed to me that (as in practice, it must rest with each nation to determine when, if at all, the public interest demanded interference between the inventor and the public) it came to the same point as the proposition made by me the day before; and I stated to the convention that this was my view, and, with this understanding, I would agree to the clause as modified. No objection was made to this, and the clause was passed with this understanding by a nearly unanimous vote, including many Americans. The convention went on to a harmonious conclusion, and, at its end, there was a general feeling expressed that it had done all, and more than all, that could be expected of it.

In conclusion, the writer was in a position to know the sentiments of our official representatives, and of the liberal members of the Austrian Government, and also of prominent persons among the German liberal party; and in their opinion the harmonious and united action of the Patent Congress was worth a thousandfold to the interest of Americans beyond anything which could have been gained by carrying the dispute further upon a point which, as modified, had ceased to be vital.

I believe the judgment of all sober and reasonable men will bear out this opinion.

Boston, Mass. HAMILTON A. HILL.

REMARKS:—We give place to the foregoing with pleasure, since it is only fair that both sides should be heard. The unprejudiced reader will, we think, conclude with us that the statement published in the SCIENTIFIC AMERICAN, to which Mr. Hill takes exception, is substantially confirmed by his own showing.

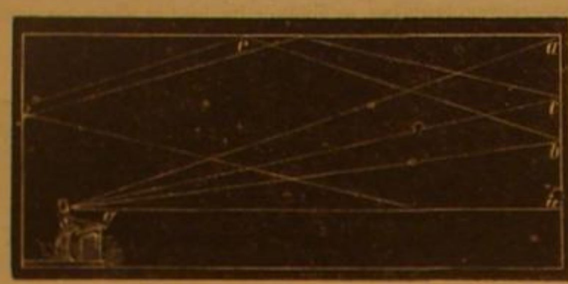
Echoes in Buildings.

To the Editor of the Scientific American:

The Presbyterian church building of Tiffin, Ohio, echoes. The dimensions of the audience room are 63 × 50 feet; from the floor to the ceiling is 27½ feet. The minister's desk or stand is 12 feet from the wall. The floor is carpeted, with exception of the space beneath the pews, which is not covered, nor are the pews upholstered. The ceiling and side walls are flat and without interruption. There are no galleries in the church. The floor of the pulpit is 20 inches above the floor of church, and the speaker is 5 feet 7 inches tall. There is a great modification of the echo when the room is full: indeed when the room is filled to its capacity, there is scarcely any echo. The angle of the ceiling to the sides is a right angle, without any cove.

Tiffin, O. J. T. POLLOCK.

REMARKS BY THE EDITOR.—The echo is probably caused by the rebound of the waves of sound from the front wall, as shown in the sketch. All the vibrations of air that strike on said wall above the line, *g d*, are reflected to the ceiling



and to the rear wall above the speaker's head. Those that strike between the points, *a b*, are reflected to the ceiling, thence to the rear wall, and then back into the ears of the auditors, arriving a moment later than the direct sound, and thus producing confusion. The erection of a front gallery would have a tendency to prevent the echo. In some late experiments in England, it has been found that wires stretched across the space, at about 6 inches apart, have broken the vibrations. This might be tried in this case by running them horizontally, at that distance apart, in a series extending from *a* to *b*. Painting them the color of the wall would conceal them.—EDS.

SUBJECTS FOR ENGINEERING PAPERS.

The Council of the Institution of Civil Engineers, London, invite communications dealing in a complete and comprehensive manner with any of the subjects included in the following list, and other papers treating on analogous questions:

a. Account of the progress of any work in civil engineering, as far as absolutely executed (Smeaton's narrative of the building of the Eddystone Lighthouse may be taken as an example).

b. Descriptions of distinct classes of engines and machines of various kinds.

c. Practical essays on subjects allied to engineering, as for instance, metallurgy; and

d. Particulars of experiments and observations connected with engineering science and practice.

List.

1. On the application of graphic methods in the solution of engineering problems, and in the reduction of experimental observations.

2. On the elasticity, or resistance to deflection, of masonry, brickwork and concrete, with observations on the deflection of bridge piers, caused by the unequal loading of the arches abutting on them.

3. On the use of concrete, or *béton*, in large masses, for harbour works and for monolithic structures.

4. On the manufacture of iron and steel as now practised; on the effect on the strength and tenacity of the metal by the admixture of substances with the ore; on the various experimental tests by which the quality may be ascertained; and on the effects of low temperature on metals.

5. On the results of experience in the recently extended use of steel in mechanism and in works of engineering.

6. On the theory and practical design of retaining walls for sustaining earth or water, and on experimental tests of the accuracy of the various theories.

7. On modern methods of constructing the foundations of bridges, and on bridges of large span, considered with reference to examples; including an account of the testing, and of the effects produced by variations of temperature.

8. On the different systems of swing, lifting and other opening bridges, with existing examples; and on the application of machinery in working them.

9. On the proportions and details of construction of lock gates, and on the application of machinery for moving them.

10. On the appliances and methods for rock boring and blasting in this country and abroad, and on the results obtained.

11. On the systems of signaling on railways, and on the comparative advantages of the absolute or permissive use of the block system.

12. On the constant use of water supply, with special reference to its introduction into the metropolis in substitution for the intermittent system; and on the waste of water and the best apparatus for its prevention.

13. On the various modes of dealing with sewage, either for its disposal or its utilization.

14. On the separate system of sewering towns, with a detailed description of the works in a town to which this system has been wholly or partially applied, and particulars as to its results.

15. On the ventilation of sewers, with a *résumé* of the experiments as to the motion, pressure, etc., of gas in the sewers.

16. On the relative value of upland and of tidal waters in maintaining rivers, estuaries, and harbors.

17. On the construction of sluices for the expeditious filling and emptying of locks of large size on navigable canals.

18. On the maintenance by sluices of the harbors on the coasts of France, Belgium and Holland.

19. On the sea works at the mouths of the rivers Adour and Maas, and on the effects produced thereby.

20. On recent improvements in the construction of steam boilers adapted for very high pressures.

21. On the best practical use of steam in steam engines, and on the effects of the various modes of producing condensation.

22. On the modern construction of marine engines, having reference to economy of the working expenses, by superheating, surface condensing, high pressure, great expansion, etc.

23. On modern locomotive engines, designed with a view to economy, durability, and facility of repair, including particulars of the duty performed, of the cost of repairs, etc.

24. On the application of steam as a motive power for pumping water or sewage, with a comparison of the advantages of the different classes of engines, and details of the cost of working for long periods.

25. On the various descriptions of pumps employed for raising water or sewage, and their relative efficiency; and on the employment of water as a motive power for pumping by means of water wheels, turbines, water pressure engines, or other machines.

26. On the employment of steam power in agriculture.

27. On the methods of transmitting force to distant points; and on the details of the existing system of rope transmission.

28. On the present state of science in regard to the manufacture of gas for illumination; and on the materials most suited for the purpose.

29. On the manufacture of mineral oils and the lamps best adapted for their consumption in dwellings and lighthouses.

30. On the out put of coal in the United Kingdom, as compared with that of other countries, illustrated by statistical tables, plans, diagrams, showing where coal is produced, and where and how it is consumed.

31. On mechanical apparatus at present in use in getting coal.

32. On modifications necessary in future coal-mining operations, suggested (or indicated) by the working of deep coal fields.

33. On turf (or peat) cutting, macerating, and pressing machinery, with experiments as to its heating power and expense as a fuel, as compared with coal.

34. On the various methods of draining distant isolated sections of mines.

35. On compressed air as a motive power for machinery in mines, with some account of its application on the continent.

36. On the use of diving apparatus in mines, especially in Westphalia and in Germany.

For approved original communications, the Council will be prepared to award the premiums arising out of special funds devoted for the purpose. They will not, however, consider themselves bound to make any award should there not be any communication of adequate merit; but, on the other hand, more than one premium will be given, if there are several deserving memoirs on the same subject. It is to be understood that, in this matter, no distinction will be made between essays received from a member or an associate of the Institution, or from any other person, whether a native or a foreigner.

The communication should be written in the impersonal pronoun, and be legibly transcribed on foolscap paper, on the one side only, having a sufficient margin on the left side in order that the sheets may be bound. A concise abstract must accompany every paper.

The drawings should be on mounted paper, and with as many details as may be necessary to illustrate the subject. Enlarged diagrams, to such a scale that they may be clearly visible when suspended in the theater of the Institution, should be sent for the illustration of particular portions.

Papers which have been read at the meetings of other societies, or have been published in any form, cannot be read at a meeting of the Institution, nor be admitted to competition for the premiums.

The communications must be forwarded on or before the 31st of January, 1874, to the house of the Institution, 25 Great George street, Westminster, S. W., London, where any further information may be obtained.

THE GERM THEORY AND ITS RELATIONS TO HYGIENE.

BY PRESIDENT F. A. P. BARNARD, LL.D., OF COLUMBIA COLLEGE.

The following very interesting paper, by F. A. P. Barnard, LL.D., President of Columbia College, on the germ theory of disease in its relations to hygiene, was read before the American Public Health Association, on November 13. After a few excellent remarks on the general recognition, among educated men, of the universal reign of law and order, Professor Barnard said:

The germ theory of disease is not, as is commonly supposed, a theory which has originated in very recent years. More than 200 years ago it was brought forward, at least as a hypothesis, by the celebrated Father Kircher, in his *Scrutinium physico medicum contagiosæ luis quæ pestis dicitur*, to account for the infectious propagation of the plague. However plausible this theory might at the time have seemed, it could then, nevertheless, claim no higher rank than that of a bare hypothesis; and it has only been in times comparatively recent that observation has brought to light a sufficient number of facts apparently favoring it to justify our advancing it in the arena of scientific discussion to the higher dignity of a theory.

Before proceeding to consider the evidence bearing on the truth of this theory, for or against, a few observations of a general nature may properly here find place. No living organism enjoys an existence of unlimited duration. Every such organism, under favorable circumstances, passes through three distinct stages, which are those of growth, vigorous maturity, and decline. The organism commences as a germ, and ends in dissolution and disintegration. Since the laws of life, as well as those of physics, are fixed and definite, there is reason to believe that all organisms of the same species, if placed in conditions equally favorable to their development, would be equally long-lived; yet, in point of fact, those which pass through the regular stages constituting their normal life are comparatively few. In the large majority, the vital functions are, earlier or later, more or less disturbed, if not arrested, by an endless variety of causes tending to produce disease and premature death. In the human race, life is often shortened by ignorant or wilful disregard of the conditions necessary to the preservation of health. Accident, also, often exposes individuals to deleterious influences. Thus, in many cases, diseases arise from exposure to extremes of temperature or from excesses in eating and drinking, persisted in until the organs of digestion become debilitated and fail to fulfil their proper functions. But beside these causes of disease, which may be classed under the head of "injurious conditions," there are other influences directly morbific, which, whenever they come into play, cut short the duration of life. Poisons belong to this class, but the effects of these are felt only in occasional and accidental instances. Other noxious influences, of which the pernicious consequences are more widely spread, are those which produce the diseases called zymotic. Such are malaria, contagion, and infection, instrumentalities to which are owing the widespread ravages of epidemic.

It may be remarked that there are many cases of disease in which the cause is not traceable directly to any of the sources above mentioned, but in which the disease has been transmitted by inheritance from a parent similarly affected. In such cases there is nevertheless every reason to believe that the disease in its first appearance was produced in a healthy organism by causes belonging to one or the other of the classes above named.

The diseases which it is the object of the present paper to consider are only those which belong to the epidemic or contagious class.

THE EPIDEMIC OR CONTAGIOUS CLASS OF DISEASES.

No subject has occupied more the careful attention of physicians, or has been a subject of more elaborate observation and experiment, or has led to more marked difference of opinion or more animated controversy, than that of the nature of the influences by which these diseases are transmitted from individual to individual. That many epidemics arise from peculiar conditions of the atmosphere, not in the least as yet understood, can hardly be doubted; and in this case the influence which excites disease simultaneously in many is not dissimilar to that by which contagious diseases are transmitted from individual to individuals. Two theories, distinctly opposed to each other, have long been held on the subject. These may be distinguished as the chemical theory of infection and the germ theory. The chemical theory is founded on a presumed analogy between the propagation of disease in living organisms and the process of fermentation in certain forms of organic matter without life. This theory assumes a ferment to be an organized substance in a certain state of decay, which possesses the property of exciting the same decay in other organic substance with which it is in contact. Applying this theory to disease, it supposes that infection is communicated by the instrumentality of particles thrown from the person, or from substances proceeding from the person diseased, and borne by the air to other persons in full health, in whom they excite, probably by contact with the membranous linings of the lungs, the same diseased condition which exists in the patient. The opposing theory presumes that the diseased person is suffering from an invasion of his system by microscopic algoid or fungoid vegetative forms having the property of rapid self-multiplication, and that the spores which proceed from these fungi or the cells of the algæ are wafted in like manner by the air from person to person, penetrating the systems of the healthy, and establishing new colonies to generate disease in them.

A *prima facie* evidence, which so far as it goes is favorable to the germ theory, is found in the well known fact that all the forms of cryptogamic vegetation are propagated by spores, which they shed freely abroad in all directions, and that these are borne in infinite numbers through the atmosphere, which they pervade near the surface of the earth in all places. The fact of their universal presence is made manifest by the promptitude with which fungoid growths spring up in all circumstances in which the conditions favor their development. We know that the numbers of spores which all fungi produce are incalculable. The larger fungi give us evidence of this. The spores of a single puff ball have been estimated to be more numerous than the entire human population of the globe. It is true that to ordinary observation the presence of foreign matters in the atmosphere is not perceptible, except when such foreign matters take the gross form of clouds of smoke or dust; but particles of smoke or dust, and in general of all inorganic substances, are so heavy that they soon subside; yet when the air is thus left apparently free from all foreign admixture, it is demonstrably full of organic particles so extremely light as not to subside for many hours or even days of perfect rest. The chemist, it is true, is unable to detect them by his tests, delicate as they are; for being organic, and composed in general of but two or three elements—which elements are in great part those of the atmosphere itself—they produce no distinctive reactions under the ordinary processes of analysis. But there is a mode of analysis much more delicate than even that of the chemist. It is that which has been applied incidently to this question by Professor Tyndall, in his interesting investigation into the chemical effects of light upon vapors. Professor Tyndall discovered that there are many substances of great volatility which, when in the state of vapor, are easily decomposed by light. He found that a perfectly transparent vapor-like steam, when traversed by a luminous beam, is absolutely invisible; while we all know that if we admit a beam of sunlight into a darkened room, through an aperture in the shutter, the path of the beam through the apartment is as distinctly marked as if it were a solid bar. That this visibility of a beam of light in the air is not owing to the power of the aerial particles themselves to reflect light, is demonstrated by him by proofs entirely conclusive. A beam of light from an electric lamp was made in his experiments to pass through a large glass tube closed at both ends by plates of glass, ground on. No light was permitted to escape into the room; and, accordingly, when the tube was exhausted of air altogether, and no light from its interior was reflected to the eye, it was perfectly invisible. But if the air of the room were allowed to re-enter it, it immediately became brilliantly luminous, as in the case of a sunbeam admitted through a window shutter. He showed, however, that a filter of rather closely compacted cotton will shut off entirely, or almost entirely, the organic matters which the air contains; and he showed, finally, that absolute rest for a long period of time will cause these particles completely to subside. He constructed a closed space, cubical in form and several feet in linear dimensions, glazed so as to permit him to pass through it a beam of light, and to observe the path of the beam. This small apartment was made absolutely airtight, and left to itself. On each succeeding day the brilliancy of the transmitted beam grew less and less; and at length, at the end of a week, it could no longer be perceived at all. The apartment was optically empty.

