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CANADIAN MECHANICS MAGAZINE AND PATENT OFFICE RECORD

Vol 4. JUNE, 1876. No. 6.

ARCHITECTS; THEIR RESPONSIBILITIES AND PRIVILEGES.

IN a leading article in the May number, we dwelt at length upon the anomalous position an Architect is placed in when he assumes, with his own artistic duties, those of a Clerk of Works, by taking upon himself the superintendence of the whole of the minor details of construction. Of course we mean it to be understood that these observations apply only to the profession in cities and large towns, and not to small places, where it would not be convenient to obtain the services of a practical superintendent; but in any case, a trustworthy foreman should always be on the spot to see that the Architect's plans were carried out in all their *details*, in accordance with the spirit of the plans and specification. It must be evident to architects in Montreal, Toronto, and other prominent cities of Canada, that there is now in those cities a sufficient number of buildings erected annually to create a want of a certain number of practical builders to occupy the position of Clerks of Works, similar to those employed in England, but whose duties should be modified to suit the method of carrying on the building business in this country. We require some one who should always be on the spot to superintend the execution, in every part and in every branch, of an architect's design, to see that the materials were sound, and every portion of the building constructed in a proper and workmanlike manner; for to hold an architect responsible for all the inferior workmanship and materials that a builder can cover up and hide from view, during the intervening periods between his visits to the building, is a great injustice; and if the members of the profession were unanimous in insisting that their clients should provide a superintendent to supervise the construction of large buildings, and to be continually on the spot, watching over every portion in progress, it would, in the end, be much more satisfactory to the clients, the architect and the builder.

The term "Clerk of the Works," and the duties appertaining to the position, are so little known to the public in Canada, that in introducing this office in the architectural profession, with the view of its being ultimately generally accepted, it would be better to drop the old title, and adopt one that would distinguish the line and application of his duties; and as we have architects, and architectural surveyors, there is no reason why the term Architectural Superintendent should not be adopted in lieu of clerk of works. For the information of the general reader, we here lay down the line of his duties. An architectural superintendent should be thoroughly acquainted with all the practical methods of construction, the value of building and decorative materials, the quality of cements and mortar, &c., and in fact he should be practically educated in most points of all kinds of modern construction, and not a man of mere superficial knowledge who imposes upon the public by a bold pushing manner and a smattering of technical terms. It is not necessary that he should be a practical draughtsman, although he should be able to make drawings in detail for the workmen when necessary, and to thoroughly understand all working plans, sections, &c.; for the architect, with his assistants of practical draughtsmen, does not require a superintendent with such proficiency in drawing or design as to usurp his position, nor does he require either his judgment in the matter of decoration, strength of iron girders, roofs, ventilation, heating, &c.; in these matters, if he requires an opinion, he seeks it from those of known ability. For the strength of iron girders, he would, if he needed it, seek the advice of an engineer; ventilation and heating are entrusted to special men, whose systems are well understood and accepted by the architectural profession generally; what he wants in a superintendent is a person of known integrity and of thorough practical knowledge of the details of construction in all branches of building, in order to assist him in perfecting their arrangements, and to see that his plans and designs were not spoilt by the ignorance of the builder; for it must be borne in mind that the number of builders in this country who are thoroughly educated to their business, are very few, and those few are principally from the parent country.

When it so happens that you have a builder, as a contractor, who possesses very little practical knowledge of his business, beyond putting up a plain building; and mechanics who can only work by "rule of thumb," it is a very difficult matter for an Architect to get him to understand the working plans for decorative work, &c., and this frequently leads to differences between them in carrying out the design. In such cases when there is an intelligent and practical superintendent on the spot, he is enabled to assist the builder by explaining the detail drawings as the work progresses.

The public will inquire by whom are these architectural superintendents to be paid? Are they to pay the architect for his plans and specifications, and also pay a superintendent as well? Certainly, such is the rule; a clerk of works is paid by the day, by the proprietor, so long as his services are necessary; and the proprietor is always the gainer, by not only securing better workmanship and materials, but in avoiding all those irritating causes of annoyance which arise from extra charges, from misunderstandings, and from errors, often to a great extent, that are constantly taking place during a few hours' absence of the architect.

Let such of the public who have had experience in building call to mind the mortification experienced from inferior workmanship in their buildings, and how often matters that should have been closely watched, have been forgotten or passed over; or work that had to be pulled down from the want of having a practical person always on the spot. It may be said that in the erection of small buildings the cost of a superintendent would be too great; but in such cases he could take charge of more than one building, and if found to neglect his duties, he would be dismissed. The situation of an architectural superintendent should be an honorable one, and only those properly qualified allowed to practice.

Another branch of the architectural profession for which there is also a necessity, particularly in Montreal, is that of an Architectural Surveyor, one on whom builders, particularly, could depend to take out quantities with care and truthfulness, and to make up measurements of work, estimates, &c. We particularly want some rule, established by law, for the measurement of builders' work. Sometimes the grossest errors occur, and no two parties will take their measurements alike. His duties should assimilate to those of his profession in England, and one or two in each city should be specially appointed by a Board of Architects for that duty. In concluding these remarks, which are made simply with the view of raising the standard of the architectural profession in Canada, and placing its members in a right position in the eyes of their clients, as to their duties towards the public, and their own proper rights and privileges, we have not intended that they should be considered as in the slightest degree having any personal application to any member or members of the profession; on the contrary, we hope that they will lead to some movement among all its members in the Dominion to unanimously unite in obtaining from Parliament an Act defining their legal rights, responsibilities, and privileges, and making it imperative that all architectural students shall be articled, and pass an examination before a Board of Examiners before entering upon the responsible duties of the profession.

We purpose continuing this subject in our next in relation to the responsibilities and duties of Builders.

French Polish Reviver.—Half pint linseed oil, 1 oz. of spirits of camphor, 2 ozs. vinegar, ½ oz. of butter of antimony, ½ oz. of spirits of hartshorn.

FORT CHAMBLY OR PONTCHARTRAIN.

(*See page 167.*)

We have been favored by Charles Walkem, Esq., C. E., formerly of the Royal Engineer Staff in Canada, with a sketch and description of this very interesting and historical relic (the only one of the kind in North America), erected in the days of its earliest settlers to protect them from the constant attacks of the aborigines of the country, as well as for offensive operations in later stages of its history. Could its old and crumbling walls speak of the scenes of horror and tragedy that have taken place before them under the continued assaults of an implacable foe—the crafty and revengeful Iroquois—they would furnish material for a romance equal to (and perhaps truer to life) than has ever been pictured to us in the most vivid lights by America's greatest novelist in his best romances of Indian life. Such relics of a bygone and eventful era certainly should not be allowed to go to ruin. Five hundred years hence, if in existence, this old fort will be a hallowed spot to all tourists and antiquarians when this Dominion will have become one of the powerful countries of the world.

The *Times* observes that a piece of intelligence published last week would two centuries ago have excited a greater sensation than the outbreak of a most formidable war or even than the news of a crushing defeat. The plague, it seems clear, is once more threatening the confines of Europe. The progress of the pestilence last year in the valley of the Lower Euphrates aroused some alarm, and the contagion some weeks ago began to spread in Mesopotamia, and since the beginning of March it has reached Bagdad. The new outbreak shows much of the old and mysterious fierceness before which medical science for many centuries recoiled in despair. There is no reason to expect that its ravages will be limited to Turkey in Asia. Both in Egypt and in European Turkey the conditions in which the plague breeds and spreads are still prevailing, with little mitigation since the time when Cairo and Constantinople were almost annually decimated by its attacks. Happily, there is not the least ground for believing that the essential conditions for its reproduction in Western Europe any longer exist.

THE PATENT BILL.

The following is a concise summary of the main provisions of Lord Chancellor's Patent Bill as it leaves the House of Lords.

Application: Proceedings Thereon.—The first step is the filing of an application and declaration, together with "a specification describing the nature of the invention." The fee will be 5*l*. Notice of the application will be advertised, and any person having an interest in opposing the grant may do so on leaving particulars of his objection and paying a fee of 2*l*. During six months from the date of application the applicant will be allowed to use and publish his invention without prejudice to the patent. This is called "provisional protection," and the period may be extended for another six months, but not more, by a petition to the Lord Chancellor. After the expiration of a certain period, to be fixed by the Rules, the inventor must give notice to proceed, and his application will be referred to the examiner, who will report (*a*) whether the invention is a proper subject for a patent under the Statute of Monopolies; (*b*) whether the specification is sufficient; (*c*) whether the invention is new; and (*d*) whether it is useful. The examiners' report it would appear will be communicated to the applicant, who will then have to give another "notice to proceed." The Commissioners will on this transmit the whole of the documents to the law officer, who may, if he thinks fit, hear the applicant and any opponent. The law officer has full powers to award cost and to enforce payment of the same. He will then report to the Commissioners whether he thinks a patent ought to be granted or not, and this step will be accompanied by the publication of "the application, specification, and relative documents and reports." The reports will be annexed to and always go with the specification. Within a certain time (not yet fixed) the applicant must give a third "notice to proceed." If the report is favourable a warrant and letters patent will be prepared and submitted to the Lord Chancellor. If the report is unfavourable the applicant may nevertheless, after "notice to proceed," petition the Lord Chancellor for a grant and sealing of a patent. There will be no appeal from his decision, but a rehearing of the case may be granted. Section 14 provides that "any person may petition the Lord Chancellor against the sealing of a patent," but Section 35 says "any petition may be dismissed on the ground of the petitioner having no interest, or no sufficient interest in the matter." Particulars of objections must accompany every petition, and the Lord Chancellor has power to award costs and to call in the assistance of an expert. The next step is the "request for sealing," which must be made within three months from the date of the warrant and within the period of provisional protection, but the Lord Chancellor has power to extend the time for this step on good cause being shown. Failing this "request" the patent will not be sealed. The fee on the patent will be 15*l.*, and the sealing must take place within seven days before the expiration of the provisional protection and not sooner. Here again the Chancellor has a discretionary power to enlarge the time within which the patent may be sealed. Patents will be dated as on the day of application, but no proceeding can be taken in respect of an infringement committed before the publication of the specification and relative documents.

FOREIGN AND COLONIAL INVENTIONS.—If there be a foreign patent for the invention in force, no patent will be granted except to the foreign patentee or his attorney or agent, and application must be made within six months of the date of the foreign patent. The publication in this country of the specification of the foreign patent will not affect the validity of the English patent. If there is no foreign patent in force, the applicant must show either that he is the first and true inventor, or that he is entitled to all the rights in respect of the invention of the first and true inventor. No patent will be granted in respect of a communication from abroad, and the English patent will cease on the cessor of a foreign patent if there be one. No patent will be granted in this country after the expiration of a foreign patent for the same invention.

