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SCIENTIFIC CANADIAN

MECHANICS' MAGAZINE AND PATENT OFFICE RECORD

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NOTE AND COMMENT.

THE problem of the economical storage of power is likely to receive a practical solution before long according to Col. Frederick Beaumont, who writes to the London *Times* to state that air is now being compressed to 1000 lbs. on the square inch with far less cost and difficulty than has hitherto been accomplished with steam at high pressures. Independent proof of this will shortly be forthcoming from a body of well-known scientific gentlemen who have investigated and tested the matter for themselves. For locomotive purposes the results obtained from the storing of electricity do not approach those obtained from the storage of air in the amount of force actually available for traction or propulsion. For tramways there is no doubt of the cost of air being considerably below steam, and air engines could be used on the Underground Railway at a cost in capital expenditure somewhat in excess of that for steam engines, but in daily working expenses very little, if at all, beyond the present cost of steam, while it is obvious that the difficulties of ventilation and deterioration of girders would vanish.

THE daily press of New York has reported a meeting of milkmen, called for the purpose of giving expression to their sentiments on the subject of skimmed milk. Although there were some fifty dealers present, it was very apparent that the meeting was in the hands of one man. This person in his remarks, stated the object of the meeting as follows: "We are here to find whether the milkmen in this city have any rights which the Board of Health is bound to respect, and if we have we propose to have them respected, even if we have to go the trouble of a lawsuit." It is proposed to sell skimmed milk in the city in spite of the Sanitary Code which prohibits its sale, although there is some talk of selling it as skimmed milk and at a lower price than the genuine article. We presume the Board of Health will stop the sale of skimmed milk even though it is advertised as such. It is not a poison and never killed any one directly, but milk is the one article of food for young children. The lower price would lead to the use of the inferior article by many of the poorer classes, and the little ones suffer from a lack of proper nourishment. If people are unable or too ignorant to protect themselves public policy requires that they should be protected. What is true of dangerous burning oils is to a certain extent true of skimmed milk. If the price is a temptation to buy dangerous or unwholesome articles, their sale should be prohibited. If the dealers in skimmed milk object to the Sanitary Code as in any way oppressive, there exists in the State of New York an act to prevent the adulteration of food which will completely cover their case.

"PROVERBIALLY slow" is an epithet which may be applied once too often to the good citizens of Halifax. Like every maritime people it is true they appreciate the importance of ballast; but the reputation of the possession of great wealth augurs enterprise as well as caution. If they have in the past been dilatory, they are now redeeming the time by many new enterprises. Not to mention the sugar refinery—a story of the past, as the cotton mill is of the future—one has to report the construction of a long pier or wharf which is being extended into deep water to accommodate the largest steamships in the discharging of cargo, as well as in coaling. A switch of the Inter-Colonial Railway is run down to this point, for the transfer of freight and passengers without any delay. At this locality also is to be erected a large grain elevator, a necessity to every extensive shipping port. A dry dock of 600 odd feet is also in hand, calculated to accommodate the largest vessels undergoing repairs. These are some of the improvements now going on in the harbour of Halifax, which is admittedly the best upon this continent, and accessible at all seasons. The depth of water is said to be sufficient to float with safety the largest ships of the British navy, and that for miles up the harbour into Bedford Basin. Halifax, and we may add St. John, situated on the extreme eastern coast of the Dominion of Canada, cannot fail to command more and more attention; and till the problem of navigating the river St. Lawrence in winter is solved these ports are destined to have a monopoly of the foreign trades. When on tracing on the map the continuous artery of communication formed by the Inter-Colonial, Grand Trunk and Pacific Railways, stretching from those shores to the Pacific coast, by which the products of the forests and farms of the great West may be expeditiously transported many thousands of miles on their way to Eastern markets, one is impressed by the favorable position of these cities by the sea.

THE measurement of water in pipes is a practical operation, more easily performed than many mechanics are aware of, and often of the utmost use, especially to millwrights. A pipe 1 inch in diameter and 1 yard long will contain 28.26 cubic inches of water, or about one pound in weight. The capacity of a pipe increases in the ratio of the square of its diameter—that is to say, a pipe 2 inches in diameter contains four times as much, and one 3 inches in diameter nine times as much, as a pipe 1 inch in diameter. The practical rule, therefore, for finding the quantity of water in a pipe of any given diameter is as follows, and is sufficiently exact for all ordinary requirements in mill work: Square the diameter of the pipe in inches, and the product is the number of pounds weight of water in one yard of the pipe. As a gallon of water weighs about 10 pounds, divide the number of pounds by 10 (which is done by shifting the decimal point one place to the left) and the result is the number of gallons of water in one yard of the pipe. For example, a pipe 8 inches in diameter will contain 64 pounds, or 6.4 gallons of water, for every yard of its length. For the total capacity of the pipe, it is only necessary, of course, to multiply the contents of one yard by the whole number of yards of the pipe's length. A cubic foot of water weighs 62½ pounds, and contains 6¼ gallons. These figures have slight but unimportant variations, and the rule given here will produce a result sufficiently accurate for all ordinary purposes of measurement in mill work.

PROGRESS IN INDUSTRIAL EDUCATION.

It is pleasing to note the rapidity with which the idea of a practical industrial education for the youth of both sexes on this continent is gaining favor. The experiment is being tried in many places, new schools are being opened, and the whole subject is being investigated by committees appointed for the purpose. It is only a question of time when all large towns will have schools for the practical education of the rising generation, and we trust that the day is near at hand when this system will be incorporated with the present public school system. In the progress of this new system of education, note is made of the fact that the Industrial Education Society of Boston, in 1877–8, made the experiment "to give boys that intimacy with tools and that encouragement to the inborn inclination of handicraft, and that guidance in its use, for want of which so many young men now drift into overcrowded and uncongenial occupations or lapse into idleness or vice." The city generously gave the use of one of its ward rooms for this new and novel school, and three gentlemen, a photographer and two practical wood carvers, gave their services gratuitously, Tuesday and Friday evenings of each week, as superintendents and directors of the work. The experiment was successful, and there were more applicants than the school could receive.

The outfit of the Boston school was: Thirty-two firm work benches for thirty-two boys, giving to each a space four by two and a half feet. Each bench had a vise with wooden jams and an iron screw, a drawer with lock and key, in which the tools were kept, and a gas-burner, with a movable arm. Each boy was provided with a work-apron of cotton drilling. Benches, tools and aprons were numbered, and each boy held accountable for their care and keeping. The following were the bench regulations: "Be at the bench at seven o'clock, according to your number. Do not leave the bench without permission. Make no unnecessary noise. Keep your bench neat, and do not deface it. After work place all the tools in their drawers, and return the key to the teacher. Every boy will be held accountable for the tools placed for his use."

Instruction, not construction, was the purpose of the school, its object being to make boys familiar with certain manipulations equally useful in many different trades.

This experiment has satisfied those interested, that manual education may be made an efficient part of public instruction. The student may be taught in classes, rendering it unnecessary, except in rare cases, to give individual instruction. A series of primary lessons in the use of wood-working hand-tools has been prepared by specialists in Boston which contain exactly the information required, in order that these arts may be brought as completely within reach of the ordinary educational methods as reading and writing. Eleven lessons, of two hours each, embrace the following topics: Use of the cross-cut saw; hammer-striking—square blows; splitting saw—sawing to line; jack-plane—smoothing rough surfaces; hammer—driving nails vertically; splitting saw—sawing at exact angles to upper surface; jack-plane—setting the plane iron; hammer—driving nail horizontally; bit and brace—boring in exact positions; mallet and chisel—mortising; jack-plane—producing surfaces which intersect at exact angles. Auxiliary exercises in laying out the work by measuring and lining, are incidental to all the lessons.

Since the opening of this Boston school an investigation of the whole subject has been made by a committee appointed at the instance of the associated charities of that city. This committee reports that it believes industrial training, or the training of the hand and eye and thereby the mind as well, is an invaluable element of education which deserves recognition and support such as has been given to so-called literary education; that it will interest many who do not come for purely literary studies, and that it develops faculties which other studies do not. They recommend that it should be adopted as a part of the public school system.

To show how far America is behind the other great nations in the execution of this reform, the committee obtained statistics showing that Austria has 1,037 schools for technical instruction, 4,296 teachers and 97,713 pupils, besides schools of forestry, mining and agriculture. Bavaria has 1,671 industrial schools for girls, 1,837 teachers and 71,635 pupils, a polytechnic school at Munich, 36 technological schools and 4 of agriculture. In Germany there are 34 schools of architecture, 25 of mining, 17 of forestry, 108 of commerce, 146 of agriculture, 10 veterinary and 86 other technical schools. Denmark has 49 "farmers high schools, with 3,135 students, of whom 1,003 are females. In Holland there are 11 navigation schools and 32 industrial and drawing schools. In Switzerland 4,373 females are employed in schools teaching needlework. In France a commission was for a long time engaged in the collection of evidence upon the success of industrial education elsewhere and reported strongly in favor of it. It was also declared by the directors of large industrial establishments that generally the deplorable absence of elementary instruction, even among the most intelligent of the workmen, was one of the greatest obstacles to the improvement of the artisan and the progress of industrial art. In view of these facts it appears clear that unless more attention is given to industrial education in this country, we may, in time, be obliged to depend upon foreign artisans. It is not necessary to carry this training to the extent of teaching the actual trades, since this would bring the public into competition with private enterprise. The object of the schools should be to give a general skill which may readily be turned to account in different kinds of work.

As to when the industrial branch should begin in the school coure, the Boston committee say that examples are given by the kindergarten recently started in Philadelphia for teaching the minor arts, the industrial schools in Cambridge, Gloucester and Boston, and elsewhere, wherein it is proved that courses in industrial training may be devised so suited for different ages, as that such training might be made to begin in the primary schools and be continued in the grammar schools, possibly even further, to correspond with the literary training given in the high schools. The committee add that sewing has already been successfully introduced into the girls' public schools of Boston. As to whether the proposed industrial training would interfere with the other studies they quote an authority on the "half time" system in education, who says: "There is a special mutual influence between the school and the factory which improves the quality of the work done in each."—*Industrial News.*

Engineering, Civil & Mechanical.

THE JETTY WORKS OF THE MISSISSIPPI.

Of all the engineering works ever executed in the United States, none are to be compared in respect to boldness of conception and in the magnitude of the results proceeding therefrom, with the jetty works for improving the navigation of the Mississippi river, planned and successsully executed by Capt. James B. Eads. In view of the exciting discussion which the suggestion of Capt. Eads called forth in the engineering fraternity, and the strong opposition which it aroused among influential professional officials, the prosecution of the work to a successful termination in the face of peculiar obstacles, and in spite of the condemnation of the first professional authorities of the country, has won for its originator the unqualified admiration of his fellow-engineers, and a national renown.

We present in the following a brief history of the origin and character of this important work, with engravings showing the outlet of the jetties for which we are under obligations to the *Leffel Mechanical News*. The great commercial interests involved in the maintenance of a deep, permanent channel from the Missisippi into the Gulf of Mexico, will be familiar to every reader. The great river drains twenty States and Territories, embracing an area of 757,000,000 acres of the richest agricultural districts of the country. It traverses the four great belts of wheat, corn, cotton and sugar, to say nothing of the minor products, the tobacco of the central South, the lumber of the far North, and the live stock and minerals of all sections. The importance, therefore, not only to the rich and growing States through which it passes, but to the nation at large, that this magnificent waterway of the continent should be maintained in a condition suitable for the cheap, rapid, and uninterrupted conveyance seaward of the immense agricultural and other products of the rich countries which it drains, had long been recognized before the plan of Capt. Eads was presented. To understand the case properly, it will be necessary to give a brief statement of the condition of the mouth of the Missisippi previous to the construction of the jetties.

Like all great rivers, the Missisippi carries down with it to its mouth immense quantities of silt, or mud, robbed from the land which its tributaries drain. The quantity of solid matter conveyed by the river varies according to season, being greatest during the spring, when the melting snow and ice of the North swell the volume of the tributaries and the main river to enormous proportions, causing frequent and disastrous flooding of the adjacent low lands. This year it will be remembered, the inundations were especially severe. At such time the velocity of flow of the river is much greater than at ordinary periods, and consequently its power of transporting silt, or sediment is correspondingly increased. Taking the average of one year with another, it has been estimated that the Missasipi annually pours into the Gulf nineteen and a half trillion cubic feet of water. This water carries from a half to three cubic inches of sediment along with every cubic feet of water. The aggregate of this solid matter is about 800,000,0000,000 pounds per annum, a quantity sufficient to make every year a square mile of land 268 feet deep. As the river approaches the comparatively sluggish waters of the Gulf, its velocity of flow is diminished, and a portion of its sediment is deposited. The river here becomes a broad and shallow stream, entering the Gulf through half a dozen or more passes bordered by mud banks of its own creation, and which are gradually being extended further and further out towards the deep waters of the Gulf. From this it will be seen that the river is constantly making land at its mouth and extending itself gulfward. About 12 miles from its mouth, it divides into three branches, which run down like narrow tongues into the Gulf; on each side they are bordered by low, muddy banks, and between them the Gulf extends up in shallow embayments. At the Gulf extremity of these passes, the silt deposited from the sluggish current of the river forms a bar that is constantly being extended outward. The depth of the river gradually decreases as it approaches the Gulf. At New Orleans, the river averages over 100 feet in depth and about ⅞ of a mile in width; this depth continues to the head of the passes where the river widens suddenly to a mile and a half, and shoals up to a depth of about 30 feet. At the mouth of the south pass, where the jetty works have been constructed, the depth of water over the bar at low tide was only 12 or 13 feet.

From these facts the reader will perceive that the navigation of the great river was seriously impeded by the shallow water at the Gulf entrance, making it impassable save to vessels of light draft and small tonnage. It was to remedy this state of things, and to create a channel deep enough and wide enough to enable vessels of the largest tonnage to pass freely up and down the river, that the jetty works were projected; and this the jetties have thus far succeeded in doing.

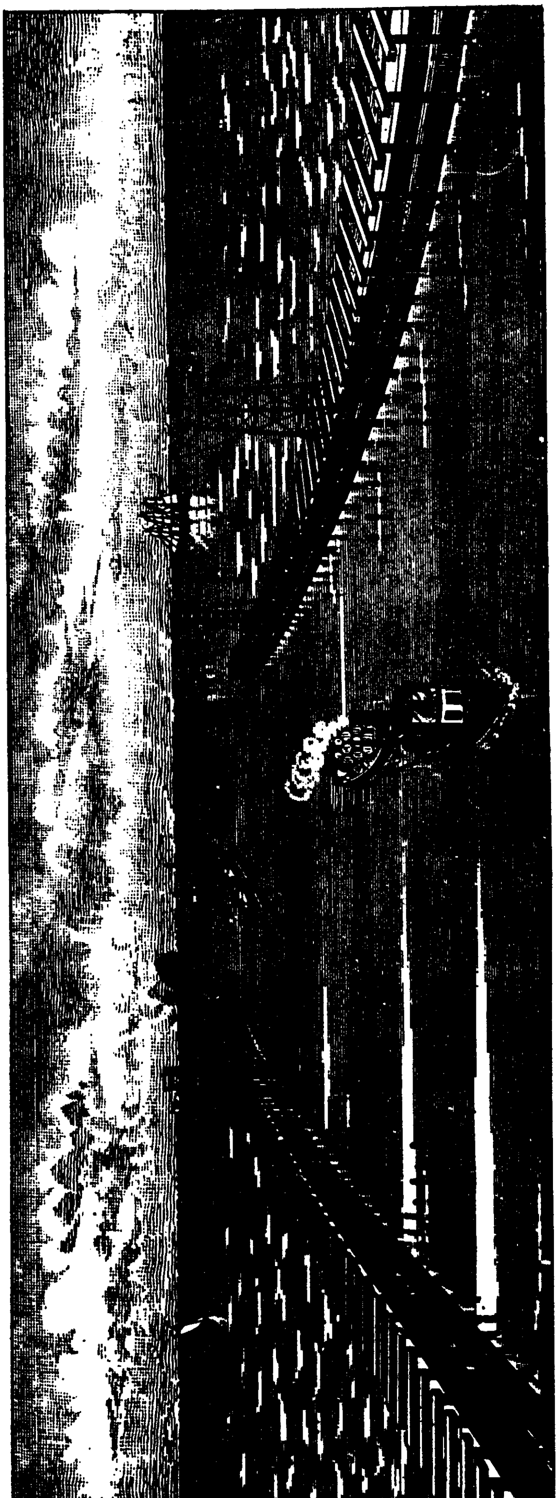
The following statement will explain the nature of these improvements. The plan of the work is remarkably simple. The object sought to be accomplished was the removal of the point where the sediment of the river was formerly deposited—namely, in the shallow vater at the entrance of the pass, further out into the deep water of the Gulf, where filling up again by natural causes will be an indefinitely remote possibility. To accomplish this object, Capt. Eads, against the judgment of some of the most eminent government engineers, proposed the adoption of a system of jetties, which had been found so successful in the cases of the mouth of the Danube and other rivers of Europe. This system involved the extension of the banks of the pass, to carry the stream far enough out, by the creation of artificial walls within which the waters of the river would be confined, the said walls being so proportioned in width, to the quantity of water escaping, as to produce an increased velocity of current, and thus force the stream to scour out for itself a deep channel.

After much discussion, the plans presented by Capt. Eads, were approved by Congress, and he was authorized to proceed with the work under conditions, which, in consideration of the professional opposition to his plans, reflect the highest credit upon his engineering skill and foresight. By the terms of the contract entered into between the government and Capt. Eads and his associates, the work was to be undertaken at the sole risk of the last named. No payments were to be made by the government until certain stipulated depths of water had been secured and maintained for a certain period. The act of Congress provided that when a depth of 20 feet had been secured, a certain payment should be made, and so on up to 30 feet; that twelve months after each of the prescribed depths had been secured, a further payment should be made, provided that the same had been maintained during that time; and that a certain annual payment should be made during twenty years for maintaining the works after their construction, and for extending them if necessary, so as to keep the channel at the required depth.

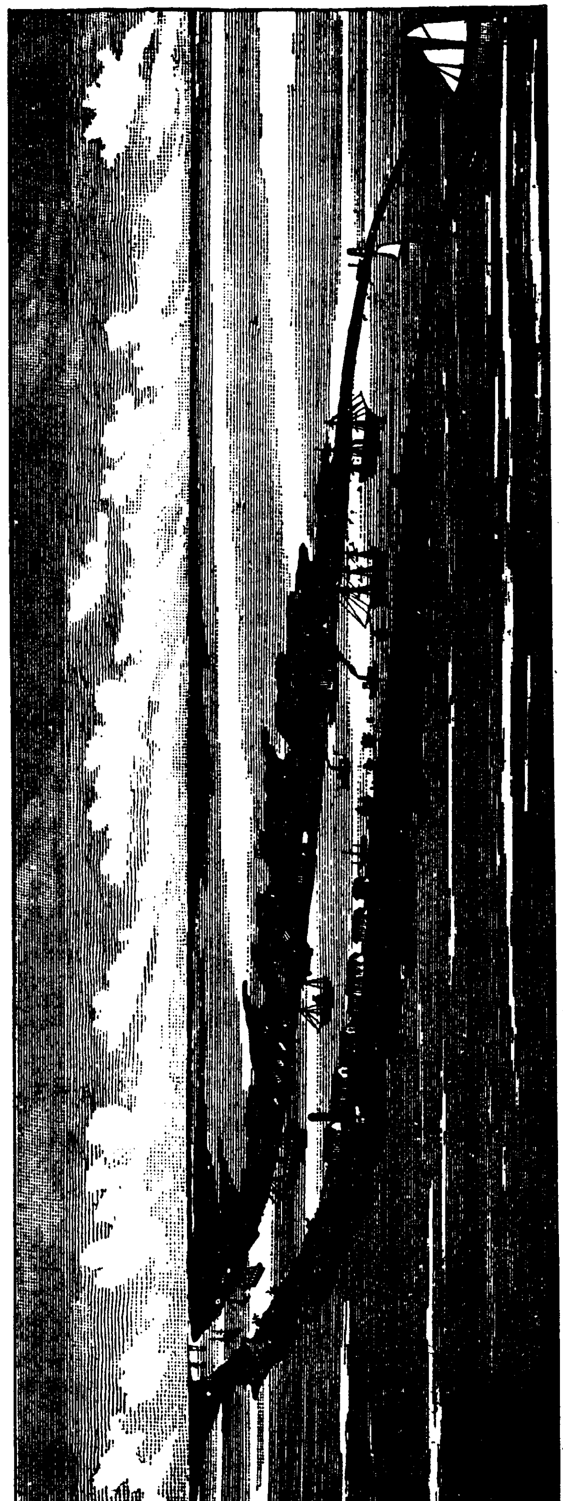
Upon these terms the work was undertaken. Extensive lines of jetties were constructed along the course of the moving waters, to act as artificial banks to the river to prevent it from expanding and diffusing itself as it enters the sea. The greatest difficulties to be overcome were to devise means for erecting these artificial walls, and making them secure and permanent upon the exceedingly unstable foundation of soft sediment, into which any works of stone would speedily sink and disappear. Piles alone or cribwork, however firmly placed would soon be undermined and swept away by the scour of the accelerated current.

To meet these difficulties, Capt. Eads constructed the artificial walls of the river with broad, flat mattresses of willow brush, securely lashed together and anchored to an interior row of piles. The preliminary work was the driving of piles along and inside of the line of the proposed structure. While this was going on, great mattresses of willow brush were constructed, firmly locked together with cross-ties and pins. These mattresses were towed into position adjoining the piles and fastened to them. Within twelve or twenty-four hours, the deposit of sediment from the current so completely filled the interstices of the mattresses as to sink them. Each mattress was not only fastened to others adjacent to it, and to the piles, but was also anchored to its place bp a layer of stone. This simple plan was found to work most satisfactorily. It was found that the sediment continued to gather in upon the mattresses until they became more solid and enduring than any part of the natural bank. The wall of mattresses was found to perfectly protect the piles from the scour of the current, while the latter in turn served to hold the mattresses in place. When built up to a sufficient hight, the structure was crowned with a firm stone paving, and the outer ends of the wall, where they were exposed to the sea, were constructed of broader and stronger mattresses supporting solid and durable works.