THE AIR FILLED WITH ORGANIC MATTER.

It is not necessary to suppose that all particles of organic matter are living germs of vegetable or animal organisms; but when we see how constantly such organisms spring up wherever the conditions favor germination, it is impossible to doubt that a vast many of them have this character; and that these are the source of those growths of minute cryptogams which thus seem to spring up spontaneously. There is no mode of accounting for such growths, except to suppose that they are actually spontaneous; and accordingly the view has been taken by some physiologists, perhaps I should say many, that the true mode of accounting for the appearance of microscopic forms of life is to suppose that they originate without organic antecedents, or as they expressed it, *de novo*. No question at the present day is more sharply debated than that which relates to the origin of life. There is no subject which has been pursued experimentally with more zeal, more earnest solicitude to reach the truth, and with more singularly discordant results than this. The notion of spontaneous generation, is not, by any means, of modern origin. It has been entertained by naturalists in every age since the dawn of scientific history. But the earlier naturalists, Aristotle and Lucretius, for instance, conceived that organisms of a high order of complexity, such as insects, or fishes, or reptiles, might be directly produced out of the moist earth softened by showers, or out of the slime and mud of rivers; whereas those of our time have long since abandoned any such extravagant notions, and confine themselves to the assertion that life in its spontaneous origin is manifested only under the simplest forms.

Less than three centuries ago the belief that living things may originate without eggs, or germs, or living parents from which to proceed, may be said to have been universal in Europe. Of the truth of this belief there was supposed to be visible evidence in the invariable occurrence of maggots in putrefying flesh. The doctrine was held as matter of faith, and those who first assailed it were naturally accused of impiety and irreverence. Prominent and perhaps first among these was Francis Redi, an Italian philosopher, scholar and poet, born in 1626. He presented a conclusive disproof of the spontaneous generation of maggots in putrefying flesh, by simply inclosing, in an open mouthed jar covered with gauze, pieces of flesh still sound and leaving them in the sun to putrefy. Putrefaction occurred as before, but no maggots made their appearance. The maggots, nevertheless, did appear on the gauze, and a little observation made their origin manifest. The flies, of which they are the progeny in the larval state, being attracted by the odor of the flesh, but unable to reach it, laid their eggs upon the covering of the jar, and out of these the larvæ were presently developed. Having demonstrated the falsity of the popular belief on this subject in a case so conspicuous, Redi naturally generalized his conclusion, and took the ground that no living thing comes into existence without deriving its life from something previously living. He did not say, as it has been said later, "*omne vivum ex ovo*," but "*omne vivum ex vivo*." He still believed that out of a living plant may arise a living animal as the insect within the gall of the oak, or the worm within the fruit which presents no external puncture. His doctrine was, therefore, that which Huxley has named *biogenesis*, in contradiction to spontaneous generation, called by him *abiogenesis*, and by Bastian *archegenesis*. But *archegenesis* had been put aside only to return again under a new form. Among the earliest revelations of the microscope was the remarkable fact that, whenever a dead organic substance is infused in water, myriads of minute creatures presently make their appearance in the infusion, all possessing most extraordinary and many of them very varied powers of reproduction. They multiply by means of *ova*, by means of buds, or gemmation, and by means of self-division, or fissuration. All this was strongly favorable to the doctrine of *biogenesis*. Where so many means of reproduction existed, every one of them so effectual and sufficient, to provide that the same forms of life should be produced without any organic antecedents, seemed "wasteful and ridiculous excess." This view, however, met here and there with a dissentient. About a century and a quarter ago, John Thurberville Needham, an English naturalist, resorted to an experiment which, with various modifications, has been since repeated many hundreds, possibly many thousands, of times, with the view thoroughly to test the question whether, in its application to infusorial life, the doctrine of *biogenesis* is universally true. He prepared an infusion, thoroughly boiled it in a flask, corked it tight, sealed the cork with mastic, and covered the whole with hot ashes, designing to destroy by heat any germs which might be in the infusion, in the substance infused, or in the air above the liquid in the flask. After some days or weeks, he found that, notwithstanding all these precautions, living organisms did make their appearance in the flask, precisely such as, in freely exposed infusions, habitually appeared earlier. This experiment was immediately repeated by Spallanzani, an Italian ecclesiastic and naturalist; but Spallanzani, instead of corking his flask and cementing his corks, sealed the vessels by fusing the glass; and having thus completely cut off communication with the outward air, kept them at the boiling temperature for three quarters of an hour. No life appeared in the infusions of Spallanzani, and the doctrine of *biogenesis* was again apparently triumphant.

Marbled Paper.

This, much used by bookbinders, is produced in a very curious way. The name is not exactly suitable, seeing that few of the specimens are imitations of real marble; but it has gradually become applied to sheets of paper of which one surface is made to imitate any kind of stone or wood. Small brown spots on a light ground, marble veining on a shaded ground, curled patterns and wavy patterns, all are produced in great diversity. The colors are of the usual kind, such as Naples yellow, yellow ocher, yellow lake, orpiment, verdigris, rose pink, red lead, carmine, *terra di Sienna*, Dutch pink, indigo, Prussian blue, verditer, umber, ivory black, etc; they are ground up very fine with prepared wax and water and a few drops of alcohol. A solution of gum is made of gum tragacanth, alum, gall, and water, and placed in a trough or shallow flat vessel. Color is thrown on the surface of this gum water, usually by striking a brush against a stick, so as to produce a shower of sprinkles. Pigments of different tints and different thicknesses or degrees of consistency are thrown on; some spread more than others, and thus a diversity of patterns is produced. Sometimes the color is thrown on by means of a pencil of very long bristles; it is diversified by means of a rod, held upright and carried along amongst the colors in a wavy or spiral course; and it is further cut up into tortuous lines by passing a kind of comb along it. All this takes place on the surface of the gum solution in the vat. When the vat is prepared, a sheet of paper is laid down flat on the solution, care being taken that every part of the surface shall be wetted; the paper takes up a layer of paint, fancifully disposed in a pattern or device, and is hung up to dry. In order that one color may not be blended or confused with another, they are ground up with different liquids, some watery, some gummy, some oily. The imitations of marble, gray and red granite, and fancy woods, are certainly not very faithful; but the paper is lively in appearance, and remains clean and bright a long time when polished. This polishing is effected by moistening the colored surface of the paper with a little soap, and rubbing it with a piece of smooth marble, an ivory knob, a glass ball, or an agate burnisher. Beautiful products have been produced within the last few years under the names of iridescent and opalescent paper. Like the commoner kinds, these receive colored devices on one surface; but great delicacy and care are called for in the processes to produce the exquisite play of light and shade which suggests the names given to these varieties.—*Practical Magazine.*

IMPROVED BOX CORNER GROOVING MACHINE.

We illustrate in the accompanying engraving an improved machine for box makers' use, the object of which is to cut, in an expeditious and accurate manner, the tenons or grooves by which the corners of wooden boxes are matched together. This operation is effected by bringing the edge of the slab in contact with a set of circular toothed blades arranged in cylindrical form, and rotated at a speed of some 3,000 revolutions per minute. The principal points of advantage claimed are the simplicity and fewness of parts, compact form, adjustability of table and blades, besides others of more detailed nature, which will be found referred to below.

A is the set of cutters arranged in succession upon a horizontal shaft, the pulley of which is rotated by a belt communicating with the driving pulley, as shown. Between each blade is placed a collar, so that a space between the cutting portions is left, which forms the tenons between the grooves of the board operated upon. As the cutters are easily removable for adjustment, it is evident that all may be made of a gage equal to the narrowest groove which might be required; because, in case a wider cut is required, blades may be placed in groups of two or even three directly side by side, so as to form a less number of cutters, but of greater thickness. In front of the cutting cylinder is placed the table, B, which is arranged with suitable arms so as to vibrate on a pivot at C, and to be swung nearer or further from the cylinder by a pressure of the foot upon the spring treadle beneath the machine. To this table there are three adjustments; first, by a screw at D, by means of which its angle of inclination to the horizontal is altered. Second, by set screws at E, which are inclosed in spiral springs, and the object of which is to regulate the distance of the inner edge of the table from the cutting cylinder, so that, as the latter wears away, said edge may be brought in the closest possible proximity to the teeth. Third, by another pair of screws at F, which regulate the outward swing of the table or its movement in a direction away from the cutters. On the inner edge of the table and placed at an angle, cutting edge up, is a blade, H, and near the same will be noticed two projections, G, resembling teeth. The latter are attached to carriers which project from and are secured under the table, and, besides, connect with adjusting screws, one of which is shown at I. By means of these screws the distance of the teeth, H, from the edge of the table may be increased or diminished, so that they may enter more or less into the space left between the cutting blades. Lastly, the table is provided with suitable detachable guiding pieces, and there is a swinging cover, which fits over the top of the cutting cylinder.

DAVIS' BOX CORNERING AND GROOVING MACHINE.

The mechanism thus far understood, the operation of the device is readily followed. For rough work, the slab is simply laid upon the table, the latter being previously brought as close as possible to (without touching) the cutting cylinder. The board is then fed by hand against the blades which, rotating from left to right, rapidly cut the grooves into the wood, until the motion of the latter is arrested by its coming into contact with the projections, G. These projections, as before remarked, enter between the blades when the table is close to the cylinder, consequently their distance from the periphery of the cutters inward governs the depth to which the latter are enabled to penetrate. This depth, depending on the position of the projections, is consequently easily regulated by moving the latter in or out by the screws, I.

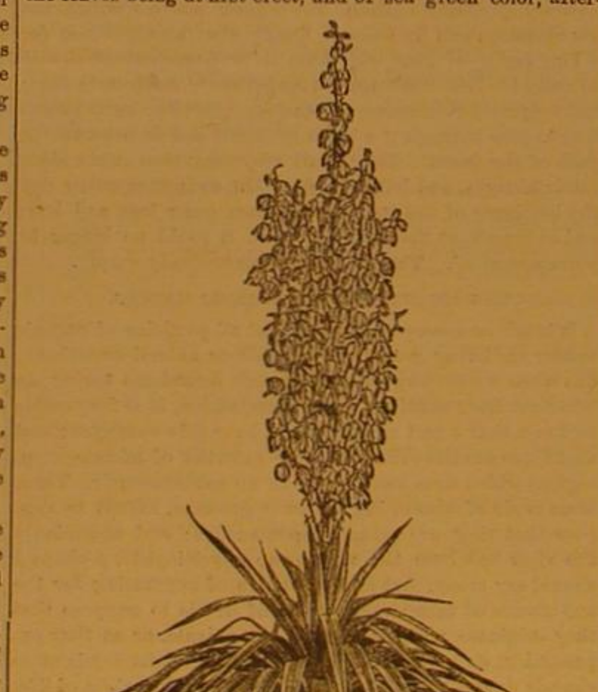
It is a common defect, of rotary blades acting as above noted, that, although the upper side of the groove in the board is cleanly cut, the under portion is apt to be ragged or to have small fragments split off inward from the edge. To obviate this difficulty the inventor employs the fixed blade, H, which, bearing directly against the under surface of the slab, ensures the smooth division of the wood, as the portions which are to be cut away to form the groove are forced directly against its edge by the teeth of the revolving cutters. This is a point claimed as of especial advantage and stated to ensure increased neatness and accuracy of work.

In case greater care is necessitated in cutting the grooves, in thin or short boards, for instance, the stuff is not fed by hand to the cutters, but by the motion of the table. It is laid upon the table and there firmly held by the operator, while the latter with his foot presses down the treadle, bringing the table slowly toward the cylinder. The slab is thus carefully brought to the cutters, which gradually form the grooves, thus avoiding the sudden impact and probable tilting of the delicate work, as might be the case were hand guidance alone relied upon. It will be noticed that no bolting in forms is required, nor indeed is there any operation needed for securing the board, at expense of considerable time and trouble. Another merit claimed lies in the fact that boards of any width may be grooved. This is done by removing one of the guides from the table, leaving the other in place. Against the latter the edge of the board is laid and in this position brought to the cutters. These, of course, groove the board for the length of the cylinder. The fixed guide is next removed and the opposite one returned to place. Against this the other edge of the slab is adjusted, and the grooves on that extremity cut, thus completing the width of the board, care being previously taken to have the second set of indentations follow those first made in proper succession.

The apparatus is the invention of Mr. Asahel Davis, of Lowell, Mass. The same inventor has also devised some novel machines of equally compact form for planing and dovetailing purposes, so that the present apparatus completes a very useful set of box makers' tools, to the perfection of which much time and care has been devoted. Further particulars may be had by addressing the patentee as above, and the devices themselves may be seen at the warerooms of John B. Schenck's Sons, No. 118 Liberty street, New York city.

THE YUCCA PENDULA.

This is one of the very best species of a beautiful genus, and its graceful and noble habit makes it simply invaluable in every garden. It grows about six and a half feet high, the leaves being at first erect, and of sea green color, afterwards becoming reflexed, and changing to a deep green. Old and well established plants of it, standing alone on the grass, are pictures of grace and symmetry, from the lower leaves which sweep the ground to the central ones that point up as straight as a needle. It is amusing to think of people putting tender plants in the open air, and running with sheets to protect them from the cold and rain of early summer and autumn, while perhaps not a good specimen of this fine plant is to be seen in the place. There is nothing more suited for planting between and associating with flower beds, for isolation and small groups, on the turf of the pleasure ground, for large vases, and for bold rocky banks.—*The Garden.*



Simple Ornaments.

A pretty mantlepiece ornament may be obtained by suspending an acorn, by a piece of thread tied around it, within half an inch of the surface of some water contained in a vase, tumbler, or saucer, and allowing it to remain undisturbed for several weeks. It will soon burst open, and small roots will seek the water; a straight and tapering stem, with beautiful glossy green leaves, will shoot upward, and present a very pleasing appearance. Chestnut trees may be grown in the same manner, but their leaves are not so beautiful as those of the oak. The water should be changed once a month, taking care to supply water of the same warmth; bits of charcoal added to it will prevent the water from souring. If the little leaves turn yellow, add one drop of ammonia into the utensil which holds the water, and they will renew their luxuriance.

Another pretty ornament is made by wetting a sponge and sprinkling it with canary, hemp, grass and other seeds. The sponge should be refreshed with water daily so as to be kept moist. In a few days the seeds will germinate, and the sponge will soon be covered with a mass of green foliage.

