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SCIENTIFIC CANADIAN
MECHANICS' MAGAZINE
AND
PATENT OFFICE RECORD

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"POWER" IN MECHANICS.

THERE are a number of terms, which are not thoroughly understood by those who use them constantly, or about which misconceptions occur in the minds of those who understand their first meaning. Amongst them probably few give rise to a larger amount of loose and ill-defined expressions than the use of the word "Power." In the first place it is a not uncommon mistake with the younger members of the engineering or mechanical trades to speak as though power were in one way the product or outcome of certain machinery. So far from true it is that machinery of whatsoever kind can produce power, that all mechanical contrivances are directly absorptive of power. The mission of machinery is to direct the application of power, and aid it in performing a given work, but in doing so it necessarily absorbs a share of that power for the purpose of running the machinery itself. Thus, for example in the case of the ordinary engine employed to drive the machinery of a manufactory of any kind. Before the power which is generated in the boiler can expend itself upon the work which is eventually performed by it, probably in a distant part of the building, it has to employ a large proportion of its force in setting in motion various fly wheels, belts and shafting, and in overcoming the weight and friction of various materials. In all this, of course, power is expended, and only a proportion of the original power is ultimately applied to the work to be done. The so-called power of an engine is usually taken at a point between its generation and application, and measured by the pressure on the piston or pistons, and this is what is meant when we speak of the *indicated* power. There is, however, another term used, *viz.*, the *effective* power, which is the measure of power exerted upon the work, *i.e.*, the indicated power less the friction of the several parts of the intervening machinery. Another difficulty yet, however, arises out of the well-known fact that machinery, like humanity, has its humors, or in plainer terms, that the same machine may give widely differing results under different circumstances. The fact makes it necessary for the purpose of ordinary calculation to adopt a theoretical standard of measurement, the power indicated by which is termed the *nominal* power. This is reckoned by the Admiralty rule on the assumption that engines with pistons moving at 226 feet per second work at a pressure of 7 lbs. to the square inch.

* * *

The next great engineering feat to be undertaken will probably be the long projected tunnel between Dover and the French coast. For ourselves we see no reason to doubt the success of the scheme under competent management. Although comparatively little has been done as yet to follow up the results obtained by the boring experiments which were made in mid-channel upwards of a year ago, yet the result of these borings was highly satisfactory so far. It has been demonstrated that grey chalk extends downwards, on the British shore, to a depth of 470 ft., whilst the French engineers tell us that on their side it reaches to the depth of 750 ft. below high water mark. Above the grey chalk is a stratum of white chalk, varying from about 270 ft. in thickness on the French coast to 170 feet on the English. If, as seems to be indicated by these figures, the grey and white chalks extend in continuous strata from one side of the Channel to the other, the work to be done will be greatly simplified, as tunnelling through the grey chalk would present fewer difficulties than in the case of even the white. Of the mechanical part of the work our engineers of to-day will have no reason to be afraid, and the ventilation may be easily secured by the use of compressed air. In short, says the *Building and Engineering Times*, "money is the only agency now requisite for the purpose of completing the Channel Tunnel."

* * *

A most important discovery has been recently made of a Phœnician inscription from the pool of Siloam, the deciphering and translation of which may be shortly expected, as a *fac simile* copy has just reached England. It was discovered a few months since by the Jerusalem correspondent of the Palestine Exploration Fund, and is composed of letters almost identical with those on the Moabite stone. The Palestine Exploration Fund have been doing excellent work on the west side of Jordan, and have now finally decided on a painstaking and accurate survey of the east side, which as it stands to-day is a blank upon the maps. Much assistance may be expected for Biblical scholars in the recovery of local names, which in the Eastern exploration have already thrown so much light upon the historical books of the old Testament. Many personal appellations have been already identified with geographical names as *Belka* with *Balak*, *Shihân* with *Sihon*, and a host of others, while the scripture names of *Oreb*, *Zeeb* and *Salmaneh* are of frequent occurrence among the Arab tribes under their modern forms of *Gorhab*, *Diab* and *Selameh*. The expedition will have started in all probability by the time these lines are read.

Engineering, Civil & Mechanical.

WATER AS A BLASTING POWER.

It appears that at some of the fiery coal pits near Barnsley, in Yorkshire, England, there is a system of blasting in vogue where water is used in addition to gunpowder, with the best possible results. The system is simple in the extreme, and, so far from its being costly, it is an economy, for, in the blasting operations performed with water in conjunction with gunpowder, a greater amount of work is done with considerably less powder and the powder is rendered harmless. The value of the foregoing will be best appreciated by a short description of the operation. Ordinarily, blasting with gunpowder is done somewhat as follows: A bore hole is made in the face of the coal about 2 inches in diameter and 4 or 5 feet deep. Into this hole a powder cartridge is inserted, with a slow fuse attached; the hole is then tamped—that is to say, it is filled with any available dry refuse rammed in tight; the fuse is lit and the cartridge fired. In this operation a flame, very dangerous in fiery pits, is created, and carbonic acid and sulphurous acid gases and smoke are generated. Blasting with water and gunpowder is performed in the following manner: Into the bore hole is inserted a powder cartridge, with fuse attached; next to the powder cartridge is inserted into the bore hole a tube containing water. These tubes should be as large as the bore hole will admit, and of any convenient length, the longer the better. They may be made of any convenient cheap material—thin tin plate, or of stout brown paper turned round on a wooden roller and pasted together, the ends closed with corks; the bore hole is then tamped, the fuse lit and the cartridge fired in the usual manner. The result of this operation may be briefly summed up. The powder, in exploding, bursts the tube containing the water, the rending force of the powder is extended through the water by the well-known principles of hydraulics, demonstrated years ago by Bramah, over the enlarged interior area of the bore hole, due to the space occupied by the water tube. A much larger quantity of coal is thereby brought down with a smaller quantity of powder; the heat given off by the burning of the powder and the gases converts a portion of the water into steam, the elastic force of which assists in the operation of blasting; the steam and water together put out the flame and flash of the powder, and absorb and neutralize the greater portion of the gases and smoke resulting from the explosion. It will readily be seen that herein are met together economy and safety by the adoption of a system simple as it is effective, and it is to be hoped that, in the best interests of humanity, our large and intelligent coal-owners will not be slow to adopt an amelioration in their present crude and dangerous practice of blasting, which will tend, in a great measure, to make explosions in coal mines a thing of the past, rather than of almost daily occurrence.

◆

THE FOREMAN.

In these days of fierce and sometimes unscrupulous competition, and of rapid mechanical advancement abroad as well as at home, it is in the highest degree essential that our own leaders of workmen should not idly rest upon the laurels they may have won in time past. They must, on the contrary,—if the firms they serve are to be kept out of the *Gazette*, and themselves saved from ruin, study thoroughly the theoretical as well as the practical sections of their various occupations, and abandon the old "rule-of-thumb" modes of procedure in conducting them. This dictum applies to all branches of manufacturing industry, but to none more strongly than to those of Building and Engineering. In point of fact these may now almost be said to be, as it were, wedded to each other, and it is difficult to draw a very broad line of demarcation between them. In view of what is taking place in respect of the training of young workmen in France and other countries of the continent, by means of apprenticeship schools, &c., and the certainty that there is of a superior grade of foremen being the upshot of it, we may indicate what we consider to be some of the main requirements and qualifications demanded of English foremen of builders, or of engineers of the present day.

To begin with, they must be skilful workmen, or it will manifestly be impossible for them to direct those who are placed under their control and guidance. Indeed, unless a foreman be capable of taking his place among a number of workmen, and, by quickness of perception, carefulness, and the exhibition of superior manipulative skill, proving to them that he has a perfect mastery in these directions, his authority over them will be minimised. Workmen are appreciative in the highest degree of real talent and knowledge in their leaders, but so also they are not slow in exhibiting their contempt for those who merely assume such characteristics.

When a foreman has demonstrated his capabilities for laying out work, and in arranging the various processes for completing it, he has done much towards insuring successful results, and he will gain the respect alike of master and man. Further, a good foreman should become thoroughly conversant with the peculiarities of construction, and the action of machines and machine tools, of which so many varieties exist, and which are of infinite importance as to economy of time and money. Without such accurate knowledge he could certainly not estimate, with any degree of exactitude, the amount of duty to be obtained from the use of such appliances, nor the approximate cost of the work to be done by them. In conducting and governing properly the multifarious duties of the workshop or the factory, a ready method delineating forms, and of thus conveying to others, through the medium of the eye, his own ideas of pieces of mechanism or the details of machinery, is a necessary accomplishment for a foreman. By such means he will readily instruct his men, and that in a manner which no mere verbal explanation would make intelligible. Pencil or chalk discreetly used by the foreman thus becomes one of the most forcible and plain teachers of workmen.

The previous training and experience of the latter prepare them to understand sketches, and thus he who can best produce the latter economises the time of all concerned, and saves his employers from needless expense. The power of making diagrams with precision and rapidity is, in fact, an invaluable acquisition for the leader of a staff of mechanics. It is a qualification which, like many others requisite for making a really efficient foreman, can only be gained by constant practice, and we most earnestly advise those young workmen who aspire (as all should do) to come to the front, and "take the lead," to miss no opportunity for acquiring it. A fair knowledge of geometry and arithmetic, and of the nature of the materials employed in works of construction, is simply indispensable. The foreman, too, must be possessed of prompt energy, and of a readiness of expedient, so as to enable him to grapple successfully with emergencies, and overcome practical difficulties that may crop up unexpectedly, as subsidences of foundations, break-downs of machinery, &c.

The duly qualified foreman will find no difficulty in deciding as to the length of time which should be occupied over any detail placed for completion in the hands of a workman under him, for he knows how long it would take if he did it himself. It would be easy to extend our remarks upon the practical essentials of good foremanship, but it seems scarcely desirable to do so, and therefore with a word or two as to moral requirements, we shall conclude. Among these last stand out prominently a love of truth and a total absence of duplicity. Let it be generally known that a foreman is above and beyond acting or speaking otherwise than conscientiously, and his moral power will be great indeed. Faith will then be placed in his judgment, and while workpeople will, as a rule, repay him with respect and ready obedience, employers will as certainly repose in him the utmost confidence.

A SELF-LEVELING SHIP'S BERTH.

Several contrivances have from time to time been designed for the purpose of alleviating the sufferings of those who are subject, when at sea, to attacks of the dreaded *mal de mer*, but none have afforded the much desired immunity from sea-sickness. Most of the appliances introduced to prevent sea-sickness have failed, either because they would not act at all, or, when they did, produced effects that were as bad as, if not worse than the malady. These contrivances have consisted of some modification of "swinging," but the roll of the vessel has not been even effectually lessened in its disagreeable effects by this method. There are many persons who are of so peculiar a temperament that the mere rocking of a boat induces nausea, while others can enjoy a channel yachting trip in rough weather without the slightest fear of those disagreeable sensations that have been so often described, yet fail to give even a scant notion of what sea-sickness really is.

It has been stated that "the immortal Nelson," among many others, although his profession necessitated a life afloat, was a martyr to sea-sickness, while many who have resided chiefly in country districts find nothing but enjoyment in a sea voyage, and can cross the channel when a half a gale is blowing, without the least apprehension of unpleasant consequences. Among the many methods introduced that profess to afford relief are belts, medicaments, nostrums and devices, each and all of which have proved to be ineffectual.

It is necessary, in referring to the remedy, to consider the cause. The oscillation and rolling of the ship at sea tends to upset the normal condition of the individual, which, were it not for the particular tumbling action of the vessel, would not be affected. The invention to which we direct attention removes the cause, the result being that the effects are not felt, and hence the "Huston" berth is a "boon and a blessing." The peculiarity of this contrivance lies in the application of what is known as the universal joint, upon which the berth is poised, and is directed in its motion by a crescent-shaped weight, thus securing a perfectly level surface, no matter at what angle the vessel may pitch and roll. It is also controlled and regulated by India-rubber springs, preventing any tendency to jump up with a sudden jerk, and is strictly a "self-leveling berth." It occupies no more space than an ordinary berth, requires no expensive setting or adjustment, interferes in no way with the present sleeping arrangement on board ship, and can at once, if desired, be transformed into a fixed berth. Admitting the fact that sea-sickness is caused by the sufferer being forced by the law of gravitation out of his normal position, the inventor of the "Huston" self-leveling berth has adopted the universal joint principle, and thus enables a passenger to maintain a horizontal situation without being influenced by the motion of the vessel.

We see by the *British Trade Journal* that experience has proved that the invention affords relief and comfort, practical men and passengers have testified to the successful application of a most simple principle. The inventor has received numerous testimonials from persons expressing gratitude for the relief afforded. Among them is one from a private gentleman who recently took passage from Rio de Janeiro to New York in the steamship *City of Paris*. The writer, it would appear, had heard of the "Huston" berth, but had some doubts about its efficiency. His scepticism was dispelled, for he writes:—"This is a large steamer of 3,500 tons, handsomely fitted, and plenty of ice for cooling drinks. We have two cabins adjoining, and, strange to say, they are both fitted with Huston's patent berths, in which we feel very comfortable as the motion is scarcely perceptible."

KITCHEN-BOILER EXPLOSIONS.

Kitchen-boiler explosions are due to an accumulation of pressure in the boiler, in consequence of the outlets being stopped up while the fire is burning. These explosions occur during the frost through the choking up of the pipes with ice. Sometimes stop-taps are placed in the circulating pipes, and should these taps be shut, or should the circulating pipes become choked with sediment, or stopped up from any other cause, the pressure would then be bottled up and an explosion might result at any time, whether summer or winter.

To prevent this, every boiler should be fitted with a small reliable safety-valve, whether the boiler be of copper or of cast-iron, and whether it be fitted with a copper cylinder or not. A safety-vale of dead weight construction is recommended as the most simple. In the event of the outlets becoming choked, it would relieve any undue pressure and prevent an accumulation, while, at the same time, it would emit a slight hissing noise, which would tell those in the kitchen that something was wrong.

In the meantime, until a safety-valve can be fixed, open the hot-water tap in the bath-room, and any other hot-water taps connected with the boiler. If the water cannot be drawn freely from these taps, do not light the fire, and if the fire be already lighted, put it out at once. If the water flows freely the fire may then be lighted, but this must be done with caution, and the taps just described frequently opened to' see that the flow continues, and that the water gradually heats. If the flow does not continue, or if the water does not heat, the supply of water to the boiler must be running short, or something must be wrong with the circulation, and the fire must be drawn. Also the cold water cistern, as well as the ball-tap should be examined, and the cold-water taps in the bath-room, and elsewhere, opened to see that the water supply is free; otherwise the boiler may run dry. When the fire is once lighted and the circulation proved to be free, the fire should be kept burning by night as well as by day as long as the frost lasts; otherwise the frost may get the mastery during the night, choke the pipes with ice, stop the circulation, bottle up the pressure, and thus lead to the bursting of the boiler. But the only true safeguard is a reliable safety-valve, and the sooner that is fixed to the boiler the better.

LAVINGTON E. FLETCHER.

AN IMPROVED MOUNTAIN RAILWAY SYSTEM.

The construction, maintenance, and operation of mountain railways have long occupied the attention of engineers. Many methods of climbing steep inclines and of rounding curves of small radius have been proposed, and several of these methods have been reduced to actual practice. The systems of Fell and Riggenbach are very well known, and the ancient system of rope tramways is in use in many places. A distinguished engineer, M. L. Edoux, has conceived a project which is based upon the application of a system of hydraulic elevators to the lifting of cars to any height. The system may be applied to great advantage, when an abundance of water under high pressure is available. These conditions will be frequently met with in a mountainous country. Although this project has not yet been realized it seems to possess sufficient merit and novelty to render it interesting to our readers. The illustrations have been specially arranged for the *Scientific American* from the author's plans, elevations, and sectional views.

The particular railway under consideration is intended to establish communication between Cauterets and the baths of La Raillère, France. Cauterets is situated in a narrow valley, at an elevation of more than 900 meters. It is a noted watering place, and during the season is filled with numbers of invalids, who go there in search of health. The hot sulphur springs for which the region is noted, are located at La Raillère, 125 meters higher up the mountain, and more than 915 meters distant.

To travel over this fatiguing route, to go and return, often twice in the same day, in the capricious weather of the mountains and in the crowded omnibuses, is uncomfortable and even dangerous to infirm persons. The waters cannot be conveyed from La Raillère to Cauterets without modifying their temperature and their chemical composition to which their therapeutic properties are due. It is, therefore, necessary to convey the sick to the springs that they may receive the full benefit of the water. This railway has been projected for the purpose of conveying the bathers from Cauterets to La Raillère.

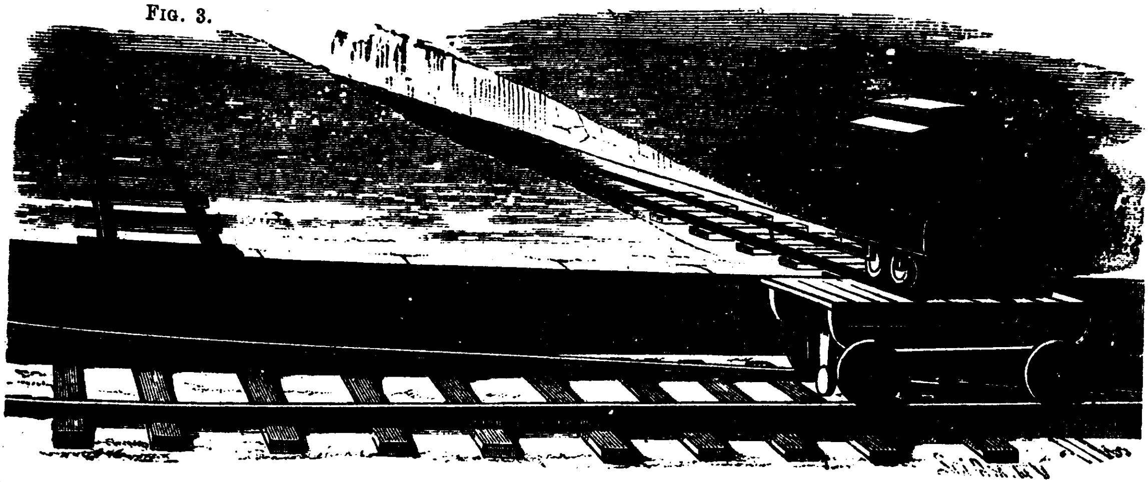
The mode of operating the railway is as follows: The car is raised vertically by means of hydraulic elevators to a greater height than its destination, which, in the present case, is La Raillère, and is then allowed to descend as far as that place by its own gravity upon an inclined railway. To return, the car is transferred by its own gravity to a second railway inclined in the opposite direction. The cars are provided with efficient brakes, by means of which the speed may be effectually controlled.

In practice, the car is not raised the vertical distance of 125 meters at a single lift, but this distance is divided into five parts of 25 meters each. There are five towers at intervals of about 40 meters. In each one is placed a hydraulic elevator, similar to those introduced by M. Edoux into the hotels and houses of Paris. The top of each tower is a little more elevated than the foot of the next one, and is connected with it by an inclined bridge. The car is raised by the hydraulic elevator to the top of the first tower, runs by its own gravity to the base of the following one, is raised to the next level, and so on. Together they form a gigantic staircase with steps 25 meters high. The last landing place is 135 meters above Cauterets.

Fig. 2.

IMPROVED SYSTEM FOR MOUNTAIN RAILWAYS.—(See preceding page.)

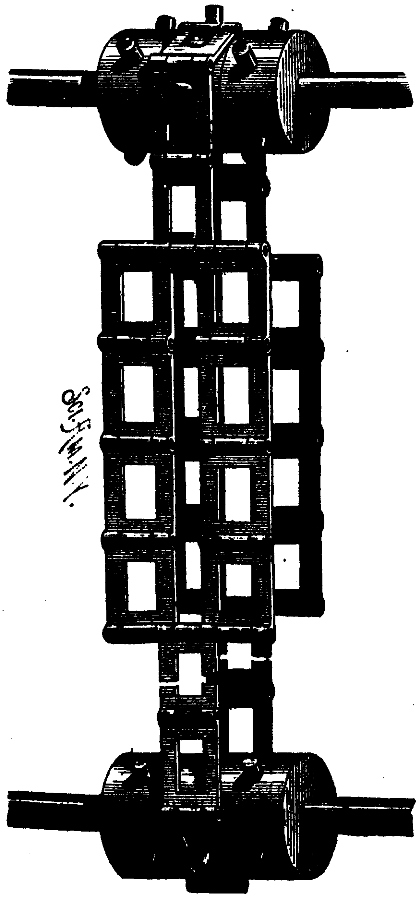
FIG. 3.



The return way, which is on the side of the mountain, terminates in the second tower. The cars descend vertically only in the first two towers, which contain two compartments, one for hoisting the car and one for lowering it.

At La Raillère the inclination of the car is reversed, and the car is transferred to the return track by means of a platform supported on wheels and provided with rails. The car on arriving from Cauterets rolls upon the platform. The latter moves by its own gravity on rails slightly inclined in opposite directions (see Fig. 3), so that when the rails of the platform join the return track their inclination will have been reversed, and the car will, of its own gravity, return to the second tower. The movement of the transferring car is controlled by a hydraulic piston. The gradient of the railway to La Raillère is 0·005125 per meter, and of the return road 0·043961 per meter.

The department engineers prefer this plan to all others. The question of construction will be taken up at the next session of the Chambers.—*Scientific American.*



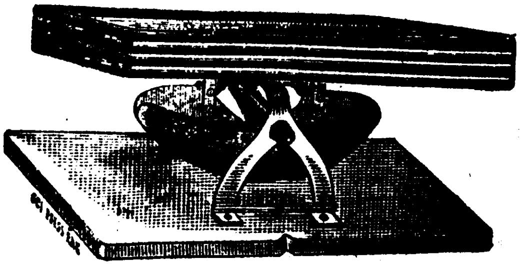
DREW'S MECHANICAL MOVEMENT.

NEW MECHANICAL MOVEMENT.

The engraving represents a novel mechanical movement for converting a continuous rotary motion into an intermittent rotary motion. The driving shaft carries a triple sprocket wheel, which is keyed on or otherwise fastened, and the driven shaft has three sprocket wheels, two of which are secured to it, while the third is movable on the shaft. The endless chain which connects the chain wheels of the two shafts is made of three separate sections—a median section alternating with two outer sections arranged parallel to each other and separated by a space equal to the width of the openings in the narrower section. This chain thus formed, as will be noticed, is double for a portion of its length, while the remainder is single.

When the driving shaft is revolved the chain is carried forward at a regular rate of speed. When the single portion of the chain comes into contact with the loose central sprocket wheel on the driven shaft, only the loose wheel is revolved, the shaft remaining stationary; but when the double portion of the chain engages the outer wheels, which are fixed on the driven shaft, the shaft is revolved until the double portion of the chain has passed over it, when it rests until engaged by another double portion. By means of this ingenious contrivance the driven shaft may be rotated either regularly or irregularly according to the relative proportion of double and single chain. This movement should find a ready application in textile machinery, and in fact in all classes of machines where intermittent rotary motion is employed.

This invention was recently patented by Mr. William P. Drew, of Preston, Minn.



HUSTON'S PATENT SHIP'S BERTH.

(SEE PRECEDING PAGE.)

Fine Arts.

THE FERROTYPE: HOW IT IS MADE.

There is a peculiar charm about the ferrotype, all its own, which is gaining recognition very rapidly among us. It has been the fashion to sneer at the picture on iron ; but just as similar objections raised to the carte-de-visite have been abandoned by *dilettanti* of art, so will those urged against the ferrotype be less loudly and less confidently uttered ere long. So far from the ferrotype being inferior to the photograph from a negative, it may be safely said that in two important respects, at least, it is superior. The simplicity of the operation and the rapidity and ease with which the pictures are made, inspire the sitter with confidence, and do not give occasion for thought of the matter in hand. There is, in fact, a free-and-easiness about the whole business which induces a pleasant expression and naturalness of position. From an artistic point of view, these are no mean advantages. It is not, however, our intention to supply a *raison d'être* for the ferrotype, but to give some concise and simple directions of working and especially to strive for the introduction to the practice of the ferrotyper of these rules of art without which no branch of photography can attain to its full development.