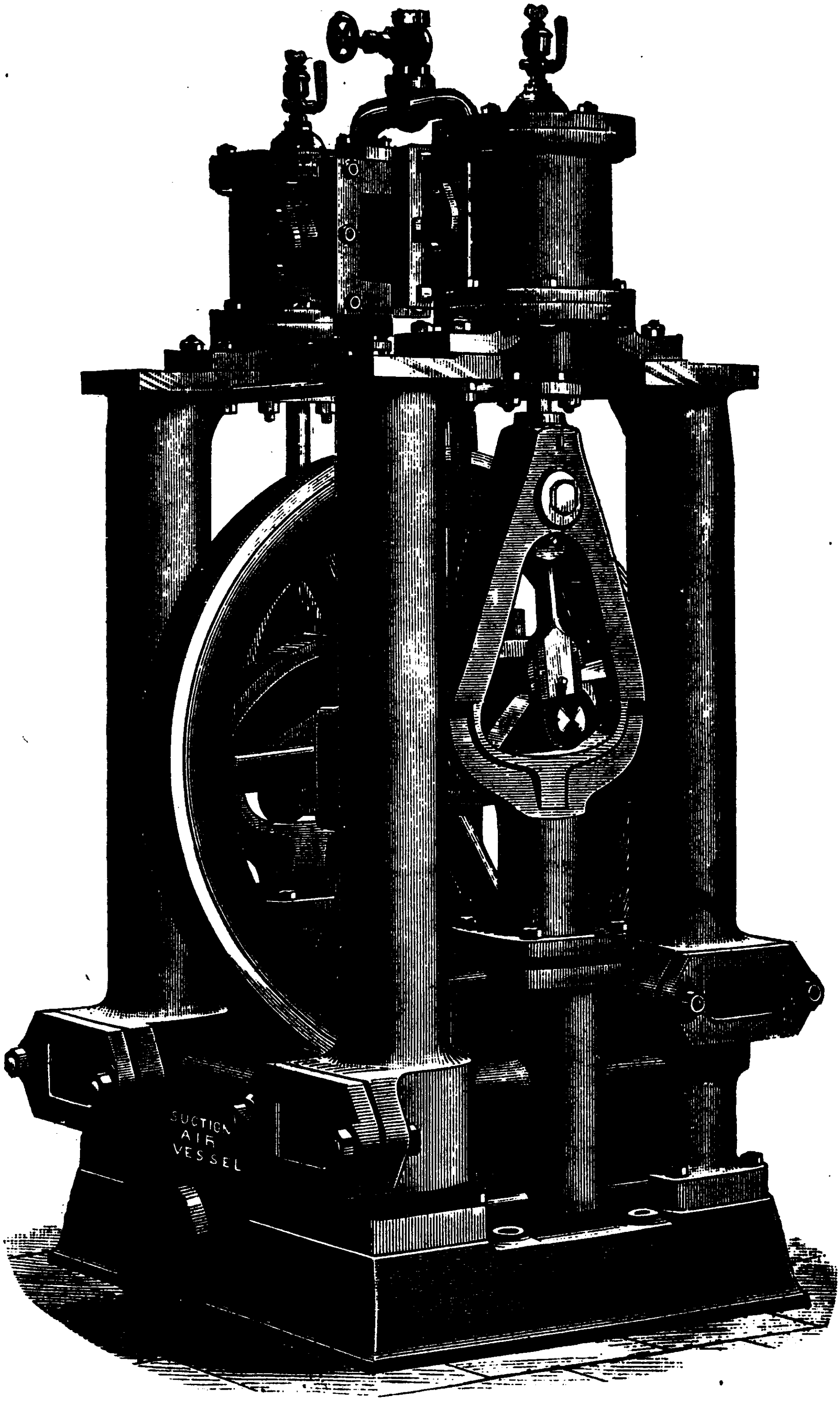
The extent and location of the jetties are as follows: The lines of the jetties are 1,000 feet apart. The length of the east jetty, from the land's end to the jetty head, is about 12,500 feet. For most of its length this jetty is constructed on a lateral shoal, where the depth averaged about 6 or 7 feet. The west jetty, on account of the further extension of the river bank on that side, begins about 4,000 feet further down than the east one, and extends parallel to it out to the same point. At its beginning it was constructed in much deeper water than was the east jetty; the depth, however, gradually shoaled to the crest of the bar, where it was some 6 or 7 feet. In addition to the jetties, the improvements of Capt. Eads comprise two auxiliary works—the



OUTLET OF THE JETTIES—PASSING INTO THE GULF.



BIRD'S-EYE VIEW OF PORT EADS AND THE MISSISSIPPI JETTIES.



DOUBLE-ACTING STEAM PUMP.

closure of the Grand Bayou and the construction of a dyke at the head of the pass. The object of these works is to deflect more water into the South Pass and thus increase the velocity, and consequently the scouring action, of the current.

During the progress of this important undertaking, the observations made from time to time gave evidence of the correctness of the theory on the faith of which it was undertaken. The channel was found to continuously and steadily increase in depth as the lines of the jetties were extended, and within a brief period after their final completion, several years ago, a channel of 30 feet in depth for a width of 200 feet was satisfactorily secured, and has since been maintained without dredging, or other artificial aid than that afforded by the jetties themselves. The fear that the action of the jetties would simply have the effect of shifting the bar a little farther out, where it would again form and prove as great an obstacle to navigation as ever, has not been verified, the sediment being most probably carried out sufficiently far by the rapid flow of the river to cause it to be carried off and dissipated by the currents of the Gulf.

The completion of this important engineering work has established the unrestricted navigation of the greatest water-way of the continent. The largest ocean steamers can now enter and pass out of the river without difficulty. The commercial results flowing from the improvement of the Mississippi's mouth are of vast national importance. Already the work has given an immense impetus to the foreign commerce of New-Orleans and other cities upon its banks. It has caused the diversion of a large and growing share of the vast grain traffic of the West from the great trunk lines of railway, and New Orleans, St. Louis and other cities upon its banks will speedily become dangerous rivals to the great Eastern cities for the exportation of the agricultural and mineral products of the West and South, of which the latter were formerly practically the sole possessors. The work of improving the navigation of the Mississippi, which Capt. Eads has accomplished in so signally successful a manner, although it has already greatly benefitted the trade of Southern and Western States that border upon it, promises for the future to yield still greater results.

IMPROVED DOUBLE-ACTING STEAM PUMP.

The accompanying illustration represent a double acting steam pump which for simple but substantial construction and effective and reliable working has gained considerable favor in England. It is the speciality of Hulme and Lund, Manchester, and is particularly suitable for the drainage of deep mines, some pumps of this class being at work at the present time forcing water 1,200 feet vertically in one lift. Four substantial columns support the steam cylinders and serve at the same time as air vessels for the pumps. The steam valves are of the ordinary kind, worked directly from eccentrics on the shaft below. The water valves are furnished with separate bonnets or doors, and are therefore at all times capable of easy inspection. The flywheels are heavy, and are turned true, so that they run with accuracy and will carry a belt for driving purposes. In all parts the most suitable materials are employed. The connecting rods and shafts are made of the best scrap iron, the piston and valve rods of steel, and the glands, bushes, steps, eccentric straps, and water valves are all of the best gun metal. The pistons are furnished with metallic packing, and the joints throughout are planed and faced. All the working parts and the packings are easy of access and of ready adjustment. Pumps of this class are specially made, capable of pumping against any pressure up to 1,000 lbs. per inch.

TUBULAR BOILERS.

The Hartford Steam Boiler Inspection and Insurance Company, in its *Locomotive* says :—

In the early history of the horizontal tubular boiler, it was regarded necessary to crowd as many tubes as possible into the lower half, especial care being taken to put them in after the plan known as "staggered," because more tubes could be inserted, and all the room economically (?) occupied. Little regard was paid to the spaces between the tubes and shell, or to the distance of the tubes to each other. The question of the circulation seems to have been little thought of, and almost no regard was paid to facilities for inspecting and cleaning. The tubes were usually 2" and 1 1-2" in diameter. They were packed so closely together that after a year or two the spaces became filled with deposits of lime and mud, and their efficiency was greatly impaired. In time, 3" tubes were introduced, but the manner of setting them was not changed. When the Hartford Steam Boiler Insurance Company first began business this was the condition of things mainly, and we at once set ourselves at work to influence, if possible, a change in this practice. Our aim was to have the tubes not less than 3" in diameter, and to have them arranged in vertical and horizontal rows, and not in any case nearer than 3" to the shell of the boiler. This, of course, reduced the number of tubes, and consequently the calculated heating surface of the boiler, and was bitterly opposed by many boiler makers. The rapid increase in manufacturing and consequent increase in the use of steam demanded important changes in the methods of constructing boilers, but the old prejudice lingered, and gave way only under severe pressure. A manufacturer wanted a new boiler of a certain horse power. He would apply to two or more boiler makers for estimates of cost. They would make up their specifications, accompanied with the estimated cost. On examination it would be found that their specifications agreed only in length and diameter. One would be crowded with tubes while the other would have them well arranged and judiciously distributed. The former would claim greater efficiency because his boiler had more tubes, and consequently more heating surface, while the latter would contend that his boiler was superior because it provided for free circulation of the water. There was great difference of opinion among boiler makers on this point, and there seemed to be no well established authority of the subject. Again and again were we applied to as umpire in such cases, and without reference to workmanship, which would be equally good in both cases, we believe we invariably advised the tubes to be set in vertical and horizontal rows, well distributed, and in no case nearer than 3" to the shell. At the bottom we advised at least a distance of 6" in the smaller boilers, and 8" in the larger onces, for abundant room to adjust the hand holes —one in each end of the boiler,—and to give a larger body of water over the fire, which is the hottest part. This was a great improvement on the old practice and came to be very generally adopted, and is largely the practice to-day, particularly in the East.

But experience raised the same question some time ago as to whether this plan could not be improved upon? Were the tubes equally efficacious? It was found that the levity of the heated gases naturally carried them to the upper rows of tubes and the lower ones consequently did comparatively little work. The question then arose how many tubes can be removed and the maximum efficiency of the boiler maintained? Another was, as to whether the size of the tubes should be increased? We have experimented more or less in this field, and to say the least, favor a reasonable departure in this direction. We have furnished many specifications for boilers, constructed on this plan, and they have given good results. Boilers makers in many parts of the country are constructing boilers on this plan.

Over the centre of the bottom there should be a distance of 18" from tubes to shell. This gives space for a good solid body of water over the fire, besides allowing room for a man hole in the front head underneath the tubes. The latter arrangement greatly facilitates the work of inspection. The entire bottom of the boiler can be inspected internally and externally, and sediment can be easily removed.

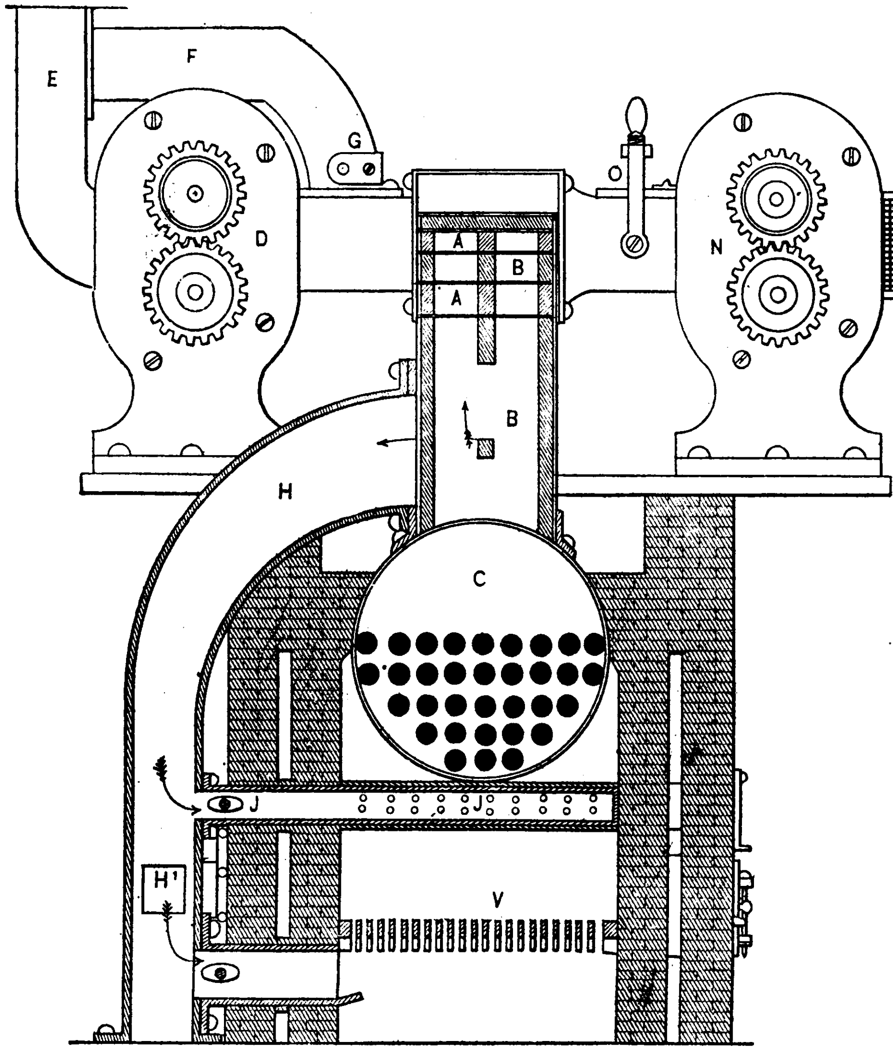
FIRE-PROOF SAFES.

The desirability of having the best made fire-proof safes in use for the storage of documents, cash, and other valuables, and the best means of setting the same in masonry or brickwork are points which continually force themselves on attention, and are just now prominently called up afresh by reason of the gigantic fires which have occurred in various places of the city. Upon this subject a writer in the *Times* offers the following observations: One lesson which the recent disastrous fires in London have taught is the desirability of using properly made safes for preserving valuable books and documents. Although the manufacture of fire-proof safes is an important speciality of the British iron trade, it is remarkable that in England itself large numbers of persons keep valuable articles in their offices and houses without the protection, which is so easily attainable, of a safe scientifically constructed to resist the attacks of fire and thieves. Most of the notorious robberies of jewellery and plate from private houses in the last few years might have been prevented by the use of safes. Fire-proof safes are sent from Great Britain to all parts of the world; while factories also exist in the United States, Vienna and Hamburg. The Sultan of Morocco recently ordered a set of safes to be made at Liverpool for conveyance across the desert on the backs of camels to a strong city in the interior. English fire-resisting and thief-resisting safes have been carried up the Andes to Potosi in pieces on the backs of mules, floated ashore on a vat at Mozambique, and dragged up to the most mountainous mining districts of Spain. They are made for Russia in large quantities of a special strength to resist the fierce heat from the burning pitch pine of which the Russian houses are to a great extent built. A fire-proof room has been sent to the Mauritius. The largest foreign markets are in Egypt and South America ; but there are few considerable seaports or commercial towns in the world in which British safes are not kept for sale. Safe deposit establishments, which are practically a collection of iron safes, exist in all the chief cities in America, as well as in London and in Liverpool. One English manufacturing establishment consumes 2,000 tons annually of iron and steel in making safes, employs 800 men, and has sent out 160,000 safes in the course of its existence. An iron safe factory is a collection of workshops of a very varied nature, in which many branches of metallurgy, tool making, and chemistry are illustrated. On entering, one sees the red powder which is used for stuffing the safes in order to preserve the valuable contents from excessive heat. The method adopted in the infancy of the manufacture was to place within the outside case metal tubes filled with water, and fastened at the end with bismuth. When the safe was surrounded by fire, the bismuth melted, the water escaped, and turning into steam kept the interior at a temperature of 212 degrees, an amount of heat which does little harm to books and papers. It is impossible to prevent these from becoming heated in a fire, but they are preserved by arranging that they shall be boiled instead of baked. The disadvantage in the use of the first expedient of water and tubes was, that in course of time the contents of the tubes evaporated and the duty of refilling them was liable to be neglected. The method now very generally adopted is to employ a chemical carrier of water, such as alum, which contains 52 per cent. of moisture and gives it out on becoming heated. The alum is mixed with sawdust for the purpose of arresting the deliquescence of the alum under the influence of heat and converting it into equally cooling, but more viscid, mud. The red powder thus formed is the principal fire-resisting agent. It is not required in safes which are only destined to hold plate or bullion, but where books and papers are to be preserved its usefulness cannot be exaggerated. The next material seen is the sheet iron or steel—oblong plates of iron from South Wales, or of Landore-Siemens steel, 6 ft. by 2 ft. These are cut into the proper lengths by an instrument like a guillotine, driven, of course, by steam, and are then tinned. The tinning is a simple process. The plate is first cleaned in a bath of muriatic acid in which zinc has been steeped, then plunged into melted tin (mixed with a little lead), which is allowed for a few seconds to hiss around the wet plate. Without the preliminary bath the tin would not adhere, but thus prepared the plate takes on a shining coat of tin which protects it from rusting and enables it to be fastened with soft solder. The tinned plate is straightened and levelled by blows with a hammer driven by pneumatic force, and the plate goes into the shops where the boxes or parts of safes are actually made. In addition to the complete safes, made to withstand fire and the assaults of thieves for as long a time as may be, fire-resisting boxes are manufactured at a lower price and of slighter construction. To finish these, the prepared plate is hammered cold into the proper shape. The plates are bent and riveted together to make the box. Within the outer box a smaller one, constructed in precisely the same way, is placed. The space between the two boxes, about 3 in., is filled with a mixture of alum and sawdust. In boxes destined for Russia the space filled with the steam generating mixture extends for 4 in. instead of 3 in. The inner boxes have small holes, invisible to the naked eye, filled with cement which melts when the fire grows fierce and allows the steam to escape into the interior of the box and keep the contents comparatively cool. The joints of the inner box are also made loose so as to allow the steam to escape into the interior ; but the outside joints are tight, to prevent the loss of steam by communication with the air. A complete safe is of more elaborate construction. In general principle it is similar to the fire-resisting boxes, but it has a more or less skilfully designed lock (the keyhole being small, and the cavities few, so that gunpowder to blow it up cannot be inserted.) The case is made extremely strong, in order that when the safe falls from a height by the burning of the floors it should remain unhurt. Machines for cutting rough iron, countersinking, round punching and square punching, braziers' shops for handles and labels, locksmiths' shops, and so forth, come into use for making and finishing the complicated combinations of iron and steel skins with which the fully-developed safes are built up. The doors, of half-inch wrought-iron boiler plates, are cut to size, planed by machinery, and hung. In some safes they are fastened by pivots, fitting into iron lugs ; in a stronger and more expensive sort wrought-iron hinges are used. The fastening apparatus, the ponderous bolts with which the lock is secured, are fitted between a steel chamber, filled with alum, and the main iron of the door. It is in the locks that the chief refinements are introduced and that the greatest differences exist between maker and maker. A strong and simple arrangement is probably better than too delicate contrivances. Great pains are now taken to prevent the safes from being burst open by wedges. The bolt bars, into which the bolts of the lock slide, are protected by bars with dove-tailed holes, into which fit small dove-tails in the door, all made in solid wrought iron. The most finished safes have bolt bars on every side, so that bolts shut not only to the jamb, but to the lintel and the sill, and even into the sides of the safe to which the hinges are fixed. All these four sets of bolt bars have dove-tailed holes cut in them, into which corresponding projections, forming part of the door, fit and guard the bolts. The number of locks can be indefinitely multiplied for the purpose of safety, and the number of iron and steel skins to the safe can also be multiplied. Often for greater security one small complete safe is placed within a larger one. A very strong safe is composed of three skins—the outer and inner made of thick boiler plate, with a quarter-inch of hardened drill-proof steel between. The iron skins may be an inch in thickness, and it is stated that no drill in the world can pierce through the steel. Specially rolled bands of iron are screwed or bent on outside to protect the joints which burglars would be most likely attack. No single rivet goes through all the skins. Rivets are placed in different positions in each of the skins. The fastenings are strengthened by screws from the inside which do not go to the outside at all. We have mentioned some, but not, of course, all of the methods employed for attaining security. Safes are tried in a furnace specially built. Outside is a circle formed of bricks, on which coal and wood are heaped up. In the midst the safes are placed, and the flames allowed to play round them for the required number of hours—four or five as a minimum. At the end of the time fixed the workmen and visitors allowed to witness the spectacle crowd round. Men, with their hands before their faces to protect them from the fire, approach the blaze, and thrust long hooks into a chain which has been left round the safes. The safes are moved, and a hook from an iron crane is pushed into the chain. Then the crane slowly drags the ponderous safe out of the flames and deposits it on a trolly. The superintendent thrusts the long key into the lock, and opens the door. If the experiment is successful the interior is seen whitened with the escaped and deliquescent alum, the books unhurt, the parchments rolled, perhaps into a scroll by heat, but with the writing on them perfectly legible.

PROTECTION AGAINST LEAD CORROSION.

Professor Emerson Reynolds, of America, has laid out the following as the best means he is acquainted with to protect lead from corrosion :—Take 16 grammes of solid caustic of soda, dissolve it in 1.75 liters of water, and add to the liquid 17 grammes of nitrate of lead, or an equivalent of other lead salt, with 250 cubic centimeters of water ; raise the temperature of mixture to 90 deg. C. If sufficient lead salt has been added the liquid will remain somewhat turbid after heating, and must then be rapidly strained or filtered through asbestos, glass-wool, or other suitable material into a convenient vessel. The filtered liquid is then well mixed with 100 cubic centimeters of hot water, containing in solution 4 grammes of sulpho-urea of thiocarbimide. If the temperature of the mixture be maintained at about 70 deg. C., deposition of sulphide of lead or galena, in the form of a fine adherent film or layer, quickly takes place on any object immersed in or covered with the liquid, provided the object be in a perfectly clean condition and suitable for the purpose. When the operation is properly conducted a layer of galena is obtained, which is so strongly adherent that it can be easily polished by means of the usual leather polisher. It is not necessary to deposit the galena from hot liquids, but the deposition is more rapid than from cold solutions.

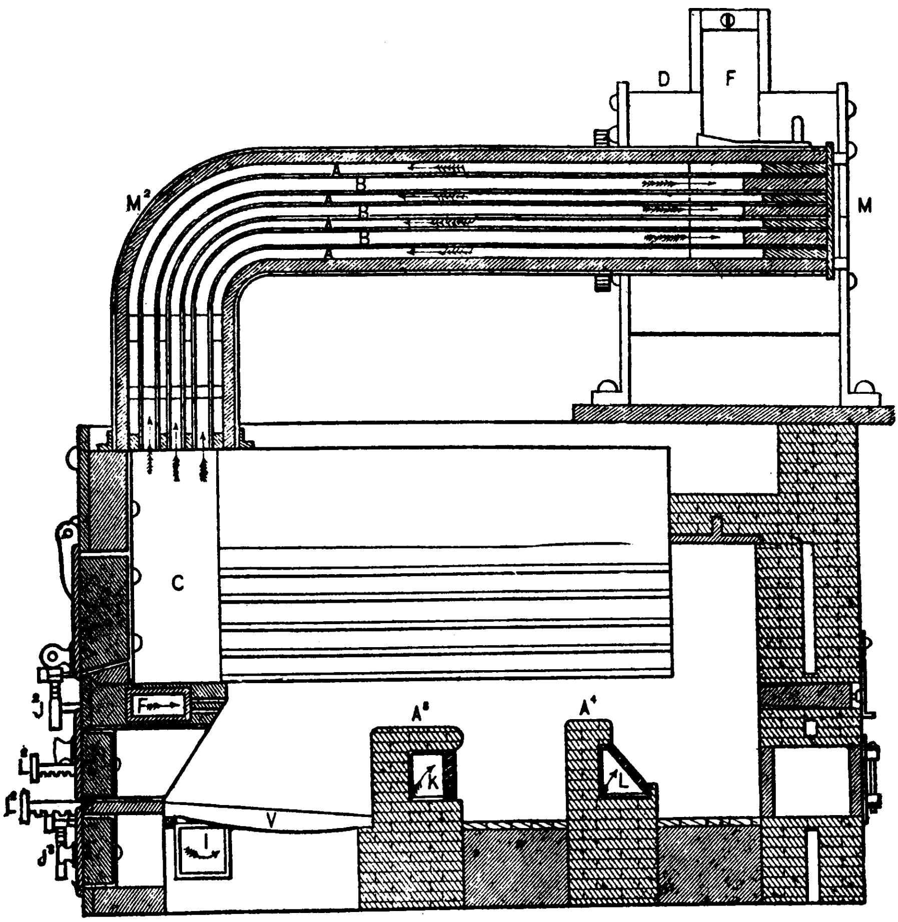
Col. Warnig's report on the sanitary condition of the White House reveals a state of things far from creditable or satisfactory, so far as the arrangement of pipes, location of fixtures and means of ventilation are concerned. Immediate steps are to be taken in the matter.