Temperature Indicator for Petroleum Oils.

Petroleum oils, as is well known, contain various volatile oils, which, in being disengaged in a state of vapor and mixed with atmospheric air, form an explosive mixture that has been the cause of numerous accidents. It is consequently important to ascertain, by a simple method, as quick and exact as possible, the temperature of ignition. M. Granier has arranged an apparatus for the purpose which he has exhibited before the Société d'Encouragement.

A small receptacle, of a cylindrical form and made of metal, is closed by a movable cover, furnished, in the center, with a circular opening. This vessel is about two thirds filled with the oil that has to be tested, so that there may be a chamber of air between the surface of the oil and the top of the cover, in which may be received the inflammable gases disengaged by the oil. A tube, soldered to the bottom of the vessel, holds a wick, the extremity of which ends in the middle of the opening of the cover. A thermometer is inserted in the oil to indicate successive and minute changes of temperature.

For the purpose of testing any oil, it is poured into the vessel to the hight already stated. The wick absorbing the oil is then lighted and thus gradually heats that in the vessel. This is hastened by the presence of some fine copper wire, which extends from the burning wick into the oil, thus spreading the heat through it. When the temperature is sufficiently elevated, the vapors are disengaged, and an explosive mixture is produced, which, on catching fire, causes a slight explosion. The temperature is noted at this moment, and the point of ignition thus ascertained.

Necessity the Mother of Invention.

Young men are retrenching in these dull times, and making strong efforts to appear well dressed and at the same time save their money. Two young gentlemen of Oil City, says the *Derrick*, have invented a novel plan to attain these two points. The two are nearly of the same size and build, and what one wears fits the other. By putting their money together, they were able to buy one good suit, and now take turns in wearing it, changing about, one week off and one on. Of course the man who has a week off is unable to accept invitations out to tea, hops, and balls; but then his suit or his half of the suit will be there as a representative.

A Mammoth Cheese.

The Painesville (O.) *Telegraph* describes a mammoth cheese which lately passed through that town on its way East. It was mounted on a substantial platform to which were attached small cast iron wheels, so that it easily moved, and the platform in turn was mounted on a heavy lumber wagon, drawn by two span of horses. The cheese was cased in a tight fitting cheese box which was firmly secured to the platform to prevent sliding. Its measurement is: Hight, 3 feet 2 inches; diameter, 5 feet 4 inches, and circumference 16 feet. Its net weight is four thousand and fifty pounds. In quality, it is said to be fully equal to any of the Carter cheese, which stands so prominent in every market. It was manufactured for Messrs. Gass, Doe & Chapin, of Boston, and will be cut for the holidays.

Fish Way in the Connecticut River.

The Holyoke (Mass.) Water Power Company have just built, under the mandate of the Supreme Court at Washington, a fish way on their big dam, against which they had long held out. It is described as a sort of covered ladder, 450 feet long, and divided by short zigzag "locks" or checks, to break the force of the cataract, and permit shad and salmon to get over the big fall at the dam. It has cost about $25,000. The State of Massachusetts, four years ago, appropriated half that amount, but the company declined to touch it; and now the latter must bear all the expense, as the courts have so decided. The Fish Commissioners of Connecticut, Massachusetts, and other New England States will meet this month to examine this work.

THE FIRELESS LOCOMOTIVE IN NEW YORK STREETS.—The Fireless Engine Company, whose locomotive we illustrated and described some time ago, have obtained the permission of the Board of Aldermen to run their machines on any of the city railroads above 14th street. This is a most important concession, and must be taken as an admission by the city authorities that the system can safely be worked without danger on our street rails. The want of some better mode of propulsion than that of horses is painfully obvious.

How to Make Money Honestly.

Professor R. W. Raymond, in his recent address at the dedication of Pardee Scientific Hall, Easton, Pa., said: Lesoinne, a distinguished French writer, defines metallurgy as "the art of making money in the treatment of metals." This definition may be applied to almost all occupations of life. The practical art of each is not only to achieve certain results, but to do so profitably, to make money in doing so; that is to say, to increase the value of the raw materials, whether wood, or cotton, or ores, or time, or ideas, by the use we make of them and the transformation to which we submit them, so as thereby to really elevate the condition of humanity: to leave the world better than we found it. This is, in its last analysis, the meaning of honestly making money. Men are put into this world with limited powers and with limited time to provide for their own sustenance and comfort, and to improve their condition. A certain portion of these powers and this time is required for the support of life in a greater or less degree of comfort, and more or less multiplied means and avenues of enjoyment, activity, and influence. Whatever their labor produces more than this is represented by wealth, and, for purposes of exchange, by money. To make money honestly is to do something for other men better or cheaper than they can do it for themselves; to save time and labor for them; in a word, to elevate their condition. It is in this sense, greatly as we Americans are supposed to be devoted to making money, that we need to learn how to make more money; how to make our labor fruitful; how to assail more successfully with our few hands the natural obstacles and the natural resources of a mighty continent; how to build up on the area of that continent a prosperous nation, united in varied, fruitful, and harmonious industries, glowing with patriotism and inspired by religion.

In this work we need specially the basis of a more thorough technical education, applying principles of science to the material and economical problems involved. This education is necessary to supply the directing forces for the great agricultural, manufacturing, and engineering improvements of the country. It is also needed as a solvent and remedy for the antagonism between labor and capital. The true protection of labor will be found in its higher education, and in opening to the individual laborer, for himself and for his children, by means of that education, a prospect of indefinite improvement and advancement.

In the realm of metallurgical and engineering operations the difference between theoretical and practical training is, perhaps, still more striking. The student of chemistry in the laboratory cannot be made acquainted with many of the conditions which obtain in chemical and metallurgical operations upon a larger scale. All the chemists of the world failed to comprehend or describe correctly the apparently simple reactions involved in the manufacture of pig iron, until, by the genius and enterprise of such men as Bell, Tanner and Akerman, the blast furnace itself, in the conditions of actual practice, was penetrated and minutely studied. Moreover, in all the experimental inquiries of the laboratory, the question of economy plays no part. It is the art of separating and combining substances which the student follows there, not the art of making money. That education of judgment and decision, of choice of means for ends which the exigencies of daily practice give, cannot be imparted in the school.

In mechanical engineering the same principle is illustrated. The highest department in this art is that of construction, and in this department the highest function is the designing of machinery. Now, the most perfect knowledge of the theory of a machine and its mathematical relations, of the strength of materials, or the economical use of power, will not suffice to qualify a man to design a machine or a system of machines, for the reason that in this work an element must be considered not at all included in theoretical knowledge, namely, the element of economy in the manufacture, as well as in the operation of the machine. A machine, any part of which requires for its manufacture a tool (such, for instance, as a peculiar lathe) which is not already possessed by the manufacturer, and which, after the construction of this one part, would not be necessary or useful for other work—such a machine could not be profitably built. In other words, machines must be so designed, in a large majority of cases, as not to necessitate the construction of other machines to make them; and the planning of machinery, so that it shall be at once economical and durable in operation and simple and cheap in construction, is not merely an important incidental duty; it is absolutely the chief and most difficult duty of the mechanical engineer.

THE PASHIUBA PALM OF BRAZIL.

Among the many wonders of the region of the Amazon river (now being traversed by Professor James Orton, and described by him in the series of letters in the course of publication in our pages), there is none more marvelous than the vegetation, of which the singularity of the species is as remarkable as their prodigous fecundity.

We present herewith an engraving of the *pashiúba* or *paxiúba* palm tree of Brazil (*iriartea exorrhiza*), which certainly "bears off the palm" for eccentricity of growth. The first sight of this tree, says *The Garden*, suggests the idea that some careful hand has been at the trouble of placing round its base a tree guard to protect the stem, somewhat after the manner in which the trees in our parks are railed and fenced in from cattle. A nearer approach, however, discloses the fact that the supposed tree guard is neither more nor less than the roots of the tree itself, which are disposed in this strange fashion. These roots are of the kind known as aerial, and spring from the trunk above the ground, new ones being successively produced from a higher point than the last. They take an oblique or diagonal direction until they reach the ground, into which they descend and root themselves. As fresh ones appear, those underneath decay and die off, leaving the tree supported by a hollow cone of roots, which is sometimes so high that a man may stand in the center, with the stem of the tree, 60 or 70 feet in length, immediately over his head. These roots are densely covered with small, hard, tubercular prickles, and are used by the natives as graters for reducing the inside of the cocoa nut to a pulpy mass, to be boiled with rice and water. The same peculiar mode of growth is exhibited by *iriartea ventricosa*, and several allied species.

A Quick Change of Gage.

The Grand Trunk Railway Company of Canada have lately been changing the gage of a considerable portion of their lines from 5 feet 6 inches to the standard of 4 feet 8½ inches.

On the main line from Stratford, Ontario, to Montreal, a distance of 421 miles—or, including sidings, 500 miles—1510 men were employed to do the work, the staff thus averaging 3½ men per mile of main line. The engineer of the Grand Trunk line, Mr. E. P. Hannaford, laid out the work personally by going over the road by hand car, arranging each gang in position, and laying out the details of working. To each 15 miles of main line an overseer was appointed, and these overseers reported progress to the engineer. Each gang of men had their allotted work, and, when they had completed it, reported to their overseer.

After the passing of the last train, it took each overseer from 3½ to 5 hours to narrow his district of 15 miles; so that had the main line been cleared of cars so that all these overseers could have commenced at the same time, a maximum of 6 hours would have completed the work of 500 miles of main line and sidings. As it was, some of the main line was taken possession of on a Friday noon, and the balance, on Saturday at daybreak. The whole was completed and trains running on the afternoon of the second day from commencement.

A Novel and Simple Electric Light.

Dr. Geissler, of Bonn, Germany, whose name is inseparably associated with some of the most beautiful experiments that can be performed by the agency of electricity, makes an electrical vacuum tube that may be lighted without either induction coil or frictional machine. It consists of a tube an inch or so in diameter, filled with air as dry as can be obtained, and hermetically sealed after the introduction of a smaller exhausted tube. If this outward tube be rubbed with a piece of flannel, or any of the furs generally used in exciting the electrophorus, the inner tube will be illumined with flashes of mellow light. The light is faint at first, but gradually becomes brighter and softer. It is momentary in duration: but if the tube be rapidly frictioned, an optical delusion will render it continuous. If the operator have at his disposal a piece of vulcanite, previously excited, he may, after educing signs of electrical excitement within the tube, entirely dispense with the use of his flannel or fur. This will be found to minister very much to his personal ease and comfort. He may continue the experiments, and with enhanced effect, by moving the sheet of vulcanite rapidly up and down at a slight distance from the tube. This beautiful phenomenon is an effect of induction.

THE PASHIUBA PALM OF BRAZIL.

ASTRONOMICAL NOTES.

OBSERVATORY OF VASSAR COLLEGE.

For the computations (which are approximate only) and for most of the observations contained in the following notes, I am indebted to students. M. M.

Positions of Planets for December, 1873.

Mercury.

Mercury rises on the 1st at 6h. 57m. A. M., and sets at 4h. 25m. P. M. On the 31st it rises at 6h. 8m. A. M., and sets at 3h. 14m. P. M.

On the 10th, Mercury and Venus will be in conjunction, the latter being two degrees south of Mercury. They should be looked for in the morning before sunrise.

Venus.

At this time (November 15) Venus is very brilliant before sunrise. On the 10th Mercury will be near it, and Jupiter will precede them and come to the meridian four hours in advance of them; all three should be observed in the early morning.

December 1, Venus rises at 5h. 28m. A. M., and sets at 3h. 26m. P. M. December 31, Venus rises at 6h. 37m. A. M., and sets at 3h. 37m. P. M.

Mars.

Mars is at this time (November 15) approaching Saturn, Saturn's apparent motion being much slower than that of Mars, and both being eastward. They can be seen well only in the early evening hours. After the 20th of November Mars will be east of Saturn, and will steadily diminish in its apparent diameter.

Mars rises December 1 at 11h. 10m. A. M., and sets at 8h. 39m. P. M. On the 31st, Mars rises at 10h. 13m. A. M., and sets at 8h. 42m. P. M.

Jupiter.

Jupiter rises December 1 at 1h. 9m. A. M., and sets at 1h. 21m. P. M. Jupiter rises December 31 at 11h. 22m. P. M., and sets at 11h. 30m. A. M., its diurnal path being for the whole month nearly in the celestial equator. This planet is becoming more and more favorably situated for observation, and its apparent diameter steadily increases until the last of March.

Saturn.

Although Saturn is not in a good position for observation, being far south in declination, and therefore low in altitude, yet with a telescope of moderate power its ring can be seen and perhaps one of its moons. With a large telescope, the ring can be seen to be divided, belts are observed on the body of the planet, and five or more moons circling around.

December 1 Saturn rises at 10h. 41m. A. M., and sets at 8h. 4m. P. M. December 31 Saturn rises at 8h. 54m. A. M., and sets at 6h. 21m. P. M.

Uranus.

Uranus having set on the 1st of December at 11h. 20m. in the morning, rises again at 8h. 59m. in the evening. On the 31st it sets at 9h. 19m. in the morning, and rises at 6h. 37m. in the evening. It is among the small stars of the constellation *Cancer*.

Neptune.

Neptune rises December 1 at 2h. 25m. P. M., and sets at 3h. 30m. A. M. On the 31st it rises 27m. after noon, and sets at 1h. 29m. after midnight. It is very near the star *o Piscium*.

Meteors.

A lookout for meteors was kept up on the morning of November 14 from midnight until 6h. 30m., eight students being employed, who divided into sets of two, each set being relieved after half an hour's watch. The night was remarkably fine, but not more than 200 meteors were seen, and of these not more than three fourths seemed to radiate from *Leo*, the point of departure for the meteors of the 13th and 14th of November.

Sun Spots.

Daily photography of the sun at noon, the record extending from October 22 to November 14, shows that the disturbances of spots and faculæ have been comparatively slight. From the 23d the spots, then being very few and mall, increased slightly in number, but on November 1 here was only one exceedingly small spot near the center of he disk, which, by its position, could not have come from any of those which appeared on the 30th (the 31st being cloudy). From November 4 to November 5, there was a marked change, a pair of spots of equal size uniting, while the resultant spot was larger than the sum of the original two. On the 10th, a group of fourteen small spots was scattered over an area a third of the diameter of the disk in length, and in breadth about one half its own length. On the 11th this group had begun to pass from view, owing to the revolution of the sun on its axis; and by the 14th, cloudy days intervening, it had disappeared entirely. Faculæ have been visible nearly every day, and were of considerable extent on October 28th and 29th.

Barometer and Thermometer.

The meteorological journal from October 15 to November 15 gives the highest barometer, October 15 and November 7, 30·5: the lowest barometer, October 30, 29·43; the highest thermometer, October 19, at 2 o'clock P. M., 71°; the lowest thermometer, November 7, at 7 o'clock A. M., 20°.

Amount of Rain.