AMENDMENT.—A specification may be amended at any time either by way of disclaimer, explanation, supplement or otherwise. If the "request for leave to amend" be made before sealing, the fee will be 5*l.* A fee of the live amount will be payable on leave to amend after sealing, except when the amendment is "by way of supplement," when 10*l.* will be charged. The mode in which amendment prior to sealing will be dealt with is left to the Rules, but it would appear that amendments after sealing will be treated as if they were original applications. The fee on a caveat against leave to amend will be 2*l.* An amendment by way of supplement will not be allowed unless it is of such a nature that it might have been included in the original patent had it then been known at the time. In granting leave to amend otherwise than by way of supplement, care will be taken that the specification, as amended, does not claim an invention substantially larger than or different from the original specification. An amendment will not be evidence in proceedings pending at the time, except in case of proceedings for the revocation of the patent. In the case of an amendment after sealing, leave may be obtained to take proceedings in respect of an infringement committed before the amendment.

USE OF INVENTION.—COMPULSORY LICENSES.—A patent will be liable to be revoked after the expiration of two years from its date unless it has been used or put in practice within the United Kingdom to a reasonable extent, or unless reasonable efforts have been made to secure the use or practice thereof, proof to the contrary to lie on the patentee. It may also be revoked if the patentee fails to grant licenses to "proper persons requesting the same," provided that it be made to appear to the Lord Chancellor that such licenses are necessary "in order to insure a proper supply to the public of articles produced under the patent, or proper means for the use of the invention by the public." The terms of these compulsory licenses are to be settled by the Lord Chancellor.

CROWN.—A patent shall have to all intents the like effect as against the Queen, as it has against a subject. But the officers or commissioners administering any department of the service of the Crown may, by themselves, their agents, contractors, or others, at any time after the application, use the invention for the service of the Crown, on terms to be, before or after the use thereof, agreed on, with the approval of the Treasury, between those officers or commissioners and the patentee, or, in default of such agreement, settled by the Treasury; and the use and publication of the invention under this section during the period of provisional protection shall not prejudice the grant of a patent for the invention.

PROGRESSIVE STAMP DUTIES.—These remain the same as at present, viz., 50*l.* before the end of the third year, and 100*l.* before the end of the seventh year, with this important proviso, however, that the Lord Chancellor is empowered to grant an extension of time for payment not exceeding three months from the expiration of the third and seventh years respectively. No proceedings can be taken in respect of an infringement committed within the enlarged time, unless leave to do so be made a part of the order for enlargement of time. The additional fees will be 5*l.* on an order for the enlargement of the time for paying the third year's duty, and 10*l.* on an order for paying the seventh year's duty. These provisions will apply to patents existing at time of the commencement of the new Act, as well as to patents to be granted on applications made before the commencement of the Act.

PROLONGATIONS.—The Bill proposes to abolish the powers of prolonging a patent at present vested in the Judicial Committee of the Privy Council.

MODERN STREET ARCHITECTURE IN STOCKHOLM.

(See next page.)

The illustration given in this number shows a good specimen of architecture in Sweden, and represents the residence of Herr Jean Bolinder, in Blasieholmen, Stockholm.

A detailed description of the building is scarcely required. Designed in the style of the Venetian Renaissance, the work, when completed, will be a proof of Herr Zettervail's (the architect's) abilities. The ground floor is intended for shops and offices, the other floors for private residence. At the back, the central part, containing the domestic offices, juts out into a garden.

DAMP-PROOF BUILDING MATERIAL.

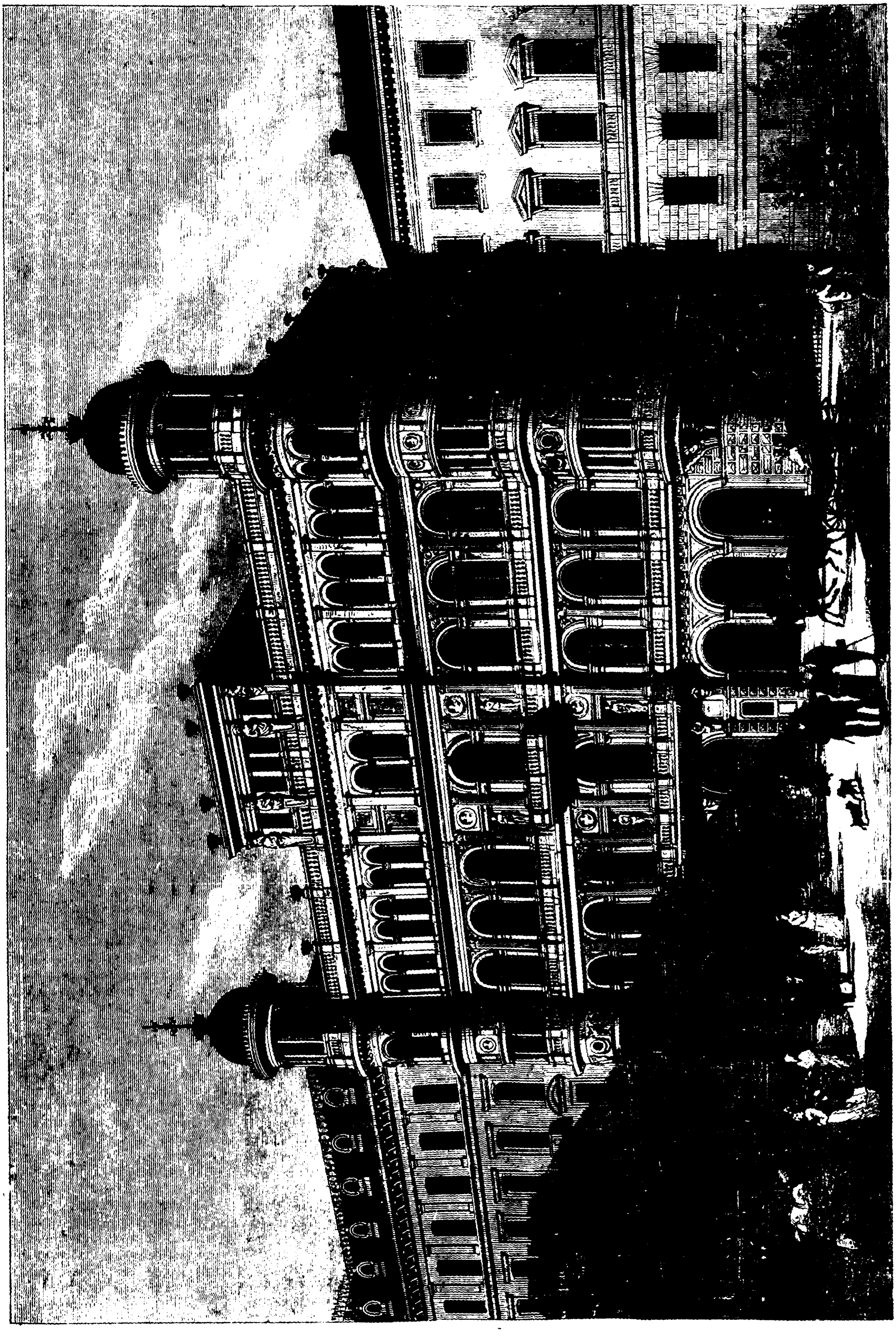
Fire-bricks and other heat-resisting pottery have been manufactured in the vicinity of Gunnislake for several years. It has been reserved for the proprietors of the Phœnix Works in that locality, to make also vitrified bricks and ware, from a material that hitherto has been almost worse than useless. They seem to have thus solved a most important problem, by the manufacture of a building material which is damp-proof, and which can be produced at a reasonable price.

Common clays when vitrified are apt to swell and puff out like a pudding. Hitherto the blue "terro metallic" bricks and tiles of Staffordshire have been accepted as the sole solution of the problem.

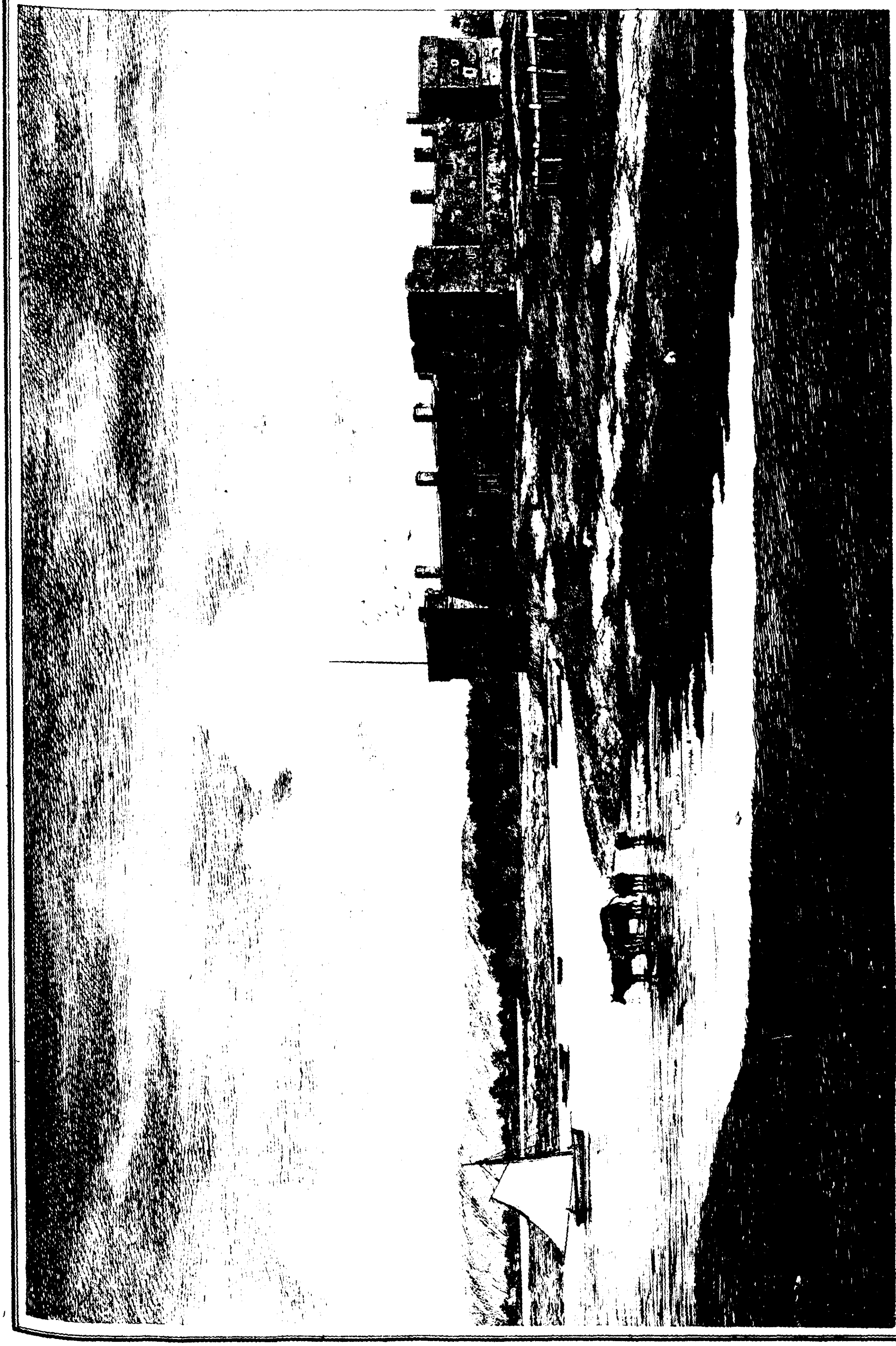
At the Phœnix Works, however, both and .white blue damp-proof bricks are manufactured thoroughly vitrified throughout, and impervious. They are not made of clay in the ordinary sense of the term, but of a soft untuous killas, or clay state, which abounds on the sett, and which on being exposed to the weather becomes quite friable. Experimenting upon this Mr. Cowell found that it would burn without change of shape to a semi-porcellaneous substance. Two varieties of killas occur in the sett, differing chiefly in the amount of iron they contain. From one of these—the irony—blue bricks, &c., are made; and from the other, white. The uses of the material are not confined to bricks, but it is worked up into paving tiles, stable pitching, kerbing, copings, damp-proof string-courses, and the like.