For the "dark room," a place in, or immediately adjoining the atelier should be provided. Here the plates are collodionized, sensitized, and developed. For this a very small space is necessary, and waste-room is a disadvantage. In a moderately large gallery with two skylights, there might be constructed in the centre a dark room five feet square, and this would be ample accommodation. Such a room would not be in the way ; and with a door on either side, entering from each light, would prove most convenient. The dark-room is fitted with a tank of sufficient capacity to hold the washing from the pictures made during a day ; a shelf for the developer and developing utensils, one for dark slides, &c., and another for the plates, collodion, &c. The sensitizing bath, and that containing the potassium cyanide for clearing the picture, may stand well apart in the dry trough of the tank as will presently be explained. The tank, or trough, over which the plates are developed, is an important accessory to the gallery. It may, by a very simple arrangement, be made to save all the waste silver, and will soon pay for itself, and if properly used, contribute liberally toward defraying the expenses of the gallery. The capacity of the tank should be sufficient to meet the requirements of the busiest day's work. Let it be made of well-seasoned wood, rendered water-tight by a coating of asphalt ; resting on the floor, it should rise to a convenient height to develop over. A tray, about four inches deep, may be formed of a board perforated with holes through which the water will run into the tank below, thus leaving the tray always dry. In the side of the tank, about nine inches from the ground, a pipe is inserted, the inner mouth of which is bent down to about three inches of the bottom of the tank. On the outside of the tank the pipe is fitted with a tap. At night, the contents of the tank are treated to a small quantity of saturated solution of copperas, for the purpose of precipitating the silver in solution. In the morning, before work commences the tap is turned on and the clear water run off, the tap being reversed when the tank is emptied to the inner mouth of the pipe *i. e.*, three inches of the bottom of the tank, so that the rich deposit may not be disturbed. By this means, during working, all the washing water, waste silver, old films, &c., may be caught and retained in the tank. The silver is precipitated at night (the waste developer assisting in the work during the day), and in the morning the supernatant water is run off, and the pipe closed against the escape of the silver-charged water, which begins to flow into the tank as development proceeds in the work of the day. A first-rate silver-saving apparatus may be made of an old felt hat, bound firmly over a hoop. By developing over this, the greater portion of the waste is caught, the rest being retained in the tank.

In the dry trough of the tank, the sensitizing bath on one hand —sufficiently removed from the influence of developer splashings —and the fixing bath on the other hand, may be placed. Plate-holders should have their place near the bath, and be kept closed, to guard them against dust, and the splashing of contaminating fluids. Over the tank should be fixed a tap placed in a convenient position for use in development. A separate cistern should be at the disposal of the ferrotyper, as a steady flow of water is necessary. The developer and pouring cups would naturally be placed conveniently to hand near the water-tap. The shelf for plates and the collodion pouring bottles should be fixed near the door, so that the operator should have the benefit of the light. The dark chamber, lighted either by gas or a window glazed with orange glass, should be sufficiently illuminated to render working easy and comfortable. In the arrangement of every detail of the dark-room the convenience of the worker should be studied, as the work must be done with extreme rapidity. We have, therefore to secure the greatest facility of working with the most perfect sureness. The glass-room should have two lights divided by a partition ; one side may be then used, generally for the ordinary styles of portraiture and interior compositions ; the other for "rustic" pictures, groups, &c., so much time of preparation and clearing away being by this means saved. The light required for the rapid ferrotype process should be well-directed, unobstructed, free from reflexions, and of good quality. Quality, not quantity, remember ! We have still to learn that the best pictures and the shortest exposures are obtained by skillfully-directed illumination—not by flooding the gallery with light. With an awful expanse of glass, top, side, and nearly all round, over a great portion of which blinds are always drawn, good effects can only be obtained by the exercise of great skill and after considerable experience of the light. The sooner the spare glass is boarded up the better. The easier the light is to manage, the finer are the results obtainable by it.

For ordinary portrait work, the sloping side light has many advantages over every other form of light. The illumination is better directed, there is less obstruction of sashes and overlapping sash panes, it is stronger, more easily kept clean, and the arrangement of necessary blinds is much more simple. The glased portion, of nine feet wide by seven feet high, will give ample illumination for any style of picture. The glass should not be nearer the ground than thirty or thirty-six inches.

Two sets of spring blinds should be provided—one drawing down from the top, the other up from the bottom, and meeting in the centre. Two or three widths may be used—three to be preferred. By this simple arrangement any required effect of light and shadow may be secured.

The combination side and sloping top, which has been a long-established favourite, is a very serviceable light, but—especially for the ferrotyper—is not so useful as the sloping side, for the reasons already mentioned. The arrangement of blinds is the same, drawing down and up to the junction of the top and side lights. The top light should have sufficient slope to allow the rain to readily run off. Dark space, of at least three feet, must be left at each end of the light for backgrounds and accessories. This space cannot be dispensed with, as it is impossible to produce really artistic pictures if the light is allowed to wonder all round the sitter. It is also required that pictures may be made at either end of the gallery.

DISCOVERIES MADE BY ACCIDENT.

BY F. H. STAUFFER.

Valuable discoveries have been made, and valuable inventions suggested, by the variest accidents.

An alchemist, while seeking to discover a mixture of earths that would make the most durable crucibles, one day found that he had made porcelain.

The power of lenses, as applied to the telescope, was discovered by a watchmakers' apprentice. While holding spectacle-glasses between his thumb and finger, he was startled at the suddenly-enlarged appearance of a neighbouring church-spire.

The art of etching upon glass was discovered by a Nuremberg glass-cutter. By accident, a few drops of aqua fortis fell upon his spectacles. He noticed that the glass became corroded and softened where acid had touched it. That was hint enough. He drew figures upon glass with varnish, applied the corroding fluid, then cut away the glass around the drawing. When the varnish was removed, the figures appeared raised upon a dark ground.

Mezzotinto owed its invention to the simple accident of the gun-barrel of a sentry becoming rusted with dew.

The swaying to and fro of a chandelier in a cathedral suggested to Galileo the application of the pendulum.

The art of lithographing was perfected through suggestions made by accident. A poor musician was curious to know whether music could not be etched upon stone as well as upon copper. After he had prepared his slab, his mother asked him to make a memorandum of such clothes as she proposed to send away to be washed. Not having pen, ink and paper convenient, he wrote the list on the stone with the etching preparation, intending to make a copy of it at leisure.

A few days later, when about to clean the stone, he wondered what effect aqua fortis would have upon it. He applied the acid, and in a few minutes saw the writing standing out in relief. The next step necessary was simply to ink the stone and take off an impression.

The composition of which printing-rollers are made was discovered by a Salopian printer. Not being able to find the pelt-ball, he inked the type with a piece of soft glue which had fallen out of a glue pot. It was such an excellent substitute that, after mixing molasses with the glue, to give the mass proper consistency, the old pelt-ball was entirely discarded.

The shop of a Dublin tobacconist, by the name of Lundyfoot, was destroyed by fire. While he was gazing dolefully into the smouldering ruins, he noticed that his poorer neighbors were gathering the snuff from the canisters. He tested the snuff himself, and discovered that the fire had largely improved its pungency and aroma.

It was a hint worth profiting by. He secured another shop, built a lot of ovens, subjected the snuff to a heating process, gave the brand a particular name, and in a few years became rich through an accident which he at first thought had completely ruined him.

The process of whitening sugar was discovered in a curious way. A hen that had gone through a clay puddle went with her muddy feet into a sugar-house. She left her tracks on a pile of sugar. It was noticed that wherever her tracks were, the sugar was whitened. Experiments were instituted, and the result was that wet clay came to be used in refining sugar.

The origin of blue-tinted paper came about by a mere slip of the hand.

The wife of William East, an English paper-maker, accidentally let a blue-bag fall into one of the vats of pulp. The workmen were astonished when they saw the peculiar color of the paper, while Mr. East was highly incensed over what he considered a grave pecuniary loss. His wife was so much frightened that she would not confess her agency in the matter.

After storing the damaged paper for four years, Mr. East sent it to his agent in London, with instructions to sell it for what it would bring. The paper was accepted as a "purposed novelty," and was disposed of at quite an advance over market price.

Mr. East was astonished at receiving an order from his agent for another large invoice of the paper. He was without the secret, and found himself in a dilemma. Upon mentioning it to his wife, she told him about the accident. He kept the secret, and the demand for the novel tint far exceeded his ability to supply it.

A Brighton stationer took a fancy for dressing his show-window with piles of writing paper, rising gradually from the largest to the smallest size in use; and to finish his pyramid off nicely, he cut cards to bring them to a point.

Taking these cards for diminutive note paper, lady customers were continually wanting some of "that lovely little paper," and the stationer found it advantageous to cut paper to the desired pattern.

As there was no space for addressing the notelets after they were folded, he, after much thought, invented the envelope, which he cut by the aid of metal plates made for the purpose.

The sale increased so rapidly that he was unable to produce the envelopes fast enough, so he commissioned a dozen houses to make them for him, and thus set going an important branch of the manufacturing stationery trade.

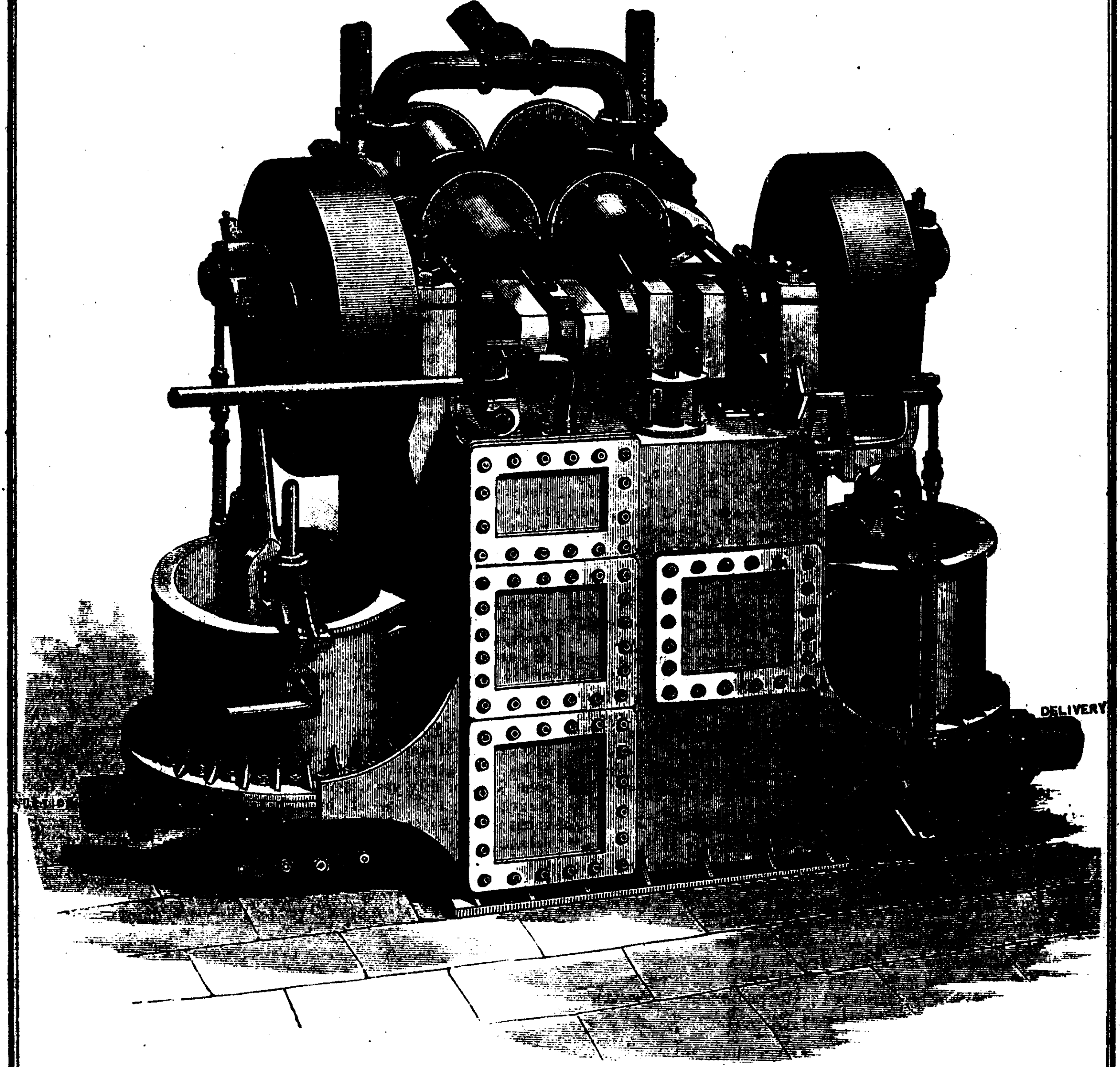
YEAST.

The yeast plant is now universally admitted to be a fungus growing and feeding on decaying organic matter, and is met with all over the globe. Nature seems indeed to have very carefully provided for its universal diffusion. The mildew which forms on the surface of yeast is really the fruit, the spores of which, it has been calculated, are but one-sixth of the diameter of the pollen-dust of the fir tree, showers of which have been sometimes met with hundreds of miles out at sea. When the yeast plant comes to maturity, therefore, and throws off its spores, they are very likely to travel over a great part of the earth's surface before settling. The propagation of the plant by the budding process just alluded to is very curious. A single cell will put forth one, or sometimes two tiny projections, which presently becomes complete cells, capable themselves of multiplying in the same manner, and thus in a few hours, under favorable circumstances, a portion of yeast introduced into a saccharine fluid will increase its volume to five or six times its original dimensions. Scientific men have made a distinction between surface yeast and sediment yeast—surface yeast being, they tell us, propagated by buds, and sediment yeast by spores. Beer yeast, at any rate has been thus divided. There is, however, very little, if any difference in the cells of the two kinds, and sedimentary yeast appears to be only a fungus developed at a lower temperature than surface yeast, into which, as a matter of fact, it is really converted by a rise of temperature. The reason of one kind appearing as a sediment and the other a surface growth is said to be attributable to a difference in the evolution of carbonic acid gas, the rapid generation of which keeps one "variety" of yeast at the surface, while the want of the buoyancy imparted by this generation of gas is the cause of the other kind remaining as a sediment. It seems, in fact, to be not a difference of kind, but of condition.

It is the rapid generation of carbonic acid gas which has given yeast its great value as a substitute for the ancient "leaven" in the making of bread, which is still used in many parts of the continent in the manufacture of black bread. Leaven is simply sour dough—dough that has been over-fermented, and which has the power of imparting its own fermentation to any fresh batch. In this case, also, the fermentation is produced by a fungus, the growth of which is attended by the evolution of carbonic acid gas. This permeates the whole mass with bubbles, which puff up the solid dough into an agglomeration of cells, thus imparting to it what we call lightness, and which within the past few years science has endeavored to accomplish in a more direct manner by "æreating" with the gas chemically manufactured. Whether in bread or an infusion of malt, however, the growth of the yeast plant is the same. The tiny vesicles of the yeast are nourished by appropriating the sugar in the fluid, or, more correctly, by decomposing the sugar. This decomposition, in some way which, so far as we are aware, is still a mystery to scientific men, produces a similar process throughout the fluid in which the yeast is operating. Whether this process, which is neither more or less than fermentation, is caused by the action of the yeast, or whether the action of the yeast is caused by the fermentation of the liquor, is a point on which a good deal of discussion has been held. Some have maintained that one is simply the accompaniment of the other, and that the two things do not stand to each other in the relation of cause and effect. It is now very generally considered that fermentation is initiated by the yeast, though it is not, we believe, a point that can be considered settled beyond dispute. As is very well known, an outcome of the process of fermentation set agoing by the yeast is alcohol. This is produced in the bread that has been "raised" by yeast just as it is in the infusion of malt or the grape juice, and it was computed by Dr. Odling a few years ago that no less than 300,000 gallons of spirit were annually generated by the manufacture of bread in London. All this escaped into the atmosphere, and some forty or fifty years ago a company was actually formed for carrying out a process of bread-baking by which this waste of spirit might be avoided. They propose making their profit by catching this 300,000 gallons of spirit, or the proportion of it corresponding to the amount of bread they made. It need hardly be said that it was an utter failure. The promoters sunk a great deal of money in their preparations, but they were unable to catch their volatile profit, and in the attempt to do so they spoiled the bread.

The baker's oven put an end to the action of the yeast by simply killing the plant, just as it would kill any other plant. It can not survive a temperature of more than about 212 degrees—the temperature of water boiling in an open vessel. The yeast fungus may, however, be dried in a moderate temperature, or it may be desiccated by pressure, and its vitality would be arrested. The plant may thus be kept for a long time, and hence it is that "German yeast" has found such a market in this country. We have no statistics at hand for the present time, but about fifteen years ago it was computed that from the large breweries of the continent nearly 6,000 tons of dried yeast were annually imported into this country, and consumed by our bakers. At the present time the quantity is probably far greater. At the same time it is a curious fact that larger quantities of yeast are bought up from our own brewers and exported in a compressed form to the continent, whence it probably returns in various forms of "baking powders," as well as in the shape of "German yeast." If the yeast trade is to revive in this country this fact will probably commend itself to the serious attention of English capitalists.

Ink for Writing on Glass.—Mr. F. L. Slocum has examined the ink for writing on glass, and, according to the *Am. Journ. Pharm.*, reports that it is made by mixing barium sulphate, three parts; ammonium fluoride, one part; and sulphuric acid q. s. to decompose the ammonium fluoride and make the mixture of a semifluid consistence. It should be prepared in a leaden dish, and kept in a guttapercha or leaden bottle.

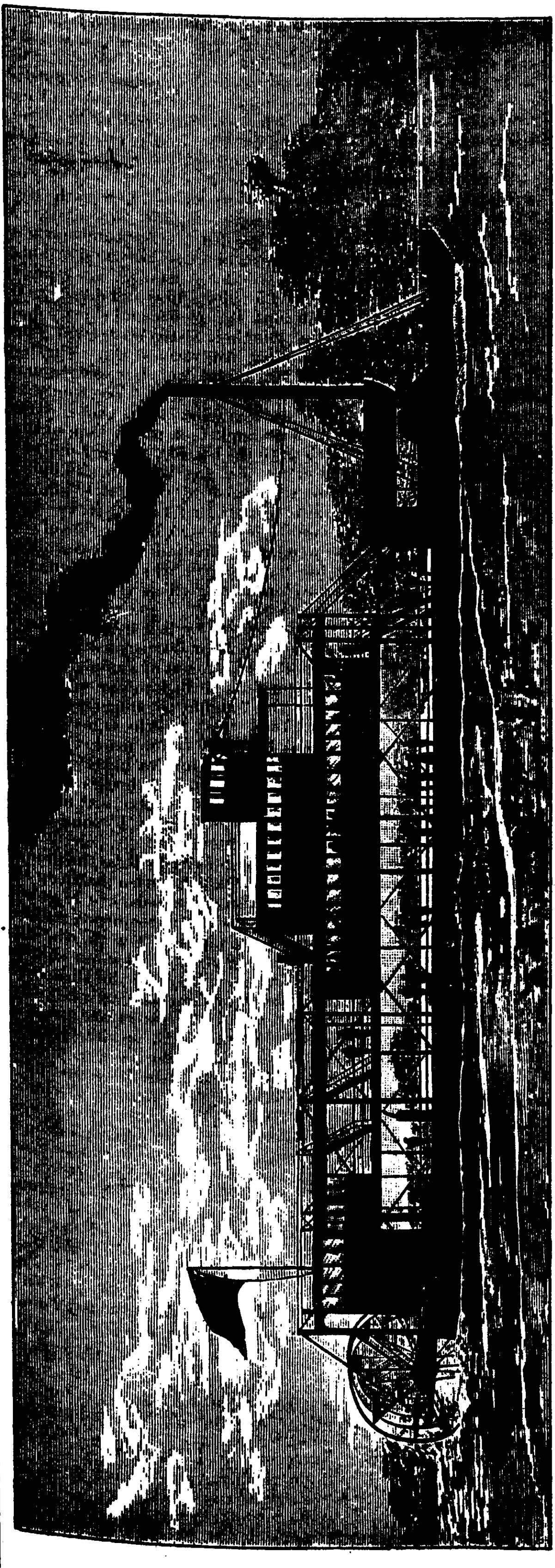


IMPROVED AIR REFRIGERATING MACHINE.

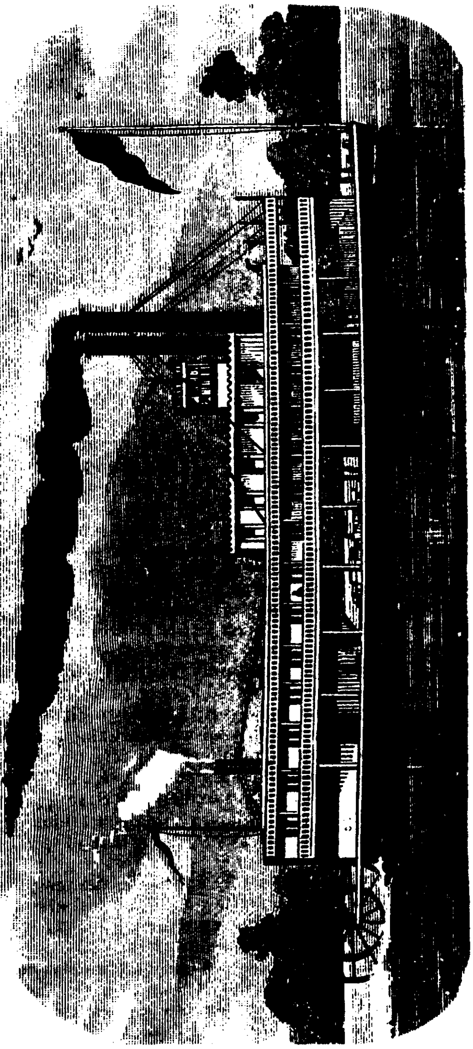
IMPROVED AIR REFRIGERATING MACHINE.

We illustrate a machine constructed by Messrs. Hall, of Dartford, for use in the Australian meat trade. The engraving is very nearly self-explanatory.

The machine consists of a pair of horizontal trunk engines, mounted on the top of a condenser. To one side is bolted a compressing cylinder, 27 inches diameter and 18 inches stroke. To the other side is bolted the expansion cylinder, 22 inches in diameter and 18 inches stroke; both these cylinders are open-topped. The valves are placed in the bottoms of the cylinders, and are worked by cams on the crank shaft and levers. Air is drawn into the compressing cylinder on the up stroke, and delivered on the down stroke, into the surface condenser at a pressure of about 50 lb. to 55 lb. on the square inch. The air here parts with its heat in the condenser, and it is then delivered into the expansion cylinder, the valve of which cuts off at about one-fourth stroke. The expanded air is then delivered through a pipe into the room to be cooled. About fifty per cent of the work expended in the compressing cylinder is returned in the expansion cylinder, the difference being made up by the engine. The machine is but one of several Messrs. Hall have in hand of different patterns. The outline diagrams show the form they recommend for ordinary use, the height being kept down to render it specially suitable for use between decks, but the machine can be made to take any form almost, and can be made of any dimensions to suit particular requirements. The condenser, or refrigerator, consists of nests of brass tubes, through which the water circulates. The tubes are of brass, half an inch in diameon the outside. The ends of the tubes are accessible through the man lids shown.—*The Engineer.*



MESSRS. YARROW'S BOAT.



THE S.S. "VICTORIA."

STEEL STEAMERS FOR THE MAGDALENA RIVER.