The rain which fell between the night of October 26 and the afternoon of October 27 amounted to 0·91 inch.

The rain which fell between the evening of November 7 and the evening of November 8 amounted to 0·65 inch.

DR. HUGGINS has discovered, by the movement of the lines in the spectrum, that the star Arcturus is approaching he earth at the rate of about 50 miles per second.

THE NEBULÆ.

BY PROFESSOR C. A. YOUNG.

Scattered here and there through the sky are thousands of little luminous clouds, for the most part so faint as to be visible only with powerful telescopes. These are the nebulæ, which to the modern astronomer are objects of great and increasing interest. A few of them, perhaps a dozen, can be discerned by the naked eye; of those visible in our northern hemisphere, the brightest, situated in the girdle of *Andromeda*, is favorably placed for observation in the autumnal months; while the second in order adorns the winter sky as the most beautiful, if not the most conspicuous, of the celestial gems which form the wonderful constellation of *Orion*.

The total number at present known is not quite 8,000, but every new investigation increases the catalogue. Many of them consist of separate stars divided by dark spaces, and are known as clusters; others exhibit starry points on a bright back ground; these are said to be resolvable; the majority, however, show no structure, but even under the highest telescopic power remain mere blotches of hazy light; and among those which thus defy all attempts to resolve them are some of the brightest. In form they are most commonly oval, and somewhat brighter in the middle. Sometimes the condensation is so great that the central point appears like a star surrounded by a nebulous atmosphere. In many instances, they are nearly circular and of uniform brightness throughout, and these are called planetary nebulæ. There are also a few annular nebulæ, which are darker at the center, and seem to be rings of the shining mist; and there are double nebulæ, which, like the double stars, probably revolve around each other in elliptic orbits; and spiral nebulæ, whose filaments are so arranged as to suggest almost irresistibly the idea of a whirlpool-like movement of the whole mass. Besides these, there are a multitude in which the nebulous matter is distributed in streaks and patches of most fantastic and unaccountable formation. To this class belongs the nebula of *Orion*.

Unless nearer to us than the stars (which there is no reason to suppose), even the smallest of these objects must greatly exceed the dimensions of our whole solar system; and yet our outside planet Neptune is so distant from the sun that the swiftest express train would require nearly 8,000 years to make the journey. And the great nebulæ exceed the small by many thousand times in bulk.

But what are they? The elder Herschel, who was the first to make a careful study of the subject, concluded that many of them at least are masses of a peculiar cloud-like substance, mainly gaseous,—the material out of which worlds are formed,—and falling in with Laplace's theory, he thought that in these objects we have instances of stars a-making. But when some thirty years ago it appeared that every increase of telescopic power resolved more and more of them into stars, a different theory prevailed, urged especially by certain astronomers who considered the hypothesis of Laplace to be hostile to revealed religion. They jumped to the conclusion that all the nebulæ are merely clusters of stars, the component stars themselves being as large as the other suns which constitute our stellar system, and separated from each other by intervals as vast, but so remote from us that even such suns and such abysses are confounded into these little whiffs of haziness.

This is the view of the matter presented by many of the popular astronomical works still current, and even in some of our text books; but fascinating as it is, it is demonstrably incorrect, and Herschel's original doctrine is much nearer to the truth. Time would fail to indicate the many facts which prove that the nebulæ (and star clusters too) really belong to our stellar system, and are no farther from us than the stars, but are scattered through the star depths, and that not without pretty well marked laws of distribution. For this we must refer to the works of Struve, Abbe, Proctor, and others who have discussed the subject.

But though such evidences are really conclusive, they would probably have produced but slow conviction had not the spectroscope intervened, and by a single observation so settled the main fact of the gaseous nature of certain nebulæ as to render contradiction impossible. It was in 1864 that Huggins first applied the new instrument to the study of these objects, and the very first he examined gave him a spectrum of three bright lines. This of course is absolute demonstration that the nebula in question is mainly a gaseous mass of no great density; and could the lines be identified with those of terrestrial substances, its chemical constitution would be known. In fact, one of the lines apparently coincides with the so called F line in the spectrum of hydrogen, and a fourth, since observed in some of the brighter nebulæ, also coincides with another line in the spectrum of the same gas. The brightest line of the whole is in the green, and very near the principal double line of nitrogen; so near indeed that at first Mr. Huggins supposed it to indicate the presence of that gas. At present, however, he thinks it certain that the coincidence is only approximate and accidental, and that the line is due to some other element, as yet unrecognized. The remaining line is also of unknown origin.

Not all the nebulæ give a bright line spectrum. Those which the telescope resolves into stars present a continuous spectrum like that of the sun; those which are classed as resolvable usually show bright lines upon a faint continuous background; and some of the brighter iresolvable nebulæ (notably the great nebula in *Andromeda*) give a simple continuous spectrum like the clusters. It must be remembered, however, that such a spectrum may come from gas under strong compression, as well as from incandescent solids or liquids. It may be added that all the nebulæ which give a spectrum of bright lines show the same lines, so far as yet observed, and that the appearance of the lines indicates that the gaseous matter is but slightly compressed, and at a temperature much lower than that of the sun and stars.

It would seem, therefore, that we are to consider the nebulæ as great clouds of gas, probably sprinkled throughout with minute solid and liquid particles. Whether they are luminous from simple elevation of temperature, as ordinarily understood, or in some other way more analogous to phosphorescence, is not certain. They are in various stages of lecting themselves around a single center to form a single sun. condensation; some granulating into star dust, and some col-

The distance and dimensions of a nebula have never yet been determined. A year or two ago, indeed, it was announced by an English observer that he had detected a parallax of nearly two seconds of arc in a nebula situated in the constellation of *Ursa Major*. This would correspond to a distance about one half as great as that of *α Centauri*, our nearest neighbor among the stars. But the observation has not been confirmed, and deserves but little confidence.

Of course, if the nebulæ are such bodies as have been described, they ought continually to change in form and appearance; and in fact the best observations upon those in *Orion's* sword and near *η Argus* seem to indicate actual alterations within the last fifty years. Yet the observations are so difficult, and what is seen depends so much on the observer, his instrument, and the purity of his atmosphere that great caution must be used in coming to any conclusion.

From what has been said it is easy to understand the interest with which astronomers regard these objects. It almost seems as if in studying them we might come to witness for ourselves the building of suns and systems.—*Boston Journal of Chemistry*.

A Whale Caught by a Telegraph Cable.

We published some time ago a drawing of a portion of the Singapore ocean telegraph cable, which had been pierced and injured by the lance of a saw fish. We have here to chronicle an accident of a still more extraordinary nature, by which the Persian Gulf cable was broken. The particulars are given in *Engineering:*

"The cable between Kurrachee and Gwadur (a distance of about 300 miles) suddenly failed on the evening of the 4th of October. The telegraph steamer, Amber Witch, under the command of Captain Bishop, with the electrical and engineering staff under Mr. Henry Mance, proceeded on the following day to repair the damage, which, by tests taken at either end, appeared to be 118 miles from Kurrachee. The cable was successfully grappled within a quarter of a mile of the fault.

"The soundings at the fault were very irregular, with overfalls from 30 to 70 fathoms. On winding in the cable unusual resistance was experienced, as if it were foul of rocks; but after persevering for some time, the body of an immense whale, entangled in the cable, was brought to the surface, where it was found to be firmly secured by two and a half turns of the cable immediately above the tail. Sharks and other fish had partially eaten the body, which was rapidly decomposing, the jaws falling away on reaching the surface. The tail, which measured fully 12 feet across, was perfect, and covered with barnacles at the extremities.

"Apparently the whale was, at the time of entanglement, using the cable to free himself from parasites, such as barnacles, which annoy whales very much; and the cable hanging in a deep loop over a submarine precipice, he probably, with a fillip of his tail, twisted it round him, and then came to an untimely end."

This is, without exception, the most extraordinary accident that has happened to any submarine cable which has come within our knowledge, although many strange accidents have arisen. In one case the cable across the river Yar, in the Isle of Wight, was broken by a bullock, which, falling overboard, got entangled in the cable, finally breaking it.

A Novel Contest between Horseshoers.

The horseshoers of New York and Brooklyn have been excited for a month past over a wager made between John Burns and George Boyle as to which of them could make a greater number of shoes in a specified time. Both men work in Brooklyn. Burns bet Boyle $50 that the latter could not turn out as many shoes as he could in eight hours. A day was assigned for the contest. Several hundred horseshoers from New York and New Jersey were attracted to Brooklyn to witness the contest, and considerable money was staked in outside bets on the result. Work was begun at eight o'clock, Burns being at Slavin's shop in Atlantic avenue, and Boyle at his brother's shop in Livingston street. Burns was watched by Pat. Boyle, and his opponent by Slavin. Each of the contestants had a "helper" and used the following described material: Two dozen and a half pieces of iron, an inch and an eighth wide by nine sixteenths of an inch thick; two dozen and a half, an inch by nine sixteenths; two dozen and a half, an inch by half an inch; two dozen and a half, an inch by seven eighths. Each piece of iron was 18 inches in length.

Both shops were crowded throughout the day, the spectators going from one to the other to watch the progress of the work. In seven hours Boyle made 10 dozen shoes, and at the expiration of the eighth hour he had turned out just 11 dozen and 10 shoes to his opponent's 11 dozen. Boyle was accordingly declared the winner. His was the fastest work that has ever been performed.

THE largest bar of gold ever produced was lately made up for exhibition at Helena, Montana. Its value was $50,000; weight, about 172 pounds; fineness, 900.

DECISIONS OF THE COURTS.

United States Circuit Court--District of Massachusetts.

L. C. CHASE *vs.* EDWARD WESSON *et al.*—PATENT HALTER.

The complainant having been long in the enjoyment of his patent, a preliminary injunction was ordered restraining the defendants from infringing it, notwithstanding affidavits were filed showing that articles embodying the alleged invention had been in use before the complainant made it, there being evidence to the contrary, and none of the articles being produced.

SHEPLEY, J.:

Limiting the first claim in this patent to that only which was invented by the patentee—*i. e.*, his device, as described in his specification, of such a mode of attaching a halter dee or other harness ring to a halter or harness strap by means of rivets, in the described mode, passing through holes in the described flanges of the dee or ring without the necessity of sewing, and dispensing with the use of any other material to form the "lap," in the mode and for the purpose described—the patent is for a different invention from that described in the patent to Samuel C. Hawkins, No. 21,674, granted October 5, 1858, which is relied upon to prove want of novelty in complainant's invention.

No exhibit is produced of any such harness ring with two flanges as some of the affiants on the part of respondents testify were in use before the date of the complainant's invention. The affidavits introduced by the complainant throw very grave doubt upon the question of the existence of any such devices at the dates indicated. These doubts are greatly confirmed by the omission to produce as exhibits in the case any such harness rings as the witnesses describe, which could easily have been produced if they had existed and been in use for so long a time. It is not, therefore, at this stage of the case, necessary to decide what effect they would have upon the plaintiff's patent if the court were satisfied of their prior use.

As the plaintiff has been long in the enjoyment of his rights under the patent, and there is no doubt upon the question of infringement, the injunction will issue as prayed for in the bill, until the further order of the court.

George E. Betton, for complainant.
George L. Roberts, for defendants.

Recent American and Foreign Patents.

Improved Pen and Pencil Case.

Charles H. Streightoff, New York city.—This invention has for its object to furnish an improved pencil case which shall be so constructed as to form a longer handle when the pencil is extended than when constructed in the ordinary manner, and a still longer handle when the pencil is drawn in and a pen extended. The invention consists of the slot of the inner sliding tube, made with an offset in the middle part of said tube, and with its rear part parallel to but not in line with its forward part.

Improved Harness Mounting.

Thomas Fawcett, New York city.—This invention consists in the improvement of terret rings which are covered with leather, the edges of the leather being sewed together on the inner side of the ring. A metallic band is then slipped into the ring to cover the sewing and receive the wear. In putting the coverings on the mountings, the edges of the leather are received into grooves or rabbets in the ring, which hold the edges in place when an inner ring is introduced. By this improvement these mountings, it is stated, are greatly improved in appearance, rendered more durable, and can be produced at less expense than by the old method of manufacture.

Improved Ferry Boat for Trains of Cars.

Frank Cass, New Orleans, La.—This invention consists of a truck on a railway car ferry boat, mounted on a series of screws on each side and arranged with vertical guide posts. The screws of each side are geared to a line shaft running the whole length of the truck. At one end, the two line shafts are geared together and connected with a power mechanism, so that the railway track can at any time be adjusted up or down to coincide with the shore tracks, so that the rising and falling of the tide will not interfere with the running of the cars on and off the boat.

Improved Lightning Rod.

Joseph J. White, Juliustown, N. J.—The object of this invention is to improve lightning rods, by rendering them more durable and easily made and more permanently joined together; and it consists in the joint, and in such a construction of the rod that the pieces slip together, and the ends lap past each other and form the joint. Two rivets pass through the joint at right angles to each other, thus securely binding the parts together, and making the joint the strongest part of the rod.

Improved Measuring Faucet.

Jacob Schalk, Jr., Guttenberg, N. J.—This self-measuring faucet consists of two faucets combined and a measuring cup. When a hollow plug is turned so that two orifices correspond in position, in whole or in part, the liquid in the can will run down into and fill the cup. When the orifice is closed, the orifice in the plug is brought in communication with an air tube, which subjects the contents of the cup to atmospheric pressure, and allows a free discharge thereof. The plugs of the faucets are connected by means of a gear wheel on each. The receptacle is placed beneath the discharge tube and the plug turned, which, by virtue of the gear wheel, turns the inner plug and closes an aperture. The liquid in the cup (and no more) is consequently discharged. When that quantity is drawn off, the faucet is turned back and the cup immediately fills, and it is ready to be again discharged.

Improved Children's Carriage.

Thomas Galt, of Rock Island, Ill.—This invention consists of the body of a child's perambulator mounted on the frame with rockers, so that it can be used as a cradle as well as a perambulator when it may be required to do so. Hooks are attached to fasten the body, so that it will not rock when it is not desired.

Improved Evaporating Pan.

David Watson, of Mexico, Mexico.—The invention consists in providing the evaporating pan or vessel with a channel or canal surrounding the same at the top, and leading at the ends into a filter, which is in communication with said pan or vessel near the bottom, the object of such arrangement being to receive the overflow caused by ebullition of the saccharine juice and filter or strain the same before it again enters the vessel.

Improved Street Sweeping Machine.

Leslie J. O'Connor, of Chicago, Ill.—This invention is an improvement in street sweeping machines of the class in which a fan is employed to draw the dust away from the rotary brush and into a suitable receptacle. The improvement relates to the arrangement of a train of driving gears for communicating motion from one of the truck wheels to the brush, in combination with vertically adjustable supports for said brush, whereby the raising and lowering of the same does not in any way obstruct or interfere with the train. The invention also relates to the arrangement of a curved sheet metal hood directly over the front upper portion of the rotary brush, and having a pipe leading from the center thereof to carry off the dust. The machine is designed for removing snow from street railways as well as dust, and the broom is extended each side beyond the truck wheels as much as it is desired to remove the snow from each side of the track.