Marlands Improvement for Utilizing the Heat of Boiler Furnaces. Fig. 1.—A Vertical Cross Section of the Boiler Setting.

MARLAND'S IMPROVEMENTS FOR UTILIZING THE HEAT OF BOILER FURNACES.

The accompanying illustrations represent apparatus patented by M. O. Marland for the purpose of securing economy of fuel in boiler furnaces, and are of interest to all users of steam-power. From a report concerning this improvement, recently made by Mr. John C. Hoadley, of Boston, it appears that this furnace setting, as it may properly be termed, is capable of giving a very great increase in the economy of fuel. In Fig. 1 a cross section of the apparatus is shown, taken near the front end of the boiler setting. The boiler C is of the plain tubular form, fired underneath. Fig. 2 shows a cross section at the back end of the boiler, and Fig. 3 is a longitudinal section through the whole apparatus. The principle of the device is similar to that of the Siemens regenerative furnace. The hot air and gases passing to the chimney are carried through tubes, having very thin walls. The air to supply the fire is carried along upon the outside or between these tubes, and becomes highly heated by contact with them. The draft is controlled, or rather furnished, by a pair of Root's blowers, and the outgoing hot air from the furnace is divided into three streams, and is drawn outward by another blower. In Fig. 1, H is an air pipe connecting with all the passages, A, and conducting air from them to the branch pipes I^1 and J1, by which the air is distributed into the ashpit, over the bridge wall and to other portions of the furnace, as K and L in Fig. 3. D and N are the cases of the two Root's blowers, N being used to force the air into the furnace, and D to exhaust it and force it out of the pipe. In Fig. 2 a section of the blower is shown. Here the arrows indicate the course of the air. Entering the blower N, it passes into the tubes A A, and turning at right angles is conducted along the whole length of the boiler, separated from the hot-air currents by thin partitions, which divide the spaces A A from B B. It then passes down the tube H H and into the furnace, from which, after passing through the fire and the tubes, it is exhausted by the blower D and discharged into the air. When the exhaust blower is not running, the valve G is opened and the gases escape by the passage T. Two blowers are not necessary, D being in many cases ample for the purpose. According to the ideas of the inventor Fig. 3 the longitudinal section,



Marland's Improvement for Utilising the Heat of Boiler Furnaces. Fig. 3.—A Longitudinal Section, showing the Passages through which the Hot and Cold Air Passes, together with the Bridge Walls and Furnaces.

shows more clearly the relationships of the various parts, especially the passages A and B, in which the gases travel in opposite directions, separated only by thin metal partitions. A4 and A8 are bridge walls, F and I the passages through which the air enters, and C the "front connection" by which the air is conducted to the exhaust fan.

We cannot present the whole of Mr. Hoadley's remarks and calculations upon the value of this apparatus. The greater portion of his report is of a character too highly scientific to be specially interesting to our readers. It is enough to say, however, that he considers a setting of the kind capable of producing a very high degree of economy, since it makes it possible to reduce the temperature of the products of combustion to a point far below that necessary to produce a draft by means of a chimney. Of course this is not all gain, because some power is required to move the blowers, but careful investigation shows that this power does not begin to absorb all of the saving which may be effected. It is estimated that the gases when they leave the boiler must be at least 75 degrees hotter than the temperature due to the pressure of steam. It would give for 80 pounds steam pressure, a temperature of about 400 degrees for the escaping gases. Actual practice shows that the temperatures of these gases vary from 500 degrees up to 1000. Mr. Hoadley is of the opinion that by Marland's plan the temperature of these outgoing gases may be reduced to that of the external air, or say 60 °F. It appears, then, that under ordinary circumstances from 16 to 20 per cent. of the total quantity of heat produced by the combustion of anthracite coal, can certainly be saved and returned to the furnace by the Marland apparatus, judiciously arranged and proportioned; that under no circumstances can such saving fall so low as 10 per cent.; and that it will often be 25 per cent., and may, in extreme cases, reach 30 per cent. Finally, Mr. Hoadley thinks that with this apparatus all good boilers using steam at 80 pounds pressure can be made to show a degree of efficiency indicated by the conversion of water at 60 degrees to steam of 324 degrees (80 pounds steam gauge), with a consumption of one pound of coal to ten pounds of water, the coal being supposed to contain five-sixths of its weight in carbon.

Home Industries.

STARVATION BY COOKERY.

Starvation by cookery is, I believe chiefly a modern sin, and less the fault of the cook than of the public. Cooking is for man a necessity and quite a saving of vital energy. For, were it not for the cook, it would take so long for us to digest our food, that, like the cattle, we should have to spend half our time in eating, and the other half in resting that we might digest it. But while our best and our daily thanks are due the cook, it is high time that he or she give up kitchen hypocrisy, and send no more to our tables things having the appearance, but lacking the reality of food. I wonder how many die of hypocritical cooking? Perhaps half of us; for while gluttony and other sins cause much disease, yet were our food real, we might the better resist their temptations and suffer less by transgression.

But we must hurry up and not keep the cook in suspense as to the charge against him, which is briefly this: that he or she removes the natural salts from our food, and hides the loss by common salt, which, far from replacing them, rather aggravates the vital failure that comes from saline starvation. Not that common salt is bad of itself; it, too, has its uses in food.

Whilst this spoliation of food has been frequently complained of, and protest made against it by health reformers, it is only of late years that pointed evidence of the nature and extent of the danger has come to light. Degeneration of various tissues and organs in the body has been recognized as the source of nearly all chronic disease and the fertile cause of that lack of stamina or endurance that characterizes modern life. Those in whom there is much degeneration say the kidneys or the liver must walk through life gently; like a shoddy garment, they are safe enough for *careful* wear, but sure to give way under any strain.

The cause of the various types of degeneration have hitherto been very obscure, but one has proved, on analysis, to be simply such tissue as the body can make in the absence of potassium and phosphates. This discovery of Dr. Dickinson's of de-alkalized fabrine, as he calls it is a startling one. This tissue has an excess of common salt; but, as compared with the natural tissue which it has replaced, it is exceedingly poor in just those food salts which our cook does not send up to our tables. Every tissue in the body has a certain length of existence, after which it dies and is replaced. But this only slowly and cell by cell, fiber by fiber. To make each tissue capable of all the various services demanded of it, requires not only nitrogenous and carbonaceous foods but also those saline elements that are so abundant in milk, vegetables and fruits. Sailors, it is well known, cannot undertake a long voyage without a daily supply of lemon juice or preserved vegetables, otherwise the terrible scurvy will disable or kill them. Scurvy is the acute disease due to this saline-starvation; whilst waxy degeneration is the chronic disease due to a less violent and more prolonged starvation from the same elements.

It is estimated that man requires 40 grains daily of potassium oxide to carry on the nutrition and health of the body; but few of the working classes in our large cities get more than 25 to 30 grains per day. For instance, white bread of which many consume a pound daily, furnishes only 7 grains of potassium, whereas the same amount of Graham or brown bread contains 25. Again, the salt pork, salt fish or ham which forms their staple meat, has lost most of the potassium to the brine, or will lose it (like salt fish) in the washing and steeping it undergoes before cooking.

Even the wealthier classes, with all their abundance, have been, by our modern habits of food and cookery, reduced to about the minimum quantity of potassium, and every little strain, as well as every little error, hastens on the decline of life and the day of physiological fatigue. Potatoes are rich in potash, but should our cook first peel and steep them in cold water to whiten them before boiling, we are cheated in every 8 ounces we eat of 9 grains of potash; for boiled in their skins, 20 grains, instead of 11, would have come to table. Should we partake of cabbage the loss is still greater, because the leafy vegetable presents such an extended surface to the water. Again corn-starch pudding is also an emasculated food, all the potash, nitrogenous and tissue-building matters having been removed in the manufacture, leaving pure starch, the most deceitful of all foods.

These losses of potash are small, but so numerous, repeated and constant that the poor body is often at its wits' end to replace the cells and fibers of each tissue as the old cells die out. So cell by cell, fiber by fiber, our livers and blood vessel are rebuilt of shoddy—of de-alkalized fibrine—a substance that, while able to keep up the form and movements of the liver, is totally unable to perform its functions of digestion and of blood depuration. So we are slowly crippled in our vital power, and especially in our ability to endure fatigue and to recover from disease or other unusual strain. At the same time our blood is imperfectly purified; it circulates imperfectly digested food and effete matters that would have been expelled had our food been natural. These degraded matters irritate the brain, making us nervous and excitable; they weary the muscles, making us easily fatigued, and they render us more liable to rheumatic and inflammatory diseases.

Dentists too have attributed to this spoliation of food the toothlessness of this generation. White bread and corn-starch were not common foods to our ancestors. And 50 years ago, vegetables were more commonly cooked in soups or broths, which gave us all the good they contain.

But not every person suffers equally from this waste of food salines. Out of 100 sailors on board a scurvy-stricken ship, 10 or 20 may escape the worst features of the disease. The causes of such individual peculiarities are beyond our skill. Why, out of 20 equally exposed to the contagion of small-pox only 15 should take the disease, is a mystery. Or, why again, in a family, where, as regards heredity, habits and food, all the children are equal, why should one or two escape, whilst the majority suffer from an epidemic of scarlet fever? Echo answers, why?

Those, then, who desire that they and their children should walk this world in no shoddy suits of flesh and blood, should inherit no sham teeth, no feeble livers and no languid limbs, must, in two respects at least, return to the ways of their fathers. First, Graham bread must entirely replace white bread; and, secondly, soups rich in vegetables must be freely used. Clear soups are, of course, inferior, but still there is less waste in rejecting the boiled vegetable itself, than in rejecting the clear soup it was boiled in. Potatoes, beans and peas form a good basis for soups, being all rich in potash as well as in the more solid constituents of food.

Physicians, especially in the army, are well aware of the wonderful power of potassium salts to remove fatigue and exhaustion and frequently, on a march, serve out a ration of special soup or Liebig's extract of meat for this quality of their potassium salts.—*Mining and Scientific Press.*

HOW OUR FRESH MEAT IS HANDLED.

A prominent dealer in live stock gives the *Tribune* the following facts and figures relative to the trade in cattle, sheep, and hogs in and around this city:

The cattle come to Jersey City mostly by the Pennsylvania Railroad, which brings the cattle shipped by the Baltimore and Ohio from Southern points. Many also come by the Erie Road. The majority are shipped from Chicago, St. Louis, and Cincinnati, by dealers in those places who are either interested with the sellers in New York or have their stock sold on commission, the charge for which is generally $1.50 per head. The best bullocks for beef come at this time of year from Ohio and Kentucky, and in the winter from Illinois and Missouri.

The breeds are usually natives or grade Shorthorns and Durhams. Illinois, Iowa, Missouri and Kansas are the States where the most corn is fed to bullocks, and the stock from those States, therefore, makes superior beef. A great many beeves are coming from the plains of Colorado, and are very fair stock. About 40 per cent. of the arrivals at this time of the year are Texans and Colorado half-breeds. They are composed in a great measure of bone and horn, and usually bring very low prices. As the country is more thickly settled the Texas cattle become tamer and easier to handle, but they are still the subject of a few stray "cuss words" from drovers and butchers.

The Cherokee cattle raised by the Indians are much like the Texans only smaller and neater. Some dealers buy the Texas cattle and fatten them on corn in Illinois, Kansas, and Missouri, and so make fair beef of them. Others in Cincinnati, Chicago, Sterling, Peoria, Ill., and Cynthiana, Ky., fat many Texas steers on distillery refuse or "slops" the grain after it has been distilled. This feed makes healthy meat of fair quality. Some say, however, that the meat of this kind is softer and more flabby, and that a distillery-fed animal will die in very warm weather, when a corn-fed one will be in good condition.

The cattle-growing part of the country has moved West rapidly in the last few years, as the new States have been opened up, until now the most of the stock coming to this market is raised west of the Mississippi. Kansas, Nebraska, Colorado, Iowa, and Missouri, have taken the business from Ohio, Indiana, and Illinois, and many farmers in the latter States are turning their attention to raising sheep and hogs as more profitable. Chicago is the great cattle depot of the country, and handles about 30,000 head a week, while New York's average was, last year, 13,018. But Chicago is a distributing point, while New York is a market. New York eats most of the live stock she receives, while Chicago has much more than she can masticate, and so sends it away.

Live stock usually stop over several hours in Chicago, and are again unloaded, watered, and fed at Pittsburgh, or some other point on the way to New York. The trains arrive at Jersey City at all hours of the night. The cars are opened or "slatted," and the animals are found to ride best put in loose with no stalls. Extra floors are put in for sheep and hogs. The car holds fifteen to nineteen native bullocks, or twenty to twenty-five Texans. The arrivals are nearly a hundred and fifty cars daily.

At daylight the sale begins and last tills about 12 o'clock. The buyers are wholesale slaughterers and shippers. These glance through the yard, look at the bulletins of animals, and then begin to bargain for some lot of cattle which has struck their fancy. If the supply is small, however, they will not bargain long, for fear a rival may step in and "leave them in the cold." There are three market days at the cattle yards—Monday, Wednesday and Friday—Monday being the principal one. At one time Sunday was the principal one for selling cattle. When a slaughterer has selected his cattle they are driven up to the scales, on which about forty can be weighed at once.

A well-fatted native steer will weigh from 1,200 to 1,500 pounds, occasionally they go as high 2,500 pounds. The dealers in New York have a curious way of selling bullocks, which is different from any other market, and as unique in its way as the tenaciousness with which the New York potato dealers cling to the "York shilling" in their business. A bullock is sold at its dress weight before it is dressed—that is, a lean animal would be estimated to dress fifty-three to fifty-five pounds a hundred, a good one fifty-six to fifty-nine, and fancy ones sixty to sixty-two pounds. Thus, for every hundred pounds of live weight the price per pound of dressed beef is charged on the number of pounds the animal is estimated to dress a hundred.

The Jersey City Stock Yards are owned by the Central Stock and Transit Company, and they are a heavy-paying investment. The charge for every head of cattle coming to the yard is 45 cents, called "yardage." and this pays for very little more accommodations than a railroad company usually furnishes for nothing in the shape of depots. The company also charges $2.50 per hundred for hay, an outrageous price, but one which the cattle men are compelled to pay. The charges are about as heavy at the other principal market of this city, the Sixtieth-street yards, the two being virtually under the same management. The Sixtieth-street yards accommodate particularly the stock coming over the New York Central and Erie Railroads, and nearly as many cattle arrive there as at the Jersey City yards. The method of handling and selling is the same.

The hog yards for the New York Central Railroad are situated at Fortieth street and Eleventh Avenue, where about 10,000 hogs are now arriving and being slaughtered every week. New pens for the brutes are building, which will lessen the inevitable smell from the swine. They are shipped mainly from Chicago, which now far eclipses Cincinnati in its hog traffic, and which handles from 100,000 a week in Summer to 50,000 and 60,000 a day in Winter.

The supply of sheep is divided about equally between Jersey City and Sixtieth Street. They are shipped largely from Ohio, Indiana, and New York. Lambs now are arriving mainly from Kentucky and Virginia, and they later will come from New York State and Canada. The stock yards around New York have changed a great deal in the past few years, the old ones at Communipaw, Weehawken, and other points being discontinued, until they have narrowed down to three large yards, one of which—Fortieth street—is solely for swine.

The Polytechnic, in Regent-st., London, will have been closed by this, and the institution where science was combined with amusement will cease to exist unless some enterprising caterer takes it in hand. The Polytechnic was founded in 1831 for the exhibition of novelties in the arts and practical science, especially in connection with agriculture, manufactures, and other branches of industry. The buildings were enlarged in 1848. The closing of the establishment will be a decided loss to popular science.

ON THE SUBSTITUTION OF OLEOMARGARINE FOR BUTTER.

Professor Riche has read an article before the *Academy of Medecine* an official report of the commission appointed by the Minister of the Interior, to give an opinion as to the propriety of substituting oleomargarine for butter in the asylums for the insane, from which the following conclusions are drawn :

1st. It appears from three years' experience at St. Anne, at Vaucluse, and at Ville Evrard, that the employees and some patients could not endure this alteration in the usual fare.

2d. The alimentation, and therefore the preservation in health of extra sensitive and very delicate patients, would be unfavorably affected. In any case it would be a serious change in the regimen of those whose constitutions were already worn out.

3d. Oleomargarine is a manufactured product and so open to fraud ; it is well known that vegetable oils are used. Moreover, experience shows that some time is required for a stomach accustomed to food cooked in fat to become habituated to that dressed in oil ; and physiological researches prove that vegetable oils are less easily digested than animal fat.

4th. Fatty substances are only absorbed into the system in the state of emulsion. Chemical practice and culinary experience having shown that oleomargarine does not emulsionize so readily as butter, and that the emulsion of the former is not as stable as that of the latter, it is reasonable to conclude that oleomargarine is not so easily assimilated as butter.

It was therefore proposed that the commission should reply to the Minister that the *Académie* considered the proposed substitution inexpedient ; and this proposition being put to vote, was unanimously approved.—*Moniteur de la Pharmacie.*

THE SCOVILLE CREAMER.

The question of cream and butter is of great importance to the farmers and dairy men, and just how to obtain the most and best quality of cream from the least amount of milk has been the source of many experiments by them.

Our engravings show a device lately patented by Mr. H. B. Scoville, of Cortland, Ohio, who has made it a study how to solve the problem in a simple and common sense manner. Fig. 1 shows the cabinet which is designed to be set above ground, Fig. 2 the form of pail used, and Fig. 3 the cabinet which is set in the ground, as shown by dotted lines.

This cabinet is made of oak, ash, pine or any suitable lumber. It is lined with galvanized iron, has pipes for receiving and discharging water, and is a most durable and convenient arrangement. The pail is made of one sheet of tin only, consequently has but one seam which is so arranged that it protects the pail from bruising while being emptied. The cover is made of heavy pressed tin, exactly of a size to fit the top of the pail so as to exclude the air. The bail is provided with cams by which the cover is locked and held firmly to its place, or removed by simply reversing the bail. The bottom is made concave, and will never need replacing. It is provided with a 6-inch gauge, plainly stamped in inch, ½ and ¾ inches, which shows precisely the amount of cream raised ; also meets the wants of those who buy or sell cream, as is now carried on in many places where creameries are established. The pail is made of a size the most practical and convenient for handling and cooling rapidly, obviating the necessity of using pipes, tubes, rubber attachment, etc., which are the drawbacks of many cans now in use. There is practically nothing to get out of order.

The creamer pail combines the advantages of deep setting, rapid cooling and convenience in handling. Cream is raised in from twelve to twenty-four hours, according to the temperature of the water.

The milk is protected from impurities of the atmosphere which so quickly taint cream, from which good butter can not be made ; from souring of milk by thunder storms ; from flies, insects, dust or dirt of any kind ; from all bad odors ; thus preserving the milk and cream clean and sweet until all of its benefits are derived, which in hot weather are double those obtained by the open pan system.

It is adapted to the wants of all—large dairies or small—from those who keep but one cow to those running a creamery. It overcomes the disadvantages of other creamers by its construction. It may be set in the ground at the well or spring, the pail being convenient to set in and out and carry away to empty when skimmed as compared with cans.

A very small space only is required, compared to the open pan system, and no expensive milk room necessary.

It is easily kept clean and sweet, with nothing to get out of repair, and has all of the merits and none of the disadvantages of other creamers.

It is claimed that the system of deep setting has proved a great benefit to those who have tried it, not only in quantity but in quality of cream. It keeps the milk at an even temperature during hot or cold weather, requiring no heated room in winter.

It is the only creamer in the market that has the bail to assist in handling, thereby saving time, labor and extra pails to carry away skimmed milk; also saving a great amount of labor in cleaning up caused by spattering and spilling. It can be taken to the milking place, milk strained into it and carried to and set into the cabinet or vat, and when skimmed carried away and emptied, with no slop or other vessel to look after. In a word, it is just what every farmer needs, and just what they can not afford to do without.

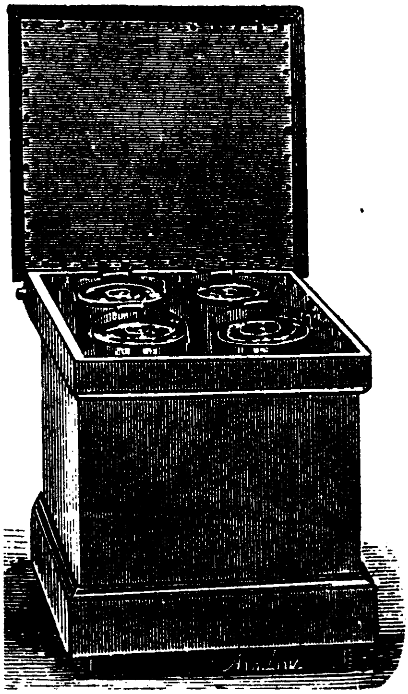


FIG. 1.

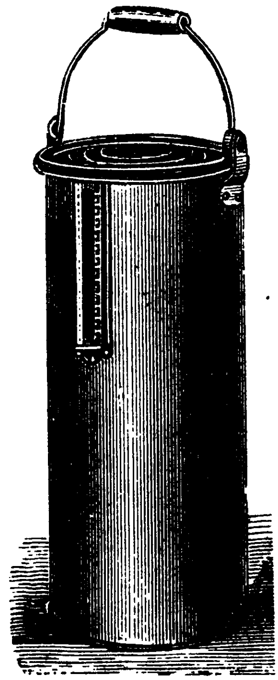


FIG. 2.

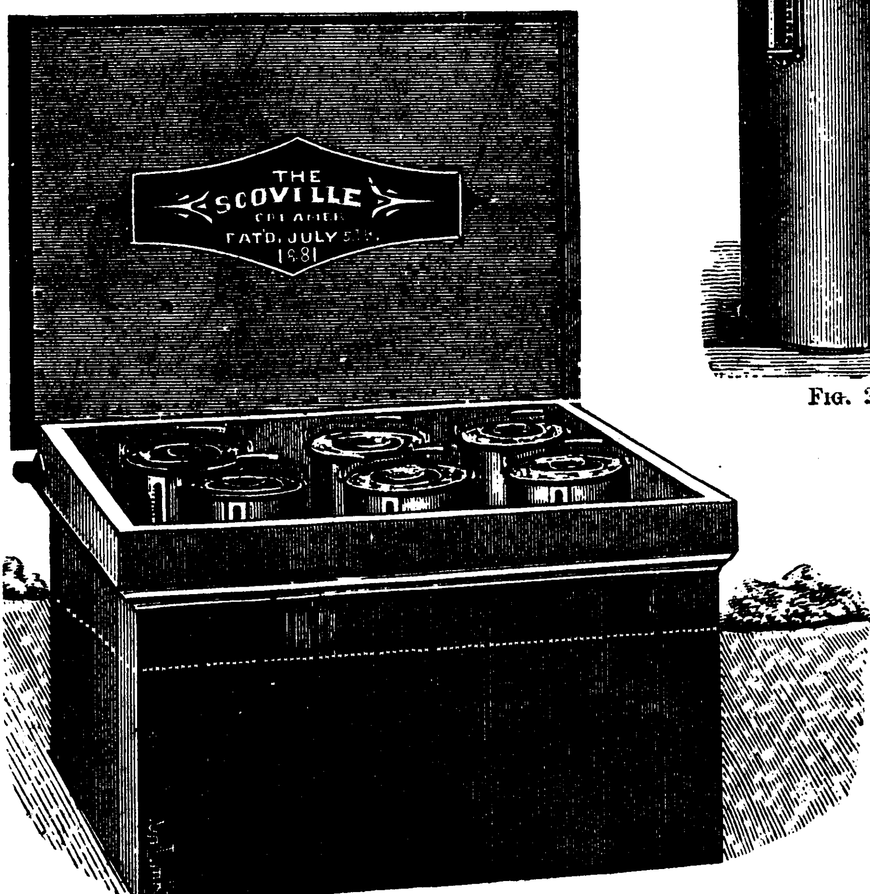


FIG. 3.