THE DEPTH OF THE PACIFIC OCEAN.

Recent soundings in the eastern part of the Pacific Ocean indicate that its bed is singularly level. The United States steamer "Tuscarora," having finished its first cruise between Cape Flattery and Unalaska, as well as between Cape Flattery and San Francisco, has recently completed a survey from San Francisco to San Diego. Its results may be stated in general to show that along the entire coast of California a depth of fifteen hundred fathoms or more is reached as soon as we go westward to a distance of from twenty to seventy miles from the shores. The greater part of this sudden fall occurs in the last ten to fifty miles. At one hundred miles west of San Francisco the bottom is over twenty-five hundred fathoms deep. The bed of the ocean continues of a uniform depth greater than fifteen hundred fathoms until we reach the Sandwich Islands, the greatest depth being three thousand fathoms at a distance of about four hundred miles east of Honolulu, which great depth is maintained until we reach within ninety miles of Honolulu. At fifty miles from that town the depth is fifteen hundred fathoms. The calculations made by Professor Bache, in 1854, based on the movements of the earthquake waves, gave an average depth of from twenty-two hundred to twenty-five hundred fathoms. The average depth of the present sounding is about twenty-four hundred fathoms. The bottom is generally a soft yellowish-brown ooze, and the temperature was everywhere about 35° Fahrenheit. In all these soundings the steel wire recommended by Sir William Thomson has been used, and, wonderful to relate, the same wire has been used in the entire work, and the apparatus still works excellently. The soundings were made at an average distance of forty miles apart.—*Annual Record.*



STREET ARCHITECTURE, SWEDEN.



FORT CHAMBLY OR PONTCHARTRAIN.

STEAM BOILER EXPLOSIONS IN 1875.

(See page 152.)

WE publish below the annual record of Mr. Edward B. Marten prepared for the Directors of the Midland Boiler Inspection and Assurance Company, of the boiler explosions which have come under his notice during the year 1875. The similar casualties for the years 1873 and 1874 were as follows :

	Number of Explosions.	Persons Killed.	Persons Injured.
1873	78	57	85
1874	78	77	108

As to the cause which led to the explosions, it will be seen that 13 are ascribed to faults in construction that might have been detected by inspection, 18 to faults that could only have been detected by inspection, 36 were caused by negligence on the part of attendants, and in one case only did the cause of explosion remain undiscovered. These proportions vary considerably from those recorded by Mr. Marten last year and which were as follows :

From faults in construction	24 explosions
From faults only to be detected by inspection	16 "
From faults that could have been prevented by attendants	36 "

It will be noticed that during 1874 no explosion occurred, the causo of which was not apparent.

During 1875, records were obtained of 68 boiler explosions, causing the death of 81 and the injury of 142 persons.

It is not to be presumed that all the explosions in the United Kingdom are here given, as these records are obtained only by private means, and through the courtesy of the owners of the boilers. All names are omitted, as the only object is to place within the reach of those who work boilers, short, simple, and clear descriptions of each case, and as far as possible the lessons to be learnt, as a warning of the evils to be avoided.

Iron works and collieries have as usual contributed the greatest number to the list of explosions, and this is ever likely, as so large a proportion of the steam power of the country is for their use.

More than half the explosions of the year have been from those causes more especially under the control of the attendants.

No. 1. (See Fig. 1.) *January 1st, 1 killed.*—Domestic saddle, welded joints. Used for warming a large building. The frost had stopped up the circulating pipes, and the pressure of steam increased till the boiler could sustain it no longer.

No. 2. *January 2nd, 1 killed.*—Domestic. The fire was lighted when the taps were closed, and the accumulating pressure exploded the boiler.

No. 3. (See Fig. 2.) *January 6th, 7 killed, 10 injured.*—Plain cylinder, 26 ft. long, by 6 ft. 6 in. diameter, ¼ in. plates, 25 lb. pressure, longitudinal seams, about 35 years old. Much patched and too weak to bear the usual pressure. The pressure gauge was said to have been incorrect, and the float did not work properly.

No. 4. *January 6th, none injured.*—Two-furnace upright, 21 ft. high, by 7 ft. diameter, $\frac{7}{16}$ in. Tube 3 ft. 6 in. diameter, with cross tubes, 50 lb. pressure. One of the cross tubes had become choked with mud, which prevented the contact of the water with the iron, and caused overheating and rupture.

No 5. *January 7th, none injured.*—Elbow boiler, 27 ft. long, by 4 ft. diameter, ⅜ in. plates, tube 2 ft. 4 in. diameter, 70 lb. pressure. The tube became overheated from shortness of water, and collapsed about 3½ in. downwards.

No. 6. *January 9th, none injured.*—Heating apparatus, 4 ft. high, by 2 ft. wide. Burst from over-pressure, frost having caused stoppage in the pipes.

No. 7. (See Fig. 3.) *January 21st, 6 killed, 19 injured.*—Lancashire, one of three, 28 ft. long, by 5 ft. 6 in. diameter. Tubes 2 ft. 6 in. diameter, 64 lb. pressure, 9 years old. The plates had been so reduced by internal corrosion, that they were too thin to stand the accumulating pressure during the dinner hour, when the machinery was standing. The plates were in many places reduced to $\frac{1}{10}$ in. Considerable damage was done to property.

No. 8. (See Fig. 4.) *January 23rd, 1 killed.*—" Breeche tube," 13 ft. long, by 6 ft. diameter, $\frac{7}{16}$ in. plates, 50 lb. pressure. Tube 3 ft. diameter at fire end, 1 ft. 6 in. at stack end. The tube collapsed in second and third rings from fire end, the plates having become overheated from shortness of water.

No. 9. *February, 2 injured.*—Plain cylinder, one of seven, 30 ft. long by 4 ft. 6 in. diameter, ⅜ in. plates, 37 lb. pressure. The plates on the side gave way where overheated from shortness of water, and the boiler was thrown forward.

No. 10. *February 8th, 1 killed.*—Plain cylinder. No particulars obtained.

No. 11. (See Fig. 5.) *February 10th, 2 killed.*—" Upright," 6 ft. high, and 2 ft. 9 in. diameter, ⅜ in. plates, 30 lb. pressure. Internal firebox. Had only been working an hour after having been repaired. The spring safety valve had been screwed down so as to prevent the free escape of steam. There was no pressure gauge attached to the boiler or engine. The fracture commenced at the unguarded manhole, and extended from top to bottom of the boiler.

No. 12. *February 26th, 1 injured.*—Locomotive 130 lb. pressure. The bottom part of the firebox gave way, being much reduced by internal corrosion.

No. 13. (See Fig. 6.) *March 1st, 1 killed, 1 injured.*—Cornish, 20 ft. long, by 5 ft. 9 in. diameter, ⅜ in. plates. Tube, 3 ft. diameter, 45 lb. pressure. The tube being unstrengthened by rings, collapsed nearly from end to end, through injury from shortness of water on some previous occasion. The shell and part of the tube were thrown forward, and the remainder of tube, with one of the ends, was thrown some distance to the rear.

No. 14. *March 15th, 1 killed, 2 injured.*—Marine verticle, 8 ft. high, and 5 ft. diameter, 57 lb. pressure. The cause of explosion was over-pressure, the valve being locked fast by corrosion.

No. 15. (See Fig. 7.) *March 22nd, 2 killed, 6 injured.*—Lancashire, one of sixteen, 30 ft. long, by 7 ft. diameter, $\frac{7}{16}$ in. plates. Tubes, 2 ft. 2 in. diameter, 45 lb. pressure. The shell, being reduced by external corrosion until too weak to bear the ordinary pressure, was rent into many fragments, which were scattered widely.

No. 16. *March 24th, none injured.*—Two-fluid. One flue collapsed from over-heating by shortness of water.

No. 17. (See Fig. 8.) *April 12th, 2 injured.*—Cornish, 2 ft. long, by 5 ft. diameter, 20 lb. pressure. So very much patched and worn as to be unfit to bear any pressure.

No. 18. (See Fig. 9.) *April 15th, 1 killed, 3 injured.*—Lancashire. One of two, 25 ft. 2 in. long, by 7 ft. diameter, $\frac{7}{16}$ in. plates. Tubes, 2 ft. 11 in. diameter, 48 lb. pressure. External corrosion had weakened the plates, so that the boiler could not sustain the usual working pressure, being reduced in some places to $\frac{1}{16}$ in.

No. 19. (See Fig. 10.) *April 28th, 2 killed, 3 injured.*—Plain cylinder, 3 ft. 6 in. long, and 2 ft. 8 in. diameter, 23 lb. pressure, ⅜ in. plates, ends dished, ½ in. thick. Corrosion had set in along the brickwork seating, and made this part so weak that it could not bear the pressure. The boiler was torn from end to end, and spread out quite flat, doing considerable damage to property.

No. 20. (See Fig. 11.) *May 2nd, none injured.*—Plain cylinder. One of two, 6 ft. 2 in. long by 2 ft. diameter. For temporary use only. The end was so corroded as to be too weak to bear the pressure, which accumulated while the boiler was left.

No. 21. *May 4th, none injured.*—Lancashire, 18 ft. long, by 7 ft. 6 in. diameter, $\frac{7}{16}$ in. plates. Tubes, 2 ft. 2 in. diameter, 35 lb. pressure. Heated by two furnaces. Both tubes collapsed from shortness of water, but dangerous consequences were prevented by the strengthening rings.

No. 22. (See Fig. 12.) *May 13th, 2 injured.*—Plain cylinder, plates arranged lengthways, 22 ft. long, by 5 ft. 6 in. diameter, ⅜ in. plates, 32 lb. pressure. Gave way from a seam rip at a longitudinal seam on right-hand side.

No. 23. (See Fig. 13.) *May 15th, 2 killed.*—Cornish. One of two, 18 ft. long, by 5 ft. diameter. Tube 3 ft. diameter, ⅜ in. plates, 60 lb. pressure. The water was allowed to get too low, when the plates became overheated and collapsed.

No. 24. (See Fig. 14.) *May 20th, 2 injured.*—Revolving rag boiler, 25 ft. long, by 6 ft. 6 in. diameter, 43 lb. pressure. For the convenience of frequent opening, the manlid bolts were hinged at one end, and slipped into notches in the lid ; therefore, although the lid was made steam tight, it did not maintain its strength, and split, when the reaction of the issuing contents displaced the boiler.