Improved Car Starter.

Benjamin F. Oakes, of Milford, Me.—The object of this invention is to provide means for moving railroad cars by hand and by one man power; and it consists in a lever having a head adapted to be pivoted directly or indirectly to the drawhead of a car at its middle, and provided at each end with an arm, having a gripe so that the lever may be vibrated horizontally to each clamp arm, acting alternately to hold the rail and give purchase to the operator.

Improved Oil Can.

William G. Cowell, of Wallingford, Conn.—The invention consists in using a can to hold oil, a heater pipe to keep it in a melted state, and a pump to discharge it from the can, all being combined to operate together. The pipe may connect at the upper end with the exhaust pipe of a steam engine, or with the hot feed water pipe of a hot air reservoir, so that it can be readily attached at any time to be heated. It may be coiled within or around outside of the can, or a jacket may surround the can wholly or in part, with pipe connections to conduct the heating medium into and out of it. This plan is preferable to the ordinary method of setting the can on a stove to heat the oil.

Improved Seed Planter and Fertilizer Distributer.

Richardson Montfort, of Butler, Ga.—This invention relates to an arrangement of vertically adjustable shoes or supplementary seed distributing hoppers with stationary receiving hoppers, whereby the delivery of seed from the latter to the former may be conveniently and perfectly controlled or stopped altogether, as required.

Improved Flour Bolt.

William Goshorn, of Waterloo, Pa.—The object of this invention is to improve the old reel bolt in such a manner that the flour is cooled in bolting, so as to be fit for immediate packing; that it bolts faster and cleaner, and requires less cloth, which lasts longer time, as no middlings or bran remains in the bolt, offering thereby less opportunity for injury or destruction by insects. The invention consists in arranging the flour bolt in upright position, with stationary cloth, and a fan with straight and curved partitions.

Improved Stove Pipe Thimble.

Thomas D. Slauson, of Havana, N. Y.—The object of the invention is to furnish an improved casing for conducting stove pipes through wooden partitions, which is easily fastened in position, protects the lathing fully against any danger by fire, and leaves no communicating holes between the rooms, being fully covered by the plastering. It consists in a double casing, which is attached suitably to the wooden partition, being provided with bent up face pieces and side perforations, through which the circulation of the air around the inner casing is kept up.

Improved Automatic Gate.

George W. Olbert and William Young, of Barr's Store, Ill.—The improvement consists in a pendent swinging gate, connected by means of cranks and rods with pivoted levers, which are arranged horizontally and parallel to the roadway, so that, when a vehicle wheel is run on to one of said levers, the gate will be thrown by the superior weight of the vehicle into a nearly vertical position, leaving the passage way unobstructed.

Improved Children's Carriage.

Albert F. R. Arndt, of Detroit, Mich., assignor to himself and W. Doeltz, of same place.—The object of the invention is to so improve the child's carriage in common use that the handle part may be detached and applied at pleasure either to the front or rear of the body. For storage during the winter months, space is saved by the disconnection of the handle, which is, in many cases, a great convenience. The invention consists in attaching, to the front and rear ends of the carriage, sockets for the handle ends, into which the latter lock by means of suitable spring catches.

Improved Check Rein.

George J. Townley, of Parma, Mich.—This invention consists in a check rein attached to the head stall on each side of the horse's head. A pulley is fastened by a frame to this rein. One end of a strap is passed around the pulley coupled with the ordinary check rein, and extends back within reach of the driver. This rein gives the driver complete control of the horse, as, by the purchase which he obtains by means of the pulley, he can draw the check just as tight as he pleases, and stop him or check his speed if he is disposed to be unruly, or attempts to run away.

Improved Mode of Securing Wheel Hubs to Shafts.

Edwin Sanford, of Hartford, Conn.—For fastening pulleys, cog wheels, etc., on the shafts in a way to save the expense of boring the hubs, turning the shafts, and fitting the wheels to the shafts, it is proposed to cast the wheels with their holes a little larger than the shafts, and with three or more grooves in said holes, in which gibs or keys are fitted. On the latter the wheels are secured and trued to the shafts by set screws, screwing through the hubs and clamping the gibs on the shafts.

Improved Apparatus for Cleaning Cesspools, Sinks, etc.

J. P. Florimond Datichy, Brooklyn, N. Y.—The object of this invention is to improve the machines for emptying and cleaning sinks, privies, cesspools, sewers, marshy lands, etc., in a perfectly odorless manner, so that the work can be done in the day time without the least discomfort and annoyance to the occupants of the dwellings, and without the use of separate machines by which the vacuum in the tank is created. The invention consists of a tank of suitable capacity, which is provided with double acting pneumatic pumps and all necessary appurtenances to insure the efficient working of all the parts. The tank is carried on a four wheeled truck of suitable strength, and the vacuum is created by the hind wheels working the air pumps by eccentrics, said action to be discontinued by the application of a regulating gear, which frees the piston from its shaft, according to a gage placed on a cupola connected with the tank, which assists, also, the perfect working of the machine.

Improved Toy Device for Making Soap Bubbles.

Samuel B. Bliss, New York city.—The object of this invention is to furnish, for the amusement of children, a toy instrument by which soap bubbles may be easily and quickly produced, without the spilling of soap water and other inconveniences. The invention consists, mainly, in the arrangement of a double tubular casing for soap and soap water, with an air pipe and exit tube, in which latter the quantity required is regulated by a suitably constructed valve arrangement.

Improved Internal Spring Coupling and Brake.

Léandre Mégy, José De Echeverria and Felix Bazan, Paris, France.—This coupling system is based on the use of one or several blade springs suitably curved, inclosed within a hollow drum or pulley, and working by their own expansive force, which keeps them pressing more or less closely against the internal cylindrical face of the said drum or pulley. This expansive force, independent of any exterior action, causes a close adhesion of the said spring to the hollow pulley, which makes them, as it were, a single piece by preventing their sliding on one another, and this adhesion can only be destroyed by an impulsion from the exterior. It follows, therefore, that, if one of the two mentioned pieces, either the spring or the pulley, is set in motion, it naturally carries along the other one, so long as the resistances which the latter has to overcome are insufficient to produce the sliding of the said pieces on each other, or so long as the adhesion between the spring and drum is not destroyed, either completely or partially, by any exterior action. The self-acting brake is claimed to afford security for the handling of the heaviest loads. The ascending movement being caused by the effect of the adhesion of the spring to the pulley, then if this adhesive force was able to raise the load it will, of course, be able to maintain it in suspension at any period of its ascent. The workman has no ratchet to lift up, no kind of operation to perform in which he could make a mistake; he has only to turn the crank round to cause the load to ascend, to weigh lightly on the same crank in a contrary direction in order to cause the said load to descend; he may, at pleasure, regulate the descending speed and stop it at any moment by only letting go the handle, having no effort to make, no danger to run, since the crank does not revolve when the load moves down, so that he has nothing to preoccupy his mind. The almost instantaneous stoppage which takes place when suddenly letting loose the handle cannot have any hurtful effect on the chain, for the active impulse is employed only to cause the spring to slide till that impulse is annulled by the friction of the latter on the pulley.

Improved Oscillating Gland for Flowing Oil Wells.

George Finton, Meadville, Pa.—This invention relates to an apparatus which is fastened to the top of the casing to prevent the escape of oil or gas during the process of drilling oil wells; and it consists in a ball and socket gland which permits the rope from which the iron tool is suspended to pass through the gland oil and gas tight, and to move up and down in the act of drilling without permitting either oil or gas to escape, except through proper orifices. If oil escapes, it may be conveyed to an oil tank, and if gas escapes it may be conducted off to a distance, so as to avoid danger.

Improved Method of Propelling Boats.

Abram Beekman, New York city.—To the bar or lever of the paddle are hinged two blades in such a way that when moving forward through the water the pressure of the water will close them. These are kept from closing against each other by one or more stops, interposed between them and attached to the bar, so that as the paddle begins to make the stroke the pressure of the water may open or spread the blades so as to present the greatest possible surface. The upper ends of the bar are designed to be attached to the shafts, which are arranged so as to be operated independently of each other. The shafts are placed in line with each other, and a pintle may be attached to the end of one shaft to enter a socket in the end of the other shaft. Levers are attached to the inner parts of the shafts, extending above and below said shafts, and having handles attached to their upper ends and foot rests attached to their lower ends, so that the operator can apply hand and foot power.

Improved Fastening for Bedsteads.

James M. Baird, Wheeling, W. Va.—The object of this invention is to produce a simple and reliable means for connecting converging rails, boards, or pieces of articles of furniture, so that such converging or joining pieces may be firmly held together, but so that they can be readily taken apart. The invention consists in the application, to such converging pieces, of wedge-shaped or oblique edged blocks, of which one is attached to each piece in such position that the two blocks, when overlapping each other with their oblique faces, hold the pieces to which they are attached properly together.

Improved Shears.

Allen Lapham, Paterson, N. J., assignor to himself and Orville W. Leonard of same place.—This invention consists of a compound lever arrangement of one of the arms or handles of the shears, to increase the leverage. The handle or arm is in two sections, of which one is a part of the blade, terminating a little beyond the pivot by which the two blades are connected together, and is pivoted at said end to the other section a short distance above its lower end. The latter is connected by a link to the handle for a fulcrum. It extends from the pivot which connects the two sections along with the other handle to its end. A wider sweep and more power is thus given to the blades. The improvement is designed more particularly for the "snip" shears used by tinners and others for cutting sheet metal.

Improved Picture Frame.

Felix Reifschneider, New York city.—This invention consists of a round or oval frame, of wood, metal, or other material, covered with velvet or other cloth, and the cover secured at the edges by ornamental spun metal bands, in addition to being glued to the surface of the metal or wood portions.

Improved Mordant for Dyeing.

Gustav A. Hageman, Copenhagen, Denmark.—This invention relates to the mordant chemically known as acetate of alumina. Acetate of soda is calcined to an anhydrous or a monohydrous state, and then pulverized by means of a fine sieve. The finest powder is removed and mixed with a fresh charge of hydrous acetate to be calcined. The coarser powder of average fineness is separated by another sieve, and forms the part prepared for use. Sulphate of alumina is ground and then sifted in a similar manner. The two coarse grained powders thus obtained are then mixed with each other, preferably by sifting both at the same time through an open sieve, and the mixed powder is ready for packing. The sulphate of alumina may be used in the form of crystal alum, concentrated alum, aluminous cake, etc.

Improved Elastic Seat for Railway Rail Joints.

Lewis Scofield, Jr., Atlanta, Ga.—This invention is an improvement in cushioning the joints of railroad rails; and relates more particularly to a socket plate for the rubber cushion, which is provided with end flanges to adapt the cushion for use with wooden sleepers or cross ties.

Improved Boiler Feeder.

Rafael Rafael, Havana, Cuba.—The object of this invention is to furnish an automatic water feeder for steam boilers. There is a many chambered cylinder, the periphery of which is provided with cogs, which engage with a perpetual screw of the driving shaft, by means of which the cylinder is slowly revolved. The cylinder is placed between two plates, which are secured together by bolts. The cylinder revolves watertight between these plates, the contact surfaces being ground so as to make tight joints, and still allow the cylinder to revolve. The feed water descends through a pipe and fills one of the chambers, the air contained in the chamber being forced out through an upper pipe, in which the water rises to a level with that in the tank. Power being applied to the pulley on the worm shaft, the cylinder is slowly revolved, and the full chamber is carried round to the discharge pipe, while other chambers are filling and being moved in the same manner. When the chamber reaches the discharge pipe, the water is subjected to boiler pressure of steam by means of the steam pipe; and if there is a deficiency of water in the boiler, the water in the chamber will fall by its own gravity, and the chamber will move along filled with steam until it reaches orifices in the upper plate, when the steam will be discharged. The cylinder thus keeps revolving, and the chambers constantly discharge water in sufficient quantity to keep the water in the boiler up to the desired level.

Improved Water Wheel.

Eli Overton, Utica, N. Y.—The gages for regulating the capacity of the buckets according to the volume of water to be used consist of horizontal plates, constructed in the form of the cross section of the space between the upper or vertical portions of the buckets. They are attached to the lower end of the curb surrounding the upper portion of the wheel, and extend above it and the upper wall of the chutes as high as the gages may require to be lowered. The gages for the chutes are attached to the curb, which is the gate to be raised and lowered by it, and thus be adjusted as readily as the gate is. The gate being connected by its sleeve with the sleeve to which the wheel gages are connected, both the wheel and the chute gages will be adjusted together and alike, and at the same time that the gate is opened, so that the labor of adjusting the wheel gages separately to the different hights as the stream varies, or as the labor to be performed by the wheel varies, will be avoided.

Improved Ice Cream Freezer.

Miller F. Graves, Sunbury, Pa.—In the bucket is made a stationary tube of perforated sheet metal. This is placed at the center, and extends nearly as high as the top of the pail, and is large enough to receive the cream can, which has a non-conducting cover lined with charcoal. The ice is packed in the space between the tube and the shell of the pail, and is, by the curb, prevented from filling up the center of the pail when the cream can is taken out, so that as many cans can be put in and taken out as may be desired, without repacking the ice.

Improved Safety Platform for Railroad Car.

Richard Strode, of Coatesville, Pa.—The invention is designed to prevent persons from falling between the platforms of cars, and fracturing their limbs, or otherwise more seriously injuring themselves. It consists in a relative construction of the platform ends which enables them to come into contact, yet allows the lateral motion required in the attachment to each car of a projection which passes under the opposite one (and this prevents them from telescoping with one another), and finally in pendent stops which are placed on the sides of platform and outside of the rail to prevent cars from readily upsetting and falling over embankments.

Improved Reversible Plow Point.

Robert M. Pattillo, of Cartersville, Ga.—This invention relates to the plow iron now generally used in the cultivation of cotton upon a one horse frame, and attached only to the foot of standard by a bolt, which passes through the plow, and which holds it in a notch upon an inclined surface. These are known through the South as twister plows, the share and mold board being in one piece, somewhat spirally concaved. The invention consists in the peculiar relative construction of the two parts of these twister plow irons, so that the mold board and point become interchangeable, and, wearing at different parts, enable nearly or quite double the service to be obtained out of the same quantity of metal.

Improved Bee Hive.

Joseph R. East, Fincastle, Tenn.—The hive is so constructed that honey can be removed with perfect safety, yet without injury to the bees, and the swarm can be divided, or entirely removed from the hive, with equal facility. The hive is also well ventilated, is provided with means of protection against moths, and adapted for use of a ventilating attachment in the form of a wire gauze basket which allows admission and circulation of air, and forms practically an extension of the hive, which the bees may enter at any time whenever the heat is too great within the hive.

Improved Car Coupling.