In our last issue we published a description of a light draught steel steamer built in England for the Government of the United States of Columbia, to ply on the River Magdalena. The illustration of this steamer we give on this page, in order to compare it with a second of American manufacture. American mechanics have also been engaged in constructing light draught vessels for the Magdalena, the one here illustrated being the "Victoria," belonging to the Magdalena River Navigation Company. The "Victoria" was built at Pittsburg, Pa., by James Rees, Esq., of the Duquesne Engine Works, who also built the "Francis Montoya" for the same stream, and, like the English steamer, was shipped in pieces after being temporarily set up.

The "Victoria" differs materially from the boat of the Yarrows, which has practically no upper structure, and is shorn of cabins and other accessories, in order to attain extreme lightness of draught. The "Rees" steamer was intended for a regular freight and passenger traffic, to accommodate which she is provided with a full length cabin on the upper deck and an officers' cabin above on the hurricane deck. The upper works are complete with all the appointments and fixtures of a regular North American river vessel. The hull is 155 feet in length, 82½ feet beam, and 4½ feet depth hold, constructed of steel, in eight water-tight compartments. The boiler, also of steel, is of the locomotive type, 18 feet long, 45 inches in diameter, and has forty-one 3½ inch tubes, furnishing steam at a working pressure of 150 lb. per square inch. The cylinders are 16 inches diameter, with 6 feet stroke, of the direct-acting high pressure type. The steamer has a capacity of 400 tons cargo, and yet draws but 22 inches with steam up, a splendid result for a vessel so complete in all particulars.

THE IRISH FARMER'S HOME.

BY W. MATTIEU WILLIAMS, F.R.A.S., F.C.S.

Presuming that the readers of the *Building Times* are devoted to the study of every order of architecture, a few words on the above may be interesting, as it differs sufficiently from Doric, Ionic, Corinthian, or Gothic, to deserve a separate class to itself.

My first intimate acquaintance with the whole economy of one of these edifices arose in this way. After lodging for a night in the Trappist Monastery of Mount Melleray, I walked over the Knockmeledown Mountains, on the flanks of which that curious fraternity has settled, and proceeded towards the parallel range of the Galtees, along a valley which lies between the two. My destination was Mitchelstown, in the neighbourhood of which is the most extensive cavern in Great Britain, so extensive that nobody has ever completely expolored, it and its full magnitude remains unknown. On my way I was overtaken by a corporal and private of the constabulary riding in a coal-cart. They offered me a "lift," which being rather foot-sore I accepted, but in mounting the vehicle was warned to be careful of the rifles, as they were loaded and on full cock, in accordance with regulations. "What regulations?" I exclaimed; and was then informed that a man had been shot and an agent wounded, the district proclaimed and evictions were to be executed forthwith. At the end of my lift where our roads parted, the hospitable police officers told me how to find the cavern, and where I might lodge for the night in the village of Burncourt. I walked to Burncourt, found the grocer's shop indicated by the constables, but in spite of a furious storm of rain and thunder and lightning was refused admittance. Then I tried a little sheebeen with the same result, tried to hire a car for Mitchelstown, but none was to be had. For the first and only time in Ireland I was a houseless stranger that nobody would shelter or assist. A well-dressed man drove past me in a car; I asked to share it with him, and he replied with an oath. All were thinking of the miserable wretches who on the morrow were to be torn from their homes, the homes of their fathers and grandfathers, and left to the pitiless storm now raging. I was evidently a Saxon, and suspected of some hand in the coming misery, and was therefore sentenced to have a temporary taste of eviction by way of preliminary retribution.

Tired already and completely drenched, the prospect of eight more Irish miles to Mitchelstown in the darkness and among these scowling people was not agreeable. Just as I determined to tramp on a bright inspiration arose. The constables had given me the name of the man who shows the cavern. He would understand the natural history of an English tourist. With some difficulty I obtained a clue to his residence, and by the time of full darkness reached it. Tim Mulcahy is a fair specimen of a respectable Irish cottier, and his residence of the better class of Irish farm houses. His holding comprises nine Irish acres; his stock four cows, one calf, five sheep, one horse, three or four pigs, and several fowls and geese. He manages on this to sustain himself, his wife, and seven children. This farm house has two rooms, both literally on the *ground* floor, for like most of such houses, the only flooring is mother earth beaten down by the tread of bare feet. Cleanliness of floor, as understood by English housewives, is simply impossible in such places. A sort of birchen wisp is used for roughly sweeping it. In too many cases it is strewn continuously with potato peelings and other refuse. It was not so here. The clay floor was as decent as such a floor might be. The walls of the house are built of rough stones and very thick. Two to three feet is a common thickness of wall in such places. In this respect the Irish cottier is better lodged than the renter of a London suburban villa. The thatch also being very thick, and the window very small and deeply recessed in the thick wall, the protection from the outer climate is sufficient. In every other respect these tenements are deplorable, and utterly disgraceful to the men who receive rentals for them. I speak of Ireland generally, never forgetting that some estates are nobly exceptional with tenant farmers living in floored cottages that are actually fit for human habitation. These, however, are but few. Under a massively built chimney was a hearth on which was blazing a large peat fire, above which was suspended by a chain an iron cauldron containing potatoes.

Presently supper was ready, and the banquet was laid by simply spreading a cloth on a rough oblong table and turning out upon it the contents of the cauldron. The family picked up the potatoes one by one in their fingers, tore off the skins rather deftly, dipped one side of each in a heap of salt and ate it. This went on till all were satisfied; the remainder was then carefully mashed in an oblong trough and served to the pigs. Varied with a little boiled cabbage, such is the food of these poor creatures day by day for weary weeks and months and years. They produce other food, fine fat poultry, rich pork and bacon, delicate veal, butter and eggs, but these are sent to England, and their produce pays the rent, the residual cabbages and potatoes feeding the men, women, and pigs. If the potatoes and cabbages fail, what then? The father, mother, and children must either eat the landlord's portion or starve. The law decrees the latter alternative, and the Land League advocates the former.

In the room with the blazing fire were two beds against one wall, one bed for the mother and father, the other for the boys. The room beyond was the girls' bed-room, and very small. At first glance the dirt-paved floor seemed to give its character to all the rest, but after I had rested awhile, had become accustomed to the gloom, and could fairly take in the details, there were evidences of a melancholy struggle for cleanliness and decency. On the rough shelves were some cups and plates and a tea-pot, all displayed as dainty ladies exhibit their costly Wedgwood. There were some poor ornaments and an American clock. The bedding, though unbleached and very coarse, was clean, and to maintain its cleanliness a simple device was used The family had one pair of slippers. The girls went first to bed, one by one, each washing her feet in a large bucket of water, then putting on the slippers walked in them to the bedside, to avoid the touch of the clay floor. The next fetched the slippers and did the same. Then the boys similarly retired to a sort of tressle that the mother had extemporized in order that I might occupy their bed. The father and mother retired last. By the side of each bed was a square piece of wood, kept scrupulously clean. This was the poor substitute for carpet, upon which each one trod after the washing of feet, and tae casting off of the family pair of slippers.

No pigs were allowed in this cottage, as they are in too many. The poor farmer had built a pig-sty for decency sake with his own hands and stone of his own hewing, but of course it was included in the next revaluation, and he had to pay additional rent for it. In Ireland one of the "rights of property" is that of appropriation by the landlord of every tree the tenant plants, and every addition his industry may give to the market value of the land. I have said that this house and its inhabitants are superior specimens of the condition of Irish farm-houses and Irish farmers. This may be understood by the fact that next morning on visiting the National School at Skeenarinky, I found one of the daughters engaged in teaching there.

There is another class of hovel far inferior to this, the ground plan square, or in some cases rudely circular, with a thatch on the top, and only one room, in which pigs and bipeds live together. These are simply horrible, so much as that it requires a positive effort of courage fairly to enter one, and very few Englishmen ever have crossed the threshold of any of these. I should like to question every Irish landlord, and learn how many of them have spent an hour inside these residences of their tenants. No English livery stable keeper would allow his horses to live in such.

The worst specimens that I have seen are those which form the villages of Keel and Dooagh, in the Island of Achil. I have hobnobbed with Laplanders in their huts built of turf on a wooden framework, and found these in every respect superior to the average hovels of Keel and Dooagh, which simply consist of four rude stone walls, with a hole serving as a door, a floor of mud, and a covering of rotten straw. These biped-styes are grouped without any arrangement of streets, or any means of draining away the accumulations of filth that rests between them. In this filth were wallowing together, at the time of my visit, dirty pigs and dirtier children *absolutely naked.* Had I not seen these worse than Hottentot settlements I could not have believed it possible for human beings to have existed in such surroundings, but should have concluded that they must have been exterminated by fever.—*From the Building & Engineering Times.*

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Les Mondes gives the following old recipe for testing the age of eggs, which, it thinks, seems to have been forgotten. As *Nature* thinks so too, we may reproduce the recipe for our younger readers, and also as having other possible applications. Dissolve 120 grammes of common salt in a liter of water. An egg put in this solution on the day it is laid will sink to the bottom; one a day old will not reach quite to the bottom of the vessel; an egg three days old will swim in the liquid; while one more than three days old will swim on the surface.

THE library at Alawick Castle is illuminated by means of three lamps, each containing three of Mr. Swan's incandescent carbon lights. The result is said to be most satisfactory, the effect being far superior to anything produced by gas.

PHOTOZINCOTYPES.

In Moll's *Notizen*, Herr J. Husnik writes as follows on photozincotypes with a sensitive asphalt solution :

We have at last reached the point of a more intimate knowledge of asphalt, and have thereby obtained a correct explanation of many of its properties hitherto kept secret.* It appears that by treating this substance with ether certain less sensitive components are removed, so that a residue "insoluble in ether" is left, which possesses in a considerably higher degree that sensitiveness to light so much desired in order to render the asphalt process practically useful. The way in which asphalt manifests its sensitiveness to light consists in becoming insoluble, or difficult of solution in its usual solvents, after exposure. Thus, a zinc plate, coated with an asphalt solution, which has been exposed for some time under a linear negative, may be developed by spirit of turpentine, so that all the whites dissolve while the lighted parts remain undissolved. And if after fully developing, the zinc plate be washed first with spirit and then with water, and now allowed to become perfectly dry, the operation of etching may at once be begun ; but, as such a plate had formerly to be exposed for hours in the sun, and for days—in winter even for weeks—in the shade, in order to get a good picture which could be developed with turpentine, it was not possible to turn the process to practical account. Gillot, Yves, and Barret, and other firms in Paris have, however, employed the asphalt process for years, but the secret of the greater sensitiveness of their solution was never known.

In Switzerland and America also one often heard of the asphalt process being employed for zincography, and, as already mentioned, the veil has now been torn from the secret. We know at last that progress in this process is to be sought in the direction of elimination from the solution of the insensitive particles.

Such a sensitive solution can, when requisite, be diluted with a little anhydrous benzole (not benzine, in which asphalt is insoluble). Benzole which contains a little water cannot be used either, as in drying it would cause the asphalt solution to wrinkle up and would not furnish an equal surface.

The solution must be kept perfectly free from dust. Before being coated the zinc plate should be carefully dusted, and any excess of the coating solution should be poured off into another vessel, and not back into the stock bottle until it has stood to settle for a couple of days, after which the upper part may be poured back. When the film has become dry it may be slightly warmed and then exposed under a clear line negative—preferably in the sun, as then only half an hour of an exposure is required. The plate is now laid in a bath containing oil of turpentine, and when the image has become visible the denser portions may be gone over with a small soft pencil, so that they may be developed at the same time as the light.

When the shadows appear sufficiently clear, remove the plate and coat it with alcohol or place it in a bath containing alcohol, and when the oil of turpentine has been partially washed out, place it under a jet of water falling from a certain height, so that the water may come in contact with the whites and remove any oil of turpentine that might still be adhering to them.

The development is an operation requiring great care and rapidity of work, which can only be learned by practice. The plate, being well developed, is next warmed, and when it has cooled again the next stage is the etching. Should the shadows, however, not be deep enough, they should be gone over with a pencil dipped in the oil of turpentine, and when that has been allowed to act for a short time the whole plate should again be washed in the above mentioned turpentine bath, and the procedure with the alcohol bath and the water tap repeated. This plan gives sharp pictures, and may be used with advantage for much reduced reproductions of woodcuts.

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HOW THE FRENCHMAN LIVES.

The French laborer probably gets more for his wages than any other. His food is cheaper and more nourishing. His bouillon is the liquid essence of beef at a penny per bowl. His bread at the restaurant is thrown in without any charge, and is the best bread in the world. His hot coffee and milk is peddled about the streets in the morning at a sou per cup. It is coffee, not slops. His half bottle of claret is thrown in at a meal costing twelve cents. For a few cents he may enjoy an evening's amusement at one of the many minor theatres, with his coffee free. Sixpence pays for a nicely cushioned seat at the theatre. No gallery gods, no peanuts, pipe, smoke, drunkenness, yelling, or howling. The Jardin des Plantes, the vast galleries and museums of Louvre, Hotel Cluny, palace of the Luxembourg and Versailles, are free for him to enter. Art and science hold out to him their choicest treasures at a small cost, or no cost at all. French economy and frugality do not mean that constant retrenchment and self denial which would deprive life of everything which makes it worth living for. Economy in France, more than in any other country, means a utilization of what America throws away, but it does not mean a pinching process of reducing life to a barren existence of work and bread and water.

Miscellaneous.

THE UTILIZATION OF SAW-DUST.—The saw-dust, which has become such a nuisance at Minneapolis and along the river below that growing city, offers a promising field of enterprise for whoever will utilize it. Several applications have already been made of it, and now arrangements are being made by a French manufacturing chemist for the establishment, at Minneapolis, of a laboratory to make from the saw-dust an acid, now imported from France, and largely used by dyers, chemists and druggists. It is to be hoped that the enterprise will be successful.

TESTIMONY OF THE ROCKS.—From a small erratic block, wholly unlike the rock of Mount Washington, found on the summit of that mountain recently, Prof. C. H. Hitchcock infers that the glacial ice was deeper in that region than has hitherto been supposed. The boulder resembles the rocks of Cherry mountains ; and if it was carried to Mount Washington by ice as Prof. Hitchcock believes, Mount Washington must have been totally submerged by the ice sheet at some time during the glacial epoch.

A FIRE TELL TALE.—A plan has been recently contrived by M. G. Dupré, in which the contacts of the automatic key for ringing an alarm bell are kept apart by a piece of suet or tallow, which on melting by the heat allows them to come together through the operation of a small weight attached to the uppermost contact bar. The idea is so simple and the apparatus must be so cheap that it will doubtless be largely patronized for public buildings, banks, etc., and even for private mansions.

M. LEON VIDAL describes his selenium photometer before the Photographic Society of France the other day. It is on the principle of Bell's photophone, a galvanometer indicating the exposure required in a direct and trustworthy manner. A battery, giving a feeble but constant current, a selenium receptor, and a galvanometer, are all the apparatus needed.

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THE COMMERCIAL TRAVELLER'S SCHOOLS AT PINNER.

Our illustrations comprise, first the railway front of the main building the institution, the foundation of which was laid in 1853. and the schools were finished and opened in 1855, the Prince Consort being then present. The cost was about £25,000, besides ground,s which the London and North Western Railway Company parted with £2000,.it being now considered worth four times that amount. Our second engraving represent part of the George Moore Memorial Buildings," which were erected when it was found necessary to enlarge the institution.

Just before this time Mr. James Hughes, a partner in the firm of Moore, Crampton, Copestake and Co., had engaged to preside at the annual dinner (in 1876), and the appeal which he made in anticipation of that festival was so successful taat the large sum of £17,000 was raised. Shortly before the anniversary Mr. Moore's mournful death occured- and it was then decided by the Board of Management that the additions they were about to make to the institutions should bear the name of "The George Moore Memorial Buildings." These new buildings and additions comprise an infirmary and two floors as distinct as though they were separate buildings, besides a large laundry and a fine swimming bath. New dormitories occupy the whole of the front of the main building ; but the principal feature is the centre gable of the infirmary which contains a bust of Mr. Moore, surrounded by a floral border, beneath which is a panel and *bas rélief*, representing Mr. Moore distributing prizes to the children, the whole being in Della Robbia ware, and set in black marble moulded frame with panels right and left cintaining the arms of Mr. Moore and the institution, and the fauna and flora of the neighbourhood.

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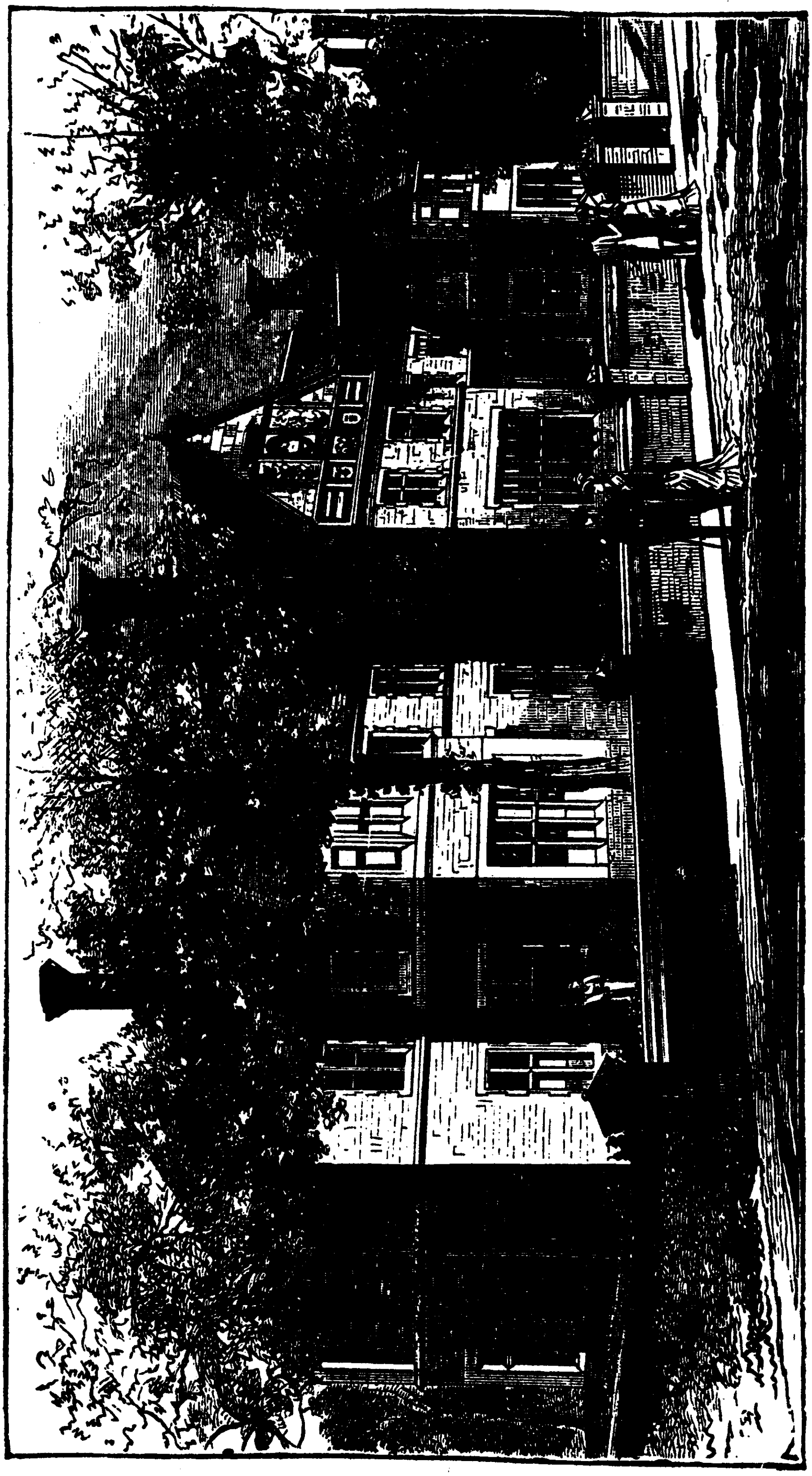
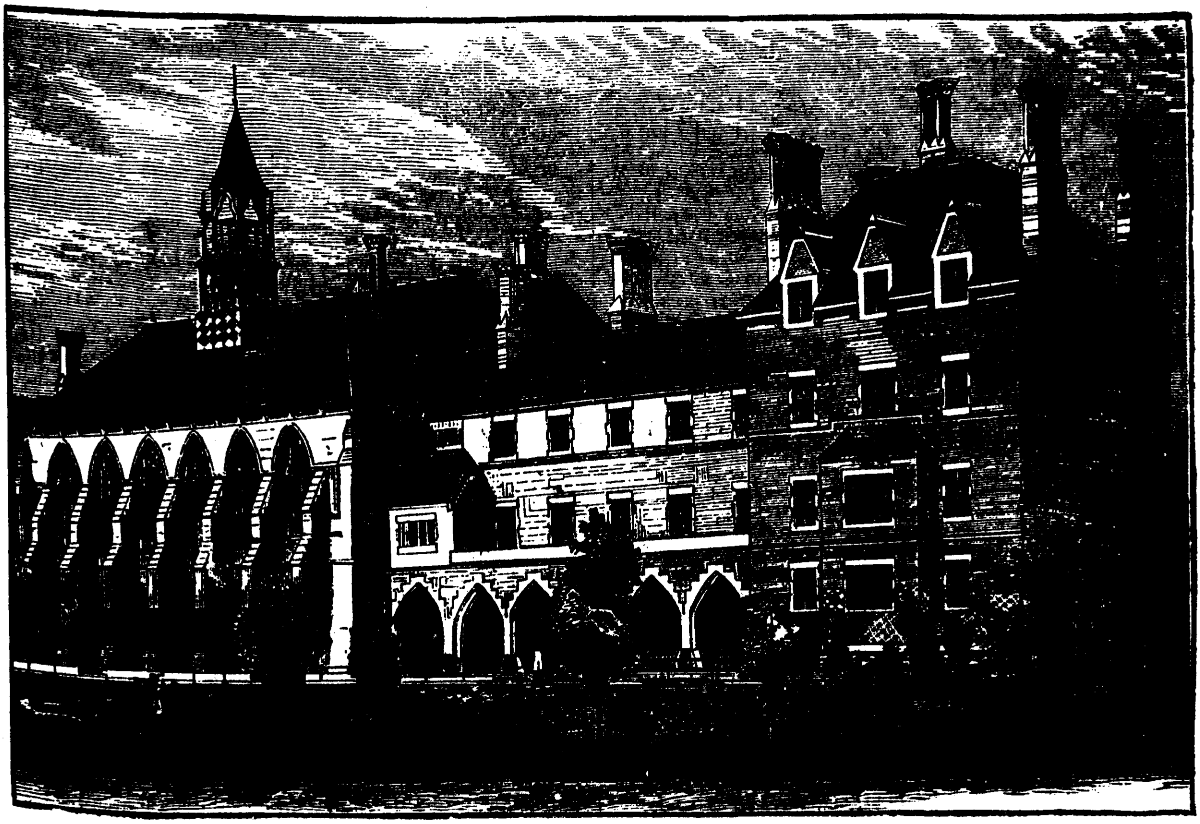
* Dr. Kayser's examination of the properties of asphalt.



THE COMMERCIAL TRAVELLERS' SCHOOLS AT PINNER.—GEORGE MEMORIAL BUILDING.—(See preceding page.)



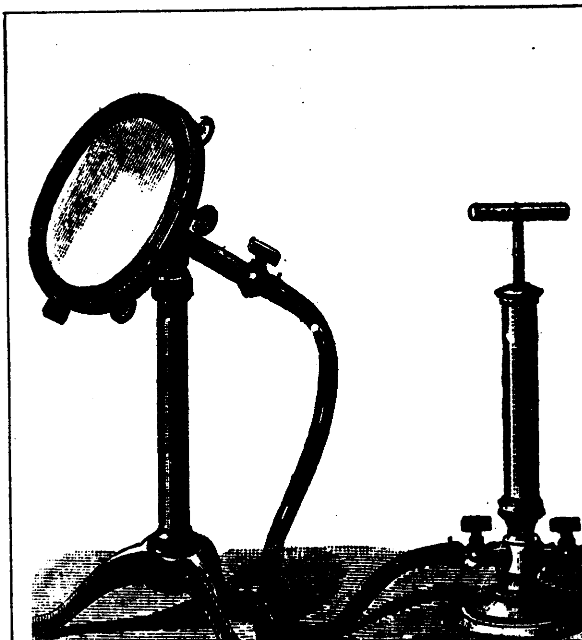
THE COMMERCIAL TRAVELLERS' SCHOOLS AT PINNER.—MAIN BUILDING.