No. 25. (See Fig.) 15. *May 21st, 6 injured.*—Marine, 35 lb. pressure, 14 ft. long, by 7 ft. diameter. Two tubes, 3 ft. 6 in. by 2 ft. 6 in. diameter, and eight tubes, 6 in. diameter, four years old. It was presumed that the safety valve was set fast, causing undue pressure.

No. 26. *May 28th, none injured.*—Cornish, 40 lb. pressure. The tube was rent, having been much weakened by external corrosion.

No. 27. (See Fig. 16.) *June 4th, 1 killed, 3 injured.*—Portable, multitubular 7 ft. 6 in. long, by 2 ft. 9 in. diameter, $\frac{3}{8}$ in. plates, thirty-six tubes, $2\frac{3}{8}$ in. diameter, 50 lb. pressure. The front plate gave way, having been much weakened by the holes for fittings being in one line.

No. 28. (See Fig. 17.) *June 9th, 1 killed.*—Model boiler, 11 in. long, by 4 in. diameter, made of copper, with slightly dished ends, seams all soldered. Heated by a spirit lamp, which having been accidentally shifted, melted the solder, and allowed the back end to be blown off, when the reaction from the issuing steam blew the boiler against the head of the lad who made it.

No. 29. (See Fig. 19.) *June 10th, 3 killed, 8 injured.*—Cornish, 18 ft. long, by 5 ft. diameter, $\frac{3}{8}$ in. plates. Tube 3 ft. diameter, 30 lb. pressure. The tube collapsed nearly from end to end, from shortness of water. There was no fusible plug, and the usual leven of water was only 4 in. above crown of tube.

No. 30. (See Fig. 10, page 152). *June 26th, none injured.*—Locomotive, 10 ft. 6 in. long, by 4 ft. 3 in. in diameter, $\frac{1}{2}$ in. plates, 120 lb. pressure. Gave way from furrowing of the strap plate, where it covered the "butt" joint.

No. 31. (See Fig. 20). *June 26th, 4 killed, 2 injured.*—Marine. One of two, 12 ft. long, by 9 ft. diameter, $\frac{1}{2}$ in. plates, 80 lb. pressure. The safety valve was out of order, and did not work freely, and over-pressure forced the dome from its seat, tearing it through the line of rivet holes at the base.

No. 32. *July 1st, 3 killed, 1 injured.*—Marine, 65 lb. pressure. The dome was blown off; being of inferior metal, and badly attached to the shell, gave way from over-pressure, the free action of the safety valve having been prevented.

No. 33. (See Fig. 21.) *July 5th, 4 injured.*—Lancashire. One of two, 28 ft. long, by 6 ft. 6 in. diameter. Tubes 2 ft. 6 in. diameter, $\frac{3}{8}$ in. plate in shell, $\frac{7}{16}$ in. in tubes, 15 years old, 54 lb. pressure. External corrosion had so reduced the strength as to make it unable to bear the usual working pressure.

No. 34. *July 7th, 1 injured.*—Sulphur boiler, cast iron, 6 ft. high, by 6 ft. diameter, supplied with steam at 35 lb. pressure. The outlet became stopped, and the boiler pressure thus coming on the pan, was more than it could bear, and the boiler gave way, and the top was blown to a height of forty yards, demolishing a wooden shed in its descent.

No. 35. *July 8th, none injured.*—Multitubular, 65 lb. pressure. It was torn to pieces by over-pressure.

No. 36. *July 14th, none injured.*—Lancashire, 35 lb. pressure. Ruptured in the bottom, where much weakened by external corrosion.

No. 37. (See Fig. 22.) *July 15th, 2 killed, 5 injured.*—Plain cylinder, 37 ft. 8 in. long, by 6 ft. diameter, $\frac{3}{8}$ in. plates, 30 lb. pressure. The flues of the boiler were so arranged that the flame was carried too near the surface of the water, causing such quick formation of steam bubbles, as to prevent the perfect contact of water with the iron. The plates thus became overheated, and were ruptured, as shown in the sketch.

No. 38. (See Fig. 23.) *July 20th, 3 injured.*—Vertical. Bone boiler, 9 ft. 0 in. high, by 6 ft. diameter, $\frac{3}{8}$ in. plates, and supplied with steam at 40 lb. pressure from another boiler. The top being flat; was too weak to bear the pressure, and rent off, allowing the top to be blown upwards.

No. 39. *July 23rd, 2 injured.*—Locomotive, 10 ft. 6 in. long, by 3 ft. 10 in. diameter, $\frac{7}{16}$ in. plates, 120 lb. pressure. Gave way at ordinary pressure, having been much weakened by internal corrosion or "pitting."

No. 40. *July 28th, 3 killed, 1 injured.*—Plain cylinder, 36 ft. long, by 5 ft. 3 in. diameter, $\frac{3}{8}$ in. plates, 56 lb. pressure. Gave way at the usual pressure, having been weakened by external corrosion, caused by leakage from fittings.

No. 41. *July 30th, none injured.*—Plain cylinder, 36 ft. long, by 3 ft. diameter. Ruptured at two plates in the bottom, from overheating by accumulation of deposit.

No. 42. *July 31st, 1 killed, 6 injured.*—Economiser or feed-water. Gave way from over-pressure, as the valve did not work freely.

No. 43. (See Fig. 24.) *August 10th, 2 killed, 12 injured.*—Plain cylinder, 28 ft. long, by 5 ft. diameter, $\frac{3}{8}$ in. plates, 40 lb. pressure. The plates in the flue at the front end became overheated from shortness of water, and caused rupture, the first ring of plates being thrown some distance, and the egg end still further through the roof and first floor of a cottage, 250 yards distant.

No. 44. (See Fig. 25.) *August 18th, 1 killed, 10 injured.*—Plain cylinder. One of three, 38 ft. 6 in. long, by 5 ft. 6 in. diameter, $\frac{3}{8}$ in. plates, 48 lb. pressure. Gave way at a seam rip, where a patch had caused straining in the holes of an old plate.

No. 45. *August 15th, none injured.*—Tubulous, similar to No. 62. One tube over the fire ruptured, in consequence of overheating.

No. 46. *September 2nd, none injured.*—Plain cylinder, 40 lb. pressure. Ruptured at a seam rip near a patch, the rent extending till the boiler was torn into two pieces, one being blown to a considerable distance.

No. 47. (See Fig. 26.) *September 3rd, none injured.*—Cornish. One of eight, 25 ft. long, by 6 ft. diameter, $\frac{7}{16}$ in. plates. Tube 2 ft. 9 in. diameter, $\frac{3}{8}$ in. plates, 70 lb. pressure. Gave way from overheating of the plates, caused by accumulation of deposit.

No. 48. *September 7th, 6 killed, 3 injured.*—Revolving rag boiler, 19 ft. 6 in. long, by 7 ft. diameter, $\frac{7}{16}$ in. plates, about ten years old, steam being supplied from two Cornish boilers at 60 lb. pressure. The ends were flat, and the large manholes, for convenience of filling, were insufficiently guarded, and cracked at the edges, and too weak to bear the ordinary working pressure and strain of the material constantly falling as the boiler revolved.

No. 49. *September 8th, none injured.*—Two-flued furnace boiler, 45 lb. pressure. One flue collapsed from end to end, being too weak to bear the ordinary pressure.

No. 50. *September 10th, 1 killed.*—Economiser or feed-water heater. One of the pipes burst in consequence of overheating.

No. 51. (See Fig. 27.) *September 22nd, 1 killed.*—Vertical, 5 ft. 3 in. high, by 3 ft. 2 in. diameter, internally fired, and external annular flue. Firebox 3 ft. by 2 ft. 6 in., 70 lb. pressure. The top gave way, being unstayed and of weak form, the first rent commencing at the unguarded manhole. The safety valve was blowing a short time before the explosion, but the attendant foolishly held it down to stop the noise, causing more pressure than the boiler could bear.

No. 52. *September 29th, none injured.*—Vertical, 11 ft. high by 5 ft. diameter, 50 lb. pressure, $\frac{5}{16}$ in. plates. Smoke tube 14 in. diam-ter, not protected by lining. The tube collapsed at the part which passed through steam space, from overheating.

No. 53. (See Fig. 28.) *October 15th, 1 killed, 1 injured.*—Lancashire, 23 ft. 8 in. long, by 7 ft. diameter, $\frac{3}{8}$ in. plates. Tubes 2 ft. 10 in. diameter, 68 lb. pressure. The right-hand tube collapsed from end to end, and was shot forward, carrying the front end of the shell. The shell containing the other tube was thrown backwards about 60 yards. The tubes were too weak to bear the usual pressure, not being stayed or strengthened in any way.

No. 54. (See Fig. 29.) *October 26th, 4 killed, 8 injured.*—Balloon, 12 ft. high, by 12 ft. diameter, $\frac{3}{8}$ in. plates, 15 lb. pressure. The boiler gave way by the dome-shaped bottom being forced downwards until the crown plates ripped out and the rent extended round the plates joining the bottom and top of the boiler, when the reaction of the issuing contents sent the top upwards, and its fall divided it into two parts. The boiler was worked at far too high a pressure, but the immediate cause of the explosion was the giving way of one of the internal stays, and the sudden strain upon the others caused them to give way also, and the whole fabric was ruptured.

No. 55. *October 29th, 1 injured.*—Ammonia still. One of two, 12 ft. high by 8 ft. diameter. All openings were by mistake left closed, and the pressure accumulated to more than the vessel could bear.

No. 56. *November 8th, 1 killed.*—Still, 6 ft. high by 4 ft. diameter, $\frac{3}{8}$ in. plates. Ends flat, $\frac{7}{16}$ in. thick, steam being supplied from a range of boilers at 40 lb. pressure. One of the doors by which the still was filled was blown out, owing to the giving way of one of the fastenings.

No 57. *November, none injured.*—Vertical, 5 ft. 6 in. high, by 3 ft. $2\frac{1}{2}$ in. diameter, $\frac{3}{8}$ in. plates. Failed at the unguarded manhole, the rupture extending through a line of rivets in crown of shell, which was blown off.

No. 58. *November 9th, none injured.*—Ammonia still, 12 ft. high, by 9 ft. 6 in. diameter. Shell $\frac{3}{8}$ in. thick, ends $\frac{1}{2}$ in. Flat bottom. There was no safety valve, and all outlets were closed, and the pressure ruptured the bottom of the shell, through a line of rivets.

No. 59. (See Fig. 30.) *November 13th, 1 killed.*—Marine, 14 ft. 6 in. long, by 7 ft. 6 in. diameter at front end and 6 ft. 6 in. diameter at back end. The tubes collapsed from accumulation of salt.

No. 60. (See Fig. 31.) *November 18th, 1 killed, 5 injured.*—Plain cylinder, 18 ft. 2 in. long, by 3 ft. 8 in. diameter, $\frac{5}{16}$ in.

BOILER EXPLOSIONS IN 1875.—(See previous illustrations in May Number.)

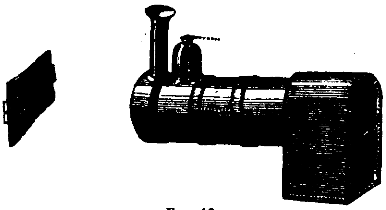


Fig. 19.