Willie D. Pope, Gadsden, Ala.—The bumper heads are alike and made of the usual hopper shape. Pivoted within at its angle, by a transverse pin, is a two armed lever—one arm of which projects toward the mouth of the bumper, and has a hook on its extremity, and the other extends up through a slot in the upper part of the drawhead. The link, entering, is guided by a spring so as to catch under the hook. A cord may be attached to the forward end of the upper arm of the hooks and carried up to the top of the car, so that the hook may be raised for uncoupling from that point.

Improved Plow.

John S. Hall, Pittsburgh, Pa.—This invention relates to plows, and consists in a projection plate applied to the rear of the mold board so as to serve several useful purposes; in a novel mode of splitting the beam so that the landside is formed out of the same piece of metal; also in placing the hook which connects the mold board and beam at the rear end of an extension of the beam and enabling it to hold by the rear end of the mold board.

Improved Artificial Teeth.

William C. Tracy, Brooklyn, N. Y.—This invention has for its object to furnish artificial teeth, single and in blocks, so that they may be more conveniently and firmly secured to the various plates or bases upon which they are set or mounted. It consists in a platinum lining upon the back of the teeth, with or without pins. When the teeth are to be applied singly, or in blocks, to a rubber or vulcanite base or plate, the platinum lining will be covered up and concealed by said plate.

Improved Wood Fence.

Robert F. Ward, Senatobia, Miss.—The stakes are used in pairs, set at such an inclination toward each other that they intersect or cross, and are placed at the usual distance apart to form a panel of fence. A rider is supported in the angles formed by the intersection, and an upright is placed centrally between each pair of stakes. These uprights extend to near the intersection of the stakes, with a rider extending across the top ends thereof. Braces are attached to the stakes at one end, while the other end rests, beneath the lower angle of the latter, on the rider. The uprights are connected with the stakes by slats, and placed at an angle of fifteen degrees with the surface of the ground. Rails rest on these slats, and their ends lap past each other by placing them on opposite sides of the uprights. The fence is said to be straight, and proof against unruly stock as well as high winds.

Improved Grave Covering.

Joseph R. Abrams, Greenville, Ala.—This invention relates to mounds erected over graves, and consists in three arches of stone sunk in the ground so that their upper faces are about level with the surface. On these rest four inwardly inclined plates, which support another plate with an oval opening and an angular recess.

Improved Device for Changing the Speed of Machinery.

Alfred Betts, Wilmington, Del.—This invention consists in a mechanical movement by which the velocity of a drive shaft may be quickly lessened to give greater power, or the reverse, a portion of the former being converted into the latter, or *vice versa*, as may be desired.

Improved Explosive Engine.

Josiah M. Welbourn, Caledonia, Ohio.—The object of this invention is to construct an engine which is driven by the explosive force of powder charges. The invention consists in the introduction and explosion of powder charges into chambers, which are alternately discharged to act on pistons, which turn the driving wheels, and are regulated by suitable mechanism. The base frame on which the engine is placed is of oblong shape, and contains two powder chambers arranged parallel to each other in longitudinal direction at both sides. The driving wheels produce, by alternately completing one half of a revolution on each wheel, rotary motion of a shaft from the reciprocating motion of the pistons. Each powder chamber is closed by an adjustable breech piece, which may be detached for cleaning out the chamber. The closely fitting piston moves in the chamber, its piston rod connecting, by a cross pin, with a strong spiral spring, which is also applied by cross head and pitman, to the side of a driving wheel. The required quantity of powder is introduced, in cartridge form, into the chamber by means of a vertical casing, which is arranged on guide rails placed on the top of the chamber. A brush of casing serves to secure the cartridge in recess of the sliding piece, which is carried forward and backward in guide rails. On the forward motion of the slide the cartridge drops into a chamber, to be carried back toward the breech piece by the returning piston, and be discharged by the concussion against the breech block. The piston is, by the explosion, forced forward again, and causes, by its action on the pitman, the rotation of the wheel. The smoke and gases escape through side apertures, admitting the immediate recharging of the chambers.

Improved Butter Print Press.

Lewis Coates and Joel T. Criswell, Collamer, Pa.—The object of this invention is to furnish to farmers and dairymen an improved butter print or press, by which the butter may be quickly and evenly formed into cakes of required weight, with suitable print marks thereon, without previous weighing. It consists in a sliding box, into which the butter is introduced and pressed on a printing block, by a follower block and lever, into suitable shape and weight.

Improved Painted Cloth Cover.

William D. Richardson, Pawtucket, R. I.—The cloth or other material used for ornamenting, is backed before painting on with any stiff material, whether of pasteboard, wood, metal, rubber, or any combination of the same, provided it is thick and strong enough to fasten permanently and securely thereon. It is cut of the exact size required, and bound with metallic edges to protect the edges and prevent a disconnection of the cloth from the board. The metal edges serve also as an ornamental finish. If used as a table cover, it may be glued, tacked, or screwed down, or it may also be used as a movable cover, and be made with leather and cloth hinges to be folded up, which, in the case of chess boards and other games is very desirable.

Improved Armpit Shield.

James Sibley, New York city.—The object of this invention is to provide means for protecting the dresses of ladies from the ruinous effects of perspiration under the arms; and it consists in a shield or protector made of what is known as chamois skin or equivalent material and oiled silk or equivalent material in combination.

Improved Life-Preserving Mattress.

John J. Woodfine, Hoboken, N. J.—This invention is a life-preserving mattress, made of cork strips or similar buoyant material, having end sections connected with a middle section by straps that interlock, one sliding upon the other and both together, allowing the said end sections to turn up on either side of the middle one, so that they can swing up edgewise when the mattress sinks by the weight of a person. Cords are arranged on the edges of the middle and end sections for grasping the float by one floating in the water, and they are provided with the loops, also, for grasping hold of and for making temporary rowlocks, in which to use paddles for propelling the raft.

Improved Taper-Turning Attachment to Lathes.

Michael Neckermann, Pittsburgh, Pa.—This invention consists of a toothed rack on a lathe frame, and a system of gears on the tool slide, which moves lengthwise of the lathe, combined with the screw which works the tool slide crosswise in such manner that the tool is fed crosswise of the lathe at the same time that it is fed lengthwise, so as to turn tapers. The wheels are graduated and the supports contrived so that, by the use of interchangeable wheels of different sizes and numbers of teeth, tapers of various predetermined angles can be produced, and they can be turned either way—that is to say, from the large to the small end, or *vice versa*.

Improved Car Coupling.

James Griffith and William F. Miller, Adamsburg, Pa., assignors to themselves and C. D. B. Eisaman, of same place.—The entering coupling bar passes back in such a direction as to strike the pivoted block below its pivoting point, swinging the same back and continuing on beneath its lower edge. An enlargement is formed in the upper part of the drawhead, to give room for the pivoted block to swing in. The coupling bar is made with a joint in its middle part, to adapt it for use in coupling cars of unequal hight. This joint is made with almost straight shoulders, to guard it from dropping down too far. The ends of the coupling bar are rounded off, and have shoulders formed upon their upper sides near their ends, to receive the lower ends of the pivoted blocks, and thus sustain the draft strain. With this construction, the lower end of the block is free to swing inward, to allow the cars to be coupled by the entrance of the coupling bar. To uncouple the cars a key is drawn out, which allows the block to swing freely in either direction.

Improved Vehicle Axle Box.

Oliver P. Rice, New York city.—This invention has for its object to diminish the wear and friction of axle journals and boxes, particularly those of rail car trucks; and it consists in a chambered axle box provided with a flange in which the lubricating material is contained, and from which it is discharged to the frictional surfaces, and on a perforated journal sleeve, which is also provided with discharge orifices by means of which the axle is lubricated. There is a cap nut on the end of the axle, which incloses the ends of the box and sleeve, and comes in contact with the hub of the wheel.

Improved Wheel for Vehicles.

Peter C. Hairston, Crawfordsville, Miss.—The object of this invention is to construct an improved metallic wheel for wagons, carriages, etc. It consists of a hub with projecting central piece and two detachable collars, into which the two dovetailed ends of the spokes are mortised and held by lateral screw connections. The curved spokes bear against the tyre, and are, with their conical outer ends, screwed therein.

Improved Railway Switch.

Joseph J. Rockwell, Shell Rock, Iowa, assignor to himself and Peter C. Wette, of same place.—This invention consists of apparatus arranged in connection with the switch to be actuated by a shaft or wheel on the locomotive coming in contact with a lever alongside of the rail, and caused to unlock the switch and change it, and shift the target before the locomotive runs on to the switch, the said apparatus being arranged so that a locomotive approaching from either direction will shift it.

Improved Miner's Pick.

Richard K. Walton, Clarington, Ohio.—This invention consists in a movable bit attached to an ordinary pick, provided with two triangular points and prevented from turning by a clamp screw.

Automatic Lubricating Water and Gas Cock.

Edwin F. Brooks, Baltimore, Md.—This invention consists in a water or gas cock provided with a valve having an oil reservoir in one or both ends and connected with the outer surface of the valve by a suitable aperture; also in a spring piston, applied in connection with the screw cap so as to expel the oil.

Improved Children's Carriage.

Lucinius Havasy, Hoboken, N. J.—The body is constructed mainly in the form of a covered chair with inclosed sides, and suspended by arms from a rod, which is mounted at the top standards, extending up from the lower portion of the frame about as high as the top of the body, so that it can be swung forward and back whenever it may be desired to do so to quiet the child. For this purpose the wheels are made small and arranged wide apart, to suspend the body as low as possible, and afford a substantial support for the body when swinging. It is proposed to mount the frame on the middle cross bar of the wheel frame by light, flat, semi-elliptical springs, bolted to said bar at the middle, and connected at the ends to the side pieces of the frame by their turned up flanges, which are notched and fitted in notches in the frame.

Improved Sash Fastener.

Edward Burstow, Horsham, Sussex county, England.—This invention relates to the ordinary sash fastener, which prevents the window from being opened, and consists in means whereby the introduction of a blade or instrument between the sashes in order to unlock them may be effectually prevented.

Inventions Patented in England by Americans.

[Compiled from the Commissioners of Patents' Journal.]

From October 30 to November 3, 1873, inclusive.

BOILER FURNACE.—L. Stevens, Washington, D. C.
BOOT LASTING MACHINE.—G. McKay, Boston, Mass.
EXCAVATOR.—T. FitzRandolph, Morristown, N. J.
FURNACE FOR IRON, ETC.—S. Danks (of Cincinnati, Ohio), London, England.
HORSESHOE MACHINERY.—M. E. Hawes, Somerville, Mass.
MAKING CANS, ETC.—T. J. Powers, New York city.
METAL TUBING, ETC.—S. W. Wood, Cornwall, N. Y.
NAILS AND SPIKES.—B. T. Nichols, Roselle, N. J.
PEN FINGER GUARD.—S. T. Pomeroy (of New York city), London, England.
PRESERVING TEETH.—G. H. Chance, Salem, Oregon.
PUDDLING FURNACE.—S. Danks (of Cincinnati, Ohio), London, England.
RAILWAY CARRIAGE.—W. B. Rogerson, Paterson, N. J.
SLIDE REST, ETC.—S. W. Wilson (of Philadelphia, Pa.), London, England.

Value of Patents,

AND HOW TO OBTAIN THEM.

Practical Hints to Inventors.

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

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

HOW TO OBTAIN *Patents*

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

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

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

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ANSWERS TO CORRESPONDENTS

In our answer to T. C. E., page 331, current volume, it is stated that either borax or shellac will probably dissolve the gum of the peach tree. The word ether should be substituted for either.

P. G. W. asks: Is it practicable to raise water 14 or 15 feet with a steam ejector through a 3 inch pipe? How many cubic feet of steam at a given pressure to 100 cubic feet water raised will be required? Will it be as economical as to use a steam pump for the work? Answer: The ejector will work very well under the circumstances mentioned; but probably it will not be as economical as a good steam pump.

T. asks: 1. Has there ever been discovered, and if so what is it, a geometric rule for trisecting any angle save a right angle? 2. Is there any known way by which a hyperbola or parabola may be trisected? Answers: 1. An equation of the third degree is involved in the solution of this problem. 2. We do not understand what you mean by this question.

A. M. asks: How can I get iron out of dipping acid (nitric and sulphuric) which has accidentally been dissolved in it? It gives the brass articles a dull color when dipped in it. Answer: If the mixed acids are not too strong, you can precipitate the iron as prussian blue by the addition of dilute solution of yellow prussiate of potash (ferrocyanide of potassium). Add the yellow prussiate solution by degrees, stirring well until a blue color ceases to be formed, and then allow to settle. Pour off the acid from the precipitate.

C. A. asks: How can I remove and prevent rust on a cooking stove? Answer: Remove as much of the rust as possible by scraping and brushing, and then rub with plumbago, ordinarily called black lead. The ordinary stove polish is this substance prepared for the purpose.

J. A. M. asks: What is the best material for a bake oven? Answer: A brick oven will probably be the most serviceable, but you can make one of mud or clay.

F. W. D. asks: If a current of electricity be passed through a telegraph wire, always in one direction, how can I find the direction it takes, knowing nothing of its connections with the battery, yet having access to the wire? Answer: If the wire runs approximately north and south, you might be able to tell the direction of the current by placing a magnetic needle beneath it, and observing the deflection. If the wire runs nearly east and west, it would probably be necessary to attach a compensating magnet, so as to annul the influence of the earth's polarity. In case the intensity of the current is not sufficient to deflect the needle, you might be obliged to employ a delicate galvanometer, and also to cut the wire and attach the ends to the instrument. You will find directions in regard to the use of galvanometers in any good text book on electricity.

J. H. M. says: 1. I have two boilers, 4 feet diameter, 16 feet long, with two 16 inch flues. The fire is under front end of boilers; it passes under boiler and returns through the flues and up the chimney. Will some one tell me how large and how high a round iron chimney should be to have a good draft? Fuel is wet sawdust. I want to carry 90 lbs. steam and burn as much sawdust as possible. 2. Will some one describe a furnace and give its capacity for burning sawdust and making steam? 3. Is there a tightening pulley in use with a rubber tyre? Would such a thing not be preferable to wood or iron, being a saving of belts? Answers: 1, 2. It is quite common to use sawdust for fuel, in many localities. If you will write to any good builder of stationary engines and boilers, he will probably send you an engraving illustrating the arrangement of furnace. Perhaps some of our readers who have had experience with this fuel will be kind enough to send descriptions. 3. We scarcely think that such a pulley would be desirable.

D. T. T. asks: 1. What attractive or lifting force has the most powerful magnet ever known? 2. Is there any magnet that will lift an object upward to any distance? Answers: 1. About $5\frac{1}{2}$ tuns. 2. No.

R. B. says: While at breakfast this morning a drop or two of coffee was by accident spilt on my plate, and came in contact with some sirup I had been eating. The peculiar shade assumed by the mixture raised my suspicions that all was not right with the sirup. On further trial, I found that the coffee and sirup, when mixed, turned very dark, while coffee and molasses did not change color. I afterwards tested the sirup with tannin, and found, as I expected, that I had a pretty fair article of ink from the mixture. I presume the sirup was made from starch. I would be glad to have your opinion as to the healthfulness of such sirup, and whether coffee may be considered a fair test for glucose? If so, it certainly is a very simple test, which can be made at any time, and should be better known. Answer: The reaction of which you speak indicates the presence of iron in the sirup. Tannic acid, it is well known, as well as its salts, are characterized by striking a deep black color with the persalts of iron. There is sufficient tannin in coffee to effect this reaction, and the iron in the sirup is probably due to the iron vessels used in its manufacture. We have ourselves noticed the reaction of tea with iron.