THE SCOVILLE CREAMER.

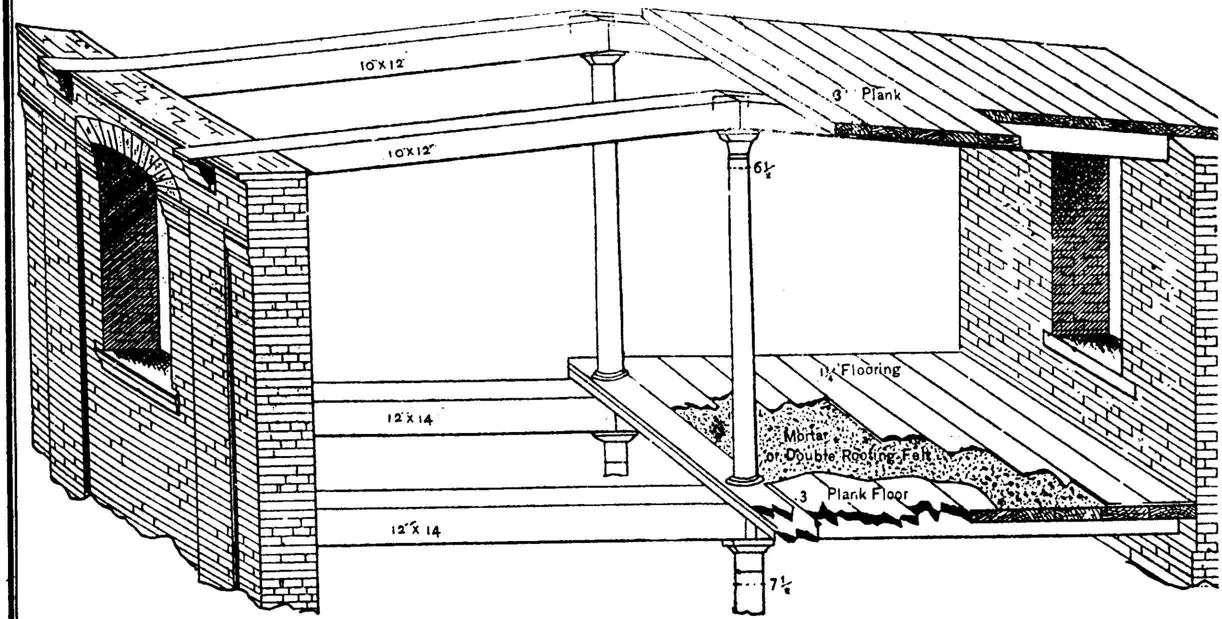


Fig. 1.—Perspective View showing Arrangement of Floor Beams, Rafters, Columns, &c., and Manner of Laying Floor.

SLOW BURNING ROOFS AND FLOORS.

The accompanying illustrations, from the circulars of the Boston Manufacturers' Mutual Fire Insurance Company, are of special interest as giving precise details in regard to an improved method of construction—namely, the slow burning, which might be, perhaps, more properly called fire-proof than the usual iron construction which has received that name. The roof itself is probably the most novel and striking feature in the design. The timbers are split or single, as the case may be, the aggregate width being 10 inches and the depth 12 inches. On top of this

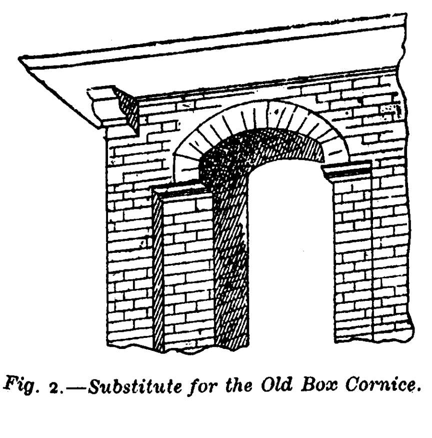


Fig. 2.—Substitute for the Old Box Cornice.

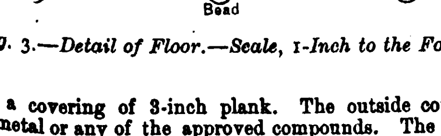


Fig. 3.—Detail of Floor.—Scale, 1-Inch to the Foot

is laid a covering of 3-inch plank. The outside covering is either metal or any of the approved compounds. The company in their own practice use 2½-inch as well as 3-inch plank. This apparently excessive thickness of plank is essential to safety, because there is always a very much better chance to save property before a wood roof is burned through than afterward, and this great thickness adds to the time necessary for the flames to reach the open air.

When practically considered, it is found essential also to the stability of the covering, whatever it may be, to have a considerable thickness of wood on top of the so-called rafters. It keeps the upper room warm in Winter and cool in Summer, and at the same time checks what is so frequently an annoyance, condensation or dripping from the roof.

In Northern climates this thickness and strength of roof is not at all unnecessary since deep snows, especially if followed by light rains, as not unfrequently happens, will load the roof to a greater extent than a full complement of machinery in a cotton or woolen mill. In fact it is estimated that the weight of a foot of snow would be nearly double that usually found on the weaving-room floor of a cotton mill. The 10 x 12 timbers are shown supported on iron columns which are, for the upper floor, 6½ inches in diameter at the neck, and those for the floor below 7½ inches in diameter. This construction is shown with considerable detail in Fig. 1, which represents an ideal section through a building constructed in this manner.

In Fig. 2 we have details of a very important feature in all mill construction, namely, an open cornice, which is made by allowing the timbers to project, their ends being formed into brackets. The common box cornice, whether of wood or metal, is considered dangerous in the extreme by the company we have named, and as they rightly say it is a useless cause of danger. The effect produced by an open cornice is good, as will be seen from the illustration.

The flooring, also, deserves mention. It consists, first, of 3-inch planks which are laid upon the beams, spaced 8 feet from center to center, the spans not exceeding 24 feet, with timbers dimensioned as those shown in the cuts, 14 inches deep and 12 inches wide, either singly or split. On top of the bottom flooring plank, which is put together with tongues, we have a layer of roofing felt or of mortar, on which a layer of plank is bedded. This top flooring is of 1¼-inch stuff. In Fig 3, which shows a section of the flooring, a bead is used on the under side of the floor plank covering the joint. This supposes the planks to be of even width, and the bead covers the cracks which would be made by shrinkage. It should be nailed as shown, upon one side only. This finish is liked by many persons as it relieves the flat surface. Floors made in this way are essentially fire-resistant, and a long time is necessary for the fire, whether on top or beneath, to burn through to the upper surface so as to cause a draft. We think a foundry built with a roof as carefully laid as this, would be free from the complaints which so often reach us about the insecurity of such roofs and their frequent leakages. We have not at hand the figures of cost for this construction, but we imagine when the durability and lessened insurance is taken into consideration, that this will be fully as economical as the more flimsy plans usually adopted.

Trade Industries.

BOOT AND SHOE MAKING BY MACHINERY.

Never before has there been so good an opportunity for the public to become familiar with the modern processes of boot and shoe making as was presented in the "Model Shoe Factory" of Messrs. Houghton, Coolidge & Co., recently running in the Fair of the New England Manufacturers and Mechanics' Institute at Boston. About 100 hands are employed, making an average of 600 pairs of boots a day, and doing the work thereon the same way as the business is followed in half a hundred towns in Massachusetts, with all the modern appliances for facilitating production and making the best finished goods in complete and regular operation. There have been other exhibitions in which portions of the work have been shown, and much of the machinery now employed in the boot and shoe manufacture has been in use many years, but here a visitor can see every detail of the work, from the leather as it arrives from the tanneries and currying shops until the finished goods are boxed up in the cases which are to convey them from the exhibition building to distant parts of our own country, or even to foreign ports. We have, it is true, but a small export trade in boots and shoes, but this exhibition has been an object of great interest to many foreign visitors interested in the trade, as well as to our own manufacturers, and some orders for goods for export direct have been placed by foreigners who have been there looking into our processes of manufacture.

The illustrations on our first page give a good representation of this "Model Shoe Factory" and the building in which the exhibition is held, as well as of some of the most important machinery used. The building is a solid structure of iron and brick, and occupies a ground space of 403 by 551 feet, the shoe factory taking up an area of about 50 by 450 feet, and in this section are to be found nearly 100 machines, large and small, operated by over 500 feet of shafting. But it is curious to note that, with the vivid portrayal of the methods of modern manufacture here brought before the eye, the crowds constantly passing and repassing seem nowhere to find so great an attraction as in watching the work of the venerable looking shoemaker, who, occupying an old shoemaker's bench on which he has followed his trade for fifty-six years, continues here to represent, in the midst of such surroundings, the difference between "the old and the new."

The cutting of the sole stock, as in most modern factories, is here done with dies, and the fitting up of a large factory with the different sizes and shapes of dies required forms no inconsiderable item of expense, leading the manufacturer to strenuously oppose any change of fashion which will necessitate the making of a differently shaped sole. In many cases the sole leather is first cut into strips, the width of which equals the length of a sole, but the later and more approved plan is to cut directly from the whole side, as here shown. The whole side is laid out upon a large table, the top of which is level with the bed of a machine long enough to take in its entire length, so that the workman can place the die on any portion of the side, and then, by a treadle movement, instantaneously bring down a bar with sufficient force to cut out the sole. This may be done as rapidly as the operator can place the die, but good judgment is required in selecting the most thick and solid parts of the leather for outsoles and heels. Smaller machines of the same style are used for cutting out the taps, counters, and heel lifts, as these are cut from the parts of the side left after all the outsoles possible have been cut therefrom, the idea in each instance being to so place the dies on the stock as to avoid waste.

The cutting of the uppers is all done by hand, the sides of upper and calfskins being laid out where the cutter can have good opportunity to examine the leather in every part before placing his patterns thereon, in order not only to cut up the stock with the least waste, but to be sure and have good strong leather on the vamp and forepart of the boot, the poorer portions being used for the backs.

In order, however, to give the leather such shape that it may be brought to fit the last snugly, and not partially straighten out or lose its form at any time afterward, the uppers must be broken or crimped. To do this work well was always a laborious and tedious operation, until, about ten years ago, the S.W. Jamieson crimping machine was introduced. A view of these machines is shown at the top of the page. By their use the vamp of a boot of the heaviest cow-hide leather can be forced into the desired shape for lasting almost instantaneously, the stretch of the leather required in this forming being so evenly distributed that the strength of the stock is not impaired and the leather will hold permanently its new form. The machine is a powerful but not very complicated one, a former, worked by a lever, forcing the upper into suitably shaped jaws, which close upon and smooth it into the desired shape. These machines have so fully met the requirements of the trade that they have become deservedly popular and been widely introduced, as it had hardly been possible, before this machine was brought out, to thoroughly crimp the leather used in heavy boots and brogans so that they would steadily retain their shape after repeated wettings.

For the putting together of the uppers of boots and shoes two distinct styles of machines are used, one using waxed thread for heavy leathers, and for stock in general which has oil or stuffing in it, and the other using dry thread for goat and sheepskin work, for fancy stitching generally, and for putting in linings, working button holes, etc. The goods made in the "Model Shoe Factory" being a standard grode of heavy work, wax thread machines only are used here, two, with steam-heated wax cups, being used for siding-up boot legs, two for sewing in the heavy sole leather counters which give a proper stiffness to the heel, two for making stays over the seams on the inside of the leg at the ankle, and another stitching on the straps at the top. Besides the machines here shown doing this work, there are others shown in the Fair for similar use, and for sewing on heavy harness and belting.

The uppers having been put together, and the soles, slightly dampened, having been pressed into shape by a "beating out," or sole moulding machine, the next operation is the "lasting," or the drawing of the upper snugly and evenly over the last, so that it will fit closely in all parts, and the edges just lap over the outer edge of the insole, all temporarily fastened until the outsole can be attached. This is commonly done by hand, the workmen drawing the leather over wi h pincers and tacking it in place. To do this work by machine has been a task the solution of which has been sought by mechanics and inventors for many years, but no machine for the purpose has yet been introduced which has met with any considerable degree of favor from manufacturers. There is a lasting machine at work here upon which years of labor and experiment have been expended, and it appears to do its work fairly well, but it can hardly be said to have passed beyond the experimental stage as yet, and has been adopted by the trade to only a limited extent.

For the putting on of the soles, for different methods are shown—one by a machine sewing directly through from the inside to the outside (this being under the well-known Blake-McKay patents), one by pegging, and another by wire screwing, and the fourth by what is known as the Goodyear and McKay system. Of the machinery for the latter we give illustrations on the first page, in connection with which will also be found views showing the appearance of the stitch on a finished shoe, a cross section of insole prepared for stitching, and bottom with welt attached. The boots and shoes made by this process differ from all other machine made work, and are a direct imitation of hand-made goods. The shoe is lasted as for hand sewing, except that the insole is channeled, and then a machine working with a curved needle and awl in a small circle sews on a welt, in the same way as it would be done by hand, after which another machine sews the outsole to the welt. The only difference that can be detected between a boot or shoe made on these machines and one made by hand, is that in the latter the stitches are not likely to be as regular and even as they are in the machine-made work.

Of course, boots and shoes made in this way have no nails or threads on the inside to hurt the foot, they can be readily repaired the same as a hand-made shoe, and they have all the advantages or flexibility with a proper firmness of sole, which is always found in welted shoes. The machines for making this work have been perfected only by the expenditure of many years' labor and a great amount of money, but Mr. Charles Goodyear, their inventor, whose father gave to the world its great India-rubber industry, would never stop short of the realization of the idea with which he started out, of making boots and shoes by machine which would be in every respect equal to the best of those made by hand. That he has succeeded is now being abundantly attested, not only by the samples of work shown, but by the increasing demand for the machines in shoe factories, and for the goods made thereon from buyers in all sections of the country.

Besides the machines for making welted goods, the Goodyear and McKay exhibit also shows their machines for making "turns" a technical name in the trade to denote shoes which are made inside out, and then "turned." This of necessity can only be done in work where both the sole and upper stock are light, but there is a heavy trade in such goods, a very large proportion of which is made on these machines.

Among the machinery required in a modern boot and shoe factory, that for making and putting on heels occupies an important place, and the work in this department is an object of never-ceasing interest to the visitors at the Fair. It is represented in one of the views at the top of the page, and consists of a combination of machinery covering the forming, attaching, and trimming of heels, by what are known as the McKay, Bigelow, and Fisher machines.

The Bigelow machine takes a heel, the lifts or layers of which have been assembled and tacked together, consolidates and shapes it under enormous pressure, punches it with nailholes, and inserts and partially drives the nails. The McKay machine receives a heelless shoe and the heel thus prepared, and instantly nails and clinches them together, at the same time paring the heel to the required shape.

The Fisher machine, now on exhibition for the first time, we have given the most prominent position at the right of our cut on account of its novelty. It is a modified and improved form of the Bigelow machine, the substantial difference being found in the construction and operation of the mould which compresses and forms the heel. In the Bigelow machine, the mould is made in one piece and is adapted only to certain shapes of heel, while in the Fisher machine the mould is made in halves, which first approach each other and compress the heel laterally, then vertically, and finally punch it with nail-holes, all at a single descent of the plunger; thus closing every joint in the heel, which, upon the machine, may be made of any shape whatever. This machine is the simpler and less expensive, as well as applicable to a wider range of styles.

After the bottoms and the heels have been attached and trimmed, there is quite a variety of machines for trimming and shaping the edges, for buffing the bottom, and for burnishing the edges of the sole, shank and heel, in all of which operations the work is greatly expedited and generally better done than it would be possible ordinarily to do by hand. But one of the last operations is the treeing, which has much to do with the making of a nice looking boot, for the leather, which has been repeatedly wet and constantly handled through so many operations, must be again made to look its best, with all the seams smoothed down, and the shape of the boot effectively brought out.

For this purpose a machine is here used which is quite new in the trade, a representation of which is given in one of the separate views on the first page, while it can also be readily seen in the foreground of the large view at the bottom. By this machine hot air is used to warm the leather thoroughly through, and soften the oil and tallow with which it has been curried. The operator, after putting the wet boot on an arm of the machine, passes it on and adjusts another, until, when twelve boots are thus placed, the first one has come round to him again, sufficiently warmed and dried to be ready for the final rubbing, after which it goes to the packer. The amount of heat usually applied is only about one hundred degrees, though this can be regulated at pleasure, and the better feeling and fine finish which this process gives to the leather are easily perceptible. The hand rubbing is also materially lessened, as is the work of taking out and putting in the feet, and far less space is required for drying than is called for under the old system.

Our illustration gives a view of the machines as they have thus far been constructed, but patterns are now being made for a new style of table, in which the trees are so arranged by a slotted joint that they may all hang down instead of being rigidly extended in their circuit as at present. A company has been formed for the introduction of these machines under the title of the Hot Air Boot Tree Manufacturing Company.

In all the work of a modern shoe factory, two points stand out in marked prominence. One is the extreme care which is taken in the cutting of stock, not only to see that there is nowhere any waste, but to have every piece of leather, so far as the best experience can effect the object, worked up into just the part of a boot or shoe for which it was intended when the leather was bought. The other, and equally important point is the minute division of labor.

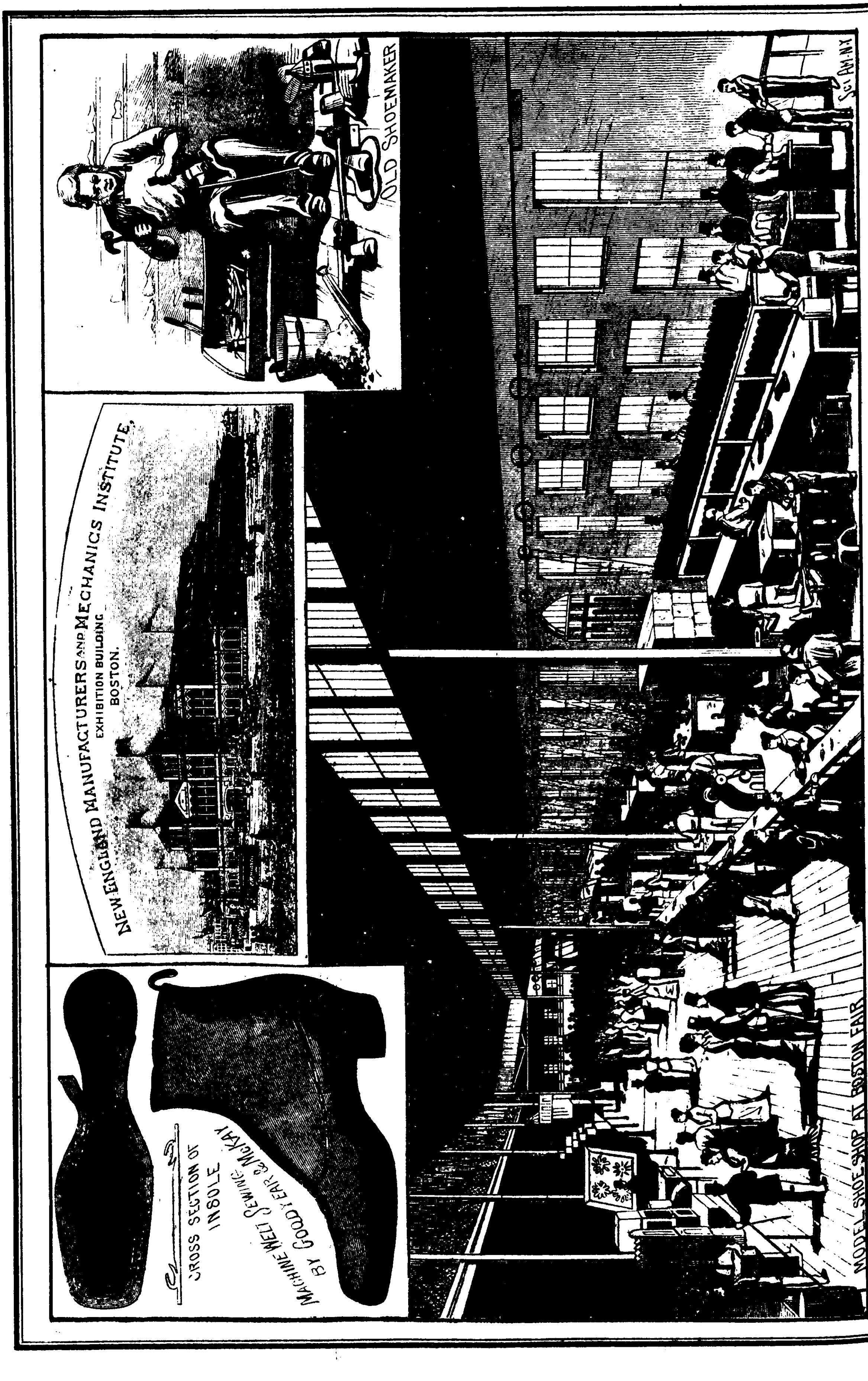
It has often been said of late years that there are no shoemakers now as we used to know them in former times, and this is to a great extent true, for but comparatively few of the workers in shoe factories now know more than one or two special details of the work. But this limiting of their labor has made them especially skillful therein, and machines have been devised for nearly every separate operation. In the boot and shoe manufacture Massachusetts has always been almost immeasurably ahead of every other section of the country, and Boston is by far the largest market for boots and shoes in the world. There were shipped from there during 1880 over two and a quarter million cases of boots and shoes and rubbers, to interior and coastwise ports, the cases holding from twelve to seventy-five pairs per case, and containing, at a low estimate, over fifty million pairs. But with this vast trade the competition is especially keen, a dollar profit on the cost of twelve pairs of staple boots being considered a fair working basis on the business as it is being done this year, with much of the business being done at even less than this figure. It is, therefore, particularly appropriate, that in one of the two great fairs now being held in Boston, we should have so thorough a representation of an industry so distinctively pertaining to that section, and one in which the people everywhere are so directly interested.