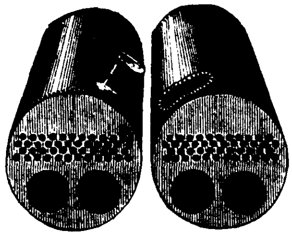


Fig. 20.

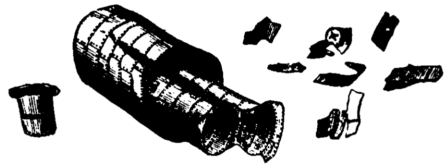


Fig. 21.

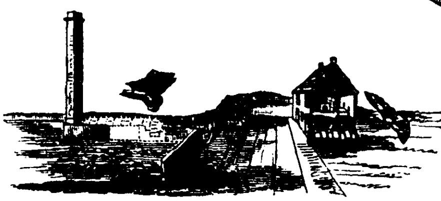


Fig. 22.

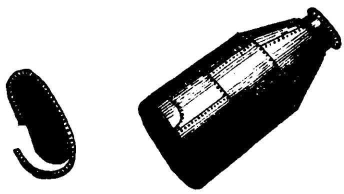


Fig. 23.

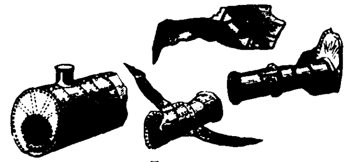


Fig. 26.

Fig. 24.

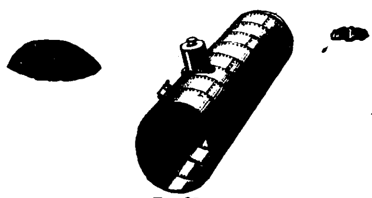


Fig. 25.

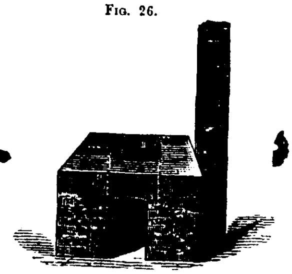
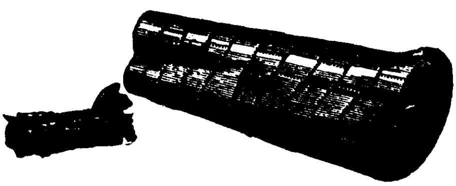


Fig. 27.



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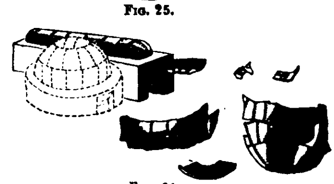


Fig. 29.

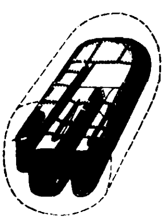


Fig. 30.

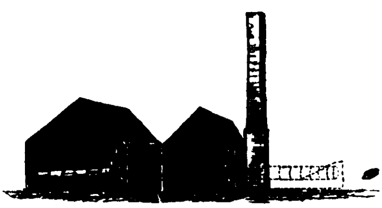


Fig. 31.

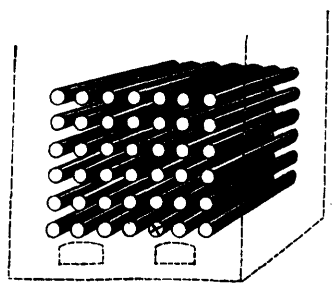


Fig. 33.

Fig. 34.

Fig. 35.

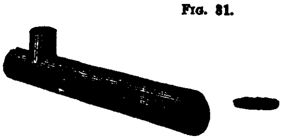


Fig. 32.

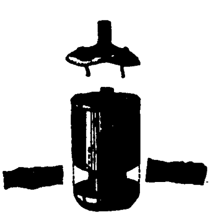


Fig. 37.

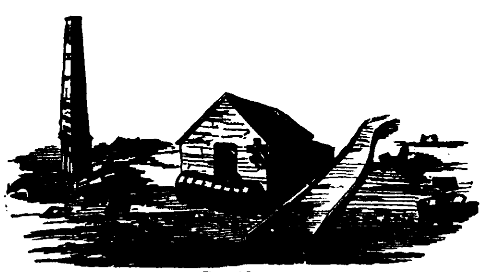


Fig. 36.

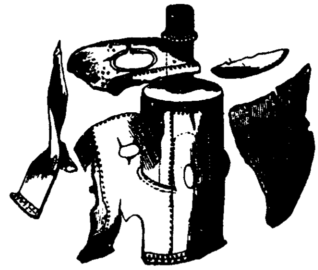


Fig. 38.

COMBINED CENTRIFUGAL PUMP AND ENGINE.

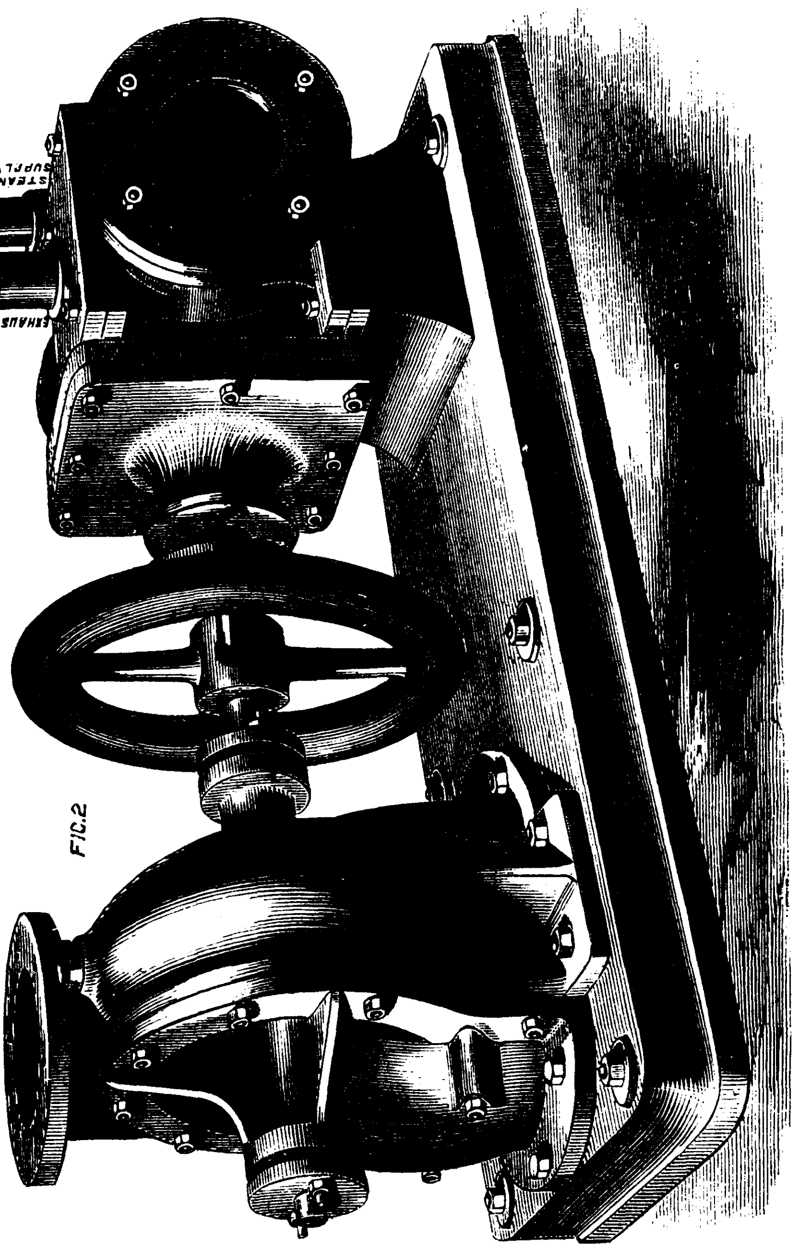


FIG. 2

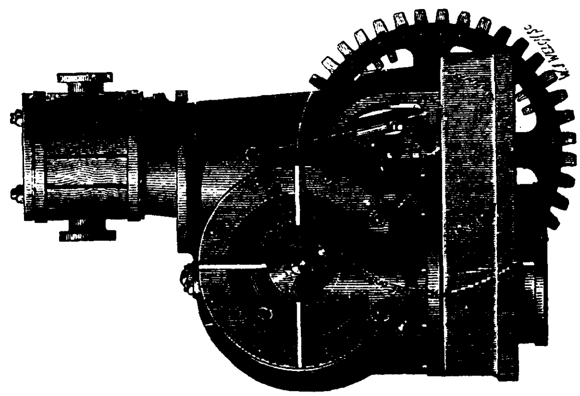


FIG. 1.

plates, 40 lb. pressure, 19 years old. The front end gave way, being much reduced at the flange from external corrosion, caused by dampness in the brickwork seating.

No. 61. (See Fig. 32.) *November 20th, 3 injured.*—Plain cylinder, 17 ft. 9 in. long, by 2 ft. 6 in. diameter, ⅜ in. plates. The ends were defective and patched, the back one gave way, and the issuing steam forced the shell of the boiler about 120 yards forwards.

No. 62. (See Fig. 33.) *November 24th, 2 killed.*—Tube boiler. Each tube was 12 ft. long, by 8½ in. diameter, ¼ in. thick, 150 lb. pressure, being especially designed with a view to bear more than ordinary pressure. One tude gave way over the fire, either from a flaw, or injury by overheating from shortness of water, or accumulation of scale, and the escaping hot water scalded two men who happened to be clearing a space behind the boiler, from which there was no ready escape.

No. 63. *November 30th, 1 killed.*—A steam jug burst at a defect in the casting, caused by the core not being placed in the centre of the mould.

No. 64. (See Fig. 34.) *December 16th, 2 killed.*—Tube boiler, similar to No. 62. One tube ruptured in the upper part of the boiler, having been overheated by the flame passing up the space where some other tubes had been removed for repair.

No. 65. (See Fig. 35.) *December 17th, 2 injured.*—Plain cylinder, 6 ft. long, by 12 ft. 6 in. diameter, ⅜ in. plates, 40 lb. pressure. Gave way at a longitudinal seam in the bottom, where the plate was reduced to half its proper thickness by internal and external corrosion.

No. 66. (See Fig. 36.) *December 21st, 8 killed, 1 injured.*—Cornish, 24 ft. long, by 5 ft. diameter, $\frac{7}{16}$ in. plates. Tube 2 ft. 6 in. diameter, 46 lb. pressure, 15 years old. The tube collapsed from weakness, and forced the two ends out, which flew in opposite directions. It was torn in several pieces, and some parts thrown considerable distances. The ends were insufficiently stayed, causing the angle irons to be much strained and injured.

No. 67. (See Fig. 37.) *December 22nd, 2 killed.*—Vertical, 7 ft. high, by 4 ft. diameter, ⅜ in. plates. Fired internally. It exploded from over-pressure, caused by over-weighting and fastening of the safety valve.

No. 68. (See Fig. 38.) *December 27th, 1 killed, 1 injured.*—Marine vertical, 8 ft. high, by 5 ft. 2 in. diameter, ⅜ in. plates, 65 lb. prsesure, 5 years old. The plates were so corroded inside and out, that the boiler was unable to bear the usual working pressure.