J. A. C. asks: 1. Would rubber dissolved in bisulphide of carbon be of any use on the inside of a gum belt from which the rubber has been worn off? Would it adhere well, or would the solvent injure the cotton of the belt? 2. Would this solution do for waterproofing boots and shoes? 3. We are using a locomotive boiler with 66 two inch flues; we have had great trouble with their leaking; we have had them reset, but they were no better. Then we stopped using the water from our well, and took it from a dam on a small stream, since which we have had no trouble. Now the tubes are clean, or very nearly so. Do you think that any kind of clear water would cause them to leak, at once? From appearances, it was the water that caused it, but we are surprised that any water should cause it at once, and thought that they must become coated so as to overheat first. Answers: 1. We do not think that you can repair the belt in the manner mentioned. 2. There is a solution made for this purpose, which answers very well. 3. Fresh water sometimes cuts out scale or mud at once, causing leaks.

S. A. T. says: I had about $10 worth of postage stamps, torn apart, in a tin box on my desk; and somebody upset ink on them, which has dissolved the gum on them and soiled nearly all of them. The gum has dried and they are all stuck together and soiled with ink. What can I do with them? I can soak them apart, but now about the ink? Answer: After carefully soaking the stamps apart, you can remove the ink stain by brushing them over with a fine camel's hair brush dipped in a dilute solution of oxalic acid. Oxalic acid is poisonous, so that care must be exercised in using it.

J. T. A. asks: 1. Can buckshot be fired from a swivel boat gun, so as to kill large birds at 1,000 yards? 2. What would be the length and caliber of such a gun, and the proper charges of powder and buckshot? Answers: 1. No. 2. Your best plan would be to copy as nearly as possible the 12 pound mountain howitzer, used in the army. The weight of this gun is 220 pounds. You might place your buckshot in canisters, and thus obtain a range of perhaps 500 yards; but the deviation of the balls at the end of their path would be over a space of fully fifty feet in diameter. The proper charge of powder is ½ lb. to the above mentioned weight of projectile. If you have facilities for making shells and understand the arrangement of time fuses, you can do good execution at 1,000 yards range, elevating your piece to 5° and cutting your fuse at 3 seconds. For further information, consult any standard work on gunnery, or the Army Ordnance Manual, whence you can obtain full particulars as to caliber, material, length, etc.

W. P. asks: In heating a greenhouse by hot water, would it not do to carry the smoke along the floor in an ordinary heating flue, and thus utilize its heat instead of carrying it directly up the chimney as is usually done? Answer: A very common method of heating greenhouses is to carry the smoke flue along the floor, as you suggest.

R. asks: Which locomotive engine has the most power to start a heavy freight train, one with large drive wheels or one with small? Answer: The engine with small wheels has more tractile force, other things being equal, because the difference between length of crank and radius of wheel is less than in the case of an engine with larger drivers.

H. D. asks for a formula for bay rum. Answer: Tincture bay leaves 5 ozs., otto of bay 1 dram, bi carbonate of ammonia 1 oz., borax 1 oz., rose water 1 quart. Mix and filter. Bay rum is said to be made in the West Indies by distilling rum with the leaves of the bay tree.

P. asks: What is the exact difference in time between New York and Washington? Answer: Twelve minutes, fifteen and forty-seven hundredths seconds, (12 min. 15·47 sec.).

S. E. asks: What is a horse power of an engine? Answer: A horse power, when used in reference to a machine, is a unit for expressing the amount of work that it is capable of performing in a given time, being the power required to raise 33,000 pounds one foot high in a minute.

F. O. W. says: What is the requisite education for entering the United States navy as engineer? Also, what experience, influence, money, etc., are needed? In what text books would one be examined? Answer: We believe that it is necessary for all those who wish to join the engineer corps of the United States Navy to enter the Naval Academy as cadet engineer. If you will write to the chief of the Bureau of Steam Engineering, Navy Department at Washington, we think you can obtain a circular giving full particulars.

F. P. B. says: Why does a barometer show the same pressure of atmosphere inside a room as it does outside? Answer: Because the atmosphere of the inside of an apartment communicates, through the cracks of the doors, windows and other parts, with the outside atmosphere. If the room in which the barometer is placed is airtight and rigid, the barometer will not be affected by changes in the exterior atmosphere.

A. B. K. asks: 1. What is used to give imported pickles their agreeable flavor? 2. Is there anything that will prevent the icing of cakes from rapidly turning yellow? 3. What is used to prepare the sugar for molding for ornamenting? Answers: Wash your vegetables and fruit in cold spring water, and steep for some days in strong brine; drain, dry, and put in jars; add the spice, if required, and fill up with hot, strong, pickling vinegar; cork up tight, and tie over with bladder. When the jars are cold, seal over the corks with sealing wax. The ordinary difficulty is with the vinegar. It is useless to try to make good pickles with sour cider. Use a malt vinegar, if you can get it. 2 and 3. Beat the white of eggs to a full froth, with a little rose water; add, gradually, as much finely powdered sugar as will make it thick enough, beating it all the time. Use vegetable coloring matter for the ornaments. This ought not to become rapidly discolored, if the sugar is pure.

C. S. K. asks: Why does a hair out of the tail of a horse, thrown into warm water, become animated in a few days, with apparently some of the characteristics of the snake? Answer: It does not.

J. A. asks: What is the law in regard to joint interests of employer and employee in case of patentable improvements on machinery? For instance, employer, A, is using new and peculiar machinery of his own device and construction; employee, B, is at work for A, for *per diem* wages, and he proposes changes and improvements which, with A's advice and consent, are put in at A's expense of time, material, and risk, some of which improvements in their details A requests to have tried; the improvements operate successfully; A proposes to have a patent, and orders a model constructed, which B goes on and builds, employing the assistance of other workmen of A. Now to whom belongs the right of the patent? Can either party claim it for himself? Or does it belong to both? If B may claim it, what becomes of A's right and interest, the improvement being devised expressly for him at his expense and under his order and knowledge? Answer: The rule is that when an employer directs an employee to make a thing, giving him general instructions what to make, the invention belongs to the employer, the other party having merely exercised his mechanical skill in carrying out orders. But where an employee gets up a new improvement without such instruction, the invention belongs to him though made while at work for another party. Where the invention of an employee is put into use with his knowledge and consent, the employers have the right to continue the use of the specific machine thus made, after a patent has been granted to the inventor.

J. P. says: I have observed the following phenomenon which I cannot satisfactorily account for. I placed a lamp in a room some twelve feet distance from the wall, and held a plano-convex lens in the rays of light near the wall, and observed the focus to be a small speck; I then removed the lens into close proximity with the lamp, and found the focus to be many times greater than in the former case. I also noticed that these were the only two points where a lens could be placed to form a focus or image upon the wall. What I wish to know is this: 1. Why does not the lens in the second case produce the same sized focus or image as in the first? 2. Is it because the lens in the second case intercepts a greater number of rays and is incapable of converging to a small focus? 3. How may I clean a speculum which has become covered with fly dirt without injuring the face? Answers: 1 and 2. There is only one position of the lens (with respect to the light of the wall) where a true focus can be obtained. This is where the diverging rays of light from the candle are refracted to a focus by the plano-convex lens. The nearer this lens is moved to the source of light, the more divergent the incident rays become; and consequently the less convergent are the rays after refraction, and the farther the true focus is from the lens. 3. Rub gently with soap and water, using a soft woolen cloth, and then rub with chamois leather.

A. H. says: We have a breast wheel 25 feet diameter by 12 feet face. The wheel gears into a pinion 3 feet in diameter; on same shaft with pinion is an intermediate gear 5 feet in diameter, which gears into another pinion $2\frac{1}{4}$ feet in diameter; on the shaft with last named pinion is the main drum, 8 feet in diameter, from which we belt to different parts of the mill. Recently we have added machinery so that the buckets of the wheel fill full and a small quantity of water spurts out at each side of the apron; at the same time we fall short of our regular speed about 4 revolutions on loom shaft, or about ½ of one revolution of the water wheel, which runs $7\frac{1}{2}$ feet per second on the rim. Can I lag the main drum sufficiently to gain the right speed as the wheel now runs, or would it be better to lag up more and run the wheel slower? Would it be any gain in power, or effect any saving of water, to throw out the 5 feet intermediate and the $2\frac{1}{4}$ feet pinion gear, put a larger drum on the jack shaft, and so get power and speed direct from wheel? Answer: There will probably be a little gain if you throw out the intermediate gear; but lagging up the wheel will have no effect if the water wheel is not sufficiently powerful, as we judge, from your statement, is the case.

W. E. says: 1. It has been the practice, in building up a wagon spring, to punch a slot in one leaf, and a nib on the other, so that the nib will enter the slot and keep the leaves straight. Where these slots and nibs are made, about one third of the strength has been destroyed; and the strain is thrown on the weakest point and they soon break. If I make a spring without these slots and nibs, but, in the place of them, with an ear on two inside corners of each leaf to rest against the inside edge of the next longer leaf, and thus, in connection with the bolts in the center, keep them straight, would it not be an improvement and patentable? Answer: Probably the value of this method would depend upon the cost of manufacture. As to your water wheel query correspond with a manufacturer.

J. K. W. says: I have difficulty with my boilers on account of want of draft. I have 2 boilers, set side by side, 12 feet long, 42 inches in diameter, with 38 flues each. They are connected with a breeching. The smoke stack enters at top of breeching, runs back about 4 feet, then turns at a right angle and runs 10 feet, thence upwards 75 feet. Stack is 18 inches in diameter all the way from boilers. Is there any way to increase the draft except by enlarging the smoke stack? If not, how large should the smoke stack be to give sufficient draft? I very seldom have enough draft, except in very cold weather, and not always then; sometimes one boiler will have a fair draft and the other none at all. I tried a blower last winter, first in the smoke stack and afterwards under the grate bars, but failed to receive any benefit. I have since tried a jet of steam in smoke stack, taken from another boiler, running with 40 pounds of steam, but still fail to improve the draft. I burn anthracite coal. Answer: Possibly the chimney is not properly proportioned. You do not send enough data to enable us to determine.

O. A. F. says: In your issue of October 26, 1872, in answer to E., query 10, page 216, A. H. G., of Mo. says: "Make a mixture of sal soda 40 pounds; gum catechu 5 pounds, and sal ammoniac 5 pounds, and use one pound of the mixture to each barrel of water used, and it will take the scale off the boiler." 1. Will this mixture injure a boiler in any way; and will it take the scale off which is formed by different kinds of water? He also states that, after the scale is once removed, sal soda will prevent any more forming on the boiler: is that true? 2. I also wish to know how copper is deposited on iron wire, such as is used for pail bails. Answers: 1. We know nothing of the merits of this mixture, and would hardly recommend the use of sal ammoniac in a boiler. 2. We believe it is done by dipping them into a solution of sulphate of copper.

C. R. M. asks: 1. What is the best length of lead to give the valve of a steam engine? The cylinder is 14 inches by 20, making about 110 or 120 strokes per minute. The present lead is hardly one sixteenth of an inch. Many years ago, I had an engine of 2 feet stroke. The motion had to be reversed; and in doing so, the length of lead was changed from almost nothing to about one fourth of an inch. The engine ran much faster with the same steam. Would it improve my engine to give it more than one sixteenth of an inch lead? 2. I wish to case my boiler. Ought I to use anything besides the planking; and if so, what is best? Will the boards alone do? The boiler is on the locomotive plan. Answers: 1. We think you should give the valve, if set cold, about three eighths of an inch lead. Possibly you may have to try it at several points, before hitting upon the best position. 2. See our advertising columns for boiler covering.

J. S. M. asks: 1. What is the best way to filter the water after it has passed through a surface condenser? The steam goes in on the outside of the tubes, and water is pumped through the tubes by a circulating pump. The air pump is a fresh water pump, which pumps the water overboard; there are two plunger pumps, which take the water from the bottom of an air chamber on the air pump. There is a delivery on the air chamber close to the top. 2. Why is the delivery at the top of the air chamber? 3. How do pumps draw the water when it is so hot? 4. Does this condenser have tube heads besides the outside heads? 5. If there is a cut-off on an engine, is there any need of the main valve to do more than just cover the ports? Answers: 1. We do not think that it is necessary to filter the water. 2. Probably for convenience. 3. The pump will draw water unless the tension of the vapor is sufficient to overcome the vacuum that would otherwise be produced. Some pumps are fitted with relief valves, to allow the escape of the vapor when it exceeds a given pressure. 4. Yes. 5. It is not absolutely necessary, but it is sometimes convenient. You might find Auchincloss on "Link and Valve Motions," and Molesworth's "Pocket Book," useful. Much of the information you want can only be acquired by practice.

C. W. D. asks: 1. What is the difference in velocity of a body, for instance iron or lead, falling through air or through a vacuum; and is the rule for computing the velocity the same? 2. Can air be used as fuel? 3. You say in your answer to A. M.: "The specifications and drawings issued at the Patent Office are divided into classes, and those of any class are sent for ten cents," but you do not say who sends them, yourselves or the Patent Office. Answers: 1. In this calculation, the resistance of the air must be considered. 2. We think not. 3. In our answer to A. M., we said that the price of the specifications of any class was ten cents each. You must send to the Patent Office at Washington for them.

M. E. J. asks: 1. What is the rule for finding the number of pounds weight to hang on a safety valve lever, and the proper distance from the valve or fulcrum when the area of valve and number of pounds pounds pressure per square inch is known? 2. Will the number of pounds indicated by steam gage show the number of pounds per square inch in the boiler? Answers: 1. Box's rule is: If we have a 3 inch valve for 45 lbs., steam, and the effective weight (of valve and lever) on the center of the valve is 12 lbs., the distances from fulcrum to center of valve, and from fulcrum to position of the weight, being 3·25 and 19·5 inches respectively, or 1 to 6: Then, the area of a 3 inch valve being 7·06, we have $[(7·06 \times 45) - 12] \times 3·25 \div 19·5$, or $[(7·06 \times 45) - 12] \div 6 = 51$ lbs. 2. The steam gage, if in good order and properly set, shows the pressure per square inch in the boiler above the atmospheric pressure.

G. A. H. asks: Can sheet zinc be tinned? If so, what is the process? Answer: We presume it could be tinned by being placed in a bath of molten tin.

T. F. de S. asks: How can I anneal lamp chimneys? 2. What are carbon diamonds? Answers: 1. Place them in cold water, and heat it slowly to boiling point. Then allow it to cool gradually. 2. Carbon is supposed to be an element. It exists in crystallized and amorphous states. Soot or lampblack is a good example of amorphous carbon. Diamond is one form of crystallized carbon.