The firm of Houghton, Coolidge & Co., who make the exhibit, run several factories, in different towns, for the production of a variety of leading styles of goods, which are sold in all parts of the United States, their aggregate manufacture not being exceeded by that of any other house in the country, and being materially greater that that of any foreign house. Mr. A. L. Coolidge, being one of the executive committee having in charge the getting up of the fair, proposed and undertook the setting up of the "Model Shoe Shop," when but little time was left to make the arrangements, but in selecting as its superintendent Mr. C. H. Tilton, who was a manufacturer for him in Ashland, Mass., he obtained a practical manager of rare executive ability, and the work has gone on smoothly from the day of the opening in such a way as to form the principal attraction of the exhibition, and be in every way a credit to the originator of the plan and the great industry it so well represents.—*Scientific American.*

FURNITURE POLISHING

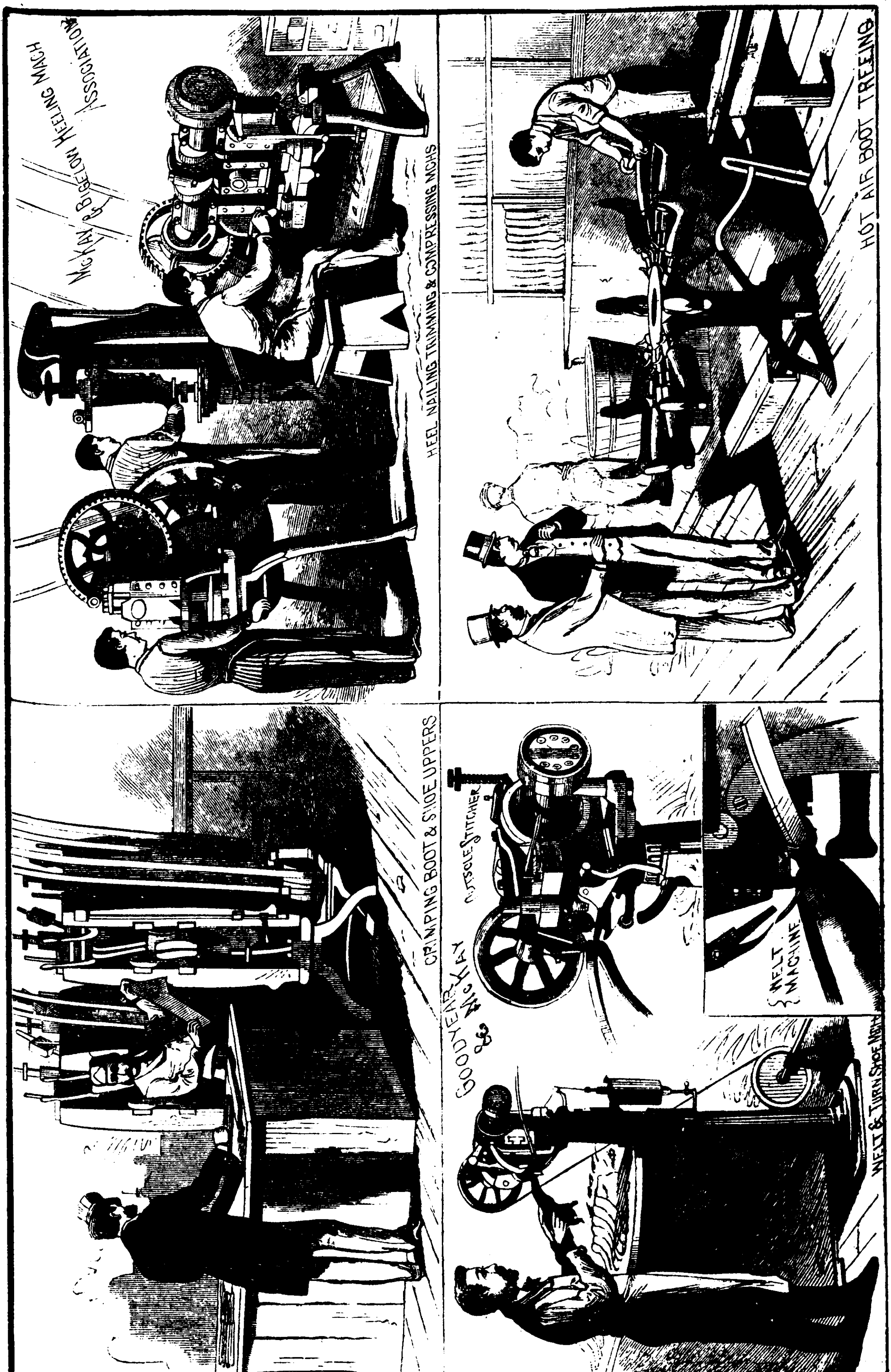
In setting about polishing anything the first necessity is a thoroughly smooth and clean surface. With new furniture not much will be required for this purpose on flat surfaces, except the use of sand-paper. With old furniture the former polish must be carefully scraped off with a steel scraper. The edge of a small piece of window-glass makes a very good substitute but requires more care than the scraper. The article is first rubbed up with No. 2 sand-paper followed by No. 1 fine, the strokes being made in the direction of the grain of the wood. The work should then be rubbed over with plaster of Paris mixed with water, rather thinner than cream. This should be well worked over the surface, then immediately rubbed off again. This serves to close up the pores of the wood. A very thin coat of linseed oil should be next applied and the work put aside until the oil has dried. Any stain which it may be desirable to apply should be used at this stage of the process. To apply French polish, make rubber of cotton wool, wet it with polish, cover it with a piece of soft linen rag through which the polish has to ooze, and polish a small extent at a time and regularly. Take long and light strokes and when the rubber sticks lightly touch with a drop of linseed oil, applied with the finger-end. Extensive flat surfaces require "finishing" after polishing. This is done by cleaning off the surface with spirits used in small quantity. If French polish be used on turned work in hard wood, such as ebony, sandal, box, and others of a like nature, merely apply the polish on a piece of clean flannel while t e article revolves in the lathe; after giving one or two coats finish off with spirits on same rubber. A drop of oil should be applied to every rubber except the last one for finishing. Should the wood be porous such as pine, Honduras mahogany, alder, willow, or similar woods, the grain should be filled up with either glue size or plaster of Paris; if for turned articles, plaster of Paris mixed with oil and applied with a rubber while the article is in motion, will generally be found sufficient. For glue size, dilute common glue with hot water until quite thin. When dry, the surface may be papered off with sand-paper when the surface will be quite smooth, no matter how porous the wood.

—*Metropolitan* says that Mr. Swan, having found that the Faure secondary batteries are well suited to operating his incandescent lamps has been led to the following scheme for domestic lighting: He proposes to establish in each house a certain number of secondary cells, and to connect all the cells in the different houses with the central station, where a dynamo machine will be worked by steam, sending a current of high intensity through a comparatively thin conductor, to charge the secondary batteries. It is found that the current can be taken from these batteries and used for the lamps at the same time that the charging process is going on."



EXHIBITION OF THE NEW ENGLAND MANUFACTURERS AND MECHANICS' INSTITUTE, BOSTON.

BOOT AND SHOE MAKING BY MACHINERY.



EXHIBITION OF THE NEW ENGLAND MANUFACTURERS AND MECHANICS' INSTITUTE, BOSTON.

BOOT AND SHOE MAKING BY MACHINERY.

Chemistry, Physics, Technology.

IMITATION JEWELS.

The following are some of the very latest recipes for making imitation stones. Rue Turbigo, Paris, exhibits some paste jewels which even connoisseurs cannot readily distinguish from the real article, and must make use of scales or file to be satisfied whether they are handling a product of nature or of art.

The imitation of precious stones is to-day an interesting pursuit of chemistry although in ages of antiquity, Egypt and Greece had already attained in a high perfection. All the precious stones, except opal, may be successfully imitated. The easiest of counterfeiting is the chrysoprase.

The coloring substances are the following oxides: Gold, for purple (*Purpura Cassia*); silver, for yellowish green; copper, for bright green; iron, for pale red; cobalt, for blue; tin, for white; manganese in small quantity to make the glass devoid of color; in a larger, to give it an amethyst color; in great quantity, to make it black and opaque; antimony, for reddish hyacinth color.

To prepare the mass for the body proceed as follows: Pure flint or rock crystal is heated white, cooled in water, pulverized, and sifted with a silk sieve; thereupon exposed to the action of muriatic acid for several hours, washed, dried, and again sifted. Of this substance five different bases are prepared:

For the first base—1½ parts of the flint or rock crystal powder; 2½ white lead in scales; ½ saltpeter; ½ borax; ½ white arsenic.

For the second base—1 part prepared flint; 2½ white lead; ½ cream of tartar; ¼ calcined borax.

For the third—1 part prepared rock crystal; 2 red lead; ½ saltpeter; ½ cream of tartar; pulverize the mixture, melt it three times and after every melting pour into cold water. This for the three proceeding bases.

For the Fourth—1 part prepared rock crystal; 3 calcined borax; 1 part cream of tartar; melt, pour the mass into lukewarm water, add an even amount of red lead (*minium*), and repeat the melting and cooling twice.

For the fifth base—Take 1 part prepared rock crystal and 3 cream of tartar, melt in a crucible, dissolve the mass in warm water, and add nitric acid as long as a boiling takes place; it is then carefully washed, dried, and 1½ parts white lead are added. To 1½ parts of this mixture add $\frac{1}{12}$ calcined borax, next melt and pour into cold water. This makes, when $\frac{1}{12}$ part saltpetre is added, a handsome crystal glass, which without further addition, makes the artificial diamond, called Strass, from its inventor.

The following are recipes for imitations of precious stones.

For Yellow Diamond—16 ounces of fourth base, 24 grains horn silver; 20 grains antimony.

Sapphire—25 ounces of fifth base; 2 drachms 46 grains cobalt.

Oriental Ruby—1 ounce of fifth base, and a mixture of 2 drachms 48 grains purple of gold, and the same quantity of sulphuret of antimony and fusible manganese, and 2 ounces of rock cry-tal; *or*, 20 ounces of the flint base, ½ ounce fusible manganese, and 2 ounces rock crystal.

Balay Ruby—16 ounces of fifth base, and the preceding coloring substance, lessened by one-fourth; *or*, 20 ounces flint base, same coloring mass, but less manganese by one-fourth.

Oriental Topaz—24 ounces of first or third base; 5 drachms black antimony.

Brazilian Topaz—24 ounces of second or third base; 1 ounce 24 grains black antimony; 8 grains purpura cassia (purple of gold).

Saxonian Topaz—24 ounces or first of third base; 6 drachms black antimony.

Amethyst—24 ounces of fifth base; 4 drachms manganese; 4 grains purple of gold.

Emerald—15 ounces of any one base; 1 drachm of blue carbonate of copper; 6 grains antimony; *or*, 1 ounce of second base; 20 black antimony; 4 grains cobalt.

Beryl—24 ounces of third base; 96 grains black antimony; 4 grains cobalt.

Common Opal—1 ounce of third base; 2 grains loadstone; 26 grains of some absorbing earth.

For the imitation of pearls, thin balls of glass are used, which by an addition of a small quantity of potash and oxide of lead, receive a bluish glittering sheen, and the inner sides of which are covered with the scales of a small river fish (*Cyprinus alburnus*). To make these scales pliable and adhesive, they are steeped for some time in spirits of ammonia in which a small amount of isinglass has been dissolved. Messrs. Savary & Mosbach exhibit some which, being sold, are in all respects equal to the Roman.—*Illustrated Scientific News*.

COLOR RELATIONS OF METALS.

In a paper on the color relations of copper, nickel, cobalt, iron, manganese and chromium, read before the Chemical society, Mr. T. Bayley records some remarkable relations between solutions of these metals. It appears that iron, cobalt and copper form a natural color group, for if solutions of their sulphates are mixed together in the proportions of 20 parts of copper, eight of iron and six of cobalt, the resultiug liquid is free from color, but is gray and partially opaque. It follows from this that a mixture of any two of these elements is complementary to the third, if the above proportions are maintained. Thus a solution of cobalt (pink) is complementary to a mixture of iron and copper (bluish green); a solution of iron (yellow) to a mixture of copper and cobalt (violet); and a solution of copper (blue) to a mixture of cobalt and iron (red). But as Mr. Bayley shows, a solution of copper is exactly complementary to the red reflection from copper, and a polished plate of this metal viewed through a solution of copper salt of a certain thickness is silver-white. As a further consequence it follows that a mixture of iron (7 parts) and cobalt (6 parts) is identical in color with a plate of copper. The resemblance is so striking, that a silver or platinum vessel covered to a proper depth with such a solution, is indistinguishable from copper.

There is a curious fact regarding nickel, also worthy of attention. The metal forms solutions which can be exactly simulated by a mixture of iron and copper solutions; but this mixture contains more iron than that which is complementary to cobalt. Nickel solutions are almost complementary to cobalt solutions, but they transmit an excess of yellow light. Now the atomic weight of nickel is very nearly the mean of the atomic weight of iron and copper, but it is a little lower, that is, nearer to iron. There is thus a perfect analogy between the atomic weights and color properties in this case. This analogy is even more general, for Mr. Bayley states that in the case of iron, cobalt and copper, the mean wave length of the light absorbed is proportional to the atomic weight. The specific chromatic power of the metal varies, being least for copper. The specific chromatic power increases with the affinity of the metal for oxygen. Chromium forms three kinds of salts—pink salts, identical in color with the cobalt salts; blue salts, identical in color with copper salts; and green salts, complementary to the red salts.

Manganese, in like manner, forms more than one kind of salt. The red salts of manganese are identical in color with the red cobalt salts and with the red chromium salts. The salts of chromium and manganese, according to the author, are with difficulty attainable in a state of chromatic purity. He thinks that these properties of the metals lead up to some very interesting considerations.—*Chemical Review*.

APPARATUS FOR GAS ANALYSIS.

Those of our readers who are interested in the subject of gas analysis are familiar with the apparatus devised for this purpose by Dr. Wilkinson, of this city. As we have had occasion to remark in these columns, the results obtained with this apparatus are only approximately correct, which we believe is all that is claimed for it. The gas engineer has neither the time nor inclination to make a gas analysis requiring all the nice manipulation of the Bunsen method. As a general thing, what he wants is an apparatus which shall give rapid results, and at the same time sufficiently accurate for the purposes of his work.

One prominent defect of the Wilkinson apparatus is the uncertainty attending the treatment of the gas with the various reagents and the washing process necessary after the addition of each. The solvent action of the liquids upon the gas is very decided, and forms an objection, especially when the apparatus is used by those not familiar with the reagents employed, and who think it better to use too much than too little.

This objection has been obviated as far as the "washing" is concerned, in some modifications devised by Mr. A. H. Elliott, which consist in removing the gas after its treatment with the reagent, and without washing, to a second tube for measurement.

The accompanying illustration shows the apparatus as modified. It consists of two tubes *a* and *b*, the latter being graduated, and holding 100 c. c. from the mark *c* to the zero point *d*. The tube *a* is of about 125 c. c. capacity. These tubes terminate above in capillary tubing, and are joined by the rubber tubing at *e*. The tube *a* is provided with a ground funnel *m*, of about 60 c. c. capacity, and with the stop cock *f*. The measuring tube *b* has a stop-cock at *g*. Both tubes are closed at the bottom by rubber stoppers, fitted in the one case with the glass tube *h*, and in the other with the tube and three way cock *i*. These are connected by rubber tubing with the aspirator bottles *k* and *l*. The stop-cock *i* has one delivery through its stem.

To operate the apparatus, the bottles *k* and *l*—of about one pint capacity—are filled with water, the stop-cock *i* turned so that *a* and *l* are in communication, the cocks *g* and *f* are opened, and the bottles are raised above the level of the funnel. By this means all air is expelled, and the tubes filled with water. When the water begins to rise in the funnel close the cocks *g* and *f*.

To introduce the gas, remove the funnel and attach the tube delivering the gas, then slowly lower the bottle *l*, and open the cock *f*, by which means the tube *a* is filled with gas.

The gas is next transferred to the tube *b* for measurement, by closing the cock *f*, and raising the bottle *l*, and opening the cock *g*, and lowering the bottle *k*. The gas is forced from *a* into *b*, and when it reaches the zero mark adjust the bottles so that the water level in each shall be the same as that in the tubes, and then close the cock *g*. The excess of gas in *a* is expelled by raising the bottle *l*, and opening *f*. The gas remaining in the capillary tube, between *c* and the vertical tube, is disregarded.

Having measured the gas it is treated with the various chemicals, in the same order as in the Wilkinson apparatus. The funnel *m* is adjusted, and in it is placed the reagent. The gas is then transferred from *b* to *a*, by raising the bottle *k* and opening *g* until the capillary tube is filled with water, when *g* is closed. In order that the reagent may enter the tube and the gas may not escape, the bottle *l* is lowered to about the level of the water in *a*, by which the pressure is removed.

On opening *f*, the reagent runs into the tube *a*, care being taken that some still remains in *m*, as otherwise the gas might escape. When the absorption is complete, the gas is transferred to *b* and measured. In case any of the reagent is noticed in the capillary tube at *e*, it can readily be expelled by forcing a few drops of water from *b* into *a* before the gas is transferred.

Before making a reading, it is important to adjust the water in level *k* to that in the tube *b*. The tube *a* is to be washed out after each treatment, and the waste water run off through the cock *i*, by opening its stem delivery. To submit the gas to the second treatment, *a* is filled with water and the gas transferred as before.

It will be noticed that variations of temperature are not provided for; but when desired, the tube *b* can be surrounded with a water jacket, in order to maintain a uniform temperature.

Mr. Elliott states that an analysis including the determination of carbonic acid, oxygen, illuminants, and carbonic oxide, can be readily made, in twenty to thirty minutes; and that while the results are quite as accurate as those obtained with the Orsa apparatus, the analysis requires but about one-fourth the time

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La Lumière Electrique gives an interesting note on the Planté method of engraving on glass by means of the electric current. A concentrated solution of nitrate of potassa is poured over a sheet of glass placed horizontally in a shallow tray. A platinum wire, which constitutes one electrode of a Planté battery of fifty or sixty elements, is placed in the saline solution near one side of the tray. The other electrode, also of platinum, is surrounded, except at its point, with some insulating material, and serves as a pen for writing. Any characters traced upon the glass are found to be deeply etched upon its surface, and this is independent of the lightness and rapidity of the strokes. The action is both calorific and chemical. The chemical action of the current under these conditions is very powerful, the effects being greater than those produced by hydrofluoric acid. Either the positive or negative electrode can be employed for writing, but with the latter the current must not be so strong and the marks are more distinct.

TO CRYSTALLIZE GRASSES AND FLOWERS.—Dissolve six ounces of alum in one quart of water, and boil until dissolved; then steep the grasses or flowers in the solution while hot. If, by the time the water is cold, the crystals are too large, then add more water. Separate the little branches gently, taking off the superfluous lumps. Fern leaves, oats, flax and the long feathery grasses are the most beautiful for crystalizing.

Scientific.

CUT-OFF FOR ELECTRIC LAMPS.

The present tendency in voltaic arc systems is to place several lamps in the same circuit, their number varying from three or four up to forty. The great advantage of such an arrangement exists, as well known, in the great saving wire that results from it. But, as an offset, it is necessary to employ currents of very high tensions, and if this be too great the apparatus may become dangerous, and then, too, the insulation of the wire is very difficult.

In practice it is well not to attain so exaggerated tensions, but to be content with placing only ten, twelve, or sixteen lamps, at the most, in the same circuits. But under these conditions all the lamps are mutually independent, and if one of them, through some accidental cause, is extinguished all the rest go out at the same time. This is a very grave trouble, for which various remedies have been sought. It was for the purpose of obviating it that Mr. Rapieff devised his "safety apparatus," and that all the British lamps are furnished with an arrangement called a "cut-off." Mr. Anatole Gérard's "automatic sentinel" which we are about to describe, accomplishes the same object with at least as great simplicity and with one additional advantage—it is completely independent of the lamp; it forms an apparatus apart, easy to watch, and always within reach of the hand whenever it is desirable to make several lamps in the same circuit independent of one another; and it is applicable to all lamps in service, whether they are continuous current or alternating current, voltaic arc or incondescent.

The accompanying cut will allow the working of the apparatus to be readily understood. It consists of a straight fine wire and single-bobbin magnet, the extremities of whose wires are connected with the upper terminals, to which also are joined the two wires coming from the lamp to which the apparatus is adapted. The conductor coming from the machine is connected with the lower terminal to the left, and the wire proceeding from the lower terminal to the right goes to the second lamp and second apparatus.

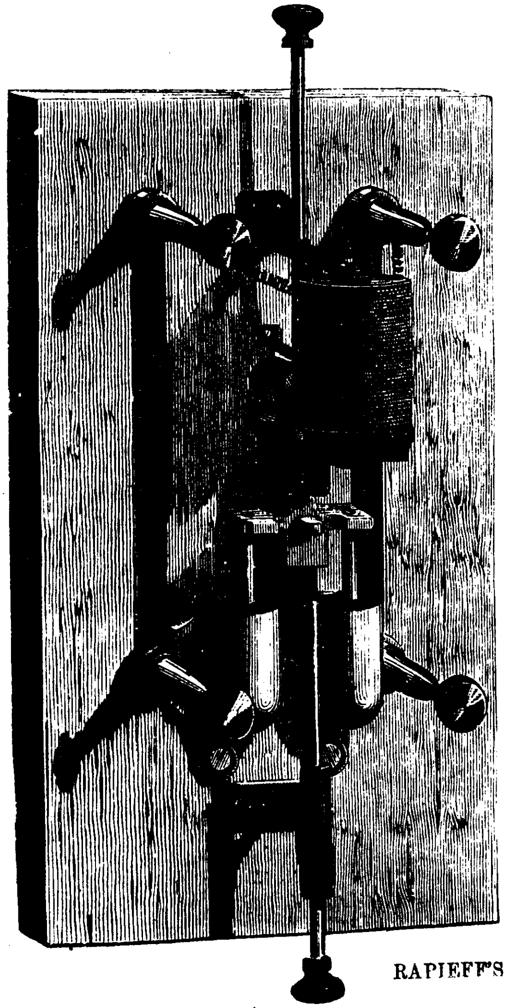
The two lower terminals are in metallic communication with two small iron cups which are half full of mercury. Above these cups there are two iron rods fixed to a metal cross-piece carrying a hook which engages with a second hook fixed to the armature of the electro-magnet. When the current passes it divides itself between the lamp and the fine wire of the electro-magnet without the armature being attracted thereby. In case of an accident or the extinction of a lamp, the entire current passes through the fine wire, and the electro-magnet becoming active, attracts its armature, which, on tilting, disengages the hook and allows the two rods to drop into the cups of mercury.

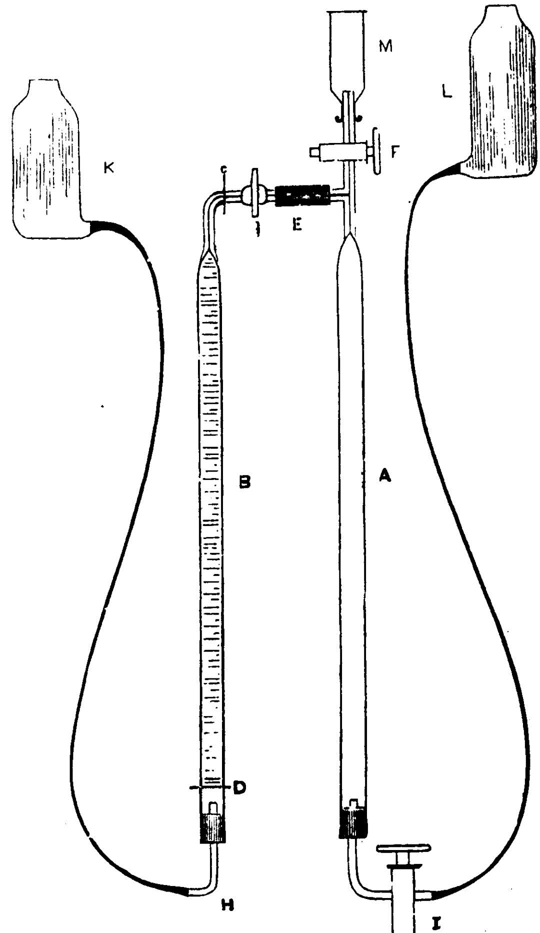
The current then passes directly from one lower terminal to the second, that is to say, from one lamp to the other, through the intermedium of the iron rods; and thus the circuit is not interrupted by the accident which happened to one particular lamp, and all others continue to operate just as if nothing unusual had occurred.