HENRY BESSEMER.

MANY men have spent their lives in attempts to improve the manufacture of iron and steel, and not a few have contributed valuable methods to those already known. But though their names will always be associated with their special efforts, to Henry Bessemer alone, so far, belongs the privilege of having stamped his name so indelibly upon a process and a product of manufacture as to render that name not only a familiar one wherever iron and steel are made, but a necessary adjunct to the technology of metallurgy.

Henry Bessemer was born at Charlton, in Hertfordshire, on the 19th of January, 1813. His father, Anthony Bessemer, was a typefounder of some note, and named his son after Henry Caslon, with whom he had formerly been associated in business. The elder Bessemer was a talented man, and had some singular experiences. At the age of eleven he was taken by his parents from London, his birthplace, to Holland, where nine years later he erected the first floating steam-engine for draining the turf pits near Haarlem. Soon after he migrated to Paris, where he received the high honour of election as a member of the Academy, at the early age of twenty-five. The Revolution of '92 totally ruined him. In spite of his English nationality he was compelled to serve on the commissariat, and, but for the opportune death of Robespierre, he might have lost his life. As it was he was accused before the Assembly, but contrived to escape to his native country, there to commence life afresh. Here, by assiduous industry, he recovered his position, and ultimately purchased a freehold estate in the hamlet of Charlton, Herts, where his distinguished son was born.

With such a father, it might have been expected that young Henry would have received a thoroughly scientific education, but he had only the opportunity afforded by an ordinary private school in a neighbouring country town. His chief amusement during his youth was modelling—an occupation for which every bank furnished clay, and the abundant leisure of a country boy supplied the time. In this he attained considerable dexterity, while at the same time exhibiting a considerable amount of incapacity for a kindred art—that of drawing from copies. This was singular, especially considering that he was exceedingly skilful at producing original designs, and afterwards turned this power to great pecuniary advantage. Mechanical matters also occupied a share of his attention, and at the age of eighteen his education—in that better sense of after-school progress which is so valuable—was so far advanced that, when his parents removed to London, he was able to start for himself as a modeller and designer. Within two years of his time young Bessemer became a contributor to the Royal Academy's exhibition at Somerset House, his exhibit being a model of St. Luke's Church, Chelsea, thus early evincing the love and taste for architecture which has clung to him through life, and which may be traced to the beautiful additions he has made to his own residence. The magnificent conservatory attached to this, and constructed in marble and iron, is a most elegant erection, and shows not a single bolt or tie-rod to mar its pure architectural effect.

Perhaps the main characteristic of Mr. Bessemer's mind is an extraordinary power of seeing through difficulties and suggesting remedies. One of the earliest illustrations of this was afforded when a friend happened to lament, in his hearing, that it appeared impossible to procure modern specimens of the fabric known as figured Utrecht velvet for decorative purposes. Bessemer, though but a youth, devised machinery suited to supply the want, and the figured velvet then made by him was extensively employed in furnishing some of the State apartments in Windsor Castle.

Again, more than forty years ago, about half a million sterling was annually lost to the revenue through the fraudulent transfer of stamps from old documents to new ones. This system of fraud was most easy, as the blue paper stamps could be readily unfastened, and removed from a valueless deed, and put on to a new skin. Having invented a plan to remedy this, he furnished details of the invention to Sir Charles Presley, of the Stamp Office, and it was so highly appreciated that in less than two months from that period an Act of Parliament was passed, calling in all the old stamps, and issuing dated stamps, precisely like those now in daily use for deeds, bills of exchange, &c. Just about this period Lord Althorp, who had promised young Bessemer a sinecure worth six or eight hundred a year for his invention, ceased to be Prime Minister, and Bessemer, tired and wearied by reiterated applications to the Stamp Office, at last gave up all further attempts, and never succeeded in getting one shilling in payment for his ingenuity, which has saved so many millions to the State. His loss, however, may have been his country's gain. Although nothing could have repressed his inventive ingenuity, it is just possible that in the repose of the Stamp Office he might never have thought of manufacturing steel.

About the same time our inventor came near to preceding Jacobi and Jordan in discovering electro-plating. The study of the prevention of forgery in stamps led Bessemer also to explore the same field in reference to bank-notes. He had become an expert amateur and engine-turner, and a great admirer of the wonderful designs produced at that time by Perkins and Heath. By much study and many approved appliances he was enabled to trace the multitude of ever-varying and intricate lines, such as we are now familiar with on American bank-notes and coupons, and although he failed to interest the authorities of the Bank of England in his plans, the demand for such work, for patent-medicine labels and other similar devices, was considerable, and at prices almost fabulously high, so that his ingenuity in devising the delicate and elaborate mechanism by which these beautiful lines were traced on steel, by a diamond point, became a source of considerable profit as well as a pleasure to him. On one occasion when he was challenged to produce a medallion in line engraving, on the supposition that no one in England was acquainted with the secret of working it, he sat up all night before his engraving machine, and only when the grey light of dawn stole in to witness his success did he know how long he had been in his workshop.

The high price (7s. per oz.) of bronze powder in 1837, attracted his attention. Learning that it was simply a form of brass, and that its intrinsic value was less than a shilling a pound, he began to inquire into the mode of its manufacture. This he found to be very simple, although most laborious and expensive. Thin alloy known as "Dutch metal" had to be beaten by hand into leaves after the manner of making gold-leaf, and were afterwards ground with honey by a muller upon a slab until it was reduced to the required state of division. Experiment followed investigation, with a view to the adaptation of machinery to this manufacture. Bessemer, after one failure, devised some machinery for this purpose, which succeeded admirably in producing the required article on a large commercial scale, and wholly without manual labour in any of the processes. The machines were never patented, and to this day they have not been gazed upon by outsiders. The bronze and gold paint factory thus organized is still in existence, and long furnished Mr. Bessemer with the means necessary to patent and pursue his many other useful inventions without ever having had recourse to the capitalists to assist him. Among others, this profitable manufacture furnished the means of pursuing his costly experiments in the manufacture of iron and steel, which may be considered as the crowning invention of his life. His bronze factory has long since been transferred by him to those who so faithfully kept his secret for nearly forty years.

The story of "Bessemer steel" has now to be told.

About the time of the Crimean war, Mr. Bessemer made some suggestions to the British Government on the subject of a new projectile, by which rotation could be secured with rifling. The idea was ridiculed. Being in Paris soon after, Mr. Bessemer mentioned the matter to the Emperor Napoleon, who thought it worth a trial. Accordingly, experiments were made at Vincennes, and proved satisfactory. Eight out of ten boards, 100 metres apart, were pierced by the shot, which, being japanned, evidenced by abrasion the extent of their rotation. The experiments were continued, but stopped on account of the weakness of the guns employed, it being necessary to fire a 90-pound elongated shot from a 30-pounder smooth bore. In point of fact, the metal of which ordnance were then cast, whether iron or bronze, were not strong enough to bear so great a strain. Hence Mr. Bessemer's attention was turned to the possibility of improving it; and the French Emperor informed Mr. Bessemer, by autograph letter, that he might draw on Barings to any amount for his expenses.

The natural outcome of Mr. Bessemer's meditations upon the purification of iron was the suggestion that by blowing air or steam into it while fluid, its impurities—carbon, phosphorus, silicon and the like—would be burned away, and a "mild steel," easy to cast, and of considerable strength, would be the result. This was not reached at one leap, nor without great labour and numerous experiments. A small furnace was put up, and air forced by an air-pump through a bath of molten iron. The heat produced was so intense as to melt the Stourbridge firebricks, of which the furnace was built, and reduce them from 4½ inches in thickness to a mere shell half an-inch thick. Later experiments were made on quantities of iron varying from 10 to 15 cwt., and the result was deemed so successful that Mr. Bessemer, after taking out several patents, proclaimed his method to the world in a paper read at the Cheltenham meeting of the British Association in 1856 under the title, "On the Manufacture of Iron and Steel without Fuel." The manner in which the new process was received is well illustrated by an extract from Dr. Percy's account of an experiment he witnessed at Baxter House, Mr. Bessemer's then residence. The apparatus employed was a large crucible-shaped vessel, with six air-holes or tuyers at the bottom, through which air was forced by an air-pump. Turning on this blast, melted crude iron was then run in it from a cupola furnace to a depth of eruption of flame, and sparks suddenly occurred, and bright red-hot scoriæ or cinders were forcibly ejected, which would have inflicted serious injury on any unhappy bystanders whom they might perchance have struck. After a few minutes all was again tranquil, and the molten malleable iron was tapped off. At first I doubted whether the metal which I saw flowing was actually malleable iron; and after the analysis in my laboratory of a portion of this identical iron and the detection in it of phosphorus somewhat exceeding 1 per cent., my scepticism was rather confirmed than otherwise. However, I soon became convinced that Mr. Bessemer was correct in asserting that he had succeeded in producing a temperature higher than ever before attained in metallurgical operations, sufficient, indeed, to render malleable iron "as liquid as water," and this without the employment of any fuel, except that contained in the crude iron, in the form of carbon and other foreign matters, which it was necessary to eliminate.

The new process was severely criticised, and was met with the objection hinted at in Dr. Percy's remarks above quoted—that phosphorus and sulphur, two deadly enemies to iron, were not removed. The remedy was, however, soon found in the exclusion of all iron containing these two elements from the operation of the Bessemer convertor, which was the improved form of the crucible-shaped vessel used at first. This, and the easy adaptation of the process to the manufacture of true steel by adding to the decarburised iron a specified proportion of the useful alloy called spiegeleisen, were rapid developments of the invention which soon assumed a permanent place in the industries of this and other iron-producing countries. The quantity of Bessemer steel made annually in England alone is over 500,000 tons.

Few inventions have spread themselves over the world so rapidly as the Bessemer process, or have been more liberally acknowledged in foreign countries. The first public body to recognize its value here was the Institution of Civil Engineers (of which Mr. Bessemer is an associate), who awarded him the Telford Gold Medal for his invention. The Iron Board of Sweden made Mr. Bessemer an honorary member of that body, and the freedom of the City of Hamburg was presented to him by the municipality. The King of Wurtemburg also presented him with a gold medal, accompanied by a letter acknowledging in the most flattering terms the advantages which the invention had conferred on his kingdom. In 1872 the Society of Arts presented him with the Albert Gold Medal. In Austria the invention had been most successful, and the Emperor conferred on Mr. Bessemer the distinguished honour of a Knight Commandership of the order of His Imperial Majesty Francis Joseph. Among these foreign recognitions of the value of the Bessemer process, none could exceed that of America, which is indeed unique. In one of her great opening territories, where iron ore existed in myriads of tons, and which must ere long become the centre of a vast industry, the foundations of a new city have been laid, to which the name of Bessemer has been given in recognition of his invention. The Emperor Napoleon, who took so deep an interest in the invention, and who was, in fact, the indirect cause of the invention having been made, was desirous of presenting Mr. Bessemer with the Grand Cross of the Legion of Honour; but it was intimated that unless Her Majesty the Queen would permit it to be worn in this country, the honour would not be conferred. Mr. Bessemer proceeded to Paris, and made application twice to the Foreign Office for the necessary permission, and was twice refused. The Emperor, in consequence, was precluded from carrying out his original intention, but with his own hand, and with very flattering observations, His Majesty gave Mr. Bessemer a magnificent gold medal in lieu of the more highly-prized decoration. It is difficult to understand why the British Government should persistently refuse to allow an Englishman to receive such a mark of distinction, when offered as a pure reward of science. If there is no recognition in this country of such services as Mr. Bessemer has rendered the world at large, and this country in particular, it is hardly right to make "Her Majesty's pleasure" the apparent bar to this justly-merited reward in countries where such services are appreciated by the State. It is impossible that Mr. Bessemer should not feel deeply disappointed in thus being deprived of the honour intended to be conferred on him, and to which he was justly entitled, if ever a man was, while mere hangers-on of a Court are allowed to flaunt their empty honours wherever they go. There is, however, one recognition which we are sure Mr. Bessemer will not complain of, and it is a crucial test of the value of his invention, viz., the recognition given it by the great manufacturing firms of this country, who have most cheerfully paid him over a million sterling for the use of his invention. The real magnates of the iron manufacture, too, paid Mr. Bessemer the well-deserved compliment of electing him as the second President of the Iron and Steel Institute. His term of office was signalized by the foundation of the Bessemer Medal, which has been awarded successively to Mr. I. L. Bell, Dr. C. W. Siemens, and Mr. R. Mushet, whose names, like Mr. Bessemer's own, stand out with prominence in the history of British science and commerce.—*Iron*".