ON MAGIC MIRRORS.

BY MM. BERTIN AND DUBOSQ.

The people of the far East, the Chinese and the Japanese, in bygone times were only acquainted with metallic mirrors; and even to-day they make only these. They are made of speculum metal, of various forms and sizes, but always portable. One of the faces is polished and always slightly convex, so that its reflection gives images which are reduced in size; the other face is plane or slightly concave, and always has cast on it ornaments which are in relief. Among the many mirrors thus constructed there are a few which possess a wonderful property: when a beam of the sun's light falls upon the polished surface and is reflected on to a white screen, we see in the disk of light thus formed the image of the ornamentation which is on the back of the mirror. The Chinese have long known of these mirrors and value them highly; they call them by a name which signifies *mirrors which are permeable to the light*. We, of the West, call them *magic mirrors*.

Magic mirrors are exceedingly rare. We only find mention of them four times in *Comptes Rendus* of the French Academy of Sciences. The first was presented to the Academy by Arago, in 1844; the second and the third were brought to the notice of the Academy in 1847 by Stanislas Julien and by Person, and the fourth was exhibited before that society in 1853 by Maillard. It is true that even so far back as 1832 Brewster gave a theory of the phenomena of magic mirrors; but his explanation was made on the basis of the description of one of these mirrors which came from Calcutta, but which Brewster had never seen. Finally, in 1864 and 1865, M. Govi read before the Academy of Turin two papers on very beautiful experiments which he had made with three magic mirrors; this brings to seven only the number of which, up to that date, had been seen in Europe since men have begun to observe facts in a scientific manner. Therefore very few persons had seen magic mirrors till the month of last April, when an English physicist, Mr. Ayrton, Professor at the Polytechnic School at Yeddo, exhibited several of these mirrors, which he had brought with him from Japan. He experimented with them, and very successfully, before a small audience in the laboratory of M. Carpentier. He then left for London, and it will probably be a long time before we again have the privilege of seeing these marvelous mirrors.



THE MAGIC MIRROR.

In the meantime I received a visit from M. Dybowski, my former pupil, who had returned from Japan, where for two years he had been the colleague of Professor Ayrton. He brought back with him as objects of curiosity four *temple mirrors*—that is to say, antique mirrors; these are far superior to mirrors of modern production, for the manufacture of these mirrors has been nearly abandoned by reason of the introduction of the silvered mirrors of Europe. We tried them together; three were circular, and the thinnest of them, which is a disk of 15·3 centimeters in diameter, was found to be slightly magic.

To try such a mirror we reflect a sunbeam from its polished surface on to a white cardboard, about one meter distant. But to obtain the very best effects we must illuminate the mirror with a diverging pencil of light; this pencil is made still further divergent by reflection from the mirror, because its reflecting surface is convex. We can now receive the reflected rays on a screen at a greater distance, and we at once see distinctly the magnified image of the ornamentation on the back of the mirror. These raised designs appear on the screen in white on a dark ground. The image thus made by our mirror was confused, because the mirror was not a good one; it would have been sharply defined had the mirror been properly made. I then knew of no means by which I could make it give better effects.

The means by which the mirror could have been improved were first pointed out by M. Govi in the second of his two papers to which we have referred. It is a consequence of the true theory of magic mirrors. The theory was not reached at once.

Stanislas Julien has found in the writings of a Chinese author of the twelfth century of our era an explanation of the wonderful effects of these mirrors. The author supposes that the designs in relief on the back of the mirror are reproduced by deep engraving on the front, and then a finer and more highly reflecting metal is poured into the lines of this engraving. On polishing the face of the mirror the magic effect is produced in the image by the greater reflecting power of the finer bronze.

The theory of Brewster does not differ substantially from that of the old Chinese. The polishing of the mirror effaces traces of the operation of engraving, rendering the surface the same throughout when inspected by ordinary light, but this engraving is developed when the sun's rays are reflected from the face of the mirror. But Brewster, who proposed this explanation, was not aware this reflecting surface was really amalgamated.

This very ingenious theory was not known in France when they began to take interest in magic mirrors; if it had been it might have misled those who sought an explanation of these curious phenomena. The first French physicist, Person, who had the opportunity of experimenting with one of these mirrors, at once gave the true explanation of its action. He satisfied his own mind, by direct experiments, that the polished surface of the mirror was not regularly convex. It was so in all parts except those corresponding to the design on the back of the mirror. "The rays," says he, "reflected from the convex portions diverge and give but a feebly illuminated image; while, on the contrary, the rays reflected from the plane portions of the mirror preserve their parallelism and appear on the screen as an image by reason of their contrast with the feebler illumination of the rest of the image."

This irregularity of surface of these mirrors is brought about by the peculiar process adopted in working them, and which was explained to us by Professor Ayrton.

The mirror comes from the mould as a disk with a plane surface, and before it is polished this surface is scored in all directions with a pointed tool, and naturally it offers more resistance in the thick than in the thin parts. This operation tends to make a slightly concave surface, but the reaction of the elastic force of the plate makes this surface slightly convex; and this convexity is more pronounced in the thin portions of the plate than in those corresponding to the design on the back of the mirror. This irregularity of form of surface cannot be detected in diffused light, but it may, in the case of thin mirrors, produce the magic effect by the reflection of a very bright light, like that of the sun or of an oxy-hydrogen jet. This is, indeed, the case with all badly wrought metallic mirrors; thus a plate of silver may give good reflected images, but on reflecting from it the sun's rays we will see on the image formed on a screen all the marks of the hammer which it received when it was being flattened. It is really a true magic mirror, only its reflected image is irregular and confused, while that of the magic mirror is regular like the design on its back.

The experiments of Govi were made to overthrow the theory of Brewster and to establish that of Person. Though these experiments are very interesting, I shall not here describe them, because they have already been extensively published in the annals of science; I will only recall the last and the most curious of his experiments, that in which he heats the back of the mirror. The thin portions should heat more rapidly than those in relief; they will become more convex, the irregularities in the form of the surface will become more pronounced, and the magic effect will be increased; it may even be thus produced in mirrors which, without such treatment are devoid of magic properties.

When I became acquainted with the papers of M. Govi, I proposed to M. Dubosq to associate himself with me, in order, first, to repeat the experiments of the learned Italian, and then to study generally the interesting phenomena of magic mirrors, in the hope of being able eventually to reproduce them in his workshops. At first we had at our disposal only the mirror brought from Japan by M. Dybowski, and which gave confused images with the reflected solar rays. These images became very sharply defined when we had heated the back of the mirror with a gas lamp, and the mirror gave very magic effects.

We then made a mould and reproduced this mirror, not in Japanese bronze, but in ordinary gun metal. The first copy was roughly worked on the lathe, after the Japanese manner, in order to render it magical, but this was broken. The second was worked carefully on an optical grinding tool; the surface was then polished and nickel plated, but it was not magical; but it acquired this property in a high degree when it was heated, and it even retained traces of this property after it had been repeatedly heated. Several Japanese mirrors which we procured have given analogous results.

We then engraved letters on the back of little rectangular Japanese mirrors. On heating these the letters appeared in black in the reflected image. When we cut lines around the design on the back of the mirror, heat rendered them very magical, for the design stood out framed in the black lines which bordered the figures.

Thus it is seen that heat is very efficacious in rendering mirrors magical; but is not without its inconveniences. First of all, it injures the mirrors, which thus lose their polish, especially when they have been amalgamated; also, the mirror is often not heated equally and the images are deformed. It occurred to us that the change of curvature which was required could be obtained more uniformly by means of pressure. M. Dubosq therefore constructed a shallow cylinder of metal, closed at one end by the metallic mirror, and at the other by a flat plate of brass, having in its centre a stop cock, which we could attach by means of a rubber tube to a little hand pump. This pump could be made either to condense or rarefy air. If the rubber tube was attached to the pump, arranged as a condenser, a few strokes of the piston sufficed to compress sufficiently the air in the shallow cylinder.; the mirror became more and more convex, the cone of reflected ray became more and more open, and in the image on the screen the design on the back of the mirror became more and distinct. Our Japanese mirror, when thus treated, gave very fine images, and the copy which we had made, and which gave no result as ordinarily experimented with, now became a magic mirror as perfect as any of those which Professor Ayrton had exhibited before us. A mirror in brass, nickel plated, on whose back was soldered tin plate figures, around whose borders were cut lines, became very magical by pressure, and gave the design on its back in light surrounded by dark borders.

This is what I call the *positive image*. We can also obtain the *negative image*, or the inverse of the preceding one, by rarefying the air in the shallow box. To do this we have only to attach the rubber tube to the pump arranged as an ordinary air pump. On now working the lathe the air in the shallow box is rarefied, the mirror becomes concave, the cone of the diverging reflected rays close up, the image of the design is reduced in size, changes its appearance, and becomes an image of the design on the back of the mirror; but this now shows in shade bordered in bright borders.

These experiments require an intense light. A jet of coal gas is insufficient; but the oxy-hydrogen light is sufficiently intense. We intercept it with a screen perforated with a small hole, so that the diverging pencil which falls on the mirror may not spread too much. The mirror is mounted on the top of a column, so that it can be made to face in any required direction. The effects are most brilliant and the best defined when we experiment with the rays of the sun. When we expose the mirror to the beam of the porte lumière it is generally not entirely covered by the light; in this case it is best to use a diverging beam obtained by means of a lens placed between the porte lumière and the mirror.

Thus we have seen that we can now make copies of the Japanese mirrors, some of which may be magical, but all may be rendered so by making them covers of the shallow box containing either compressed or rarefied air. This pressure box and its mirror, made in the Japanese style, certainly forms one of the most curious pieces of apparatus which is to be found in the cabinet of physics.

We shall not, however, stop here. One of these days, while our mirror is magical under the influence of pressure, we will take a cast of its surface, and then reproduce this by means of galvano-deposition. This surface will have all the irregularities of that of the magic mirror, and will produce by its reflected rays the image of a design which no longer exists on its back.—*Journal de Physique.*

MAMMOTH FIRE BOAT.

The tendency, of late years, to erect large and high buildings has been such that our present system of combating fires is in many cases wholly inadequate for the purpose. Buildings are now erected double and treble the height they were twenty years ago, while our means of combating fires in them remain practically the same. The miniature fire engine used in Turkey has its use in extinguishing fires in the shops and bazaars of that country, but would be wholly useless here or in London or Paris. Our old hand engine did good duty when we had small two-story houses, but it had to give way to its more powerful rival, the steam fire engine, when our cities became larger and buildings higher. But the present steam fire engine, powerful though it be, has in many cases shown itself completely inadequate to combat fires in large and high buildings. Many of our large structures have a thousand tons of combustible material in them, each ton of which, in burning, will give off heat sufficient to evaporate ten tons of water. Therefore the heat generated would dissipate ten thousand tons of water, and, moreover, only a small fraction of the water used ever reaches the fire.

Fully one-half of the fires in New York and Brooklyn are confined to the river front, where an unlimited supply of water is at hand, only requiring steam power to place it where it will do the most good. In our engraving will be seen a new fire boat, which has been designed by H. S. Maxim, M.E., of New York. Mr. Maxim proposes to make a fire boat on a grander scale than has ever been thought of heretofore—one that shall have power sufficient to completely and almost instantly extinguish any fire, great or small, that may be within its reach. The hull is of iron, 250 feet long and 40 feet beam. She has two complete engines, so that one wheel may back while the other goes ahead, thus enabling her to turn, as it were, on a pivot, or to move in almost any direction. The space below the deck is full of machinery. The boilers, 3,000 horse-power, are so constructed that their full force may be used either on the paddle-wheels or on the pump. The engines are of the compound type, using steam at 80 pounds pressure to the square inch. The pumps are of the compound duplex pattern, and are of great size and strength, being able to convert the full energy of the boilers into power for projecting a stream of water. The novel features of this boat consist of the vertical stand pipe and the two discharge pipes mounted on trunnions, as shown in the engraving. The stand pipe connects with the pump below deck, and may be revolved in any direction, while a telescopic joint admits of running it up or down. The lower discharge pipe is designed to extinguish fires on shipboard or for sinking a ship. It has a nozzle of 20 inches diameter, which, of course, is immense, considering that it has the sea for a supply and 3,000 horse-power to force it. The top discharge is 60 feet above deck, and the nozzle is 60 feet long from the trunnion. It may be moved up or down or turned in any direction; when at its highest elevation the nozzle is 100 feet above the deck.

A novel feature connected with this discharge pipe is the variable sizes of discharge nozzles, which are arranged in a cylinder like the chambers of a revolver, and may be changed without stopping the flow of water. The cylinder has five separate nozzles; namely, 6 inch for great distances and very high pressure, 8 inch for less distance, 10 inch for fires near at hand, and a sprinkler, consisting of one hundred three-quarter-inch diverging openings. The nozzles may be changed and the discharge directed by a single operator placed in a cab situated on the top of the stand pipe. All the movements are made by the agency of small steam engines. When we consider that this boat can throw a ten inch stream of water, which is 100 times the size of a steam fire engine nozzle; that, instead of being thrown from the ground and nearly all its power lost in raising it to the fire, it is thrown from a height of 100 feet, and with a force great enough to break through iron blinds, wooden shutters, doors, or roofs, and that the force of the water would be such that it would be dashed into a spray of sufficient volume and density to fill every nook in a large building; that a large floor could be flooded in one minute, and that the largest fire possible in any building now erected could be extinguished as quickly as a fire in a drygoods box or barrel could be extinguished with old appliances—some idea of its power can be formed. In addition to the fire-extinguishing features, she is also provided with a means for demolishing walls, staving in sides of ships, and for making fast to ships that are in flames.

For demolishing buildings in case of great fires, the usual mode has been to place under or near to them a large quantity of gunpowder. This was resorted to in Boston; but with poor success; its action is uncertain and unreliable. It often occurs that a fire is inclosed in a strong room with heavy walls, and that there is no means of getting a stream of water on to it. In such cases it becomes necessary to make an opening in the wall. To accomplish this, Mr. Maxim has invented a peculiar kind of a gun, which will throw a wooden projectile with any degree of force necessary. The projectile is of hard wood, 4 feet long and 16 inches diameter. The force used is gunpowder of a very coarse and slow grade. The powder chambers are from 2 inches to 6 inches diameter, and may be changed at will. For instance, if a charge of powder filling a breach tube, 3 inches diameter and 4 feet long (ignited at the end nearest the wood), should fail to penetrate a wall or the side of a ship, then a larger tube would be used with more powder, until, by experiment, a blow could be given with precision in the exact spot needed. When the fire is on shipboard, and it becomes necessary to make an opening in the deck, one of the two mammoth picks or hammers may be used. They are drawn up by steam and may be dropped at any height like a pile driver. A hole could thus be made instantly, while the same when only slightly embedded in the deck may be used to make fast and thus pull the ship out in the stream to sink, or to remove it from others which are on fire.

A boat of this kind, aside from a fire boat, would be well calculated for breaking up the ice in the harbor. Her great power and independent wheels would enable her to go anywhere.

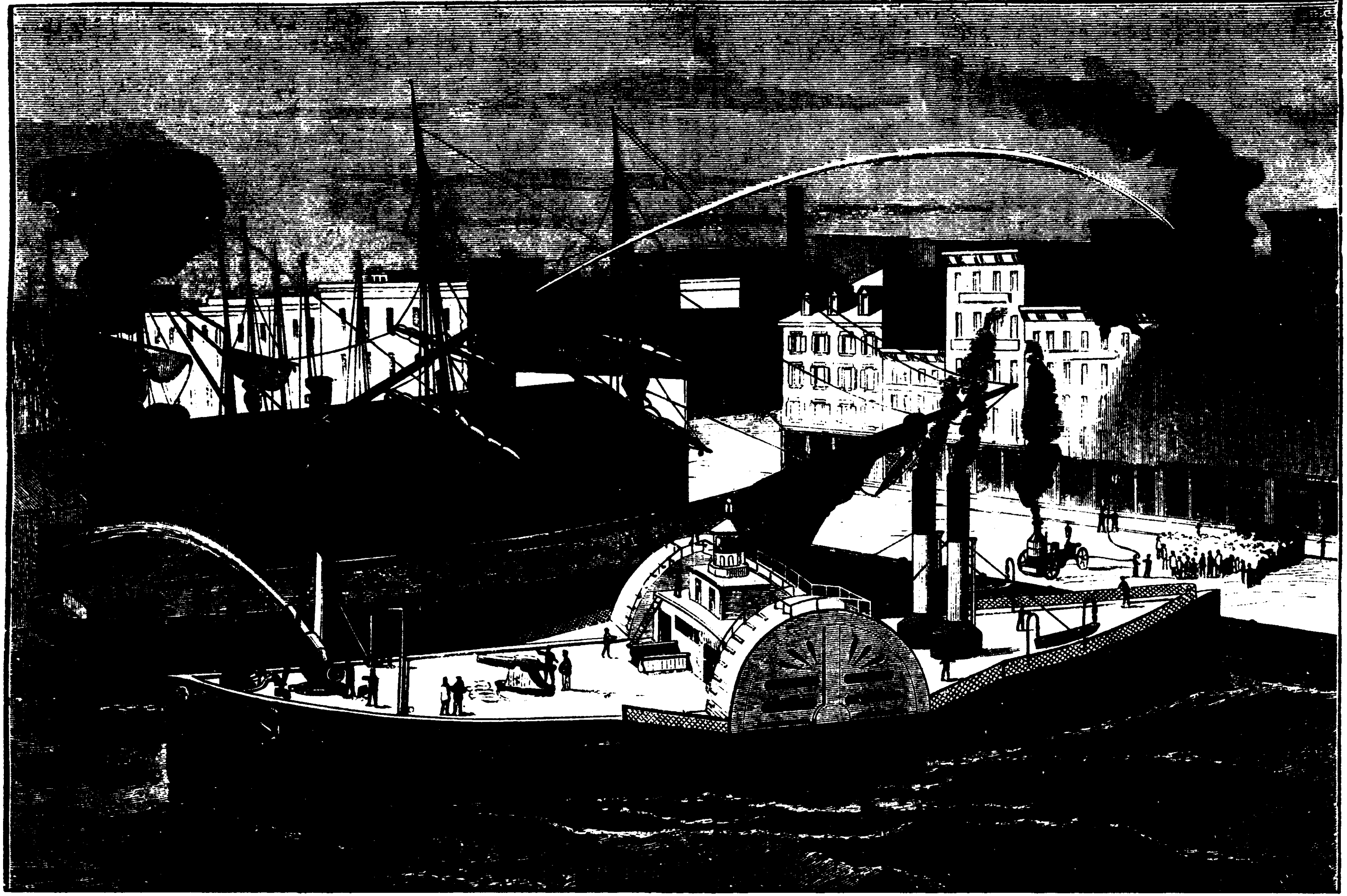
Large fires, when within two or three blocks of the river front, could be reached with hose from this boat. It would supply over one hundred lines the same size as used by the steam fire engine, or better, four large lines twenty-five times as large (4 inch or 5 inch nozzles). The discharge pipes would have to be mounted on wheels like a field piece, and would constitute, as it were, the artillery of the fire department. Linen hose can now be made of any size and strength. With proper appliances, hose 8 inches diameter could be readily put down. What is wanted is a stream of water of mammoth proportion, one that will reach 200 or 250 feet, and will have volume sufficient to deluge any building within its reach.

Suppose a boat of this kind should be anchored off the Battery with a lookout, and also connected electrically with the fire alarm system of the three cities. Suppose the boilers all connected and a fire constantly in one of them; the furnaces of the rest carefully charged with cannel coal, as in steam fire engines. One single fire would keep the water in the whole at the steaming point, therefore steam would be always up with a single fire burning. Now, suppose a fire to break out, the lookout sees it, or the alarm is sounded at once, the torch is applied to all the furnaces, steam is turned on to the donkey engine, the anchor comes up, and at the same instant the paddlewheels move; by the time the fire is reached all the furnaces are burning, the steam is up to 80 pounds, and anthracite coal is put on. When the boat stops she turns the steam off her engines and allows it to be used on the pumps.

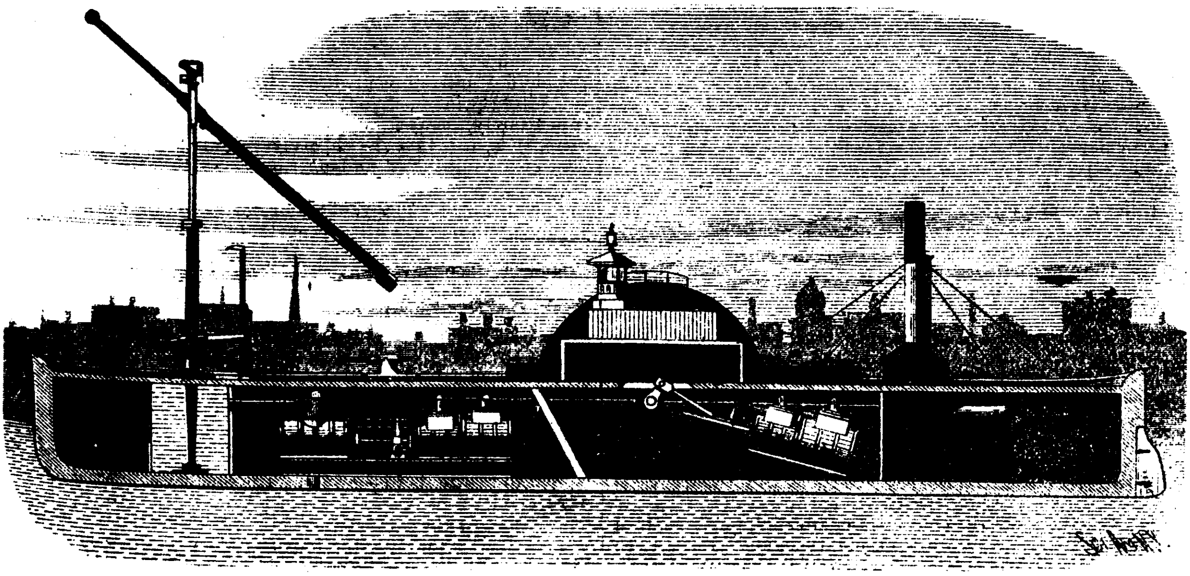
The cost of a boat of this kind would, it is true, be great, but there has not been a year during the last decade that such a boat would not have paid for herself; and, moreover, the cost of maintenance would be much below proportionately that of steam fire engines, such as are now in use. Many great fires have destroyed millions of property simply because the water pipes were not sufficiently large to supply the water for the engines. There are streets in New York and Brooklyn where, in case of a great fire, the supply of water would not be sufficient to supply the engines. In this respect the boat would have the advantage of an unlimited supply.

We are informed by Mr. Maxim that this boat is the result of a careful investigation of facts and observations, and that he designed it some years ago after witnessing the destruction of some large ships and warehouses by fire.

Any further particulars may be obtained from H. S. Maxim, 120 Broadway, New York.



MAMMOTH FIRE BOAT DESIGNED BY H. S. MAXIM, M.E.



LONGITUDINAL SECTION OF FIRE BOAT.

TROUVE'S ELECTRIC MOTOR.