As may be conceived, it may be easy, instead of establishing a *direct* communication, to intercalate a resistance equivalent to that of the lamp put out of service, so as not to disturb the conditions of the electric circulation; and it would be easy likewise to utilize the fall of the rods for actuating an alarm bell, or even an indicating tablet, and thus to convert the apparatus into an automatic tell-tale, which would not be without utility in certain kinds of night work.

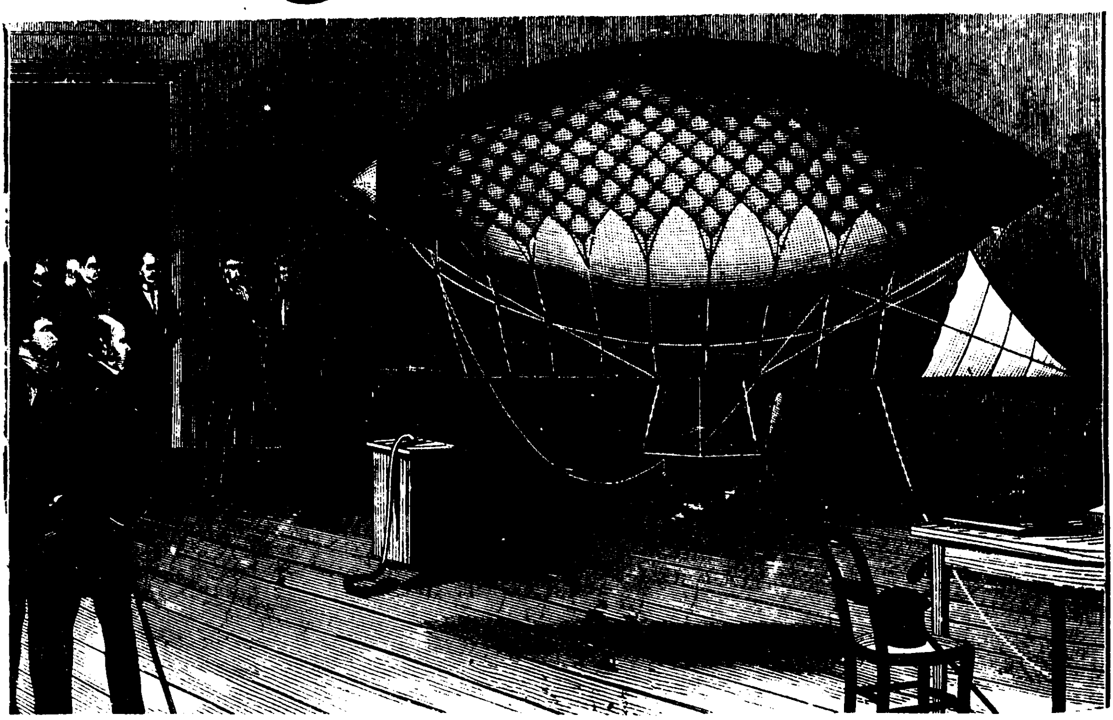
This apparatus also replaces the ordinary commutator; since, in order to relight a lamp when extinguished it is only necessary to press on the button located beneath. On raising the rod it strikes against a spur projecting from the cross-piece which supports the two rods, and, lifting it, causes the the two hooks to engage, and the current then passes through the lamp. To extinguish a lamp it is only necessary to press upon the upper button, when the rod to which it is attached tilts the armature, disengages the hooks, and closes the circuit anew by the dropping of the iron rods into the mercury cups.

In a more recent model than the one here represented, Mr. Gérard has arranged the mercury cups one above the other, instead of placing them side by side. The present arrangement gives greater width to the apparatus, which often has to be located on a narrow support, but the principal is in no wise changed thereby.—*L'Electricien.*

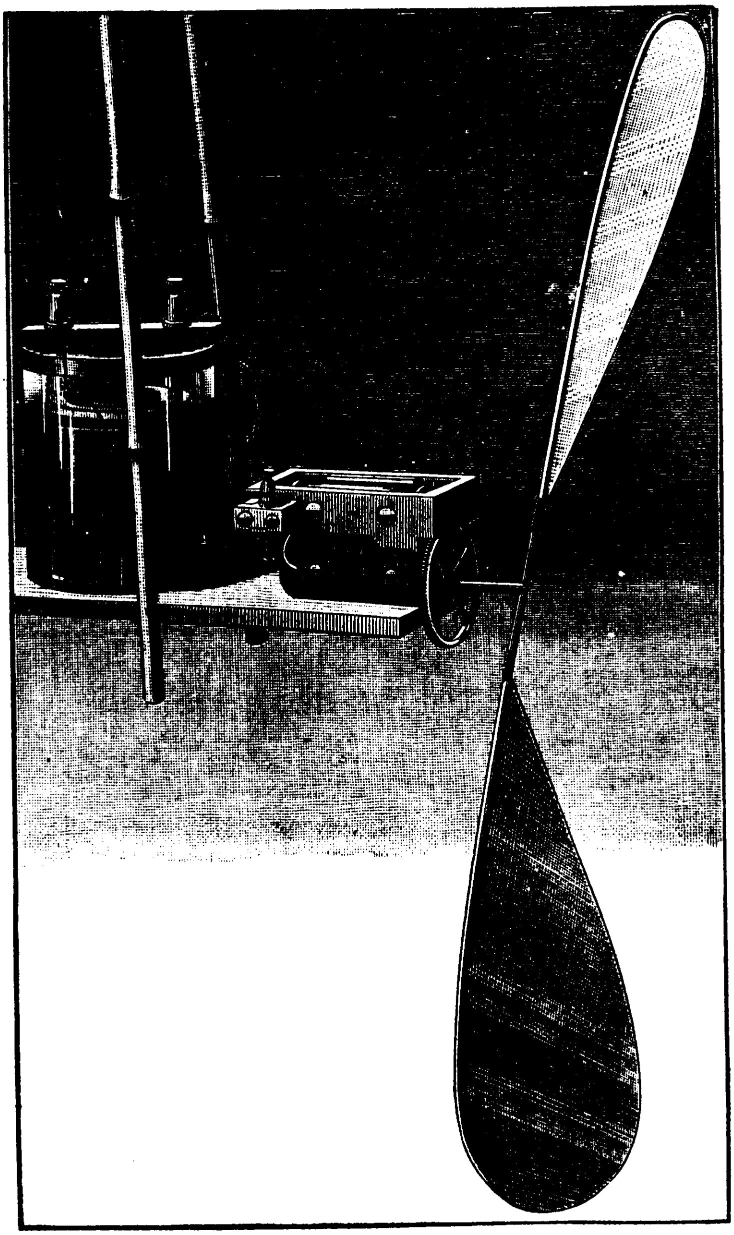




RAPIEFF'S CUT-OFF FOR ELECTRIC LAMPS.



ELECTRIC FLYING MACHINE.



PROPELLER OF ELECTRIC FLYING MACHINE.

ELECTRIC FLYING MACHINE.

The improvements recently made in electric motors have suggested to the eminent French electrician, M. Gaston Tissandier, the idea of employing these machines to propel air balloons. They can be used in connection with M. Planté's secondary couples, which store a large amount of electric energy and weigh relatively little. Such a motor possesses great advantages. There is no danger of firing the volume of hydrogen above, and it has a constant weight, there being no decrease by combustion.

In making his experiments M. Tissandier employed a small oblong balloon ending in conical points. This balloon, which is like that used by M. Giffard, is 3 m. long by 1.30 m. in diameter, and has a volume of about 2,200 liters. Inflated with pure hydrogen it has an ascensional force of 2 kilogrammes.

It is worked by a small electric motor resembling the Siemens dynamo, and weighing 220 grammes. This works a light propeller 40 inches in diameter. This motor is suspended below the balloon, and will propel the balloon for several miles with a Planté element of 220 grammes, while with a secondary couple weighing 1·300 kilogrammes the duration of its rotation is considerably increased. Under these conditions the armature turns 6·5 times a second, and acts as a propeller, giving the balloon a speed of 1 m. a second during more than 40 minutes. With two secondary elements, a propeller 60 inches in diameter can be used, which will propel the balloon at the rate of 2 m. a second during 10 minutes; and with three elements a speed of 3 m. can be obtained.

These experiments took place in the "Conservatoire des Arts et Métiers," at Paris, in a large hall, where the balloon could move freely, restrained only by a light rope dragging behind it, which served at the same time to guide and to measure its speed.

The working power of the electric motor was measured by the simple method of lifting weights. A secondary element, and afterwards two elements together, were attached to the motor, and it was found that the swiftness of the revolutions varied according to the weight lifted.

This little motor, when developing a maximum of energy with a single element, produced a force of 90 grammes at a speed of 5 revolutions a second. With two elements a speed of 12 revolutions a second was obtained and a power of 420 grammes. With three elements the power was 1 kilogramme.

In working with two elements, if the speed is reduced to 5 or 6 revolutions a second, the power is also reduced, and, on the other hand, if the speed becomes greater than that which corresponds to the maximum power, the working force is correspondingly reduced. For example, if the speed obtained is 14 or 15 revolutions a second, the power is only 375 grammes. The manner in which this trial balloon acted, and the speed obtained with the propellor, afford a very satisfactory outlook for the aerial navigation, as it must be remembered that in balloons the surface does not increase with the volume, consequently the results obtained with larger balloons would be still more favorable.

In working condition an electric motor equal to 6 horse power and weighing 320 kilogrammes, with 900 kilogrammes of secondary elements, would easily carry 1,200 kilogrammes when attached to in a hydrogen balloon of 2,000 cubic meters, elongated in shape like those used in 1852 by Giffard, and in 1872 by M. Dupuy de Lôme. This balloon would be 40 m. long by 13·50 m. wide across the center, and its ascensional force would be about 3,300 kilogrammes. It would weigh, with all its accessories, 1,200 kilogrammes; so there would remain for the voyagers and for ballast over 1,000 kilogrammes. In calm weather this balloon, worked by an armature of 5 to 6 m. in diameter, would obtain a speed of 20 kilogrammes an hour, and in windy weather would be powerful enough to move out of the direct line of the air current.*

Of course, this balloon could only go for a limited time, but that could easily be decided by experiments, in which results even more favorable might be obtained by making the motor and piles especially light for this purpose.

Until now no balloon has ever been really steered, that is, has never returned to its point of departure after having navigated the atmosphere at the will of its pilot. Necessarily such voyages can only take place in calm air and during a short time; but the essential point is that they have succeeded at all; and no physicist can deny that the electric motor and the secondary piles have solved the problem of aerial navigation.

MEASURING THE POWER OF BELTS.

The *Mechanical Engineer* mentions a simple, and, it thinks, effective device for measuring the power of driving belts, without going into any tedious dynamometric calculations. An ordinary two-part champ, with a hook on one plate, is secured to the belt, and to the hook is attached a common spring balance such as icemen use. The other end of this is in turn fastened to the nearest wall or timber that will give a direct pull. The engine is then started, and the reading of the spring balance at the moment the belt slips is the actual resistance or tension of the belt per minute, gives the total foot-pounds transmitted by it for the time reckoned. This will, it is thought, prove a very useful device for parties hiring power, as there cannot be any question of accuracy of calculation, any theories of width of belt per horse-power, or any error of any kind, because the actual dead pull of the particular belt in question under test, with all its perfections or imperfections as they actually exist, is given.

Spontaneous Combustion.—The most frequent instances of this happen with cotton rags or waste, that may have been more or less saturated with oil. Few people are aware of the ease with which these materials originate fire. Two or three bushels of rags wet with linseed oil, the drying oil such as painters use, left in a heap, have been known to char in the interior within little over an hour, and then, after smoking awhile, and being placed where there was a slight current of air, burst suddenly into a blaze. Painters rags are probably quicker at this performance than the waste used in oiling machinery and in printing offices; but there is plenty of evidence to prove that even the heavier oils thus thinly spread in cotton stuff, will heat, if in a mass, and start a fire. One of the largest printing and lithographing establishments in Boston is obliged, by the terms of its insurance policies, to take out of and away from the building, every night, all the oiled rags used about the machinery during the day time.

* Of course the idea of guiding balloons against strong winds belongs to Utopia; but for short voyages, such as escaping from a city during a siege, it would be very valuable to be able to steer the balloon.

Architecture, etc.

TESTS OF CONSTRUCTIVE MATERIAL.

One of the most interesting exhibits both to the engineer and mechanic as well as to the general visitor, at the Fair of the Massachusetts Charitable Mechanic Association now in progress at Boston, is that sent from the Watertown Arsenal. The exhibit consists of materials which illustrate the results of tests made by engineers in the service of the government upon a machine specially constructed for the purpose. The arrangement of the exhibit is such that each article tells its own story, while those persons who are sufficiently interested to desire the particulars may learn them from a pamphlet near at hand. The exhibit consists of three groups of objects, which have been ruined respectively by tensile strains, bursting strains and compression. One of the objects most likely to attract popular attention is a steel wire cable of the kind being employed in the East River Bridge. The diameter of this cable is 1⅞ inches, and the strain to which it is submitted was 150,000 pounds, or 75 tons. The cable itself remained intact with this severe test, but the bail of the socket parted, which shows like many others of the Watertown experiments, that in constructions of this class the weakest point frequently lies, not in the cable itself, but in its fastenings or fittings. A hammered iron bar 5 inches in diameter was broken by a tensile strain of nearly 723,000 pounds, or 36,900 pounds per square inch. Under this tension the bar parted with a loud report. The fracture shows a crystalline structure. A smaller wrought iron bar was broken asunder by a tensile force of 51,340 pounds per square inch. This bar drew down at the place of fracture, and shows a fibrous structure at the break. In the group which contains specimens destroyed by compression, two iron columns of different forms give some idea of the relative value of the shapes shown in supporting great weights. A latticed iron column some 10 feet long, of a pattern quite familiar to all who are acquainted with bridge work was ruined by a pressure of 574,500 pounds. A circular flanged column, known as the "Phœnix" pattern and of much smaller size and weight, sustained nearly 50,000 pounds more than the weight above given. Tests of this kind have determined definitely the value of the latter form, but its liability to deterioration from oxidation upon the inside detracts somewhat from its value in practical use. An 8-inch column of the "Phoenix" pattern which has been subjected to a test for compression, shows, by the perfect symmetry of its present crushed form, how perfectly it is adapted for supporting weights.

A much needed lesson to builders is splendidly illustrated by pine columns, which have in some instances supported remarkable pressure. The first of these columns, originally 12 feet long, yielded to a pressure of 190,000 pounds the weak spot being a large knot, which acted as a wedge and caused the destruction at less than the proper figures. Another of these columns is a stick 12 feet in length, tapering from about 7⅝ in. to nearly 6½ in. in diameter. This stick, being practically perfect, has shown its weakest point to be at the smaller end, for it is at that point that the crumbling of the fibers has taken place. As an argument againt the prevalent custom of turning down wooden columns at the end, this test stands unquestioned. A seasoned hard-pine girder 11 inches square and 10 inches long, when tested, bore the astonishing load af 751,000 pounds—a conclusive proof of the value of such timber for columns.

As an example of bursting strain, a model one-third size of the breech of a 10-inch cannon is shown in the centre of the section. This cannon was partly filled with beeswax, and a close-fitting steel plug was forced into the aperture. Under a pressure of 599,000 pounds, the model being a stout casting 2 ft long by 11 inches outside diameter, was fractured in every direction. Several other interesting tests of steel bars, cast bars, boiler plates, etc., complete this display. It is a graphic method of showing facts that are of interest to every thinking man. It is a popular presentment of facts frequently published in technical journals, but not easily accessible to the average reader.—*Metal Worker.*

FLOOR BUILDING.

So few of the floors constructed in new houses are, says the *Building News*, equal to their work, that the attention of architects and builders might be profitably called to the subject. In going over some of the newly-erected houses in the suburbs of London, it is not infrequent that one finds dwelling house floors which have sunken so much in the centre as to destroy the comfortable assurance that they are safe. These instances occur chiefly in houses erected by speculative builders, who seem to be under no regulation of any kind in respect of floor timbers. * * * Many practical builders have a conviction that if a timber as a joist has a larger cross section than another it must be stronger. Thus they fancy a piece of timber 8 inches by 3 inches, which equals 24 square inches in sectional area, cannot be so strong as a piece 5 inches by 6 inches which has 30 inches in area. The fact is, the smaller piece is the strongest of the two if both are placed upon edge, as every one knows who has studied the principles on which the strength of beams depends. It is easy to convince the most practical of this seemingly inexplicable fact. If two beams of like size are placed side by side, two will resist twice the amount of one of the pieces. This is so self-evident that experiment is not needed to establish the fact; in the same way three beams will resist three times as much as one, and so on of any number. In plain English when lengths and depths are equal, a beam of six inches in breadth will bear three times as much as one of two inches in breadth. It may be shown by experiment quite as readily that the strength increases more rapidly than the depth. In point of fact, another law of proportion is observed—namely, that having two beams of the same breadth and length but of different depth, the strength increases more rapidly than the depth; thus it is found a beam nine-inches deep bears more than three times as much as one only three inches deep. These are very simple statements derived from facts and experiments and no complex conception of the resistance of certain fibres on both sides of a neutral axis, or quotations in algebra, are required to establish them.

In dwellings the load on a floor is chiefly made up of furniture, though this is generally placed, at least the heavy articles, round the walls of rooms. The space occupied by tables and other objects in the centre of a room reduces the available standing area, and thus, for all, ordinary floors, 70 lbs. per superficial foot may be calculated for as the full load in extreme cases. Rules founded upon the resistance of beams to rupture are, however, of little use, as the floors may be seriously affected by deflection, and deflection is directly as the cube of the length. In regarding stiffness the load per foot has been given by one authority as 90 lbs. per foot, including weight of materials. It makes all the dfference to place joists an inch nearer, though builders like to give as much interval as they can, for economy's sake. Instead of joists being placed 12 inches apart, it is oftener to find them 13 inches or even 14 inches, and the consequence is a scantling which has been found to answer in a well-built house fails when it is introduced with a greater distance or interval. Then the modern speculative builder's floor is seldom properly stiffened by cross bridging. There is only one row instead of two or more. Of course no practical man will deny the advantage of bridging his floor joists. It helps wonderfully to prevent deflection under a concentrated load, for the joist immediately beneath the load is relieved of direct strain, and the joists on each side take a share of the weight. Generally it may be taken that a properly bridged floor is capable of sustaining, without mere deflection, twice as much load as the same floor without bridging, so that the cost of the introduction is amply repaid.

A MODEST MAN (?).

The noted correspondent, Gath, lately said, in one of his letters, that "not long ago all the Examiners in the Electrical Department of the Patent Office were brought up to Menlo Park and shown Edison's light. He gave them a dinner. They had not the least conception of the thing. Sometime ago Edison said that there were but two things, which could work him any injury. The first would be the gas companies in despair putting down their rates to fifty cents a thousand or less, so as to underbid even his electricity and try to force him off by the dull weight of capital. He said he could stand that as long as they could. The next was the possibility that some other inventor might make gas out of water or some cheaper material. In that case,' said Edison, 'I have only to go back to my laboratory. I am a professional inventor, and the only problem presented to me is to go and make anything cheaper than it is now made, and I do it.'

"While he has this great confidence, he is one of the most modest men in the world. At the Government Electricians' dinner, his lawyer, Mr. Eaton, said: 'Gentlemen, I am going to show you what I can do with Mr. Edison, prodigy as he is, I am going to make him blush.' At this all eyes were directed to Edison, and there he was seen with his hand on his ear, and his face covered with blushes."

We have no desire to dispute Gath's testimony on this point. We fear there is a little too much sarcasm in the above. There was not the least necessity in the world for Gath to tell people that Edison is modest, everybody knows that, and the object of a correspondent is to detail *news*. Any man who says he needs simply to go back to his laboratory for the purposes of making something better than some one else is not immodest, he is only confident. Such a man ought to blush; hence we are inclined to believe that Edison did blush. A man who can't blush on a proper occasion is not fit to be an inventor, and if this great inventor didn't blush before a whole room full of examiners it is the most convincing evidence in the world that he isn't an inventor.—*American Inventor*.

DESIGN FOR A COMFORTABLE DWELLING.

On the following page is presented a house built in Champaigne Ill., by Prof. S. W. Robinson, formerly of Champaign, but now of the Ohio State University. It was built from plans of the professor as an amateur architect, and was the result of five years of occasional thought and study.

It is said that we often make the pleasantest room in the house the parlor, and then shut it up and live in the back rooms. This is too true, and many renters would say: "I would never build such a house." But probably many of them would when they come to build, because the putting of parlor, sitting-room and hall in the front is easier said than done, especially if other rooms are left in convenient and desirable relation. The things desired in a modest house plan, are: 1st. A parlor fronting on the street. 2nd. A sitting-room half or more fronting on the street, and connected to the parlor by sliding or folding doors, to throw both rooms into one for entertainments, or even family comfort. 3rd. A dining-room opening from the sitting-room, as it evidently should. 4th. A sleeping and toilet room of ample size, opening off the sitting-room. 5th. A hall fronting on the street, large enough at least for a hat and coat rack, or for receiving three or four persons, or as many as are likely to come at once, the same being in communication with the parlor and sitting-room. 6th. A kitchen opening off from the dining-room, with its stove, table, pump, sink, etc., in convenient relation.

The arrangement of rooms in the second story is a comparatively easy matter. When the house is to be heated by a hot-air furnace, still further thought will be needed in securing such a position of the smoke and air flues as to properly heat and ventilate all the rooms. Though the number of our days depends much upon this latter point, it is usually disposed of as if involving nothing but the number of hods of coal.