A RECENTLY patented draw-bridge, designed to afford perfect facilities for crossing navigable streams without impeding navigation, is the invention of Lieut.-Com. H. H. Gorringe, U.S.N., of Washington. The bridge is composed of a number of floats, each pivoted or hinged at one end, the other end being moored to anchor-piles by means of a chain passing over a windlass on the swinging end of the draw or leaf. By revolving the windlass the draw or leaf may be swung clear, so as to afford vessels a single passage as wide as the length of the draw; a reverse motion of the windlass closing the draw and opening the roadway. Since this operation may be performed with either or all of the floats, vessels may pass through the bridge at any point selected, or the whole width of the river may be thrown open to navigation. The inventor, among other things, claims "cheapness and facility of construction, greater security than ordinary bridges, freedom from obstruction to navigation, and from risk of damage by freshets, moving ice, and other floating bodies."

FURNITURE DESIGNS.

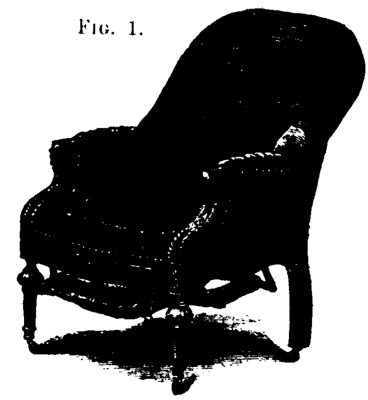


FIG. 1.

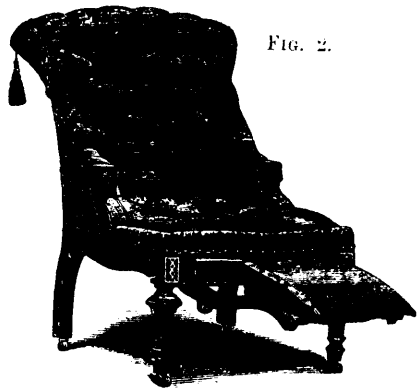


FIG. 2.

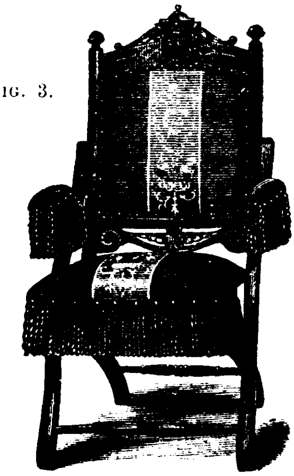


FIG. 3.

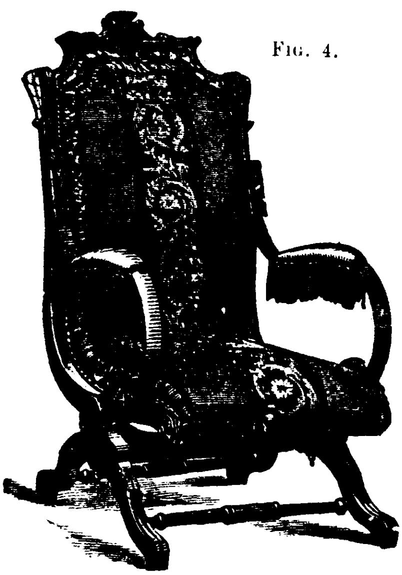


FIG. 4.

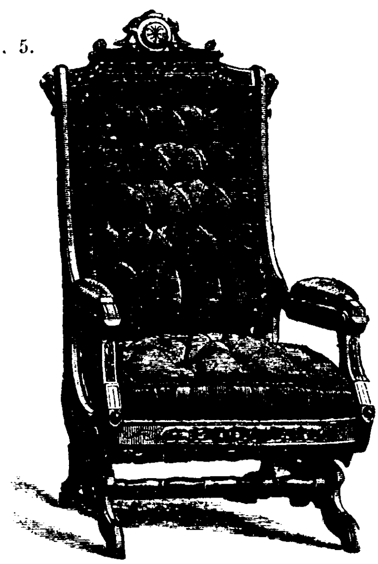


FIG. 5.

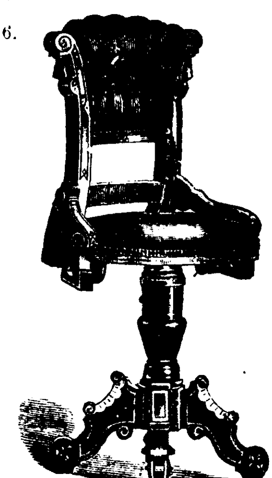


FIG. 6.


FIG. 7.

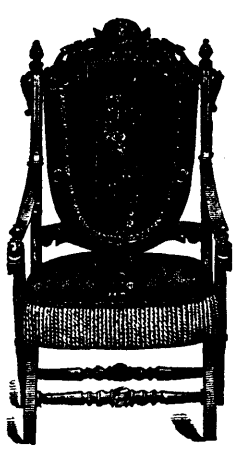


FIG. 8.


FIG. 9.

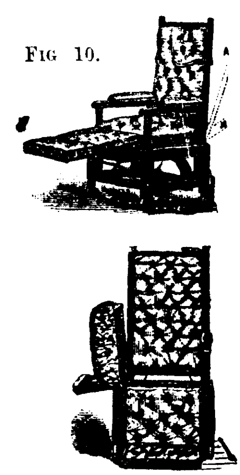
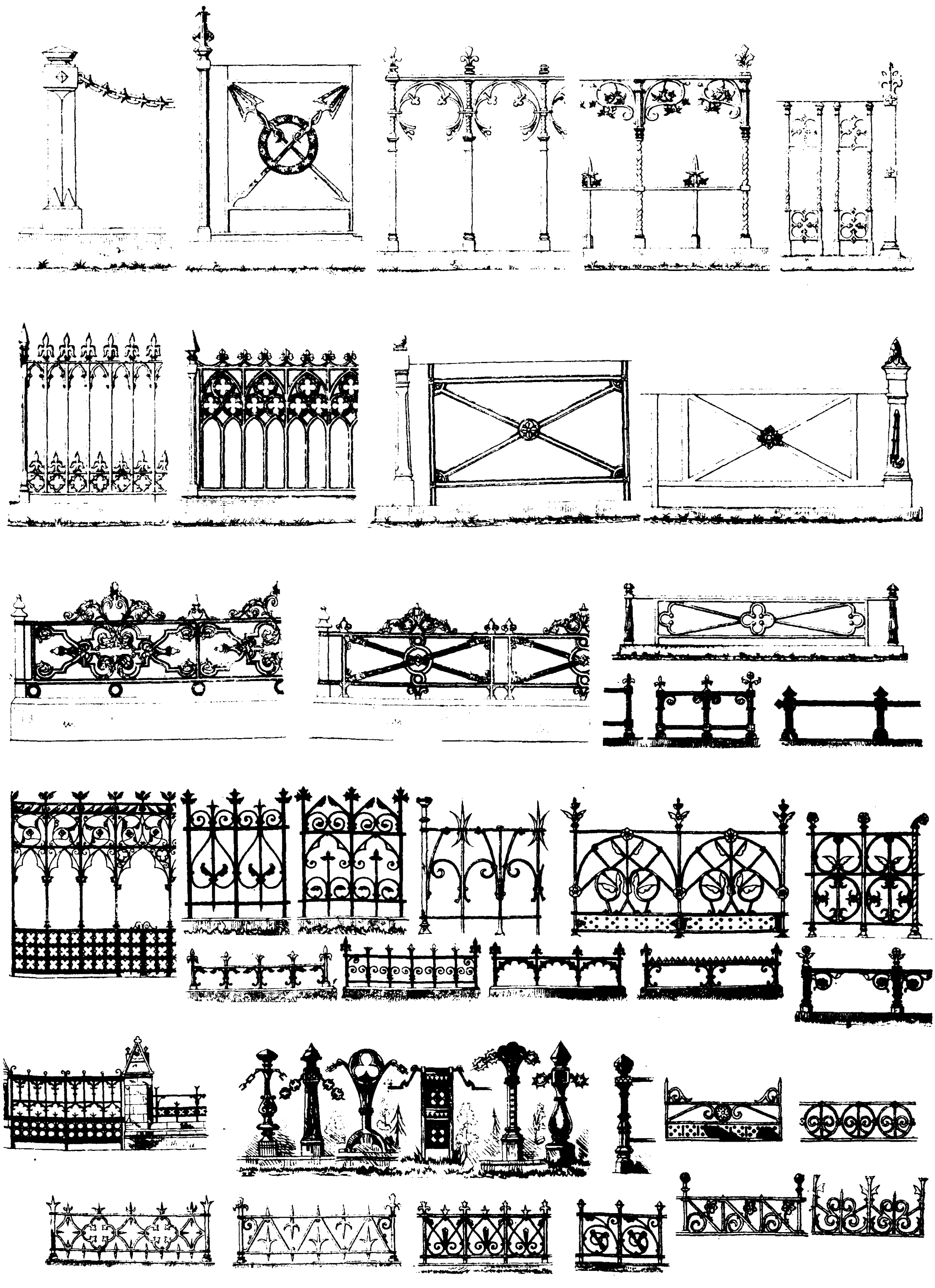


FIG 10.

DESIGNS FOR GOTHIC RAILINGS.—(From Cox & Sons, Gothic Artists, London.)



DURAND AND MARAIS' BRICKMAKING MACHINE.