When Trouvé sent his note to the Academy of Paris, describing his new electric motor which is based on the principle of the Siemens dynamic machine he wrote :—

When we trace the dynamic diagram of a Siemens coil, on causing the latter to make one complete revolution between the two magnetic poles which are reacting upon it, we observe that the work is almost nil during two quite extended periods of its rotation. These two periods correspond to the time during which the cylindrical poles of the coil, having reached the poles of the magnet, are passing before them. During these two fractions of the revolution (which are each about 30°), the magnetic surfaces designed to react on each other remain at the same distance, and the coil is not then incited to revolve. The result is a notable loss of work. I have got rid of these two periods of indifference, and increased the useful effects of the machine, by modifying the polar faces ; so that instead of being portions of a cylinder whose axis coincides with the old system, they are snail-shaped and thus in revolving gradually bring their surfaces near those of the magnet up to the moment at which the posterior edge escapes the pole of the latter. The repelling action then begins, and a dead centre is thus practically avoided.

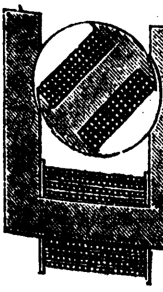


FIG. 2.

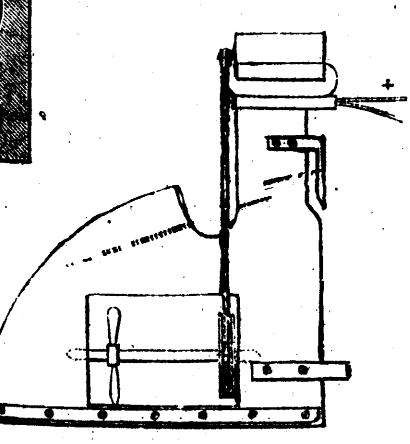


FIG. 1.

The motor which Mr. Trouvé has been recently experimenting is little more than 6 in. long and 4 in. or 5 in. high, and is consequently easily fitted to the top of a boat's rudder, as shown in Fig. 1, Fig. 2 is a vertical section without the frame work. The motor is capable of driving a sewing-machine with a Bunsen or Reynier battery of a few cells. The prominent features possessed by this new motor may be summarised as follows. Although of very small size, it has a relatively great power. The electro-magnetic effects are utilised under the best possible conditions for available work, since the inductor is very close to the armature, which almost completely incloses it (Fig. 2). The suppression of dead centres with a single movable electro-magnet is complete—a thing of rare occurrence in mechanics, and which would have had an immense influence had it been applied to the steam-engine instead of the electric motor. The direction of reaction on each other of two magnets placed in the same circuit allows the power to be indefinitely increased with that of the current employed—this power having for a limit only the resistance of the parts to breakage. The motor will run with great velocity even up to two hundred revolutions and beyond per second. No spark forms at the commutator, the current being never broken. The motor is reversible, and may, by slight modification, be employed to generate electricity. Finally, it is moderately cheap. M. Trouvé has arrived at satisfactory results by making in some cases the inductor, and in others the armature, eccentric. Fig. 1 shows the application of the motor to the propulsion of small boats. The arrangement is so simple that it requires even no change in the construction of the boat. The rudder bears within itself all the mechanical elements—motor, propeller, and connections—and forms a movable unity. The screw and its axles occupy the lower part of the rudder in an aperature made for the purpose, and the motor (which is located at the top of the rudder) actuates the screw through the medium of a belt or cord. The electro motive power furnished by the generator, which is placed in the boat, is transmitted to the motor by means of flexible metallic cords. In case it be desired to use oars only for propelling the boat, the screw being no longer actuated by the motor, becomes, free, and revolves in the opposite direction. For the last few months M. Trouvé has been making numerous experiments with his motor on the Seine with an 18-foot boat used for hunting waterfowl. The game being no longer frightened by sound of oars, was easily approached. At the very first, the speed of this boat was about 4ft. per second ; but after certain modification of details, M. Trouvé has succeeded in giving it a speed of 6½ feet per second—say 4½ miles an hour.

Mr. Trouvé does not think that, with their present resources, ordinary workman will be able to afford the expense of running these motors for their own use, and hast herefore turned his attention more especially to making them applicable to the purposes of dentists, watchmakers, and amateurs, who need a cheap and efficient power for running lathes.

Chemistry, Physics, Technology.

THERMO-CHEMISTRY

BY J. T. SPRAGUE.—("SIGMA.")

It is very interesting and instructive to observe the steady onward progress of science, and to note how, in the process of evolution, ideas and theories follow each other; each in turn ruling its particular department, accepted for a time as the perfect truth, yet to be superceded and apparently condemned. But the most interesting lesson to be derived from such a review is that *truth* never dies; it only changes its form. Scientific progress is not a succession of *revolutions*, but a continuous *evolution*. This is, in fact, the fundamental distinction between true science and the pseudo-science of the paradoxists. With the latter each imaginary discoverer of the laws and secrets of nature is an independent prophet; his doctrine springs perfect from his own brain like Minerva from that of Jupiter. In true science each new discoverer of natural laws builds upon the foundations laid by that of his predecessors, and employs the material gathered by their labours. The superstructure may be altered in form, or even applied to new purposes, but the building is yet one; the work of its successive architects remains.

In chemistry especially such apparent transformations imposed upon a true unity are very common, and the last twenty years have witnessed what appears to be an entire revolution in the chemical theories; but the changes are, after all, only modified and more complete expressions of old thoughts. During the last century, however, there has been a very complete and fundamental change in the science, yet that change, apparently entire, is destined to be but a step in progression; in the abandoned theories there was embodied a truth, and that truth, slowly growing like a germinating seed, is gradually penetrating the new theories, and combining together the old and the new into a more perfect unity.

For a century Stahl's theory of Phlogiston ruled chemistry: that theory asserted that combustion (and in consequence chemical combination generally) was due to an agent, or element, which united to matter, such as oxides, and so generated combustible substances; such substances, as we now know, being, in fact, simpler or elementary bodies; the act of combustion was the release of "phlogiston." Here we find fully exemplified that mixture of truth and error which is so commonly the result of the determination to explain facts, while the knowledge of the facts themselves is imperfect, and the processes occurring are unstudied. Phlogiston is but one of the long series of "fluids" invented by philosophers who would not wait, who thought that by covering up obscure facts in a word they could make that word explain the facts. We do the same still with the word which embodies the last of these fluids which survives, "electricity." Few recognize the certain fact that "electricity" is only a word, and a word which really only embodies facts and processes—not their cause.

Lavoisier made manifest the weak point of this theory by showing that combustion was a process involving absorption and increase of weight, and therefore could not be explained by a supposed loss of substance. This, followed by the discovery of oxygen and the development of the atomic theory, utterly banished phlogiston from the domain of science and left it a mere subject of ridicule. From that time chemistry became a purely material science, and devoted itself solely to the changes of position and union among the material particles or atoms, and working up through the successive theories of radicals, types, symbolic notations and molecular constructions, we have arrived at means of presenting to the imagination, and almost to the eye, a clear view of the infinitesimal arrangements of the elementary atoms which constitute the infinite variety of actual substances.

But, after all, valuable as these formulæ and typical constructions really are, and important as is the part they play both in scientific advance and in the practical application of chemistry, yet they are to real chemistry, to the truth of nature, only what stuffed and dried specimens and articulated skeletons are to natural history. The life is absent, the causes operating are ignored. Now the doctrine of phlogiston, despised as it now is, did really embody a truth and direct attention to that very side of nature which has been lost sight of. But all through the reign of phlogiston there were a few natural students, who, like what the ruling churches call heretics in religious doctrines, saw the errors in what was universally accepted as truth; so, during this last century, there have been at all times some who have seen that the accepted chemistry was but a one-sided view of nature, and that the received doctrines failed to explain the action going on. It has been among the students of the nature and operations of heat that these feelings have had most power. Of late years a new word has been steadily gaining power in science, and that word, "energy," is gradually displacing the old "fluids," as it is found that the idea which it represents includes all that the old fluids were invented to convey and explain. Now the interesting point is, that this idea and this word "energy" occupy exactly the position of phlogiston in the old chemistry. Here, then, it is that the old revives in the newest; the chemistry of the future will no longer be merely materialistic; it will take account of energy as well as of matter; the mechanical equivalent, that is to say, the translations of energy, will be of as much importance as the elementary equivalents, or the translations of material atoms.

Many workers have been engaged on this subject during the last 20 years, but undoubtedly, the work done and the book recently published by the Frenchc hemist Berthelot, "Essai de Mécanique Chimique fondée sur la Thermo-Chimie," must give a great stimulus to its effectual study. Hitherto what information has been gained has been scattered in isolated papers in scientific periodicals, and has been somewhat desultary in its nature. Now we have the subject traced through the whole range of chemistry, and definitive examined at the several stages, with such data as will enable many workers to give their attention to it, and to realize its importance. The concluding passages of the work so fully convey its objects that I give them here in a full translation, as the best mode of calling the attention of chemists and scientific students to the important field of work now open to them. M. Berthelot's book, consisting of 1,340 pages, in two large volumes, closes with the following summary:—

"We have finished our enterprise, which was to define the problems, and lay down the first principles of a new science, more general and more abstract than the mere description of the individual properties, the production and the transformation of chemical substances. We have searched out the very laws of these transformations, and have sought for the causes—that is to say, the proximate conditions which induce them. Let us then glance over the work done, and sketch a plan of the results obtained, so as to exhibit the object proposed, the course followed, and the results attained—that is to say, the ideal aim of the new science.

"As a commencement, the affinities have been defined, and it has been established that the "quantities of heat developed in the reactions of substances, simple and compound, indicate the measures of the work done by the molecular forces." This work has been classified as 1, Work of a physical nature; and 2, Work of a chemical nature. This distinction is most clearly seen in the case of combinations of gases effected without change of volume, and to some extent in the case of combinations referred to the solid condition. Thus the chemical energies are clearly distinguished and contrasted with the other natural energies; all alike obey the ascertained laws of mechanics.

"We have thus been enabled to deduce, rigorously demonstrate, and define, in the form of theorems, the laws which govern chemical calorimetry, that is to say, the measuring and comparing the quantities of heat liberated in all orders of phenomena, such as combination, decomposition, and substitution; direct and indirect reactions; quick and slow reactions; the formation of salt, solid or in solution; the formation of organic substances; and finally, the metamorphoses which occur in living beings.

"After the laws of theory come those of practice; therefore we have given the description of experimental methods and drawings of the apparatus by which we can measure the heat liberated in these multifarious conditions which the indefinite number of reactions compels us to examine. The theoretical and practical rules of calorimetry have enabled us to calculate out the numbers contained in a multitude of tables presenting the heat of combination of elements and compounds; the heats associated with change of state (fusion, vaporisation, solution); the specific heats of gases, liquids, solids, and solutions; a great collection, in which the labours of several generations of physicists and chemists are, for the first time, united and reduced to a common system. This extensive and arduous work has been undertaken in order to ascertain precise measures of affinities, and to enable us to anticipate correctly those reciprocal actions which substances can exert upon each other.

"This is the problem now presented to us. This problem separates naturally into two others—that is, 1. The study of the chemical combinations and decompositions as they occur; this is Chemical Dynamics. 2. The study of the final condition resulting from the various reactions; this is Chemical Statics.

"We have offered first a general exposition of the ascertained facts as to the various orders of reactions, distinguishing the diverse actions of the chemical energies and of the energies of heat, electricity, and light, which originate the phenomena. The conditions which govern the existence and stability of combinations being thus defined for each substance separately, we considered that we had arrived at the proper stage for examining the conditions which govern reciprocal actions.

"This is the fundamental result of the present work. In fact we have laid open a new principle of chemical mechanics by which the reciprocal actions of substances may be certainly predicated when we know the conditions which govern the existence of each of them singly. The principle of maximum work, so simple, so easy of comprehension, guides us to a double knowledge—that of the heat liberated by the transformations which occur, and which is readily calculated by means of the various tables, and that of the specific stability of each substance.

"We have laid down this principle or law, and we have demonstrated it experimentally by the examination of the general phenomena of chemistry; then we have traced its application in the relations of the principal groups of substances, such as the reactions between elements and the binary compounds; the reciprocal displacements of the binary compounds, especially the reactions of the hydracids among themselves, and with water; the reciprocal displacements of the acids in salts; and, lastly, the double decompositions of salts.

"The view of the chemical actions of substances, taken in their several conditions as gaseous, liquid, solid, and in solution, has thus been presented in a general outline, and reduced to one single law of chemical statics. This law not only furnishes ideas both new and fruitful, both in theory and in practical application, but the very face of chemistry and the mode of its teachings are changed by it.

"Such is the destiny of all human knowledge. No theory is final. The foundations of our knowledge undergo transformations, and the point of view is continually altered by an ever-advancing process of evolution.

"The chemistry of types, of series, and of symbolic construction which has hitherto constituted nearly the whole of the science, will hereafter be found, if not set aside (for no true science can thus disappear), at all events relegated to the second rank by the chemistry of the forces and their mechanics; this will control the former, because it will furnish the laws and the measures of its actions.

"The varied forms of matter, of which chemistry studies the diversity, are but parts of a common mechanism, the laws of which are the same when acting in the ultimate molecules of crystals, as those which control the visible parts of ordinary machines. From the mechanical (or physical) point of view, two fundamental ideas characterise the apparently infinite diversity of chemical substances, namely, the mass of the elementary particles—that is, their equivalent—and the nature of their motions. The knowledge of these two ought to explain everything. To this is due the present, and the yet greater future importance of thermo-chemistry, the science which measures the work of the forces operating in molecular actions.

"Truly, I do not deny the omissions and imperfections of the work I have attempted; but this work, incomplete as it may be, is none the less a first step upon a new pathway, which all are invited to follow and improve, until the whole science of chemistry has been transformed. This aim is so much the more lofty as that, by this evolution, chemistry would advance from the rank of mere descriptive science, by connecting its principles and problems to the purely physicial and mechanical sciences. It would thus approach more and more to that ideal conception, followed so long by savants and philosophers, that all speculations and all discoveries exhibit the unity and universality of the laws of natural motions and forces."

Justice to M. Berthelot requires the admission that his work is a most valuable one, and that it fairly fulfils his purposes; but it is only justice to others to remark that he has fallen into the common mistake of French scientists—that of ignoring the work accomplished out of France; and that, owing to his high sense of the importance of his work, he seems to think the new science owes more of its origin to himself than is truly his due. For, after all, his principle of "maximum work" is only the putting into special formula an idea which is common to many other minds, and which has been expressed by other and earlier writers. I feel it right to make this remark, not only in justice to others, but because I have long given much attention to this subject, and have often expressed similar ideas in these pages, and worked them out pretty fully in the chapter on Electro-Motive Force in my "Electricity"; the principle of "maximum energy," as the law of chemical actions, runs all through that chapter, but was not specially expressed, because it was already generally foreseen; and, as I said, "though seeking to place these facts to some extent in a new light, I am offering no new theory, but merely trying to systematize and draw important lessons from facts and laws already established." Of course, my then point of view was the electrical rather than the chemical, and the principle of maximum energy in chemical actions takes, in my work, the form of my own general law of electrolysis. "At the electrodes those substances are set free which absorb, in becoming free, the lowest specific energy." This is, in fact, though not before recognized, the same principle which governs, as Berthelot says, all chemical reactions, that of "maximum energy." For it is the same thing to say, that chemical action will occur which results in the setting free of most heat (which is the law of maximum energy), or that chemical product will result which retains the least heat, or what is the same thing more generally and correctly expressed, the least specific energy seeing that heat is only one of the forms of energy.

However, Berthelot's work must needs give a new impulse to the subject, in which many of our readers must be strongly interested, and as the book is not one very generally accessible, and would overpower and frighten many people, and as its subject is one which I have studied, I propose to do something towards facilitating its study by placing its principal features before our readers, and by developing any portion of it as to which information may be desired.

KEEPING ICE WITHOUT ICE-HOUSES.

Ice has passed from the list of the luxuries to that of the necessities of farm life. Whoever lives where ice is formed, and so near to a body of water that the hauling will not be too costly, should have an ice-house. Ice keeps best in large masses, and in building it will be found that a house to hold enough for two years will cost but little more than one for a single year stock. Occasionally, as last winter, the ice crop fails over the greater part of the country. A mild winter will cause no anxiety to one who has a supply of ice left over. In Dec., 1879, p. 503, a plan is given for building an ice-house in a corner of a roomy barn; the hints there given will enable one to convert any spare out-building into an ice-house. In March, 1879, we showed how a temporary ice-house could be made and how ice may be kept without a house. If one has an abundance of ice, but no ice-house, and has straw in plenty, it may be worth while to stack up a lot, though it can hardly be expected to last all summer. The ice-stack is especially useful when the ice-house is not large enough to hold a full supply of the ice if freely used. An ice-stack to be drawn upon during the early part of summer, will allow the store in the house to be a long time undisturbed. If the stack can be made in a shady place, all the better; select a spot where the water will drain off, and lay down a tier of rails a foot or so apart; on these put a layer of brush, and upon the brush, straw to the thickness of a foot. If possible set a strong pole in the center. Now stack up the ice as in an ice-house, taking care that the mass does not incline to one side. The covering for the sides may be straw, salt hay, swale hay, or even leaves, but the latter will need to be held in place by boards. A foot in thickness of protecting materials will do, but thicker will be better; old boards, with braces to press them against the straw, etc., may be used if needed; the stack is to be finished by a roof of straw, put on with pins and ropes, as in finishing off a hay-stack. On grain farms, where straw is abundant, the mass of ice may be covered with a great thickness of straw, by building a stack of it over the ice. In using from such a stack the ice should be taken off on all sides regularly, and care taken to properly replace the covering. The larger such a stack the better—a cube of ice 12 feet on each side—*American Agriculturist for Feb. 1.*

THE TYSON VASE ENGINE.

The necessity of small domestic motors for a variety of uses has long been felt, and has called for the exercise of much ingenuity on the part of a number of inventors, who have essayed the task of devising machines that should meet the requirements of practice. The machines that have been invented for these purposes, comprise gas, caloric, hydraulic, electrical and other forms of engines in great variety, with many forms of which our readers will be familiar from the descriptions that have appeared in this journal.

Small steam engines of various patterns have been tried, but generally required skilled attendance, smelled unpleasantly of gas, oil or decomposed lubricants, or were not readily controllable; took too long to get up steam and coal down; were heavy, bulky and expensive; or were unsafe on account of liability to explode. For one or several of these reasons, small steam engines for domestic service have not been practically successful. It has remained for Mr. Charles Tyson, of Philadelphia, to devise a domestic steam engine which practically disposes of these objections.

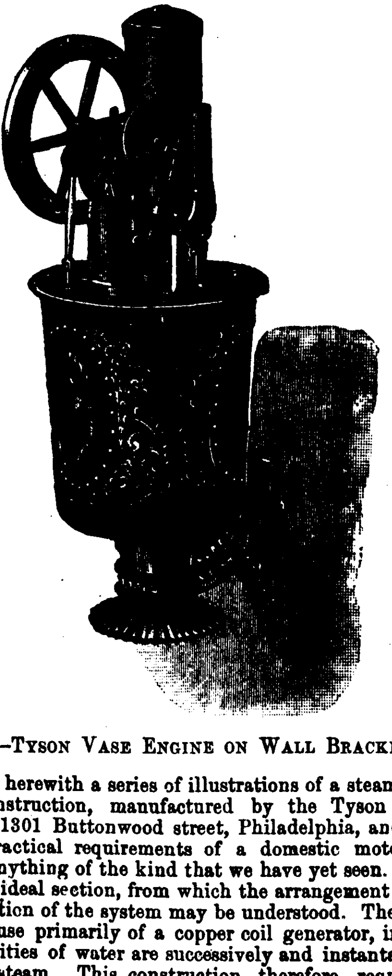


FIG. 4.—TYSON VASE ENGINE ON WALL BRACKET.

We present herewith a series of illustrations of a steam engine of novel construction, manufactured by the Tyson Engine Company, of 1301 Buttonwood street, Philadelphia, and which meets the practical requirements of a domestic motor more nearly than anything of the kind that we have yet seen. Fig. 5 represents an ideal section, from which the arrangement of parts and the operation of the system may be understood. The system involves the use primarily of a copper coil generator, in which minute quantities of water are successively and instantaneously flashed into steam. This construction, therefore, requires no water space in the generator, and but little volume for steam, and has the merits of giving great absolute strength, quick steaming capacity, and, what is highly important, no liability to explode.

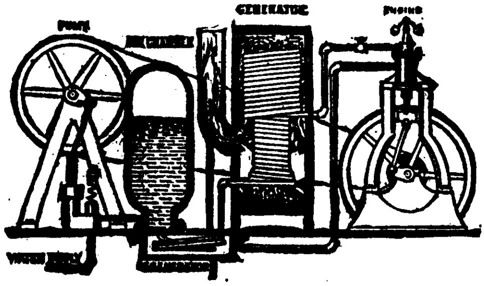


FIG. 5.—TYSON MOTOR SYSTEM.

The Tyson system dispenses with the necessity for steam and water gauges and safety valves. The pump, seen in Fig. 5, is worked by hand to produce pressure in the air-chamber; the chamber is connected to the steam chest of the engine by means of a long pipe, part of which is coiled in a receptacle through which exhaust steam from the engine has access, and part in a furnace. The water is converted into steam in its transit through this pipe, which is delivered to the chest of the engine at the pressure produced by the pump. When the engine is started it imparts motion to the pump, and the pre-induced pressure is maintained. Should the engine be stopped and the fire continue to burn, the water in the coil is forced back to the air-chamber, and the production of steam is thereby checked; the engine being again started, the pressure in the air-chamber again forces water through the heated coil, and the generation of steam is resumed. A relief valve at the right of the pump limits the pressure; this is in no sense a safety-valve, for even if it were fixed so as not to yield to pressure, no explosion could occur—the mechanism of the pump not being strong enough to produce a bursting pressure. Gas is used as fuel, but the machine can be made to burn either coal, wood or oil.

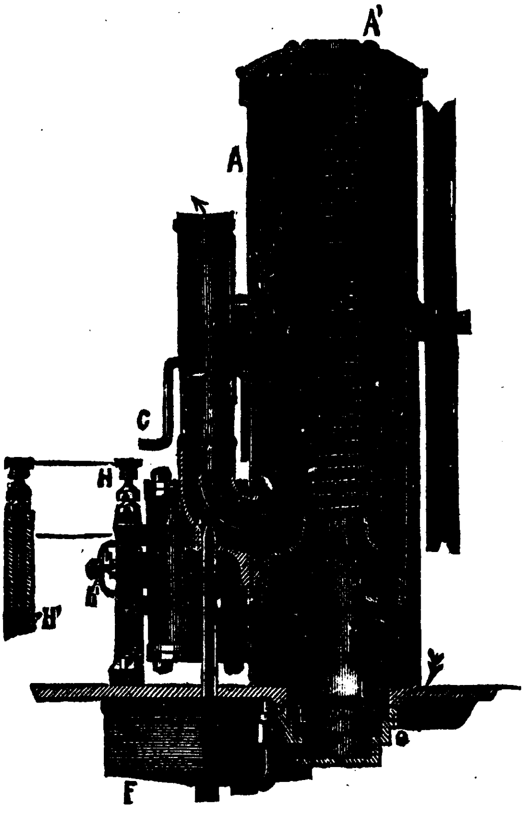


FIG. 2.—SECTIONAL VIEW THROUGH GENERATOR.

Fig. 2 shows more fully the construction of the generator. It consists of a cylindrical shell, in which is coiled about 35 feet of seamless copper tubing. The heat is supplied by a gas-burner L at the base. Surrounding this shell is a second one, leaving an annular space for the entrance of air. The air feeding the gas flame enters from below, and the gases of combustion pass up through the centre of the coils and down between the two shells, and then out by the draft pipe. On first lighting the gas, the cap A is removed and the flame allowod to burn up into the air; but as soon as steam begins to form the cap is replaced, and the exhaust steam then creates sufficient draft to carry the burning gases through the coils and out of the escape pipe. This generator has about 1-50th of the cubical capacity of that required by a boiler of the ordinary type to run the same engine.

The engine is of the simple oscillating type, and the whole apparatus is attached to a bed plate, forming the top of a vase-shaped receptacle. The vase is used to contain the water from which the pump supplies the reservoir. Four or five quarts of water for as many hours' work will be found to answer.