F. L. G. asks: What should be the dimensions of a pleasure boat, to use an engine and boiler of 4 horse power? What size and pitch should the wheel have? Answer: About 25 feet long by 5 feet beam; diameter of propeller 20 inches, pitch 2 feet.

V. G. says: A friend says that he has a common suction pump that on some days draws water 40 feet and upwards, perpendicularly. I say that no such pump ever did or will do it. Answer: You are right.

W. E. says: I have a wash pipe 1 inch in diameter leading from a wash basin, having a common plug, and protected by the usual cross bars. The pipe is lead, and has become stopped by some object, I think a mouse. How can I clear it out without taking it down? Would oil of vitriol do it, without destroying the pipes? Answer: Use a solution of caustic potash.

W. B. G. asks: Are not conical bullets for Minié and other rifles made by punching, and how fast can they be made by the machines now in use? Answer: The machine in use at our arsenals was invented by a workman named Snyder, in the arsenal at Watervliet, N. Y. We think it makes about 40 bullets a minute, but are not quite certain. Some of our readers will doubtless correct us, if we are in error.

F. L. O. says: I have a 2 horse power engine working under 15 lbs. steam. The water in our hydrant pipe indicates 30 lbs. pressure; the engine is used only for 2 hours per day. Could I use the hydrant water instead of steam in my engine? I think the amount of water used is cheaper than coal. Answer: Probably you ould not make the change, with the present arrangement of valves.

J. L. C. asks: What will produce a very bright permanent red color on leather, to be polished with a hot iron? Answer: Scarlet moroccos and roans are dyed with cochineal.

G. B. G. asks: 1. How can I give a fine blue or rich brown color to small articles made from sheet steel? 2. How, also, can articles made from sheet brass be bronzed? Answers: 1. After the articles are tempered, polish them, and heat to color, over a spirit lamp, in a charcoal fire, or a lead bath. 2. See p. 331, current volume.

F. F. B. asks: What is the lifting power of a kite, the shape of which is an inverted isosceles triangle of 10 feet perpendicular, surmounted by half a circle of 6 feet diameter? Answer: We published on p. 331, current volume, a table of the force of the wind, at different velocities. Knowing the weight of the kite, and the direction which the wind has, you can calculate the lifting power.

M. F. asks: How can I make Babbitt metal? Answer: Melt 4 lbs. copper, add by degrees 12 lbs. best tin, 8 lbs. regulus of antimony, and then 12 lbs. more tin. After 4 or 5 lbs. of the last quantity of tin have been added, reduce the heat to a dull red and add the remainder.

C. S. A. asks: 1. How much power will it take to cut a plate of iron 1½ inches thick? 2. What will be the effect of expansion and contraction on the bridge at St. Louis, Mo.? Answers: 1. The resistance of wrought iron to shearing is about 45,000 pounds per square inch, on an average. 2. The effect will probably be to raise and lower the crown of the arch a little, if the whole structure is rigid.

H. H. asks: What is the difference in cotton (between ordinary and middling, for instance), and how is it detected? Answer: The classification of different grades of cotton is made according to length and quality of fiber, and is expert work.

J. G. D. T. asks: Why is it that the sun and moon, when first appearing over the horizon, seem larger than when in the zenith? Is it owing to the peculiar condition of the atmosphere near the earth? Answer: Yes.

J. S. says: Chemistry teaches that, when a mixture of hydrogen and oxygen contains common air (probably nitrogen) it will explode when ignited. Therefore if the water for charging boilers were drawn from the bottom of a deep tank, the superincumbent column of water would weigh more than the air (or more than 15 pounds to the square inch) and all air would be expressed. I think that all surface ground water contains explosives in solution. In the tank containing water, there should be arranged some flat vessels containing alumina or the like incombustible substance; then the explosives would be neutralized, the water being purified for that purpose. Answer: We believe that a committee of the Franklin Institute made experiments on this subject in 1837, and determined that explosive compounds, other than steam, were not formed in steam boilers.

P. T. R. asks: What is oil of citronella? Answer: Citronella is an oil procured by distilling the leaves of *andropogon schænanthus*, which grows wild and very abundantly in Ceylon, whence this oil is chiefly imported.

P. P. says: In Culpepper's "Complete Herbal" there is mention made of a plant called Christ's eye, which of course is the vulgar or local name. What is the botanical name of that plant? Answer: You probably refer to the flower of the bush known as Christ's thorn, or *paliurus aculeatus*.

R. R. asks: Is the ocean level? How much higher is the city of New York than Liverpool? Answer: A level line is one that coincides with the general form of the surface of the earth, which is that of an oblate spheroid. The surface of the ocean would be level at mean low tide, were it not for the wind. As it is, the level varies in different locations. The difference between the level of New York and Liverpool, if any, is very slight.

A. G. P. asks: 1. What is carbon disulphide? 2. Can I make a liquid of transparent color to apply to the hands when bruised, so as to form a false skin? Answers: 1. Carbon disulphide is a compound of carbon and sulphur, made by passing the vapor of sulphur over fragments of red hot charcoal in a porcelain tube and condensing the gaseous product. It is also called sulphide of carbon, and sulphuret of carbon, and bisulphuret of carbon. 2. Collodion is used for the purpose you mention. This is made by dissolving gun cotton, or pyroxylin, in a mixture of ether and alcohol. It will be better for you to purchase the collodion already made from a druggist, as its preparation involves skill and care, especially in making the pyroxylin, which, when dry, is an explosive substance.

L. S., Jr., asks: 1. Have the Bessemer steel rails given the satisfaction to railroad managers anticipated, cost considered, over a first class iron rail? 2. How does the silicon rail compare with the Bessemer in wear? Answers: 1. Yes. 2. So far as we know, very few rails made of the silicon steel have been laid down, and there has not been enough time to enable a comparison to be made.

D. B. P. says: I wish to run a woven iron wire cylinder in water, and to protect it from corrosion. Tinning does not answer the purpose, and galvanizing fills up the meshes. Can you suggest a remedy? The cylinder will be subjected to some wear. Answer: You might overcome the difficulty by constructing the cylinder of wire cloth with a larger mesh than you require, so that, when it is galvanized, it will be of the proper size. Or you might have the cloth made of galvanized wire in the first place.

B. and P. say: We have to use swamp water for our boiler; it forms a soft muddy scale, easily scraped off, but it has to be done often. What is the best thing to hold it in solution that it may be blown off? 2. Water collects in our steam heating pipe and, freezing, bursts, or cracks it. What is a good cement for the cracks? Answers: 1. Probably your best plan will be to filter the water, before it enters the boiler. There are feed water heaters in the market that are said to remove all impurities which are held in solution. 2. We expect the best plan will be to renew the pipe. But you might try a cement made of red and white lead and fine iron borings. Put this over the crack, cover with a piece of tin, and wrap strongly.

F. N. says, in reply to A. R.'s query in regard to the locomotive, that air can be pumped in the boiler to almost any pressure where there is power sufficient to draw the engine; of course the engine is reversed. I have frequently seen engineers oil their throttle valves by reversing their engines for a few seconds while rolling down hill just after tallowing the cylinders, when there was, perhaps, a pressure of 140 pounds of steam on the boiler. A. R. seems to think that the air would escape by the way it entered. The throttle valve prevents this by acting as a check.

T. B. J. says, in reply to L. W.: Brass can be stained a permanent dark brown by placing it in a mixture of iron scales 1 lb., arsenic 1 oz., muriatic acid 1 lb., and holding a piece of sheet zinc near it in the solution.

G. M. says, in reply to A. D., who asked for a remedy for snails other than salt: Put ashes with the seeds into the ground, or outside of them, wherever the snails may be found.

F. V. F. says, in reply to G. W. C.'s question as to two locomotives: If the wheels were of the same size on the two locomotives, it is evident that they would both reach the foot of the incline at exactly the same instant; but the wheels being of different diameters, it is equally evident that nothing can influence the relative motions of the locomotives on the incline except the friction of the two sets of wheels, which friction is found by experiment to be inversely proportional to their radii. Hence, since the radii of the two sets of wheels are to each other as ⅜ is to 1, the friction being inversely proportional to the radii, we have S : L :: 1 : ⅜, in which L and S indicate the large and small wheels respectively. Also, in the case of the smaller wheels, in consequence of their making a greater number of revolutions during the descent than the larger wheels, the rods, shafts, links, etc., attached to them would move faster, and hence increase the friction. I conclude from these facts that, since the locomotive with the four foot wheels has a little more than ⅜-s much friction as the other locomotive, the last mentioned locomotive will arrive at the foot of the incline in a little less than ⅜ of the time that it takes the other to arrive there.

A. G. Jr. says, in reply to J. N. Q.'s query as to coloring photographs: An exact representation of any transparent leaf or plant of any color or shade can easily be made by obtaining direct from the leaf a carbon negative, then using tissue, of the color desired, for positives. You can obtain, from the following solutions and their admixtures, almost any shade of blue, green, yellow, and brown. Solution No. 1, to be used as a bath: Dissolve 2 ozs. lead in nitric acid, and evaporate to dryness. Then dissolve 2 ozs. of the resulting nitrate of lead in rain or distilled water, in a glass or porcelain vessel. In another, dissolve 2 ozs. of the ferricyanide of potassium (red prussiate of potash), mix the solutions, and filter into a suitable bath. Then float, upon this, either plain or albumen paper, and dry in the dark. Then use a paper, or carbon, or ordinary photographic negatives as J. N. Q. describes. After finding the proper time to expose (and a few experimental failures will soon do it), immerse in the following solution to make a dark green leaf: bichromate of potash ½ oz., perchloride of iron ½ oz., water about one pint. For red: sulphate of copper 1 oz., water 1 pint. For brown: weak solution perchloride of iron and a little sulphate of copper. For dark brown, more iron and less copper.

E. J. O. says, in reply to J. N. N.'s query as to a common house fly, surrounded by a kind of opaque vapor, after death: It is a mold or fungus, and is caused by the bite or sting of the mosquito. I have watched the combat, and the mold or fungus is deposited during and immediately following the death struggles of the fly.

W. E. H. says, in answer to W.'s question as to mensuration of circles: I use rules that are not given in school arithmetic books: To find the circumference of any circle: Multiply the diameter by 9 3/7 and divide by 3. To find the area of the same circle: Take ¾ of the square of the diameter. Having the circumference, to find the diameter: Divide the circumference by 19 and multiply the quotient by 6.

J. C. S. says: "When our belts slip, we pour castor oil on them just in front of the pulley, and the effect is always satisfactory; we also use tanner's or neats' foot oil on the outside of the belts. We run the grain side of our belts next the pulley, preferring always to use, for our own purposes, large pulleys and long belts, keeping them soft and pliable, and having them loose as possible."

C. H. R. says, in reply to C. C.'s question on page 250, current volume: The answer is: 12,533 lbs. less friction, which in this case would be over ¼, and also less an amount in proportion to the distance the pin for the sheaves is placed from the ends of the lines.

C. M. N. says that A. M. can solder brass to brass by taking a piece of the brass to be soldered and adding a little silver while melted in a crucible. One eighth part of silver will do, and it will melt just as the piece to be soldered begins to flow. Two parts brass and one of silver is a good solder for brass, iron or steel.

J. E. E. says, in reply to C. C.'s question on page 250, current volume: Disregarding friction (which will be about ¼), the pressure on W will be 72,838 lbs., four times the power (less friction) given by the use of the four pulleys.

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

R. W. H.—Your specimen is tripoli, of value as a polishing material.

H. S.—The black material is carbonate of iron.

J. J. T.—Galena or sulphide of lead, a valuable ore of lead, consisting of lead 85 and sulphur 12 parts, the remainder being oxide of iron or other impurity, with sometimes a little silver. Lead is obtained from it by roasting in a reverberatory furnace, and smelting the residue with coal and lime.

M. E. B.—Nos. 1 and 3 are trap rock, of no value. No. 2 is trap with spangles of plumbago, and perhaps some galena, disseminated through it.

J. T. C.—No. 1 is a vein of trap, of igneous or eruptive origin. No. 2, hornblende. No. 3. This is possibly metalliferous at some depth.

COMMUNICATIONS RECEIVED.

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

On River Navigation. By G. W. I.
On Sexadigitism. By W. T. R.
On Ecclesiastical Bickerings. By J. R. P.
On Insect Nests. By A. B.
On Snake Poisons. By T. J.
On Flying Spiders. By E. F.
On Water Gas. By A. A. H.
On the Proposed Great Telescope. By W. M.

Also enquiries from the following:

W. A. B.—S.—E. N.—S. B. H.—J. P.—B. W. W.—J. C.—T. C. C.—G. S.—C. E. B.—J. W. P.—S. N.—A. L. B.—P. L.—J. M.—F. C. D.—J. A. V.—F. D. B.—J. P. L.—C. W.—M. F.—H. Z. T.—D. T. T.—J. M. S. Jr.

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

[OFFICIAL.]

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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:

27,043.—LOCK FOR UMBRELLA STAND.—A. M. Foote. Jan. 21.
27,185.—SOLDERING IRON.—A. Burbank. Jan. 28.

DISCLAIMER.

24,484.—PAPER PULP APPARATUS.—J. B. Palser *et al.*

DESIGNS PATENTED.

,970.—CARPET.—J. B. Alden, Worcester, Mass.
6,971.—GAS BURNER.—E. R. Beach, Philadelphia, Pa.
6,972.—STOVE.—R. A. Culter *et al.*, Peoria, Ill.
6,973.—BRACKET.—O. F. Fogelstrand, Kensington, Conn.
6,974.—MATCH SAFE.—W. A. Haynes, Everett, Mass., *et al.*
6,975 & 6,976.—GOBLETS, ETC.—J. Hobbs, Bellaire, O.
6,977 & 6,978.—STOVES.—H. S. Hubbell *et al.*, Buffalo, N. Y.
6,979.—HEATING STOVE.—J. Magee, Chelsea, Mass.
6,980 & 6,981.—OIL CLOTHS.—C. T. Meyer *et al.*, Bergen, N. J.
,982.—PAPER BOXES.—E. C. Moore, Yonkers, N. Y.
6,983.—GLASS BOTTLE.—J. W. Philbrook, W. Roxbury, M.
6,984.—CARPET.—C. A. Righter, Philadelphia, Pa.
6,985.—BOTTLES.—N. Sleeper, Burlington, N. J.
6,986.—OVERSHOES.—G. Watkinson, New Haven, Conn.

TRADE MARKS REGISTERED.

1,516.—SHOES.—Kenny *et al.*, New York city.
1,517.—WHISKY.—Livingston & Co., San Francisco, Cal.
1,518.—STOVES.—Union Stove Co., Pittston, Pa.
1,519.—SCARFS, ETC.—J. W. Tuttle, Watertown, Mass.
1,520.—REFINED PETROLEUM.—C. West *et al.*, Baltimore.
1,521.—WHEELS.—S. T. Wheelwright *et al.*, Buffalo, N. Y.

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