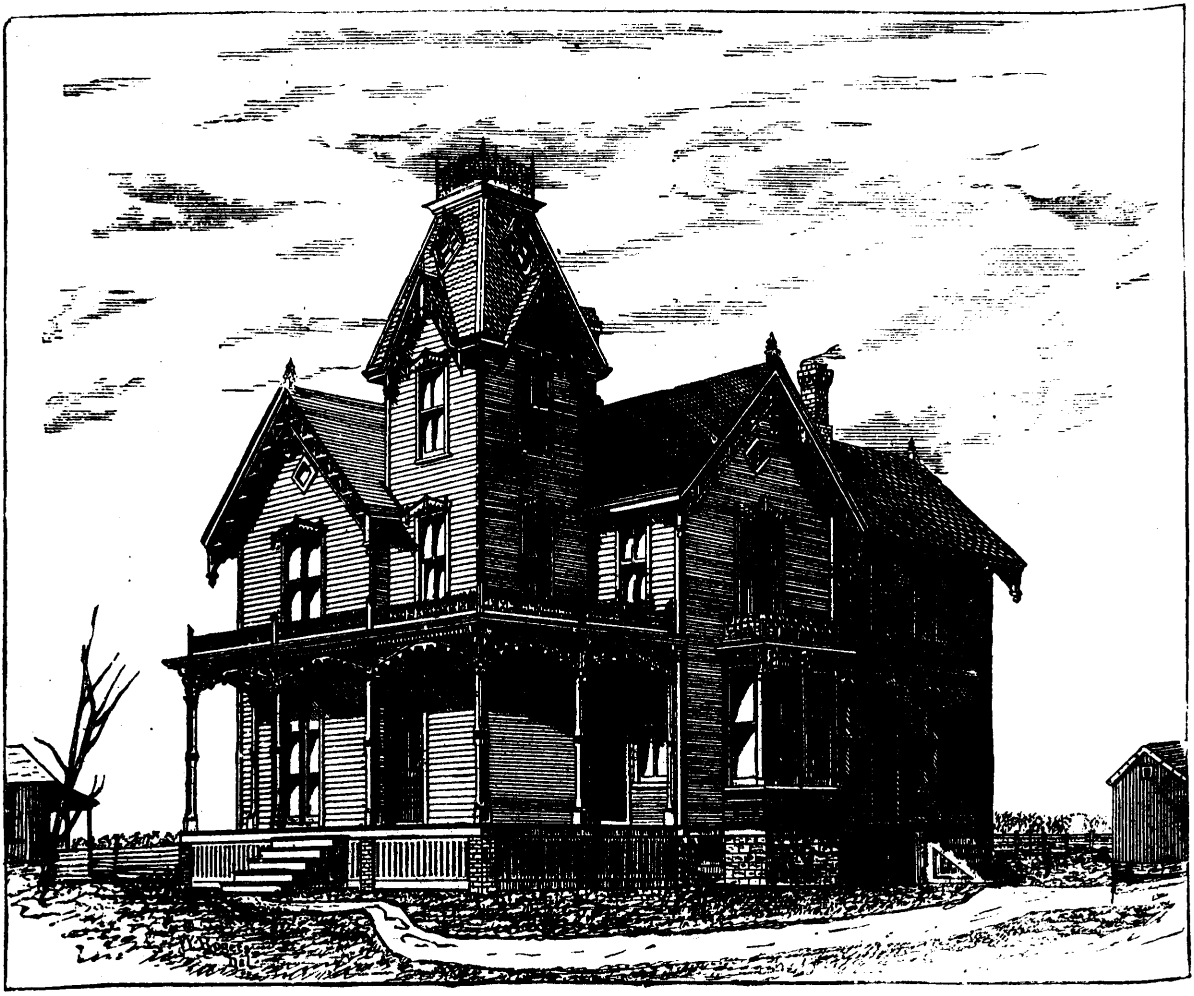
The hall has a winding stairway, and is located in the base of the tower, 9 feet square. This size of hall admits of its being in front, and at the same time allowing full front to the parlor, half front to the sitting-room, with a large doorway between; small stairs ascend to the second story of the tower.

The double rectangle at the middle of the plans are the smoke and air flues, the latter being nearest to the front. Seven rooms in the house are heated with a hot-air furnace. The air enters the room near the base or through the floor, and rises. The exit is in the wall near the base in all cases, and into the air flue of the chimney. The registers have an effective opening of about a square foot, and have been found efficient. The furnace is placed in the cellar, where space is provided for a car load of coal.

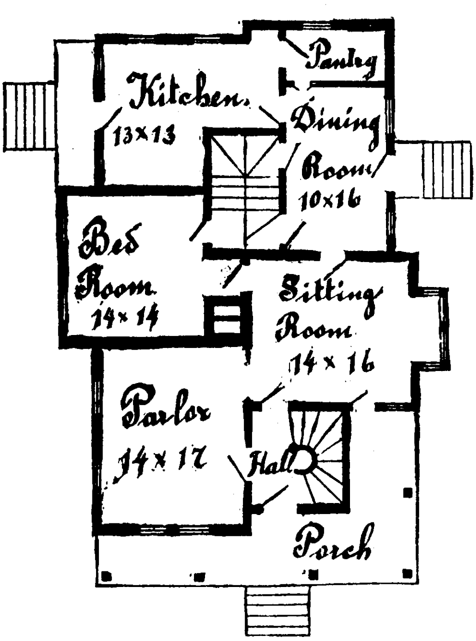
The tower has another use than for ornament. In hot weather its efficiency as a ventilator is remarkable. In quiet summer nights an enjoyable air current is established through any room having an open window and an open door and passageways to the tower, the attic windows or ventilators of the tower being open. A tower is, therefore, found useful in three ways, first, in ventilation; second, as an observatory; and third in architectural effect.

The outside is covered with ordinary siding laid on tarred paper. The ornaments are mostly cut from boards, strips being sometimes laid on, forming panel work in addition. The entire adornments of the building cost about 6 per cent of the total cost of $4,400, the latter including everything permanent, such as foundation, furnace, etc. The carpenter's contract was $3,100. All the windows, except those of the kitchen, have inside blinds, the transoms having sand-blast glass, except those of the front hall, where all lights are of cut glass.

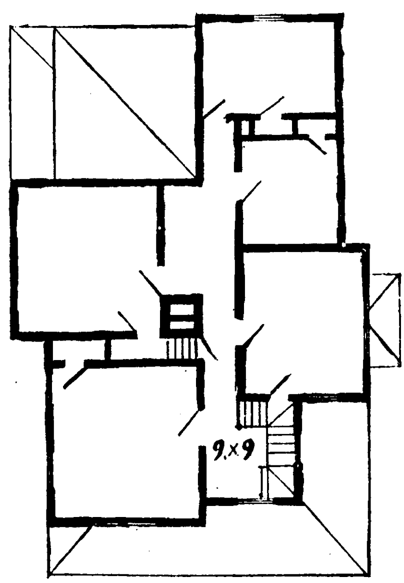
In bad seasons honey is apt to be poisonous. This arises from the fact that in such seasons the bees are often obliged to gather it from poisonous flowers.



DESIGN FOR DWELLING, COSTING $4,400.



1st. Story.



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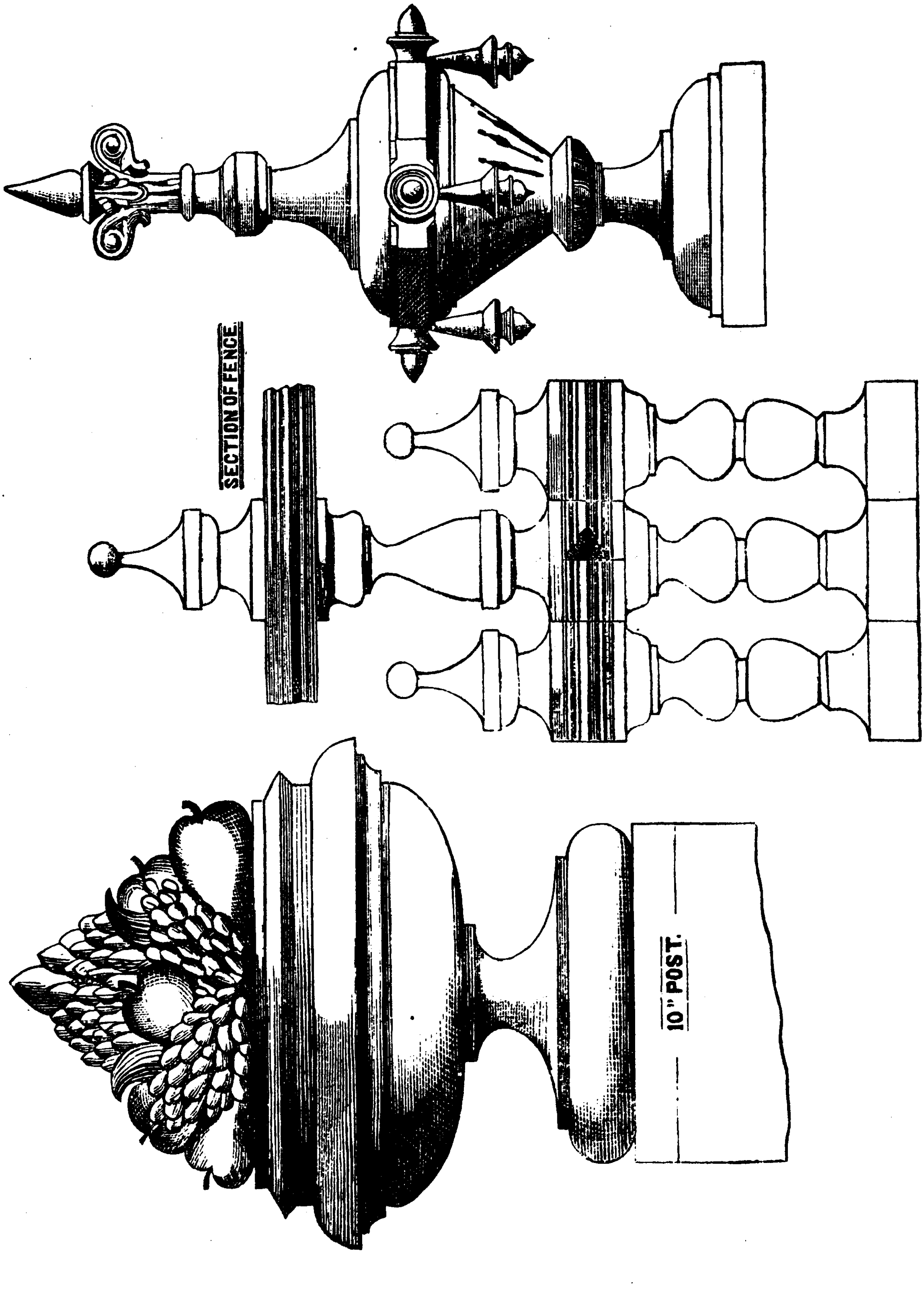


SUGGESTIONS FOR ORNAMENTS.

Painter's Work.

ON THE USE OF ORNAMENT IN HOUSE DECORATION.

There are certain principles which should govern the application of painted ornament to the decoration of buildings which are either not properly understood or are in many cases lost sight of altogether. These principles may be called fitness, adaptation of form and color to position and circumstances, harmony, correctness of drawing, and execution. No work can be successful without these qualifications

Mr. John Ruskin makes some observations on modern room decorations which we cannot allow to pass without question. He says (*vide* "The Two Paths," Lect. 3) "You will every day hear it absurdly said that room decoration should be by flat patterns, by dead colors, by conventional ornament and I know not what. Nobody ever yet used conventional art to decorate with who could do better. A great painter will always give you the natural art, safe or not. Correggio gets a commission to paint a room of a palace at Parma. Any of our people bred on our fine modern principles would have covered it with diaper; not so Correggio. He paints a thick trellis work of vine leaves with oval openings, and lovely children leaping through them into the room." Fancy our decorators decorating our English homes in this fashion! Could anything be more absurd? Vine leaves and trellis work, with even the loveliest of lovely children continually suspended in mid-air may be in good taste at Parma, but terribly out of place in English dwellings. We prefer to see our lovely English cherubs jumping about the room instead of through its walls. In these matters we are but too apt to forget that the style of decoration suitable to the sunny climes of the South and East, and most in harmony with the habits and customs of its peoples, are in a great measure, if not altogether, unsuited to our insular situation and domestic habits. We may adapt them (or rather what is good in them) to our purpose, and we may derive many valuable lessons in form and color from them; but to transplant them in their original form is a grave error. The black dado, red pilasters, and frieze with yellow, blue or white panels above, as seen in a Pompeian house, would look *outre*—out of place and tawdry—utterly foreign to our habits and to the style of our architecture. Again, we have the Moresque or Moorish style of decoration—a combination of some of the best features of the Egyptian, the Greek, the Roman, the Byzantine, and Arab styles, admirably adapted to the land of cloudless skies, where shade and coolness were a necessity, and only to be got by a particular style of architecture with open courts for light and ventilation; but in our "muggy" climate, where we have but too little sun and plenty of wind, such a style of decoration is, to say the least of it, unsuitable. Many of its beautiful geometrical diapers and ornaments we may use with advantage, and the lessons in color which it teaches cannot be over-estimated. But to make our rooms exact counterparts of the beautiful halls of the Alhambra (even if we could) would be simply ridiculous. We are aware that some of our principal decorators have got somewhat of a Pompeian fever, and have been painting black drawing-rooms, etc., *à la* Pompeii. Notwithstanding such authority, we must consider them as

Mistaken souls who dreamt of heaven.

As to Mr. Ruskin's assertion that nobody ever used conventional ornament if he could do better, we consider the assertion, to say the least of it, to be unwarranted by facts and without meaning. If Mr. Ruskin means that no artist would use flat ornament if he could paint vine leaves and trellis-work, there is no truth in the assertion; as there are many artists who can paint better things than vine leaves and trellis work who both design and paint conventional ornament. If he means that an artist who can paint vine leaves, etc., would paint them as room decorations as being more appropriate than flat ornament for that purpose, then the artist's taste and knowledge are both at fault, and his time and talents wasted.

It is a commonly received opinion that a man who can paint a picture is the right man to decorate a room. As a rule there can be no greater mistake. There are, of course, exceptions, but it will be found that the two are distinct, and require a special education or rather experience. The man who spends weeks and months in the elaboration of a picture will be too apt to treat his wall decoration in the same manner, and will show a want of breadth, a meagerness or poverty of coloring, and a finnicking littleness in his ornamentation totally unsuited to the situation. This arises not so much from any want of knowledge of form or color as from a want of experience in the handling of large masses of color. It is something like engaging a miniature painter to paint the drop scene for Old Drury. His ideas do not expand—they are bound down to a yard of canvas, consequently he cramps everything he touches. The naturalistic style of treatment as applied to house decoration is, as a rule for general application, a mistake. It is not long ago since our paper-hangings and wall decorations were treated in this manner, and we had our walls covered with large flowery patterns in natural colors—many in Mr. Ruskin's favorite trellis patterns, with bunches of grapes and vine leaves in most admired confusion. Our very floors were covered with carpets on which were represented wreaths and garlands of flowers as large as life and twice as natural, and we trampled them under foot without the slightest compunction. Our interiors were bowers of roses and posies—pretty baby-houses all.

At length better and more sober tastes prevailed, and we began to see that a room, to be beautiful and comfortable, and pleasant to sit in and to feel at home in, should be treated in a different manner; that bouquets of flowers and large masses of green leaves spotted over the walls were distracting objects; that our eyes were at once fixed upon them the moment we entered the room, and so long as we stayed in it, turn where we would, they were ever present, producing a sense of oppression and weariness. At last a master mind arose and took the matter in hand. A series of patterns for wall papers were designed by Mr. Owen Jones, which completely revolutionized our ideas and practice. These papers, both in form and color, were founded on the truest and best principles of decorative art as applied to domestic architecture, and although it is now many years since they were introduced, they have never been surpassed for beauty of form and harmony of coloring, and for adaptation to the purposes for which they were designed. They taught a lesson which our architects and decorators were not slow to avail themselves of, and as a means of purifying and elevating public taste their influence has been great, and is still and increasingly felt. Yet most of these patterns were designed upon the principle which Ruskin condemns, namely, natural leaves and flowers conventionalized. It appears to have been forgotten, or else never to have been dreamt of in the philosophy of many of our art critics and their followers, that there is such a word in our vocabulary as the word adaptation—adaptation of form to the particular purpose required, and adaptation of color to the special circumstances of position and locality; certain laws and rules are laid down, which are carried out under all circumstances and in all places. The folly and absurdity of this practice will be at once evident if we take a simple illustration as an instance.

Say a room whose walls shall be painted with a tint of color, made from emerald or other bright green and white—a color refreshing to the eye and pleasant to look upon, if our room is placed in the midst of a crowded city, where a green tree or a blade of grass is a *rara avis.* We shall feel refreshed every time we enter it. If we look out of a window our eyes will rest most likely upon a dusty red brick wall, not very clear or cleanly perhaps, but looking much pleasanter and better from the force of harmonious contrast. On the other hand, if we place our room in the country, where the look out will be upon green fields or garden and lawn, and if we treat it in exactly the same manner, we shall soon begin to find that we have no pleasure in it, and there is no feeling of relief felt on the grass plot or lawn. The natural greens of the grass and trees will have a dull faded look. This effect is produced by the large mass of bright green on the walls of the room, which completely destroys the capability of appreciating and distinguishing the beautiful varieties of tints of green which nature has so bountifully spread before us. Thus we see that the same style of treatment as regards color may be truly beautiful and harmonious in one situation, and utterly unsuitable, discordant, and out of place in another. Here also we may see the value and the necessity of the decorator being able to adapt his coloring to the particular circumstances in which the object he has to decorate is placed. Again it does not follow that because our room is placed in the country we shall discard green altogether, for if we add sufficient red and black to the same tint of bright green, to neutralize its brightness and reduce its tone, we shall have one of the pleasantest and most harmonious wall colors we are acquainted with—a color which not only produces a feeling of repose and quietness, but contrasts favorably with furniture of almost every description of wood, oak, walnut, mahogany, maple, etc., and almost any warm color or drapery or hangings will harmonize well with it. The grass, and trees, and flowers, and all pure greens look fresher and brighter by contrast with it. It is a color that interferes with nothing, but improves the color of everything in its vicinity.

SCRAP SCREENS.

Well arranged picture or scrap screens are not only very interesting to make, but are very pretty in effect, as each side has all the appearance of a continuous picture illustrative of some subject.

The frame work can be made of the number of panels and size wished for. Three panels, each panel 5 feet 2 inches high and 22 inches wide, is a pretty size for a drawing room; and four panels 6 feet high and 2 feet wide for a dining room or library. The wood must be well seasoned, and each panel must be made of exactly the same size, so that all may be quite even when folded together. It looks best to have the bottom part of the framework made a little deeper than that at the top and the sides. Width of framework at the top and sides about 2 in.; width of frame at the bottom about 2½ in. There should be two bars across about 2 in. wide. Get some unbleached cotton cloth. The width of both will be sufficient, the length required will depend on the height of the panels as well as the number of them, which can be easily calculated. Soak the cloth in hot water to shrink it, and when it is nearly dry nail it with small tin tacks along the top, round the edge of the panel, pulling it very tight all the time, so as to stretch it as much as possible, then fasten it down the sides and the bottom; do the other side of the panel the same. This requires a good deal of pulling, as it must be stretched tightly.

The canvas must be brought round the edge of the panel, so that the nails are on the outside edges and none on the front of the framework. Get some common white size, cut it in small pieces and put it into a white jam jar, with a very little water at the bottom. Put it on a hot hearth to melt, stirring it occasionally with a piece of stick. When quite melted brush it on the canvas thinly, but all over, with a painter's brush; rather a large one is best, as it can be done quicker with it. Work quickly in a warm place, keeping the size hot until both sides of the canvas on each panel are sized. It will soon dry and be ready for papering. If the screen is to be covered with colored pictures all over, which is the most effective, get sheets of large white packing paper. Lay one of the panels on a table or large board, and measure off the length of paper required by laying it on the screen. Each side must be in one piece, as joints would show a crease. Lay one of the strips of paper on a panel, and, with good smooth, common flour and water paste, brush it thickly, but evenly all over, using a similar brush to the one for sizing. It must be thoroughly and smoothly pasted, no spaces left or knots of paste, and can then be turned over so as to lay the side on which the paste is on to the canvas. This is best done by two people, one at the top and the other at the bottom, taking hold of each corner, turning it, and laying it very evenly on to the canvas, arranging it carefully to fit the shape, but not to fold over the edges. This, at first, is a little troublesome, but practice soon makes it very easy. When laid smoothly dab it with a clean cloth, pressing it gently, and rubbing out any creases or air bubbles, and it must be done quickly, before the paste gets dry. Cover both sides of the panel in the same way, and when all parts are dry, size the paper all over, in the same way as the canvas was done, and then it is ready for the pictures.

If the canvas has been well stretched, and the paper properly pasted, the surface of the panel will be quite smooth, and as tight as a drum. Common flour and water paste is used to put on the pictures with, but, before beginning to do so, it is wise to have a tolerable collection to select from. In arranging the pictures on the screen care must be taken to contrast the colors well, and it is a good plan to cover each panel in a different style. The easiest way of doing so is to put on pictures, without cutting them out, in somewhat regular order, and then to cut out flowers and arrange them round each other as if in a frame. Another mode is to cut out most of the pictures and arrange them in a confused way, part of a picture in one place and part elsewhere—any absurdity of composition is effective; flowers may be added occasionally, but not so frequently as in the first style. Another, and the most artistic, but the most difficult to arrange well, is for each panel to depict a distinct subject, such as Spring, Summer, Autumn, and Winter.

All the subjects must blend well and run into each other, with no distinct outlines, so that they appear as one picture. It would be almost impossible to cut them out exactly to fit, but the overlapping should be as little as possible. To ensure the best arrangement of any of the styles it is a good plan to pin the pictures on to the screen in various ways until the desired effect is arrived at; in pasting them on, be careful to press them well and to leave no air bubbles or raised places. Do not put the pictures anywhere within half an inch of the edge of the panel, as that margin is required to put any beading or other ornament as a finish to the screen.

When all the pictures are closely pasted on, look over them, and any little deficiencies or defects paint out with a little water-color paint to harmonize with the surrounding parts. It is then ready to be varnished and mounted.

Those who do not care to cover both sides of the screen with pictures, can put them on one side only, with cloth on the other.

Screens can be made with less trouble if the panels be covered with glazed colored paper, blue, red, green, or maroon, with flowers or pictures cut out, leaving no margin, and then pasted on separately or in groups, so as to show a good deal of the colored paper forming the ground.

Natural History.

WOODPECKERS.

The peculiar characteristics of woodpeckers are the construction of the beak, the feet, and tail. The beak is constructed for chipping away the bark and wood, the feet giving them the power to hold fast to the trunk of the tree, and the tail to support them in position, which gives to their strokes the greatest force. Their beaks are long, powerful, straight and pointed; their feet formed for grasping, are set far back upon the body; their tails are short and stiff, and act as props when pressed upon the rough bark. Woodpeckers were for a long time thought to be injurious to trees, but that prejudice naturalists now agree was wholly an error. Often, in walking through the woods or orchards, there will be seen strewn in profusion, at the foot of a tree, flakes of bark and chips of wood, sure signs of the woodpeckers' industry. It looks as though a work of destruction was being carried on, but these flakes, having become separated from the living bark of the tree, were mere excrescences under which insects and their larvæ found shelter, and to obtain them for food the woodpecker removes the dead flakes of bark and wood, so that in reality, instead of being an enemy to the farmer, he is one of his most faithful servants.

The woodpecker makes its nest in a tunnel which it excavates in the unsound timbers. Water when admitted to a tree, causes its centre to decay; but if a perforation is made through the trunk, gallon after gallon of dark brown water will rush out mixed with fragments of decayed wood showing the extent of the damage done. This oftens occurs when a branch has been blown off close to the trunk; the woodpecker is quick to discover it, and begins to cut a tunnel.

Wilson and Audubon both state that many of our woodpeckers will excavate tunnels in apparently sound and undecayed wood, boring through several inches, till they reach the decayed portions of the center of the tree.