FIG. 1.—TYSON VASE ENGINE ON TRIPOD.

Fig. 1 represents a small motor of this type now being manufactured by the aforesaid company, and introduced for driving sewing machines, dental lathes, scroll saws, and a variety of other uses. It is estimated at about 1-33rd of a horse-power, equivalent to a duty of 1,000 foot-pounds per minute. Quite a number of these machines are already in use for the above named and other purposes. It is very ornamental in design, and can be used in the shop, office or parlor, at pleasure. In a modified form, the vase is supported from a bracket attached to the wall. This design is shown in Fig. 4. A perspective view of engine and rim of vase is shown in Fig. 3.

These motors are made in the best manner by means of machinery and tools specially designed for the purpose. The very best material is used for all the parts. The pump shaft, main shaft, crank pin and piston rod are of fine cast steel. The cylinder, rod, piston and valve arrangements of the pump are of brass. The steam and water pipes, generators and heater coils (comprising 35 feet), are made of seamless copper tubing. The cylinder is accurately bored, and the piston is packed with asbestos and graphite. The cylinder is covered with a walnut lagging secured with nickel-plated brass shells. The throttle valve is of brass and nickel-plated. The main bearings are mounted with oil cups of brass, nickel-plated.

In the machines now being built a specially devised governor is provided and attached to the shaft direct, so that the engine will not race should the belt come off. An extra driving wheel upon the main shaft is so arranged that the engine can readily be attached to drive most makes of sewing machines.

The pump is of improved construction and positive in its action. The exhaust steam is utilized to heat the feed, and finally escapes into the draft pipe, making an effective exhaust blast. The engine proper is of such simple construction as not to be liable to get out of order. The drippings from the engine (oil or water) are received by the vase, and the floor or carpet thus protected. This entire machine may be removed from the vase which contains the water supply. The blast pipe is made of brass, and nickel-plated. The tripod, vase and unfinished parts of the engine are handsomely japanned and ornamented.

The machine seems excellently adapted for a great variety of domestic uses where a small amount of power is required from time to time. The first cost of the machine is moderate enough to place it within the reach of every one, and the expense of running it (say with gas at $2 per 1,000 cub. ft.) will hardly exceed two cents per hour. For further details we refer our readers to the manufacturers.

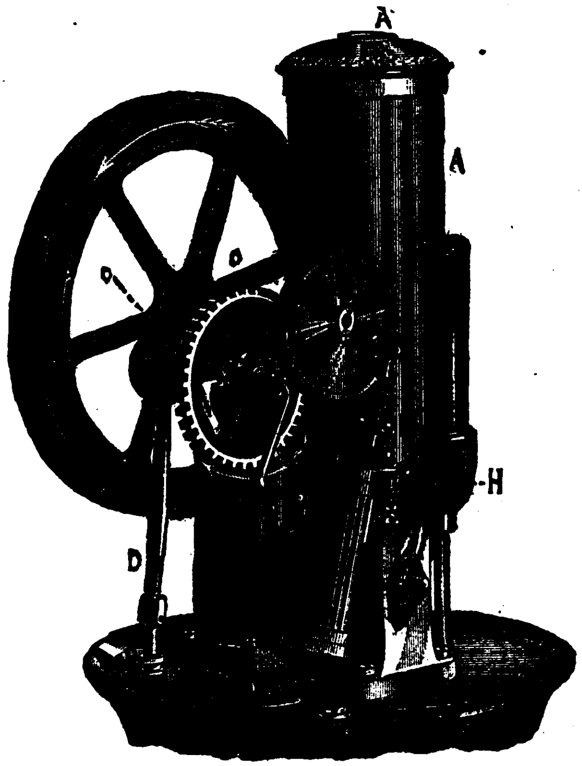


FIG. 3.—PERSPECTIVE VIEW OF ENGINE AND RIM OF VASE.

CORN AS FUEL.

Owing to the failure of railroads to furnish coal for fuel in our wide prairies in western and northern Iowa, and more especially Minnesota, the question of fuel for the future is being seriously discussed. It appears to be generally conceded that corn can be raised as cheaply and will make as good fuel as any other substitute. We have tried it. Corn in ear makes a good and durable fire, and can be burned in either hard or soft coal stoves, and is especially choice fuel for the cooking stove. An acre of corn can be raised for about $6, including the rent of the land. Fifty bushels of corn will weigh 3,500 lbs., or equal to a ton and three quarters of soft coal. This, at 15 cents per bushel (which is as much as corn is worth on the farm away from railroads this winter), would be as cheap for fuel as soft coal at $4 per ton. Two bushels of corn will make a fire which will keep a family warm all day, even such weather as we have had since the commencement of holidays. There can be no question of morality in the theory. Corn can be easily and conscientiously planted to raise fire wood, as any tree or plant. Some recommend raising sunflower for firewood, but it is not as good as corn. Nor need the talk about burning corn create any reluctance to removing to regions where they have to burn corn for fuel. It can be raised in one-tenth of the time and at less expense than timber can be raised for the same purpose. And until we have more railroads, or roads of greater capacity, farmers on our wide prairies will have to burn corn. Be it understood, however, it will take a very great emergency to induce them to do it.—*Iowa State Register.*

NEW PROCESS FLOUR.

(BOSTON HERALD, JAN. 17.

Five or six years ago there appeared in the market, for the first time in this country, a flour called "new process." Although it was very fine and white, breadmakers did not succeed with it, and it failed of the popularity expected. Finally it disappeared almost entirely from the market for a season, then reappeared, and to-day it is the flour which leads among grocers, and is very popular with housekeepers. This popularity is the growth of a season or two, but it begins to look as though it had come to stay, at least until the present mania for fine flour has passed away. While it is hardly possible that the intrinsic value of the new process flour is any greater than that which is ground in the old-fashioned mill, it is very white and fine, and more thoroughly separated from the objectionable parts of the grain. In the term objectionable the bran or hull of the wheat is not meant, but it has long been known to flour makers that the centre of the kernel of wheat, or germ, is of a waxy, albuminous nature, which tends to make the flour black and heavy rather than white and fluffy, like the starchy portion of the kernel between the germ and the hull. Millers have long made it a study, since the American people have gone dyspeptically crazy over the fine flour, to know how to grind wheat so as to leave as little of the inside or waxy portion of the grain in the flour as possible, and yet to save all of the starch portion, which alone makes the flour white and light. It is just here that the success of the Hungarian or new process has been achieved. Wheat ground by the old process, between two millstones, the upper revolving upon the lower, is, of course, separated into atoms, and the flour must necessarily contain some of the bran or woody part, and nearly all of the germ or waxy part. But, by recent improvements in mills, a maximum, nearly, of fine flour was reached, and only a minimum of the bran and germ remained. The small mills, or, as they were locally termed, "coffee grinders," came nearer to this desired quality in the flour they made than any form of grinding the country had known till the advent of the new process. Those small millstones are run very swiftly, and are found to grind off first the hull of the wheat, then the white, starchy portion which makes the fine flour so much sought for, and lastly, they were believed to roll up and keep together the albuminous portions of the grain, so that it was removed from the fine flour in bolting. But a serious objection to this swift grinding was found to exist. The tremendous friction produced heat, and the heat often injured the flour.

The Hungarian, or steel roller process, works upon a principle entirely new in wheat grinding. In fact, the wheat is not ground at all. It is simply crushed between revolving rollers. Wheat, by the new process, is not ground, but cracked and mashed. The rollers are about thirty-two inches long and eight inches in diameter. It takes from five to ten sets of rollers to constitute a mill. The first are made of steel and corrugated, while toward the last sets, they are very accurately made and finely polished, running very closely together, till down to the last set, where they are made of porcelain and so finely polished and run so closely as to absolutely crush every grain to the finest powder or flatten it out to the thinnest film.

The wheat passes through each set of rollers and is bolted for each set. Passing the first or corrugated set of rollers the wheat is simply cracked into three or four pieces, and a great deal of the starchy portion of the kernel comes out in a fine powder or dust. But it does not go off in dust. It passes through the bolting-cloth and makes the high-priced new process flour, while the coarser, uncrushed portion of the wheat passes on over the bolt and through the next set of rollers, which crack it into from eight to ten pieces, and more starchy matter falls out. This starchy portion passes through the bolt and makes the second grade of flour. Thus the wheat passes on, being broken finer by each set of rollers, and the starchy portion being separated by the bolt, till after passing through the last set but little is left except the hulls or bran, and the waxy germs, which have not fallen into powder but have flattened out very thin like wax. In the words of a Minneapolis miller: "After the wheat passes each set of rollers it is bolted or sifted through coarse cloth. This cloth lets the disintegrated particles of wheat through and passes off the bulky and large pieces, which are run through another and coarser set of rollers and cracked again. The last rollers have little else but wheat hulls and the waxy germs of the wheat, which do not crack up but smash down like a piece of wax. The germ of a kernel of wheat is not good food. It makes flour black. By the old millstone process this waxy germ was ground up with the starchy portion, and bolted through with the flour. By the new system of cracking the kernel instead of grinding it, this germ is not ground but flattened out, and sifted or bolted out, while the starchy portions of the wheat are crushed into powdered flour."

The same miller also gives the proportions of the different grades of flour obtained from 100 lbs. of Minnesota wheat by the new process:

60 lbs. best flour, worth per bbl.	$7 50
30 lbs second-rate flour, worth per bbl.	5 10
4 lbs. poor flour, worth per bbl	2 50
6 lbs. bran, worth per ton	9 00

This new milling process is completely revolutionizing the business of flour-making. When first tried in this country it met all the prejudice of millers who had been educated to the millstone, and, the new process having generally been first tried in the southwestern regions, where the wheat grown is white and starchy, the value of the rollers above the millstones did not appear so plainly. But when, about four years ago, the rollers came to be tried upon the hard, flinty red Minnesota wheat their value began to appear in its true light. The Minneapolis millers, especially, are tearing out their millstones and putting in rollers. They believe that the day of the millstone is done. It is said that mill machinery of the old style can be had almost for the removing in the flouring cities of the West. The Minnesota millers find that their wheat produces as fine and as white flour as the grains of Missouri and Southern Illinois, though they believe that under the old millstone rule that their wheat was doomed to make darker and heavier flour. They were aware that, in sweet, albuminous parts, their grain was fully equal to the Southern white wheats, but they needed the Hungarian rollers to separate the waxy germs and thus raise the grade of their flour.

But the public has really gained but little from this new milling process. The flour which formerly came from Minnesota and Wisconsin really contained more sugar and albumen and less starch than any other. The Minneapolis millers had often proved this to Eastern buyers by making dough of their flour and gradually washing it till the starch was washed away and the sugar and weighty parts remained; but, no matter, the flour was not white and light enough for the trade. A correspondent of the Chicago *Tribune* says: "A great future awaits the Minneapolis mills. The unexplored wheat-fields beyond Manitoba and along the Peace and Saskatchewan Rivers must empty into the Minneapolis mills. These mills are especially adapted to grinding hard Northern wheat, while other mills, fixed for soft Southern wheat, cannot make the same fine flour from the hard wheat. The time will come when Minneapolis will grind 50,000,000 bushels of hard wheat annually and ship it abroad in the shape of manufactured flour." Or, in other words, the discovery has been made which will reduce even this hard, sweet, Northwestern wheat into the lightest starchy flour. But the people demand it, and the will of the people must be obeyed, even to the extent of spoiling wheat in grinding.

There is one chance left yet for those who have become alive to the need of a reform in the process of making wheat into good bread. These new process rollers are well adapted to making an excellent quality of unbolted meal or Graham flour, and, if the public will demand and pay for it, such a flour will be forthcoming. What is Graham flour made of at the present day, such as is found in the market? For the benefit of poor dyspeptics—made so by eating fine, starchy flour—the answer of the Minneapolis mills, mentioned above, must be given: "The Graham flour in your market to-day, offered at less than $6 or $7 per barrel, is mostly made of poor wheat, loaded with bran. It is a common expression with us that some of those Eastern weak stomachs want bran, and we'll give them enough of bran. We are makers of fine flour, but that which won't make fine flour we put into Graham for sick folks."

The second-rate flour which comes from the new grinding process is quite a favorite with the bakers, if we may judge from the testimony of a Minneapolis salesman or mill agent who sells it to them. In fact, it is called the "baker's brand." The bakers generally use second-rate flour. By superior knowledge and skilled manipulating with proper mixings and the addition of marble dust and white earth, if the flour is too dark, they are able to make whiter and lighter bread than the ordinary housecook can of the highest grade of flour. It is this whiteness and lightness that we are all after, and the bakers try to please us. The bakers know that a flour which they can buy for $6 will make lighter and more beautiful bread, under their hands, than can be made in our homes from a flour costing $9, and hence they are able to put the difference into their own profits. The bad or last grade of flour which is made by the rollers, is shipped to Rotterdam and Germany and Holland, where it is mixed with rye and sold to the poor. The best, as we all know, is largely shipped to New England and New York. There also begins to be a demand for it in the better European markets.

MANUFACTURE OF YEAST WITHOUT ALCOHOLIC FERMENTATION.

A method of manufacturing yeast without alcoholic fermentation, and without the formation of subsidiary products, has been patented in this country by Dr. J. Rainer, of Vienna. The process is carried out in the following manner:—The vegetable albuminous substances in the corn cereals or other vegetables, or such refuse of industrial establishments as bran cornings, malt residuum, gluten, and the like, are extracted with the aid of from 15 to 20 parts by measure of water made slightly alkaline. They are then either peptonised by adding an excess of lactic acid (about 4 per cent.) or mineral acids (about ¼ per cent. of phosphoric acid, or about 4 10 per cent. of either sulphuric acid or hydrochloric acid) at a temperature of from 85 to 100 degrees Fahrenheit, or they are at once macerated in dilute solutions of the above acids, and simultaneously converted into peptone. A portion of the albuminous substances (from 5 to 10 per cent. of the total weight) in the dried cornings will be already transformed into peptone by the process of vegetation. The albuminous substances in cereals, maize, or other vegetables, and in bran and malt residuum are transformed into peptone by the addition of diastase. In order to effect the conversion it is sufficient to add to one part by weight of albuminous matter when dry by weight of dry malt, or five parts by weight of cornings. As stated the liquid in which the albuminous matter is to be transformed into peptone must contain lactic acid (4 per cent.), phosphoric acid (as much as ¼ per cent.), sulphuric acid or hydrochloric acid (about 2·5 per cent.), because the presence of an acid is absolutely necessary in the process of converting these substances into peptone.

A temperature of about 100 degrees Fahrenheit is the most suitable for the conversion of the substances into peptone, and a period of from 18 to 20 hours will be sufficient to effect it. It may, however, be also carried out at lower temperature during a correspondingly longer time. In working cornings it is superfluous to add malt, because the diastase contained in the cornings is more than sufficient for the process of conversion into peptone. Therefore, it is only necessary in this case to use one of the above-named acids in the proportions given. The slimy pectates contained in the cornings as well as in other materials are dissolved by the combination of diastase and acids. When the preparation of pure peptone is required the pectates may be separated by an endosmotic apparatus or dialydialysed in such a manner that the peptone is dialysed through proper membranes in water, while the gelatinous pectates remain as a residuum. The acids are neutralized by means of soda, or by saturating the liquid with basic phosphate of lime. The prepared peptone liquid, with or without a percentage of sugar, may be shipped as a saleable article, or it may be delivered in a dry state, or as a syrup or extract obtained by boiling the liquid down in a water bath, by steam, or preferably in a vacuum. The liquid containing peptone may be separated from solid matter (hydrocarbons, vegetable fibre, or the like) by simple extraction, maceration or pressure, or by centrifugal action, or it may be carefully cleaned by filtering or settling. It is advisable, however, before cleaning by filtering or settling to neutralize any acid present by means of soda, or to saturate the liquid with basic phosphate of lime, the latter being preferable because the phosphoric acid required by the yeast is thus abundantly furnished to it. In order to start the growth of the yeast, gelatinised starch is added after being transformed in the usual way into dextrose by boiling with an addition of mineral acids. In the place of starch thus prepared an addition may be made of maltose, molasses, or sugar mixed with beer-yeast or compressed yeast. The amount thus added should correspond to the percentage of peptone in the liquid, being one half of the dry weight of the peptone. Hydrocarbons should, however, always be only from ½ to 1 per cent. of the weight of the entire liquid, and should even then serve exclusively for the formation of the walls of the cells of the yeast.

The vegetation of the yeast will take place most satisfactorily at temperatures varying from 57 to 64 degrees Fahrenheit. At a higher temperature losses may easily occur by reason of the partial conversion of the sugar used into coagulated lactic acid or into alcoholic fermentation, instead of furnishing the yeast with substance for cells. The yeast is either propagated, as is the custom in Holland, in shallow vessels in which the depth of liquid is about five inches, so that a sufficient quantity of atmospheric air has access thereto ; or it may be better and more safely effected in vats made of wood, glass, masonry, cement, or other suitable material, into which atmospheric air is conducted by suitable distributors through tubes or pipes by means of blowers or compressors.

Instead of atmospheric air alone it is more advantageous to use air containing an increased amount of ozone or of oxygen partially converted into ozone. The latter is prepared by successively adding hydrogen dioxide to the propagating liquid. The percentage of ozone in the air is increased by means of phosphorus, or by causing it to pass through a closed vessel in which permanganate of potassa is mixed with the necessary quantity of mineral acid. The air thus enriched with ozone is allowed to pass into the propagating liquid.

The growth of the yeast will be completed within from 6 to 8 hours after every sufficient addition of dextrose, maltose or other material, according to the density of the propagating liquid used, the temperature of the latter, and the amount of the ozone in the air. The percentage of peptone of the mass may amount to from 1 to 2 per cent. or more of its weight, while only from half to one per cent. of dextrose or other hydrocarbons is added at each time in order to be sure to prevent the fomation of coagulated lactic acid or alcoholic fermentation.

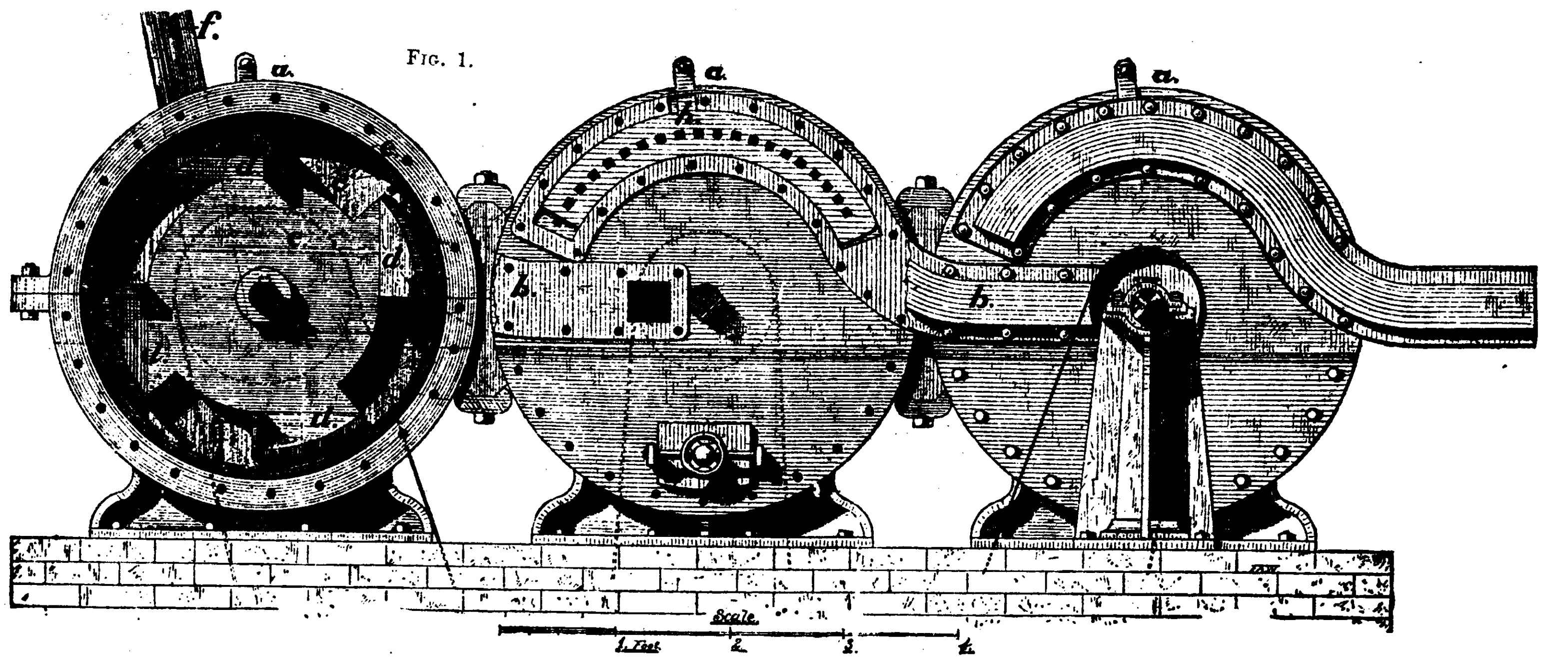
When the entire amount or bulk of the dextrose or other sugar added to promote the growth of the yeast has been consumed after from 6 to 8 hours, a further quantity thereof, say from 1-20 to 1-10 per cent., is added. The peptone may also, after having been consumed, be added in portions, or may be allowed to flow in gradually and continuously. The same propagating liquid made by successive replacement of the matter consumed remains in use for weeks or months, unless it is rendered impure by other substances, or by subsiding fermentation is made unfit for further use. In the same manner as the materials necessary for the propagation of the yeast are added the yeast produced may be successively withdrawn, and only the yeast suspended in the liquid remains behind as the germ for the ferments of alcohol to be afterwards formed. The yeast is obtained either by skimming it from the surface of the liquid or by separating it from the propagating liquid by filtration or finally by gathering it after tapping the vats from the bottom upon which it is deposited in a compact layer. In working on a large scale it is advisable to place the vat in terraced batteries in order to effect the transfer of the propagating liquid from one vessel to the other with facility. In order to produce yeast as free as possible from subsidiary ferments the propagating liquid may be prepared in a more dilute state, that is to say with a percentage of peptone of only from ¾ to 1 per cent. The hydrocarbons (dextrose, maltose, or the like) may also be added in smaller quantites, for example, as a first dose about 1-3 per cent., and then every three hours about 1-20 per cent.

The greater part of the peptone present will then be transformed into yeast in from 12 to 15 hours, a sufficient supply of pure air, if necessary, conducted through sulphuric acid or oxygen containing ozone, being provided, and the entire process being carried on at a temperature varying from 54 to 63 degrees Fahrenheit. The whole liquid is then cooled by a suitable apparatus, or by adding cold water or ice; the best temperature being from 45 to 50 degrees Fahrenheit. Within from 36 to 48 hours the yeast obtained will settle on the bottom of the vat. The propagating liquid may be allowed to flow away. The yeast obtained by this improved process is purified and condensed in the usual manner, but in order to increase its durability phosphate of lime amounting to from 4 to 5 per cent. of the total weight of the yeast to be made may be added before compressing it.

Experience has shown that from 250 to 300 parts of pure and active compressed yeast may be obtained from 100 parts of pure peptone. For the growth of that quality of yeast only about 200 parts of dextrose or sugar are required.

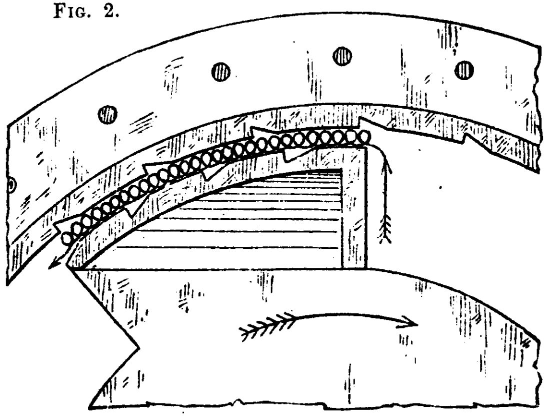
IN a recent number *Dinglers Polytechnische Journal* is described the alarm-clock of Herr Pfyffer, which, at a given hour, lights a small lamp. The lamp is above the clock. Near it is a disc, with a sectoral piece cut out, and with horizontal axis. This has a spiral spring, and, by means of a handle, is turned round to a tense position, in which it is held by a projecting nose and catch. When the nose is released at the proper time, the disc springs back and ignites a match over the lamp. The arrangement is said to work with great certainty, The same number of the journal describes an instrument for measuring velocity of rotation in locomotives and steamers especially. The special feature of it is the employment of a spiral spring for measurement of centrifugal force.

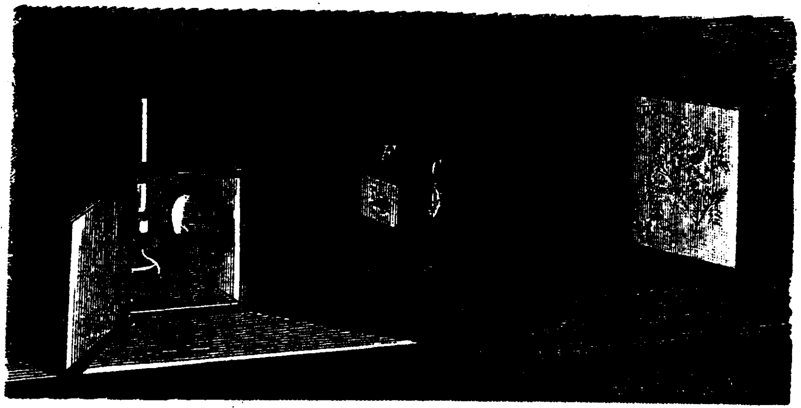
Fig. 1.



THE RYERSON PULVERIZER.

Fig. 2.



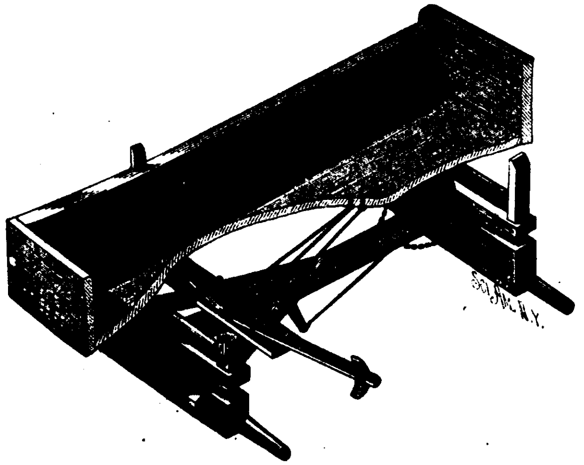


SIMPLE MAGIC LANTERN.

SIMPLE MAGIC LANTERN.

All that is required for this apparatus is an ordinary wooden packing box, A, a kerosene hand lamp, B, with an Argand burner, a small fish globe, and a burning glass or common double or plano-convex lens, C. In one end of the box, A, cut a round hole, D, large enough to admit a portion of the globe, E, suspended within the box, A, with the lamp, B, close to it. The globe is filled with water from which the air has been expelled by boiling.

Now moisten the surface of a common window glass with a strong solution of sulphate of soda, or even common table salt, dissolved in water, and place it vertically in a little stand or clip, as shown at F, so that the light from the lamp, B, will be focussed on it by the globe, which in this case answers as the condenser. The image of the glass will then be projected on the wall or screen of white cloth, W, providing the lens, C, is so placed in the path of the rays of light as to focus on the wall or screen. In a few minutes the salt solution on the surface of the glass, F, will begin to crystallize, and as each group of crystals takes beautiful forms, its image will be projected on the wall or screen, W, and as it is watched it will grow, as if by magic, into a beautiful forest of fern-like trees, and will continue to grow as long as there is any solution on the glass to crystallize. Then, by adding a few drops of any of the aniline colors to the water in the globe, the image on the screen will be illumined by shades of colored light.—*Scientific American.*



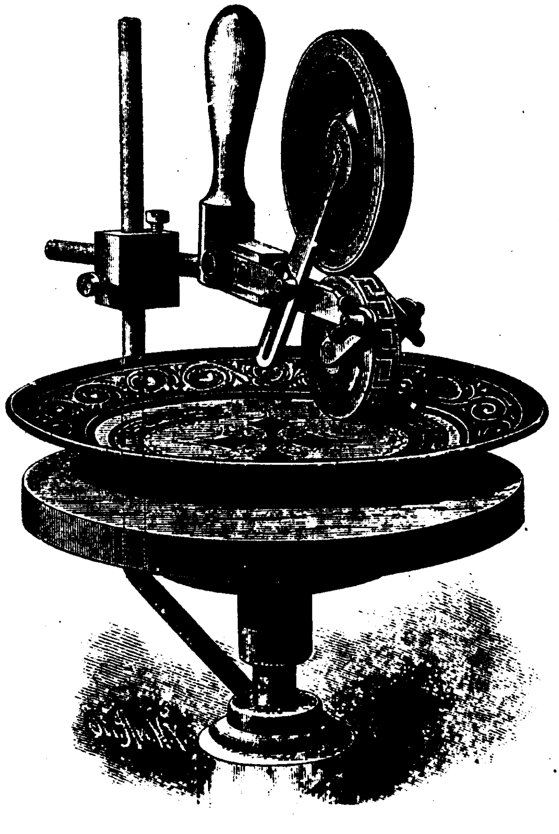
IMPROVED WAGGON BRAKE.

We give herewith an engraving of an improved automatic waggon brake recently patented by Mr. A. L. Withers, jr., of Summit Point, W. Va., which is operated by a forward motion of the load on its roller supports on the bolsters. The connection of the rear hound with the reach is by means of a bolt or stud extending through a slot in the reach, and permitting the hound to move through a limited distance. A cross bar secured to the hound carries two brake levers, projecting in opposite directions, having at their outer ends shoes which are capable of pressing the peripheries of the rear wheels of the waggon. These brake levers are pivoted about centrally to the cross bar, and their inner ends are connected by rods or chains with the bottom of the platform or waggon body, so that should the body move forward more or less on its roller supports, as in going down hill, the brakes will be automatically applied to the wheels.

A short lever pivoted to the side of the hound has its shorter arm connected by a rod or chain with the waggon body, and the longer arm is connected with the king bolt of the waggon by a rod or chain.

When a waggon reaches a level, the reach being drawn forward, the chain or rod connecting the short lever with the king bolt is drawn upon, moving the lever and drawing the waggon body backward, releasing the brake shoes from the wheels. The forward and backward movements of the body are limited by suitable stops.

This simple apparatus is entirely automatic, and applies the brakes with more or less force according to the requirements of the case, and it may be readily adapted to any waggon.



APPARATUS FOR DECORATING POTTERY.

The decoration of china, until quite recently, has been done almost exclusively by hand, rendering it not only a slow but expensive operation. The engraving shows a simple machine, invented by Mr. S. J. Hoggson, of New Haven, Conn., for applying various styles of ornaments, but principally designed for borders.

The engraving shows the invention so clearly that a description is hardly necessary. The wheel which rolls upon the work to be ornamented carries the design and receives the color from the wheel above, and both wheels are sustained by a pivoted support provided with a handle, by which they may be raised or lowered or turned sidewise, as may be required to conform to various surfaces to be ornamented. The object to be ornamented is supported by a freely turning table, which is revolved as the impression roller is pressed upon the work. The inventor claims that there is no border or ornamentation, no matter how delicate or minute, which ever came from the matrix of the type founder that cannot be produced upon china or any vitreous substance as perfectly as if the impression had been taken by a master workman upon the finest paper, and with great rapidity.

The great advantage of this machine is in its applicability to plane, concave, convex, or any other surface, creeping over it as gently as a spider would, yet leaving its web-like tracings in enamel, which when fired into the glaze of the ware in the usual manner, will last forever. It will work from ordinary type, electrotype, stereotype, wood-cut, or phototype patterns. The advantage of this over the transfer system used in old countries, on the cheaper kinds of ware, will be readily seen, and when we consider that heretofore, all such decorations done in the United States were applications of the brush, in the same manner as an artist would paint a picture, we can begin to realize to what extent this little machine can be used.

Mechanics.

THE RYERSON PULVERIZER.

Pulverization of ores by attrition of the particles upon themselves has long been sought after by inventors and mining men. Believing this principle to have been successfully carried out through the invention of Mr. Van Buren Ryerson, of this city, I solicit the favor of the columns of your valuable paper, as a means of attracting the attention of miners and mining engineers to the machine in its application of the pulverization of dry ores.

Various centrifugal machines have been before the public, from time to time, in which impingement and percussion of the ore-particles upon the inner side of the apparatus has been the main principle involved. Mr. Ryerson invented and took out a patent in 1869 for a machine that substantially embodied this idea; but, after repeated experiments, it was found to be too expensive and virtually impracticable. He recently perfected the machine which I now propose to consider.

Figure 1 gives a side elevation of a machine adapted to the pulverization of ores. Figure 2 represents the action of the machine and the principle involved. The principle involved in the reduction of ores by this machine is, that the ore-particles are caused, by mechanical application of compressed air, to rotate violently, each upon its own axis, at the same time having a path of revolution about a common center; and at a certain stage of their reduction into granulations, the size of which is regulated by the opening or closing of the discharge ports, thereby varying the pressure of air within the case, the powdered material is discharged at right angles to the plane of velocity. This is accomplished with little wear to the machine, as the particles touch no part of the mechanism during their pulverization, This rotary movement of the ore-particles is induced by a succession of eddies or reactionary air-currents in opposition to the direction in which the particles at a high velocity are moving, thereby causing the particles to be rubbed upon each other, and reducing themselves to an impalpable powder.

Reference to Figure 1 will show that the machine comprises three circular metalic cases *a*, each about three feet nine inches in diameter, discharging into one another through the pipes *b* at either side of each case.

Within each case is a revolving disk of gun-metal, shown at *c*, having at its outer periphery the four beaters *d*, the upper and front faces of which are of the full width of the space between the inner sides of the cases, the disk *c* being of a thickness to secure strength and solidity. The outer face of each beater *d* is ratchet-dressed, while the radial face is smooth. These dressings extend across the full width of the beaters, and are of uniform depth. The inner periphery of the case *a* is provided with a stationary ring of steel *e*, which is dressed in the same manner as the outer faces of the beaters, only differing in that the angle of the dressing upon the outer faces of the beaters. This construction will more readily appear in Figure 2. The distance, therefore, between the outer faces of the beaters and the inner periphery of the case varies alternately from three quarters of an inch to an inch and a half, from the apex to the base of each two notches of the dressings, when directly opposite each other.

When the disk *c* is revolved at a high rate of speed causing a rotation of the central body of air in the case, it produces a reactionary effect upon the belt of air lying between the path of revolution of the upper faces of the beaters and the dressed surface of the inner periphery of the case. The use of the ratchet dressing on the inner periphery of the case and the upper faces of the beaters will now be understood. It is not intended for grinding; but its purpose is to present a succession of abrupt surfaces, radial to the circle in which the belt of air revolves, which serve, by the impingement of this belt of air upon them, to break it up into whirlpools and eddies. These eddies of air, while each revolves upon its own axis, have also a path of revolution about a fixed center. This peculiar action of the compressed air is shown clearly in Figure 2, where the scrolled line represents the eddying character and direction of the current.

The ore to be reduced to powder, after having first been crushed fine in a Blake ore crusher, is introduced through the feed-pipe *f* at the center at both sides of the first case of the series. At the instant the crushed ore enters the machine, it flies outward in radial lines toward the periphery of the case, and is there caught up by the revolving belt of air-eddies, and each particle of ore is then rapidly reduced to powder by the violent attrition of the particles upon each other. The pulverized ore is discharged at right angles to the plane of velocity through the port-holes *g*, and forward into the next machine, where the particles are still further reduced.

The size of the granulations will depend upon the length of time that the ore-particles are retained within the case. The port-holes *g* are covered with the slide *h*, in which are port-holes of a large size and number; so that when this slide is moved backward or forward, the discharge of air is lessened or increased, and it simply rests with the discretion of the man in charge of the machine to regulate the size of the granulations of the powdered material. This feature of the machine is absolutely necessary, as it may often occur that the ore to be pulverized will be of varying degrees of hardness.

The second revolving disk moves with a greater velocity than the first, and the third with a greater velocity than the second. Thus there is the combined pressure from the first case, and suction from the one into which the material is discharged. The powdered material comes from the machine perfectly cool.

Simplicity is the leading characteristic of this machine. Its parts are few, which will necessitate but little repair; and such portions of the mechanism as are likely to ware—the circular rim of steel and the faces of the beaters—can be replaced indefinitely at a small cost.

As applied to wheat-grinding in this city, the machine has proved a great success. Important improvements have been made recently in the adaptation of the machine for that purpose, which are to be introduced practically this fall. The producing capacity of the machine is enormous. Upon what it has ground this is estimated at three hundred bushels per hour, with a small proportionate expenditure of horse-power.

The cost of the machine illustrated is given at $3,500.

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HOW ARTIFICIAL PEARLS ARE MADE.

Many persons have no doubt been frequently struck with the great beauty of artificial or imitation pearls. Those who make it their business to produce such articles of ornamentation have attained to a high degree of perfection in their art; so much so that in 1862, at the London Exhibition, a Frenchman who was an adept at their manufacture exhibited a row of large real and imitation pearls alternately; and without close inspection, we are assured, it would have been impossible even for a judge to have selected the real from the unreal. Some translations from French and German works on this manufacture have recently been communicated to *Land and Water*, and from these it appears that the art of making imitation pearls is ascribed to one Jacquin, a chaplet and rosary manufacturer at Passy, who lived about 1680. Noticing that the water after cleaning some whitefish (*Leuciscus alburnus*), a species of dace, was a silvery appearance, he gradually collected the sediment, and with this substance—to which he gave the name of *essence d'orient*—and with a thin glue made of parchment, he lined the glass beads of which he framed his rosaries, and afterward filled them with wax. The method of making the round bead is by heating one end—which has first been closed—of a glass tube, which then, when blown into two or three times, expands into a globular form. The workman then separates the bead, places the end which has been heated on a wire, and heats the other end. This process is called bordering or edging. The best pearls are made in the same way, the holes of the tubes being gradually reduced by heat to the size of those of the real pearls, the workman taking each bead on inserted wire, and, by continually turning them round in the flame of the lamp used, they become so true as to be strung as evenly as the Oriental pearls.

The process of coloring the pearl is commenced by lining the interior of the ball with a delicate layer of perfectly limpid and colorless parchment glue; and before it is quite dry the essence of orient is introduced by means of a slender glass blowpipe. It is then allowed to dry; the pearl is filled with wax, and if intended for a necklace is pierced through the wax with a redhot needle. The essence of orient, as it is called, is the chief ingredient in the manufacture of the pearl. It is a very valuable substance, and is obtained from the fish above named by rubbing them rather roughly in a basin of pure water, so as to remove the scales; the whole is then strained through a linen cloth, and left for several days to settle, when the water is drawn off. The sediment forms the essence referred to. It requires from seventeen to eighteen thousand fish to obtain about a pound of this substance! Besides the French there are other imitation pearls, made of wax, covered with a kind of pearly luster. But these do not look so well as the French pearls; while, in a heated room they are apt to soften and stick to the skin. A very extensive trade is now done in the manufacture and sale of French artificial pearls.—*Scientific American*.

Carriage Maker's Work.

RANDOM NOTES ON COACH BUILDING.

So accustomed are we to things of the present that it frequently requires considerable effort of mind to divest ourselves of the notion that they have always been as they are. It requires an effort to look back to the origin of any of the conveniences and appliances of our modern civilization. If we stop to think, we know as a matter of course that the present graceful shapes and luxurious appointments of our furniture and of our coaches are the results of a long series of experiments and improvements. Yet who, of all our readers, when he sees a coach roll through the streets, with its shining panels, crystal windows, easy seats, and gold and silver mountings, ever stops to think that only a short time ago, even at a period when mankind had attained considerable progress in the arts and manufactures, the coaches employed by even kings and queens were but little more comfortable than the common farm waggons of the present day ? If we go back a little further the coach becomes a mere car with two wheels ; a step further and the wheels are simply sections of logs ; a little further back still and there is nothing but a sledge to be drawn over the ground. From a consideration of these facts we have supposed that a little space in this journal devoted to an account of the origin and development of the coach or carriage of our modern civilization will not be without interest and value to our readers, and therefore, with this much of an introductory, we shall proceed to pen some random notes on coach building.

The term coach, in one form or another, is to be found in almost all the modern languages. An inquiry as to its etymology shows that at the root it has a meaning similar to that of our modern word couch. It signifies something upon or in which one may recline. It expresses both comfort and elegance. Popularly defined, a coach is a four-wheeled close carriage with two seats, and an outside seat for the driver. The term coach, while used in a restricted sense to indicate a certain form of close carriage, is very commonly employed in a much broader sense, to indicate coaches and carriages in general. It is in the latter sense that we shall in most cases make use of the term in these articles.

Like that of most articles of utility and luxury, the origin of the coach is in dispute, at least so far as to which country belongs the honor of first taking the step which distinguished what came to be called a coach from those forms of vehicles which immediately preceded it. The invention of the modern coach has been claimed by Holland, England, Italy, France, Spain and Germany. It is possible that the credit of the matter justly belongs to all of these countries, for, instead of being invented, coaches were undoubtedly developed from inferior styles of vehicles, and accordingly came along in the natural order of things when civilization was ready for them. As each of these countries contained centres in which the various arts which would be employed in building a coach were patronized, it is not impossible, nor at all improbable, that coaches originated in several or all of these countries at about the same time. In any event, it is a question which can never be determined to the satisfaction of all the claimants, even if some show of historical accuracy is made, and, after all, it is one the answer to which is of very little practical importance.

The earliest record of what may be called a coach relates to about the year 1280, when Charles of Anjou entered Naples, and his Queen rode in a *caretta*. By the best accounts accessible this vehicle seems to have been a small, highly decorated car, a form from which the modern chariot was derived. All vehicles of this early day were furnished with broad wheels, which, indeed, were the only ones at all adapted to the roads of the period. They were generally open overhead. History records that in the sixteenth century coaches came to be furnished with canopies. A coach with glass windows was used by an Infanta of Spain in 1631. In the time of Louis XIV. (A.D. 1643–1715) coaches were first suspended upon leathern straps, in order to secure ease of motion. The first carriage seen in England of which there is an historical account is said to have been made in the year 1555 by a Walter Rippon for the Earl of Rutland. In 1564 the same builder made a coach for Queen Elizabeth (Fig. 3). It was not until the seventeenth century that the use of coaches began to extend to any considerable degree in England.

Coming to the history of the arts and manufactures in our own country, an idea of how recent a trade our modern coach building is may be gathered from the following statements :—Before the Revolutionary War carts were not allowed to have tires upon their wheels, and private carriages were by no means common in any of the cities. The manufacture of carriages was first commenced in this country in 1768. In that year Elkanah and William Deane, of Dublin, started a factory in New York, bringing their workmen from the old country for the purpose, as they stated in their advertisements, "at great expense." They offered to make "coaches, chariots, landaus, phaetons, post-chaises, curricles, chairs, sedans and sleighs, at 5 per cent. below importation prices." From these very brief historical notes our readers may obtain a general view of the subject as we propose to treat it. We shall enter more into detail as we proceed.

Let us stop right here and give some attention to the steps which have culminated in our modern vehicles. The time was when man was without vehicles ; now he has them in abundance and of many different kinds. What have been the successive stages of their growth ? What constitute the mile stones along the path of the ages which mark the progress made in this art ?

The earliest means of locomotion was of course that supplied by nature, namely, the muscular action of the limbs. This was all very well when travelling was performed within a limited area ; but when any considerable distance was to be traversed it proved inadequate, and accordingly use was next made of horses and other animals. This mode of conveyance was not without its disadvantages, for the old and infirm were seldom equal to a journey over rough ground on either a horse's or camel's back.

The first attempt at vehicular locomotion must necessarily have been very imperfect. To those living on the banks of a river, doubtless, a raft was the first idea. A raft, of course, could be of no use in its ordinary form except where water abounded. It is very probable that in the course of time the raft was so modified as to permit of its being dragged over the land in cases of necessity, similar to the manner in which sledges are now drawn. There is little doubt but that the first land carriage was the predecessor of the sledge as we now know it. It would only be natural to place a burden, which was too heavy for the shoulders, on some sort of a frame-work on which to drag it over the ground. But slight experience was required to enable men to judge of the best forms for sledges, and therefore we find this article in very nearly its modern shape in the earliest records. A sledge, shown in the sculpture of the Temple of Luxor, at Thebes, Egypt, is very similar to those used by brewers' draymen at the present day for sliding barrels down cellar stairs, and very generally known as a "barrel-skid."

It could not have been long before observation showed that the great friction attendant on the motion of the sledge resulted in a material loss of power. Based on this fact, the next step of progress was in all probability the introduction of the *litera*, or litter, which still may be occasionally seen in Spain and Portugal. This article is really a rude sort of sedan chair, which is borne by two mules—one before it, and the other behind—the poles being slung to their pack saddles. Various modifications of this vehicle are to be met with in other countries. For example, in England, the chair was borne by two men, even so lately as the last century. In the far East the arrangement changes to the more luxurious one of a couch, and, under the name of *palanquin*, it constitutes the chief vehicular conveyance of the rich. In those countries it is borne by olive-complexioned men, who are more capable of endurance in an enervating climate than quadrupeds.

But the litter and palanquin were alike imperfect, inasmuch as they consumed a large amount of animal power for very little effect, because the whole weight of the passenger had to be carried as well as have motive power applied to it. The next step was to find something other than animal agency to sustain the load, and at this point there can be no doubt that the forerunner of the wheel was discovered. The first wheel was probably a portion of the trunk of a tree roughly shaped and connected by means of a thinner portion as an axle. Soon it was discovered that the larger the wheel the more easily it would move, and consequently the greater load could be put upon it. After using this primitive arrangement for a short time, it would be discovered that the thickness of the wheels would bear reducing so as to make them mere slices of the trunk. After a time it would also be discovered that to lighten them holes could be bored or cut through their surface, thus giving the first suggestion of spokes.

Having reached this stage it would be an easy process to round the axle cross-beam and place a frame on it capable of carrying loads, the axle being confined at or near the centre of gravity of the frame by pins or guides similar to the row-locks of a boat. The front of the frame would be a central pole or beam sufficiently long to bear the bulk or volume of the load, and also to project forward to form a pole to which the horses or oxen could be attached. Parallel with the central beam would be ranged

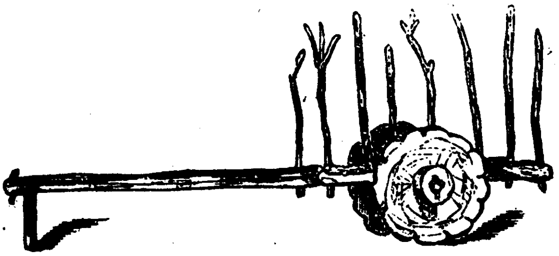


FIG. 1.—EARLY TYPE OF CAR USED IN CHILI.

two side bearers, and these would be connected together by cross framings and diagonal braces. This would then form the car or cart, the simplest form of a wheel carriage. It would be soon discovered, however, that a cart thus constructed would run best in a straight line and that to turn it in a circle, unless the circle was a very large one, an immense deal of friction would be caused. The reason of this is very simple. In the act of turning one wheel has a tendency to revolve faster than the other, because the outer track is longer than the inner one. To overcome this difficulty the cart maker would soon contrive that each wheel should revolve upon its own centre. Instead of fixing the cross-beam or axle in a square hole he would so arrange it as to allow it to play easily in a round one, of conical shape, that being the easiest form of adjustment.