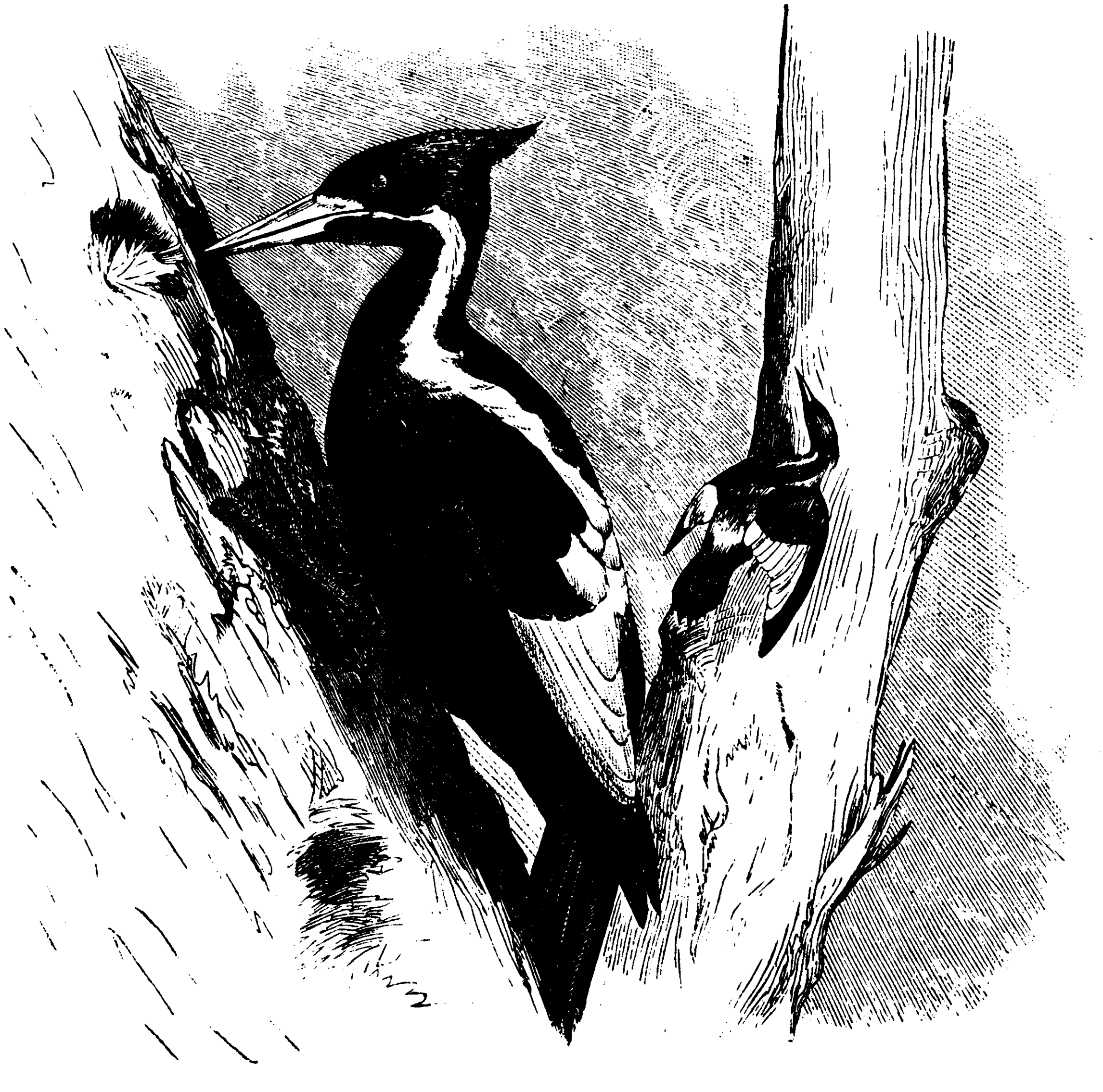
The burrowing powers of the great giant gray-bellied woodpecker are marvelous, its chisel-like beak having been known to chip splinters from a mahogany table, and to cut a hole fifteen inches in width through a lath-and-plaster partition. Even the small downy woodpecker is able to bore its way through solid wood of a tree, making an ingenious nest, the burrows sloping for some six or eight inches, then being driven perpendicularly down the tree. The tunnel is barely wide enough to admit of the passage of the body of the bird. But the perpendicular hole is roomy, and is fitted up in a style sufficient to dignify it with the name of a chamber. The male and female woodpeckers labor alternately in the burrowing and making of the nest, but they find an implacable enemy in the saucy little wren, who, when the woodpeckers' apartments are ready for occupancy, coolly takes possession, and holds them against the builders and proprietors notwithstanding their vehement and noisy expostulations.

Picus principalis is distinguished by a superb red carmine crest and bill of polished ivory. This is indeed no common bird, but is a king among his kind. No fence rails for him to perch upon, but rather the tops of lofty trees, the giant pines of the cypress swamps where the trumpeting notes and loud strokes awaken and reawaken the echoes. From the base of some of these enormous pine trees cartloads of bark have been removed, and the trees so perforated with holes that it would seem to be impossible that it was the work of birds.

A mammoth tree cut down in Lewis county, Kentucky, recently, and believed to be 300 years old, produced 33,472 feet of lumber and twenty-five cords of fire-wood. It was sixteen feet in diameter and 120 feet high.

FIG. 1.—INSTANTANEOUS PHOTOGRAPHY.—BEFORE THE EXPLOSION.

FIG. 2.—INSTANTANEOUS PHOTOGRAPHY.—AFTER THE EXPLOSION.



WOODPECKERS.

INSTANTANEOUS PHOTOGRAPHY.

We are indebted to Gen. Henry L. Abbot, U.S.A., in charge of the Engineer School of Application, Willet's Point, N. Y., for copies of photographs illustrating the remarkable sensitiveness of photo-gelatine plates, which we will briefly describe. It became necessary, one day, at Willet's point to destroy a worthless mule, and the subject was made the occasion of giving useful instruction to the military class there stationed. The mule was placed in proper position before a photo camera and duly focused. Upon the animal's forehead a cotton bag was tied containing six ounces of dynamite. The slide of the camera was supported by a fuse; the camera fuse and the dynamite on the mule's head being connected in the same electrical circuit, as shown by the wires in our engraving. On pressing the key so as to send the electricity through the wires, both the fuse and the dynamite were simultaneously fired; the camera slide and the head of the animal fell nearly together. The photo sensitive plate was impressed with a picture of the headless creature, still standing, before its body had time to fall.

Fig. 1 of our illustrations shows the animal, camera and electrical wires in position for firing. Fig. 2 shows the appearance of the animal after the explosion, as taken on the photo plate. The experiment was made June 6 last.—*Scientific American.*

Miscellaneous.

CITY BEE-KEEPING.

The editor of the *N. E. Homestead* writes as follows about a bee-keeper located in the heart of Springfield, Mass.

"Bee culture is generally supposed to belong entirely to rural communities, hence it will be a matter of surprise to many, to learn that the following facts in regard to honey making and honey makers were gleaned by personal observation of a flourishing colony of bees located less than ten rods from Springfield city Hall.

"Mr. K. A. Dearden of 51 Court street, as a means of instruction and amusement during his leisure hours, has taken to raising bees, and now has thrifty hives. If the busy little insects manifest at all times such wonderful instinct, which well nigh rivals human intelligence as they displayed on the various occasions when these notes were made, the gentleman must have a fascinating occupation in observing their habits. Mr. Dearden has constructed an observation hive, which consists of a single frame with glass sides, through which one can readily see the operations of the busy multitude within, and by watching the condition of this hive, he can readily judge how all other hives similarly situated are progressing without examining them, for what applies to one hive in a colony will apply to the others, provided the swarms are strong.

"The different kinds of bees could be distinguished, the drones being larger and more clumsy than the workers. The swarm occupying the observation hive had no queen, but there was a queen-cell which was about ready to furnish a young ruler. This cell was much larger than any of the others, was shaped much like a peanut, and in it had been placed a common egg which had been fed on "royal jelly" for the purpose of producing a queen, which process is the usual one taken by a swarm finding themselves queenless. Around this and the other egg cells the bees were thickly clustered in order to impart heat enough to the eggs to hatch them.

"Having watched the observation hive for a time, an examination was made of the closed hives. These were made by J. D. White of Chicopee, and were an improvement on the Langstroth hive. Mr. Dearden holds that a frame hive is superior to the old-fashioned box-hive, and of all kinds the white is the most satisfactory. In order to render the bees submissive the hive was smoked by means of a bellows smoker in which were burned some cotton rags. As soon as the insect smells smoke in the hive he begins to fill himself with honey, on the same principle that a man will follow when he discovers his house on fire and seeks to save as much of his property as he can. Being loaded down with the stored sweets, he has no disposition to sting as long as the movements of the operator are deliberate, but, as soon as any violent motions are made in the vicinity of the hive, he attacks the intruder with the greatest fury.

"Several frames were taken and examined, each weighing about twelve pounds, in all of which honey had been made within three weeks; as there are usually six honey and four brood frames in every hive, the amount of honey can readily be determined. Mr. Dearden is at present seeking to increase his stock rather than to produce honey, and as soon as a hive becomes crowded he removes two frames of brood and three of honey to a new hive, taking care that the queen is on one of the frames removed. All of the young bees will remain in their new quarters, while the old ones will return to their old home, provided it is within a quarter of a mile, and will commence at once to rear a queen for themselves, and also to fill the frames, which are put in to supply the places of those removed, with honey and brood. When the production of honey is sought, instead of removing the frames, as in the case just mentioned, section boxes are placed in the hive to be filled by the bees.

"While looking at the hives, a bee moth alighted at the entrance of one of them, and straightway there ensued a pitched battle, about a dozen bees attacking the intruder in fierce style, and not desisting until they had killed it, when they took up their dead enemy and flew some distance off and deposited it on the ground after administering a few farewell stings to show their animosity. A worm which was dropped into another hive shared the same fate, greatly to the amusement and interest of the lookers-on.

"In a third hive the workers were busily engaged in killing off the surplus drones and removing their bodies. A strange bee had ventured into another hive for the purpose of stealing honey, and, being detected, was set upon by some dozen of lusty workers and roughly handled.

"Bees detect members of other hives by their peculiar odor, and when it is necessary to consolidate two swarms Mr. Dearden smokes two hives with tobacco, and then as all smell alike, there is never any quarreling when they are obliged to occupy one residence. In one of the queenless hives was introduced a queen inclosed in a small wire cage in which she was to be kept for a day or two, and about which the bees immediately began to cluster. When released from confinement the swarm at once, accepted her as their ruler.

"Every spot in the hives and about the entrance thereto was kept as scrupulously neat as any lady's parlor. Mr. Dearden's careful experiments have proved that when the hives are left out of doors, without cover, the bees will take more pains in regard to keeping their surroundings neat and free from moths and worms than they will when the hives are placed in a house.

"In order to prevent swarming, Mr. Dearden examines the frames and destroys the queen-cells. While handling his bees recently he accidentally discovered that turpentine placed upon the hands will prevent bees from stinging them."

MECHANICS IN SURGERY.

Dr. W. G. A. Bonwill, of Philadelphia, has recently invented and put in actual practice, a mechanical appliance for superseding the use of hand tools in surgery. Although this is not the first instance of the introduction of the higher refinements of mechanics into the practice of surgery, it is nevertheless quite a step in advance, both in the comprehensiveness of the machinery and its varied applications, over anything which has preceded it.

The apparatus has been for some time in use in several of our principal Eastern cities, where it is received with much favor by leading surgeons. Quite recently it has been brought to the attention of English surgeons, at the session of a Medical Congress, where it has been described and commented upon as follows:

"Our American friends have always been foremost in devising mechanical appliances for superseding manual labor, and Dr. Bonwill's is the latest which has been brought under our notice. Besides saving labor, the present machine tends to redeem from something of barbarism certain surgical operations, particularly amputations. As well as being the latest addition to the list of labor-saving appliances, it is, perhaps, the most startling, inasmuch as the amputation of a limb may now be effected by the aid of machinery, just as conveniently as hair-brushing is.

"The surgical engine of Dr. Bonwill consists of an iron standard carrying an arrangement of multiplying wheel gear, which, by means of an endless cord passing over pulleys, transmits rapid rotary motion to either small drills or very fine circular saws, as the case may be. These instruments are attached to the end of a series of rods connected by universal joints, which permit the operator to move the cutting instrument in any direction he pleases while it is revolving at an incredibly high speed. It will, of course, be understood that these instruments are intended to deal only with bone. Thus with the drill it was shown that in cases where it is desired to hold the parts of a fractured bone together in a certain position, holes can be drilled and pins inserted, which, being held in a steel frame, keep the parts exactly in position. With the circular saw it was demonstrated that pieces of any required shape can easily be cut out of and removed from a bone, or a bone can be cut through in a few seconds.

"For amputations, a small, straight saw can be used. It is simply fitted into the holder, and as it is attached to a small eccentric worked from the main gearing, it has a very rapid reciprocating action imparted to it when the gearing is put in motion, which is done by means of a small hand-wheel. The comparatively slow movement of the hand of the operator is here replaced by the inconceivably rapid motion of the mechanical saw. By this means not only is the time occupied in the operation greatly shortened, but the operation itself is much more neatly performed, owing to the smallmess of the cutting instrument and the high speed at which it is moved.

"Dr. Bonwill is certainly entitled to the thanks of the medical profession, and no less those of the suffering public, for having dedicated his invention to their free service. We may add that this is not the only adaptation of mechanical means to surgical ends devised by Dr. Bonwill. He has made several other applications of machinery in minor surgery.—*Mining and Scientific News.*

The exports of cattle to England for beef will not be so large this year as for the last three years. The grass crop in England is much better than usual, and more beef will be made at home to the detriment of American beef.

POTATOES AND THEIR UTILIZATION.

One of the leading qualities of the potato is its extraordinary productiveness, far exceeding that of any esculent with which it can be placed in competition, one authority placing the yield from an equal quantity of ground at thirty pounds of potatoes to one pound of wheat.

In 1870 there were nearly one hundred and forty-four million bushels of potatoes produced in the United States, and certainly much more than that quantity will be gathered this year. In spite of the great market for this staple of food, it very frequently happens, especially in some of the exten-ive farming districts in our Northwestern States, where transportation rates are high, that overproduction so effects their value as to make the tubers unprofitable to handle, and, as a consequence, thousands of bushels of them are annually lost or thrown away.

In this connection we have been so frequently asked for what purposes other than as a food the potato can be utilized, that we will endeavor to answer the question.

Potatoes are composed very largely of starch and water, their average composition in northern latitudes being: Water, 75 per cent; starch, 21 per cent; albumen, cellulose, fat, and salts, 4 per cent. The water can be expelled by exposure to heat at a temperature of about 212 ° Fah., the residue having the composition: Starch, 83-8 per cent.; albumen, cellulose, fat and salts. 16.2 per cent.

Nearly the whole of the starch can be separated from potatoes by simple and inexpensive mechanical operations, and as starch is a commodity for which there is always a good market and as it can be stored for an indefinite time without danger of deterioration, it is obvious that potatoes may be profitably utilized in the production of starch.

The plant required to make marketable starch is quite simple and easily constructed by any intelligent farmer—a wire basket to wash the tubers, a rotary rasping machine, a few large tubs or watertight hogsheads, some wire and air-cloth sieves, and a drying-room, comprising the principal pieces.

A simple rasping machine is shown in Fig. 1, and consists of a band wheel A, over the rim of which has been secured, rough side out, a piece of sheet iron previously roughed up like a nutmeg grater by punching it full of holes with a blunt-pointed tool. The wheel is mounted on an axle supported by the wooden frame so as to revolve immediately beneath the mouth of a metal-lined wooden hopper, B

A more effective rasper or grinder is shown in Fig. 2. It consists of a cylinder *c*, twenty inches diameter and two feet long, mounted on an axis. It is armed with steel saw plates placed about three quarters of an inch apart, parallel with the cylinder, and having small and regular teeth. The plates are held in position by iron clamps, so that the toothed edges project about four-fifths of an inch from the periphery of the drum. It is driven at the rate of about eight hundred revolutions per minute before the hopper, and is capable of pulping about forty-eight bushels of potatoes an hour. In both these machines the rasping surfaces are kept clean by the action of small jets of water projected with some force.

As the washed potatoes are passed through one of these machines the pulp and wash water is run off into tubs, and after the coarser particles have been deposited, the milky liquid is drawn off into other tubs and the starchy matter allowed to settle. Or, as in large factories, the pulp may be rubbed and washed through a series of sieves, ranging from coarse wire gauze to fine hair cloth. After repeated washings with fresh water in the tubs to separate the gummy and fibrous matters, the starch granules are finally allowed to settle and after the water is run off into long wooden troughs, slightly inclined, wherein the paste gradually hardens as the water drains off. When hard enough it is cut into blocks and put on shelves in a warm room to dry out. With good management from seventeen to eighteen pounds of clear starch can be obtained by these simple means from one hundred pounds of average potatoes, which could be disposed of in bulk at present prices.

Starch is not only good for "starching" and sizing fabrics and for various food preparations, but also for the manufacture of grape sugar, glucose syrup, gum dextrine or British gum, and alcoholic liquors. When gradually heated in the dry state to about 160 ° Fah., in a rotating cylinder similar to a coffee roaster, and kept at that temperature for a short time, the starch is transformed into a gummy substance called dextrine or British gum soluble in cold water, and extensively used as a substitute for gum arabic.

When boiled for a few hours with water containing a small quantity of sulphuric acid it is gradually transformed into grape sugar or glucose—a kind of sugar extensively used by confectioners, brewers, distillers, and wine makers. The acid used is removed from the sweet solution by adding to it the proper quantitity of chalk or lime with which the acid forms an insoluble substance easily separated.

Whisky can be made directly from potatoes. The potatoes, after being finely mashed with boiling water are mixed with about five per cent. of malt, the distase of which on standing converts the starch into grape sugar. One and one half or two per cent. of yeast is then added, and the fermentation allowed to proceed at a temperature of about 80 ° Fah., until the sugar has been converted into alcohol and carbonic acid. The alcoholic liquid when submitted to distillation yields whisky—one bushel of good potatoes yields about seventeen pounds of the liquor. The fermented potato mash can also be converted into a vinegar by allowing the fermentation to continue after the sugar has all been changed to alcohol, or more rapidly by passing the alcoholic liquid through an *Essigbilder* or quick vinegar apparatus. A cheap apparatus of this kind may be made from a large barrel, as shown in Fig. 3. The barrel is provided with a perforated false bottom at *a*, and a tight shelf at *b*. Birch shavings soaked in good vinegar are loosely packed into the space between the shelf and false bottom. The shelf is perforated with a number of small holes through each of which is drawn a few strands of packing thread knotted at the top so as to loosely close the holes *d d d*; in the figure are short pieces of glass tubing secured in larger holes in this shelf. Around the sides of the barrel, just above the line of the false bottom, are pierced a number of air holes. When a warm alcoholic liquid is poured over the upper shelf of this apparatus it gradually trickles down through the pack thread and over the shavings, where it is brought into intimate contact with an upward current of air from the air holes below to the glass tube just above, and is gradually changed into vinegar which collects in the portion beneath the false bottom and flows off through the curved siphon *g*. If the barrel is small it is usually necessary to pass the liquid through the apparatus three or four times before acetification is complete.

Recently a company has been formed in California for preparing (among other things) desiccated or dried potato. The drying is accomplished by passing a current of dry air, at a temperature of about 140 ° Fah., over the potatoes, cut in very thin slices, in kilns or ovens provided with a system of movable shelves. Doubtless a large demand for such an article would not be difficult to develop.

Boiled (dry) potato mixed with zinc chloride and barytes has been used to form an imitation alabaster and coral-like composition.

DEATH IN THE SHOP.

The ordinary exposures of life and limb are great enough in factories without the additional ones afforded by unguarded gearing, shafts, and belts, and it is surprising that no legal penalties exist whereby these dangers might be removed.

It is possible to go into many shops and find traps of one sort and another that are standing menaces to all in the building obliged to pass them, and notwithstanding the daily records of accident occurring, no protection is put up. One can scarcely take up a trade journal without seeing some item referring to this matter. Milling journals are especially full of them, showing that flour mills, where quantities of gearing are used to transmit power, have not yet learned the danger of leaving them where help can walk or fall into them. Cotton mills also, where women are employed, are full of traps of one sort and another, so that operators have to be constantly on the alert to escape death or mutilation.

It goes without saying that every belt-hole in a floor, if the opening is big enough to catch the foot in, should be boxed up at least twelve inches high; that all gearing should be covered at least on the running side, if not all over, so that it would be a physical impossibility to get caught in them; but for all that common prudence palpably demands these coverings, there are but few mills that have not one or more death traps wide open in them.

Courts have decided in many instances that corporations and private firms are liable in cases of death or injury to their employees by shafts worked in exposed situations, so that if humanity does not dictate protection prudence should, and where so little trouble and expense is needed to obviate the danger, the neglect of simple precautions is inexcusable. Morally, if not legally, those who cause the death of an employee through such neglect are guilty of manslaughter.

Fig. 1

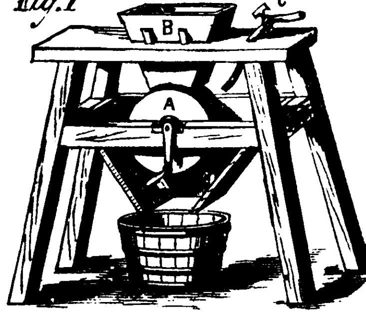


Fig. 2

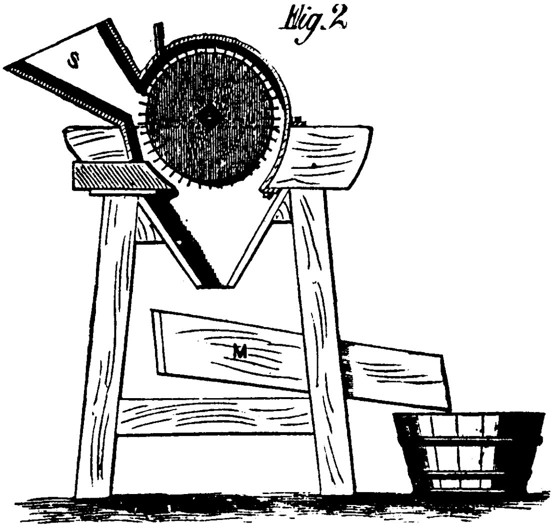


Fig. 3

UTILIZATION OF POTATOES.

ILLUSIONS OF TOUCH.

ILLUSIONS OF TOUCH.

One of our readers has recently put us in mind of an experiment which is represented in the annexed figure, and which every one has been acquainted with from his schoolboy days. The second finger is crossed over the index, and, with the two fingers in this position, a pea or marble is rolled about on a table or in the palm of the other hand. The sensation experienced is precisely the same as if two separate balls were being touched. Although, as we have said, this experiment is well known, we believe that the true explanation of the illusion of touch is not generally understood. A learned professor of sciences has recently given us this in concise form, which we here reproduce.

In the normal position of the fingers the same ball cannot touch at the same time the exterior sides of two contiguous fingers. When the two fingers are crossed the normal conditions are exceptionally changed, but the instinctive interpretation remains the same, unless a frequent repetition of the experiment has overcome the effect of our first education on this point. The experiment, in fact, has to be repeated a great number of times to make the illusion become less and less appreciable.

It is easy to perceive that in the domain of the sense of touch, the judgment, being formed instinctively, finds itself at fault when the normal conditions are modified; thus it happens, for example, when we have on the lips an accidental pimple or swelling, the glass from which we drink appears to have a distorted edge. Facts of this nature are very interesting to study from a philosophical point of view, for they demonstrate that the judgment which we form in regard to external material realities is based upon the interpretation of our sensible impressions. The impression of our senses is something entirely physical, and in no wise psychological. Interpretation is an affair of habit and education.—*La Nature.*