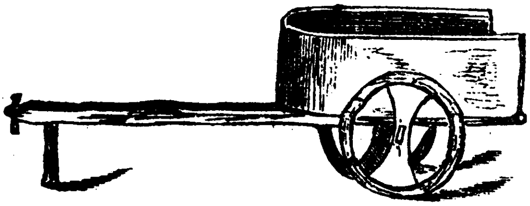


FIG 2.—TYPE OF CAR USED BY THE EARLY PORTUGUESE.

So much for the theory of the development of wheeled vehicles from the primeval sledge. The resulting form, as we have traced it, would correspond in all respects with the earliest historical specimens of carts which have come down to us, two of which appear in Figs. 1 and 2. The cars used by the Greeks and Romans for the purpose of war and festivity, as well as in their agricultural operations, were of this general type, and differed between themselves only in the finish and amount of ornamentation about them. Figs. 5 and 6 of the accompanying illustrations present forms of the war cars or chariots of these two nations. The agricultural carts of the same period as we have just indicated were of poorer quality and finish. They were more nearly of the kind shown in Figs. 1 and 2, which, although belonging to other nations are still representative types of their class. Fig. 4 represents an Egyptian car, which in all essential particulars corresponds to those of other nations shown beside it, and yet has enough of individual characteristics about it to render it easily distinguishable among a number.

FIG. 3.—COACH OF QUEEN ELIZABETH, ABOUT THE YEAR 1564.

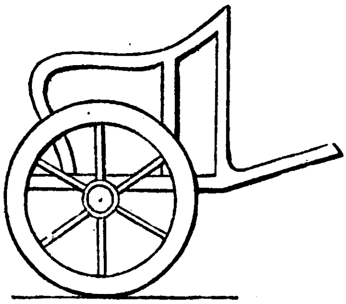


FIG. 4.—AN EGYPTIAN CAR.

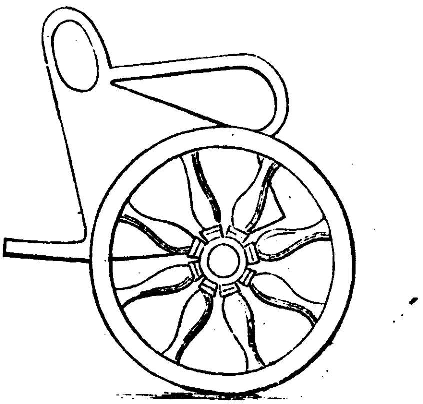


FIG. 5.—A GRECIAN CAR.

We have already referred to the State coach of Queen Elizabeth, a cut of which appears on the other side of this page. We have no doubt, many of our readers will examine with motives of interest and curiosity the "wagon" in which royalty was once content to ride. Our engraving is from an authentic source, and affords a fair idea of the remarkable historical vehicle. A detailed description of it is unnecessary even if it were possible. Although the rage for "old things" is now at its height, and this is a very old form with its historical correctness unquestioned we have no expectation of our engraving being used as a fashion plate, or of seeing modern copies of this coach on Broadway and Fifth avenue. *From the Blacksmith and Wheelwright.*

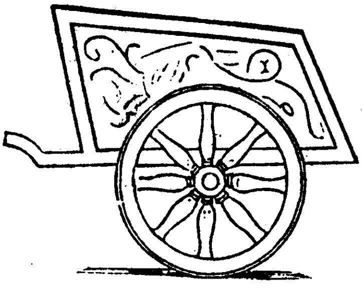


FIG. 6.—A ROMAN CAR.

IGUANA CROSSING CHAGRES RIVER ON THE SURFACE.—(SEE NEXT PAGE.)

THE GECKO OR WALL LIZARD.

Natural History.

CURIOUS FACT IN NATURAL HISTORY.

BY C. F. HOLDEN.

Our illustration represents the American iguana crossing a river, the Chagres, as wide as the Harlem at High Bridge, upon the surface of the water, without sinking below it. This wonderful performance was witnessed by Mr. John G. Bell, the well-known naturalist and former companion of Audubon. Mr. Bell states that as he was approaching the river he came suddenly upon the reptile, and alarmed it so that it sprang into the river, but instead of sinking, to his surprise, it rushed along over the water, making its claws go like lightning, so that he could not see them, and thus keeping the whole body above the water. It made quite a foam behind, and in about two minutes was over the river, up the bank and out of sight. When it is remembered that this animal weighs from five to ten pounds, and has slender claws fitted for tree-climbing, the wonderful character of the performance will be appreciated. It is from four to five feet long, and its general color is green shaded with brown. It has a strong and distinct crest running along the whole length of the back and tail, and a large dewlap or pouch under the throat, the edge of which is attached to a cartilaginous appendage of the bone and throat. The tail is very long, slender, compressed, and covered with small, imbricated, keeled scales. It has a very formidable look at first sight, and when irritated it puts on a very menacing appearance, swelling out its throat pouch, erecting the crest on its back, and lashing its tail about with great violence. It is, nevertheless, a harmless creature, unless laid hold of, when it bites with considerable force. Altogether the occurrence is a most remarkable one and entirely antagonistic to the supposed habits of the animal.

THE GECKO, OR WALL LIZARD.

Gecko is a name applied to a family of nocturnal lizards, numerous in species, found in all the warm regions of the globe. The name is said to be given them from the slight guttural cry which they make when pursuing their prey. In broad day they seem to be blinded by the rays of the sun, and repose half asleep, but when evening comes they regain all their agility.

Their appearance is quite repulsive; their bodies are flat, covered with a flabby skin, head large and flattened, a huge mouth armed with fine sharp teeth, their tongues short and fleshy, large eyes at the sides of the head, which are covered with transparent eyelids, the pupils narrow and vertical, like the cat and owl.

Considered as an impure animal by the Hebrews, the gecko is, in the extreme East, the object of great terror, and it is looked upon as impregnated with the most subtle poison. The ancient authors believed that the saliva of these animals was made use of to poison arrows. Bontius says that their bite is deadly, and another author relates that he saw at Cairo three ladies in great danger of death from having eaten some food upon which a gecko had stepped.

Although this animal is an object of repulsion and fear to the common people it appears to be absolutely inoffensive. M. Sauvage says, in *La Nature*, that he has often handled, without precaution, the different species of geckos, even the gecko of Egypt, so feared that it is named Abou-burz, or "father of leprosy," from the belief that it communicates that terrible disease to persons who partake of food with which it comes in contact.

Geckos are useful to man, as they feed upon insects, caterpillars and flies, which they entrap by placing themselves in ambush. They are often found in considerable numbers within doors, concealing themselves upon the roofs or crawling about upon the walls and ceilings. Their toes have, for the most part, a leaf-like expansion which enables them to walk even upon polished perpendicular surfaces, and they run noiselessly and with great rapidity in all directions. Their hooked claws, sometimes retractible like those of the cat, assist them to climb nimbly along the walls, where they hunt their prey from stone to stone, or by entering small crevices in the rocks into which their flat flexible bodies are able to penetrate.

Some geckos, as the platydactylus, have their toes widened the whole length, while the hemidactylus are expanded only at base, and the phyllodactylus at the extremity of the toes.

These last, formerly supposed to inhabit only New Guinea, Australia, and Chili, have been found in Europe and are known as the European phyllodactylus. They were believed to be peculiar to Sardinia, but have lately been found by M. Lataste in the Island of Pendus in the Gulf of Marseilles.

The common platydactylus, which is found in Southern France, Italy and Spain, was known to the ancients, who probably called it a lizard, and thought that its venom neutralized the poison of the scorpion. The bite of this animal, which was dangerous or even deadly in Greece, was, according to Pliny, almost inoffensive in Sicily. The same author says that the skin macerated in vinegar or reduced to ashes was a sovereign remedy in some diseases. In this species the body is often of a gray color, while the lower parts are whitish, but sometimes it is of a bronzed brown, with gray bands across the back and tail; the head, although flat is thickened at the back, the neck being distinct from the body; the skin which envelops it is transversely folded. The upper part of the skull is covered with small convex plates, the oval tubercles are strongly defined and are surrounded by other smaller tubercules with fine granulated scales, protecting the back. The upper part of the tail is provided with spines.

The geographical distribution of the hemidactylus is the same as that of the species just described. The head is short, the nose very blunt, the surface of the skull slightly convex. The toes are all provided with claws, and are not united by a membrane. From the nape of the neck to the beginning of the tail the tubercles, like small nails, are arranged in longitudinal rows nearly approaching one another. The general color of the head is gray, sometimes reddish with brown marbling.

DESCENT OF MAN.

Two French savants have for the last twelve months been keeping nine pigs in a state of habitual drunkenness, with a view to testing the effects of different kinds of alcohol liquors; the Prefect of the Seine having kindly put some sties in the yard of the municipal slaughter-houses at the disposal of the savants, in order that they might conduct their interesting experiment at the smallest cost to themselves. Pigs were chosen for the experiment because of the close resemblance of their digestive apparatus to that of man. The pig who takes absinthe is first gay, then excitable, irritable, combative, and finally drowsy; the pig who has brandy mixed with his food is cheerful all through till he falls to sleep; the rum swilling pig becomes sad and somnolent almost at once; while the pig who takes gin conducts himself in eccentric ways,—grunting, squealing, tilting his head against the sty door, and rising on his hind legs as if to sniff the wind. Dr. Decaisne, describing these experiments with intoxicated swine, remarks in the *France* that they are none the worse for their year's tippling.

These experiments, taken in conjunction with the pig's well-known personal peculiarities in feeding and his obstinate refusal travel the correct path, go far to show that man was not evolved from the monkey, as some have surmised.—*Scientific American.*

Domestic Hints.

HOW TO COOK SALSFY.

Some of our correspondents say that they have followed our advice to grow Salsify—or Oyster Plant as it is often called—and that we should now tell them what to do with it. To those unacquainted with the plant we may say that it is perfectly hardy, and if any has been left in the ground, it will be just as good in the spring, or if dug during a thaw. The roots, whether of Salsify, or of Scorzonera, often called Black Salsify— have a milky juice, which, when exposed to the air, soon becomes brown. In preparing them they should be quickly scraped, to remove the skin, and at once dropped into water to prevent discoloration. In the following recipes it is presumed that the root has been thus prepared.

Stewed Salsify.—Cut the root into convenient bits and throw them at once into water enough to cover them. Add salt and stew gently until quite tender, pour off the water, add sufficient milk to cover, a good lump of butter, into which enough flour to thicken has been rubbed, season with pepper. When the butter has melted, and the milk boils, and has sufficiently thickened, serve.

Salsify Soup, is essentially the same as the foregoing, only adding a large quantity of milk to form a soup, and omitting the thickening. To increase the resemblance to oyster soup some add a little salt codfish picked fine.

Fried Salsify.—The root cut crosswise in halves or shorter, is boiled until quite tender; remove from the water and allow to drain. Dip each piece in batter and fry quickly in plenty of hot lard, to an even light brown.

Salsify Fritters.—Boil tender and mash fine. Mix with beaten eggs and flour, thin enough to drop from a spoon and fry as other fritters. Some prefer to mix hard enough to make into balls, and fry with very little fat, browning one side at a time. —*Agriculturist for February 1.*

◆

HOW BEST TO REMOVE WARTS?

This question was discussed at the last meeting of the Conn. Board of Agriculture, one gentleman said a large wart on the udder of his heifer prevented her being milked. He was recommended to apply grease or oil, at frequent intervals. Boiled linseed oil has been thus used with good results. In one case mentioned, a number of large warts were removed from various parts of a horse by bathing them in a weak solution of potash. When warts are small at the base, they may be removed by a string frequently tightened—"tied off" as it is sometimes called. Warts are more frequent and abundant on young than old animals. They often disappear very quickly and without any application. The methods for curing human warts would make a very curious list, exhibiting many strange and fanciful whims.—*American Agriculturist.*

Notes and Clippings.

THE practice of starting the fires of locomotives, with gas instead of wood, is now, we learn, adopted to a considerable extent in Germany, *e. g.*, on the Royal Eastern Railway, at Berlin, it proves economical. The apparatus of Herr Siegert is there used. It consists of a horizontal tube, and several vertical tubes with burners. Each vertical tube has a nozzle in which the gas mixes with air drawn in latterally, before issuing at the copper burners. The lighting of the anthracite coal on the grate is done in 10 to 20 minutes, according as the gas pressure varies between 20 and 15m. The method is as follows: In a gap between the bars is inserted from below an iron plate the length of the system of burners, and so that it projects 100mm. above the grate surface. Then three or four shovel-fulls of dry coal-pieces about the size of one's fist are placed about the plate, and the rest of the grate-surface is covered 100 to 150mm. high with coal. Then the plate is drawn out, and the system of burners put into its place; 300 litres of gas lights the coal sufficiently. In the course of 30 to 45 minutes, according as the locomotive was previously warm or cold, the burning coal is pushed apart, so that the fire may extend as quickly as possible over the whole grate. The gas is conveyed to the burner apparatus through a tube of caoutchouc from a small gas-holder, and the pressure can be easily varied at will. The apparatus is supplied by Pintsch, of Berlin, at the price of 65 marks (say £3 5s.) An improvement introduced by Siegert in his apparatus consists in doing away with the nozzle of each burner, and producing the mixture of gas and air by means of a single nozzle in the connecting pipe.

A NEW mode of propelling vessels has been described to the French Academy by M. Grandt, who says he has constructed apparatus for the purpose. The principal agent is electricity. The ordinary steam-engine is set to drive one or more electro-dynamic apparatus. The current is sent through a voltameter containing acidulated water. The oxygen and hydrogen arising from decomposition are led, in a tube, fore or aft, in the boat, according to the direction in which it is desired to go. They escape by an aperture in the hull, a little above which aperture are two insulated platinum points, giving passage to an induction spark. The explosion thus caused propels the boat.

A NEW hydraulic ship has been built in Germany, and on her trial recently accomplished excellent results. More than 200 years ago a method of propelling vessels by expelling water from the stern received some recognition; but all attempts to obtain high speed have failed. A new method is based on the assumption that the propelling force depends on the contact of surfaces, and not on the sectional area of the flowing mass, so a number of tubes with narrow outlets are used instead of one large tube.

IT IS a curious fact, lately noted by M. Doutigny, that if boiling-water be projected on an incandescent surface, its temperature falls at once to 97° C. He is of opinion that this is due to work expended in production of the spheroidal state.

Scientific Items.

BUSINESS ON THE SUEZ CANAL.—It is reported that the traffic returns of the Suez Canal Company for October show the receipts to have been $628,000, against $439,919 in the same month of 1879. In the first ten months of the year the increase is from $4,865,058 to $6,633,660. The tonnage at the end of September amounted to 3,288,851 tons, and as the traffic is most active during the last three months of the year, it is believed that the tonnage by the end of December will easily exceed 4,000,000 tons. M. De Lesseps, in his argument for the canal in 1855, wrote: "It might be argued without exaggeration that almost the whole of the freight to the East will take the route of the canal." The estimates, however, were not based upon that presumption, and De Lesseps presumed that but half the shipping would pass through the isthmus. He therefore estimated the amount of tolls to be earned on 3,000,000 tons.

HOOSAC TUNNEL LIGHTED BY ELECTRICITY.—Experiments with electric light in the Hoosac tunnel have proved that a light can be thrown strong enough to do track work within the tunnel, free from smoke, and the men working at from 500 to 1,000 feet from the light. With the tunnel choked with locomotive engine smoke the light penetrated the smoke, as nearly as could be judged, 10 times as far as that of the ordinary oil headlight. The tunnel is to be lighted within a few days by 12 electric lights, using a turbine wheel at the east end of the shop for motive power. The wire to be used for connecting the lights with a dynamo machine is a new process or patent, and is, we understand, the invention of Prof. George Mowbray, North Adams, a successful man with nitro-glycerine.

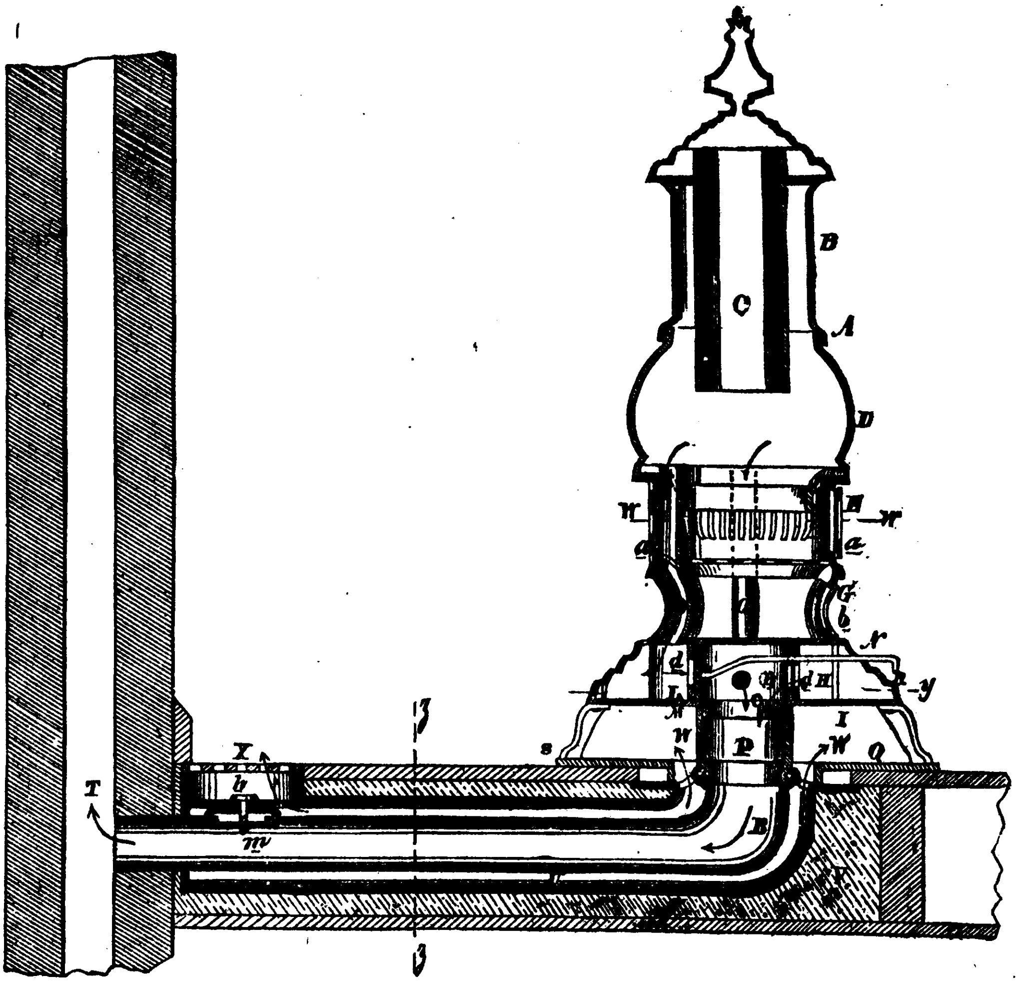
THE ENGLISH CHANNEL TUNNEL.—The French Government has extended for three years the concession for the preliminary work on the proposed Channel tunnel to connect England and France. The original concession was made in 1875, for five years. So far all the geological evidence, and especially that derived from the experimental borings, has proved to be highly satisfactory. It is questionable, however, whether in the event of a favorable termination of the preliminary work, it would actually be undertaken exclusively by private enterprise, by reason of its enormous costliness. In such an event, doubtless the two governments interested in its execution will be asked for, and will grant the enterprise, substantial assistance.

A LECTURE EXPERIMENT.—The decomposition of steam by a red-hot iron is often shown as a lecture experiment. Dr. Henry Leffman, of Philadelphia recommends the substitution of magnesium for iron. About a yard of the ordinary magnesium ribbon is so placed in a hard glass tube that the metal touches the glass in a number of points. One end of the tube is drawn out into a pretty wide jet, and the other is attached to a flask of water. Steam is produced, and after the air is expelled the metal is heated at the extreme end until it takes fire. The escaping hydrogen may be lighted at the jet. The experiment, besides being a striking one, is interesting as showing a body acting as a supporter of combustion, and becoming itself converted into a combustion.

A CURIOUS EXPERIMENT IN MAGNETISM.—M. Obalski describes a pretty magnetic curiosity to the *Academie des Sciences.* Two magnetic needles are hung vertically by a fine thread, their unlike poles being opposite one another. Below them is a vessel containing water, its surface not quite touching the needles. They are hung so far apart as not to move toward one another. The level of water is now quietly raised by letting a further quantity flow in from below. As soon as the water covers the lower ends of the needles they begin to approach one another, and when they are immersed they rush together.

CEMENT FOR MARBLE.—Sift plaster of Paris through muslin, and mix with shellac dissolved in alcohol or naphtha. As soon as mixed apply quickly, and squeeze out as much of the composition as possible, wiping off that which squeezes out before it sets. The cement will hold better if the parts to be joined be roughened by a pointed tool before cementing, which can be done without destroying the edge of the fractured part.—*Monthly Magazine.*

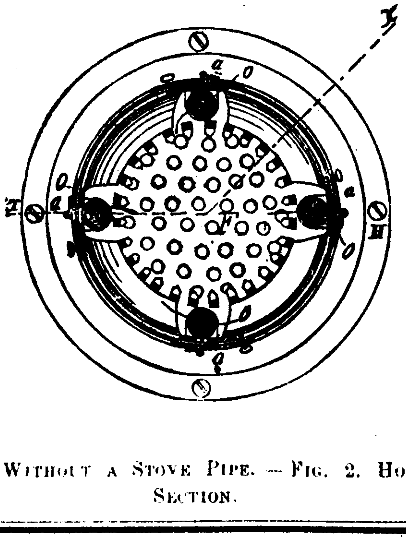
HARDENING GLUE.—The only thing that will render glue perfectly insoluble is bichromate of potash. If you add a little of this in solution to the glue and after applying the glue to the article expose it to the sunlight, it will become insoluble, even in hot water. Better expose for a good while, say an hour or so, to make sure that all the glue has become insoluble.



A STOVE WITHOUT A STOVE PIPE.—FIG. 1.—VERTICAL SECTION.

A STOVE WITHOUT A STOVE PIPE.

Even in the stove trade we find at intervals real novelties, and in the present instance we have one in the form of a stove without a stove pipe, and illuminated without a mica section.



A STOVE WITHOUT A STOVE PIPE. — FIG. 2. HORIZONTAL SECTION.

The inventor of this very remarkable affair is Mr. C. Seaver, of Traer, Iowa. In its general features the stove is a base burner, with the usual magazine section. The pipe, however, is missing, but the smoke is taken away by a short collar beneath the stove, which connects with a flue under the floor leading to the chimney. Fig. 1 represents a section of this structure; G is the magazine, B the magazine section or cylinder, and D a dome of glass, upon which the upper portions rest. The grate and fire-pot are in the usual position. The construction of these portions, however, is rather peculiar. Fig. 2 gives a section of the stove on the line W W in Fig. 1. G is fire-pot having the usual door. From beneath the ash pit a flue P B M carries the smoke to the chimney. The flue is surrounded by an outside flue, U, which has registers at X and W, from which heated air may escape to the chimney T. The internal construction of the stove seems unnecessarily complicated. The important feature, it will be seen, is the glass dome and the removal of the smoke downward. The glass dome the inventor proposes to make of the so-called toughened glass, in order to obtain great strength. Common glass, though not nearly so strong, will be safer, for it is said that the toughened article is likely to be destroyed by what may be called spontaneous breakage, cracking into small pieces without warning. Strange as the idea of a glass section may seem, it is well worth consideration. The downward draft will not be easily accomplished, and is likely to cause more annoyance than rejoicing, in spite of the fact that the inventor hopes to do away entirely with use of stove pipe.

We can see no reason why glass in large pieces should not take the place of mica for the illumination of stoves of the better grades, and our objections to this stove are not based upon this feature. It would be a matter of some curiosity to see how this stove would work in an ordinary chimney.—*Manufacturer and Builder.*