We publish on page 184 an engraving of the machine, which has lately received considerable modifications and improvements in this country. As will be seen by the drawing, a feeding hopper has been added, consisting of a fixed receiver, and a sliding chamber underneath, to which a reciprocating motion is imparted by means of two connecting rods. This chamber contains sufficient uncompressed clay to form one brick, and its size can be modified to adapt it to different natures of clay employed. In the original machine, the crude method of throwing the clay into a hopper was adopted. The manner of lifting the bars carrying the abutment plate, at the end of the compression box, has also been changed, and they are now raised by means of two cams, one of which is shown on the outside of the frame, and driven by a connecting rod and disc formed on the cam. Another cam is also placed at the forward end of the machine to assist in raising the abutment plate. The ram which compresses the clay is made hollow, and can, if desired, be warmed by waste steam from the engine, a precaution useful in working with some classes of clay. An ingenious detail may also be mentioned, which does not, however, necessarily form a part of the machine. The head of the ram is perforated, after the manner of a stencil plate, with letters or a trade mark, and to a block within the ram are attached pieces of steel corresponding in form with the perforations just mentioned. Motion is given to this block by means of a cam at the moment when the ram is at the end of its stroke, and the projecting pieces, passing through the perforations, impress the name or trade mark upon the side of the brick.

A NEW cheap coating for wood, which is very adherent even when exposed to the weather, consists in simply brushing the surface with a solution of persulphate of iron of 2 deg. to 2½ deg. Beaumé. The blue gray tint which this acquires on drying changes to an agreeable brown when linseed oil varnish is applied.

THE Committee on Patents of the House of Representatives have reported adversely on the application of A. B. Wilson for an extension of his patent for sewing machines. This is the celebrated four-motion feed now used by the Wheeler & Wilson and other machines. The committee say that the applicant has already made two or three large fortunes out of his invention, and that it is time now to give the public a chance. The testimony taken before the committee shows that the cost of making a sewing machine is not more than from £2 8s. to £3.

ACCORDING to the report of the Medical Commissioners on the sanitary qualities of river waters, published in Boston, U. S., in 1874, of all kinds of refuse, human sewage is the one most to be feared. Similar in kind, but less in degree, are the washings of clothing, and the filthy rags supplied to paper mills. Next in order, but of a different kind, are waste liquors, containing animal matters, especially such as are in a state of decomposition. First among these are tanneries and slaughter-houses, whose waste liquors are said to possess from five to ten times the manurial power of average sewage. Next are glue factories, wool screenings, shoddy and woollen mills, and soap works, others are principally dirty or offensive; while dye and chemical stuffs form the principal pollution of a large class of works, and enter secondarily into the waste products of many other industries; but it is plainly desirable, on sanitary grounds, to avoid the admission to drinking water of any kind of filthy or refuse matter.

A CURIOUS instance of what we may term the automatic purification of water is supplied by the following case:—According to the reports of the Water Department at Philadelphia, the impurity in the form of sulphuric acid, from the drainage of the coal mines, amounts, at Schuylvill Haven, to nearly 10 grains in a gallon, an amount destructive to all animal life in the water above Reading. It seems, however, that near the latter place three creeks, the Outelaunee, about six miles above, the Tulpehocken, and Wyoming Creek, at Reading, drain magnesian limestone regions, and thus tend to neutralize the effect of the sulphuric acid by forming sulphate of lime and magnesia at Reading, reducing the amount of acid per gallon to 2·65 grains, and below Valley Creek, at Valley Forge, the amount is said to be reduced to 1·5 grain per gallon, or about the same as at Fairmount Dam. The analysis of the water at Fairmount, in the years 1842, 1854, and 1865, gave respectively ·302, 1.417, and 1·508 grains to the gallon, whilst the lime remained about the same; the magnesia also increased steadily from ·230 to ·835 in the same interval.

HEATING OF JOURNALS.

Engineers in charge of machinery and steam engines are constantly troubled by hot journals. In ocean-going steamers these may occur during the whole voyage, and it is not an unfrequent practice to allow water to run on crank pins and large journals the whole time the machinery is in motion. With locomotives and steam cars, however, running water constantly on the journals is impracticable, and some other expedients have to be adopted. Plumbago and oil, sulphur, soft soap, and a variety of ingredients have been used by engineers with more or less success. The heating of journals may arise from several causes. The shafts may be out of line, dirt may have got into the boxes, there may be too much thrust on the flanges of the bearings, or by neglect in oiling the journals may have got dry. The desiderata are how to cool the journals and how to keep them so. An old remedy for cooling large journals, and one that seldom fails, is, first wash out the journal and boxes as far as practicable by means of a water hose; lubricate slightly with good oil; remove the oil cup and insert in place of it a tin or copper tunnel; fill this with soft soap and water, of such consistency that it will drop freely from the tunnel tube on to the journal, until it is completely cooled. The soft soap lubricates and at the same time the water cools. This plan has not the objection of sulphur and black lead, which cake on the boxes, and to some degree cake and grind on the brasses.

A patent has recently been issued for a new lubricant, which' it is said, has already come into extensive use, and has been recommended by numerous engineers. The material consists of a fine white powder made from a mineral of talcons magnesian character, free from grit, and is ground and bolted especially for this purpose. When applied, three or four pounds of the lubricant is well mixed with one gallon of oil. This mixture will not become gummy, and is found to be equal in service to about three gallons of the best oil. With new cat journals the cellar of the box is filled with waste, well saturated with oil up to the bottom of the journal; then a stiff paste of the lubricant is made with lard or any otter oil, and the remaining space around the journal is entirely filled with it. The lubricant is perfectly incombustible.

CHANNEL COMMUNICATION.

Although many attempts have been made on paper to solve the problem of the Channal passage, the only one which has gained practically even a limited amount of success is the twin steamer designed by Captain Dicey. But though the Castalit has certainly been found to be both a steady and comfortable vessel, in which even the most nervous traveller may embark without fear of suffering from the terrible *mal de mer*, still she lies under the great disadvantage of want of speed, a disadvantage of no small account in the go-ahead times in which we live, when, to business men especially, the loss of half-an-hour in the day is sometimes a matter of the greatest importance. In any schemes therefore for Channel communication, we consider speed must on no account be sacrificed. But by this time it has been proved that in order to construct a comfortable and steady ship, entirely free from rolling, it is absolutely necessary that she should be of such a size as to be uninfluenced by the largest waves which she can meet with on the stormiest day in mid-channel. Here, however, another consideration comes into play, for, although it is easy enough to build a vessel of sufficiently large dimensions as to answer this purpose, she would be too large to go into the existing harbours on either side of the Channel, and consequently would require new harbours to be constructed for her accommodation. Such a plan was proposed some four years ago by Mr. Fowler, but was stopped in its passage through the Houses of Parliament. Mr. Fowler's vessel, however, though it provided for trains to be run on it and carried over without disturbing the passengers, was only able to carry two trains at a time, and there seems some doubt as to whether commercially the scheme would have been a success, as the outlay and cost of maintenance, both of harbour and boats, was very great. But many persons hold that the problems will not have been properly solved until we can get into a sleeping carriage in London, and be able to sleep undisturbed until we arrive in Paris itself. A plan to accomplish this has just been brought out by Mr. H. A. Egerton of Banbury, and though gigantic in idea, and requiring a large amount of capital to start it, still appears to contain more elements of success than any other scheme of a like nature which has yet been brought before the public. Mr. Egerton's plan may be described as in a measure an adaptation of both Mr. Fowler's and Captain Dicey's schemes, inasmuch as he uses separate hulls joined together by girder beams, and provides for carrying ten entire trains at a time. The hulls of Mr. Egerton's vessel are three in number, and consist of cigar-shaped cylinders, spaced three times their diameter apart, and joined by a very strong system of girders, those in the centre resting on the top of the cylinders, but those towards the ends being raised by supports, so as to keep the level of the girders in a horizontal place. The cylinders being so far apart, there will not be the same amount of frictional resistance as there is in the Castalia. The draught in the water is exactly half the cylinder, which being 26 feet in diameter, will allow for waves of 13 feet being encountered without the superstructure coming into contact with the water. The space between the top and bottom of the girders will be fitted up as saloons. The trains run on the platform upon the top of the girders. The whole vessel is driven by three pairs of paddle-wheels, one pair to each cylinder. Of course such a vessel could not get into any of our existing harbours, but Mr. Egerton does not require large and expensive harbours to be constructed, merely providing in his scheme for a large wharf or jetty alongside of which to bring his vessel. In order practically to demonstrate the steadiness, speed, and handiness of this form of vessel, Mr. Egerton has constructed a model 12 feet long, with cylinders 6 inches in diameter, which we had the pleasure of recently seeing tried on the reservoir at Hendon. The model is on the scale of ½ inch to a foot, and ½ oz. to a ton. The experiments with it were a complete success, for in waves of 2 inches in height she was perfectly steady. She moved easily through the water with only two pairs of paddles at work, the centre pair not having been fitted, at about four miles an hour, making hardly any disturbance at all, and her handiness was so great that by reversing one pair of paddles she could be turned round quickly and readily upon her centre.

MOISTURE OF WALLS IN NEW BUILDINS.

Regulations is regard to the fitness for occupancy of dwellings, especially new ones, demand a certain degree of dryness, and the questions as to what the amount of moisture in a wall at any particular time may be, and as to what state of dryness is required through considerations of health, have been much discussed. In a particular place, a certain period for drying new buildings, dependent upon climate, material of construction, and style of architectures, may become to be fixed by experience, as necessary, but the direct testing of the walls as to the amount of moisture in them has not been trustworthy. In view of these facts, a number of experiments were made by Dr. Glassgen, under the direction of Prof. Pettenkofer, for the accurate determination of the amount of moisture present in walls at any time, and a method was finally found that gave satisfactory results. Portions of the plastering, taken from different parts of partition walls, were tested; the free water and water of hydration of the lime were determined separately, the former by drying sifted specimens in a Liebig drying tube, in a current of air freed from carbonic acid, and the latter by passing a current of carbonic acid over the specimen, thus dried while heating it. The general conclusions from the tests made of a great number of buildings, under varying conditions, were that there is a constant loss of moisture proportional to the time, and that there is a great difference between the times of drying in winter and summer, and of exposed and unexposed buildings. Further tests however, involving numerous details, are considered necessary, in order to answer the question as to when a new building may be declared dry; but it is hoped that the publication of the above method and the detailed results may lead to a fuller investigation.

Carbolic Acid Paper, which is now used in such large quantities in this and other countries, for packing fresh meats, etc., for the purpose of preserving them against deterioration by atmospheric or other influences, is made by melting five parts of stearin by a gentle heat, and then stirring in thoroughly two parts of carbolic acid, after which five parts of paraffin, in a melted form, are added. The mass thus prepared is then well stirred together until it cools, after which it is applied with a brush to the paper, in quires, in the same manner as the waxed paper—so much used in Europe as a wrapping material for various articles—is treated.

A New Mucilage.—The *Journal de Pharmacie* states that if, to a strong solution of gum arabic, measuring eight and one-third ounces, a solution of 30 grains of sulphate of aluminum dissolved in two-thirds of an ounce of water be added, a very strong mucilage is formed, capable of fastening wood together, or of mending porcelain or glass.

OUR HOLIDAY.

CRICKET. — I.

(See page 116.)

The early days of spring bring with them the return of the cricketing season, and by many persons they are more gladly welcomed on that account, than for all the other charms which accompany them. Cricket is, undoubtedly, the national pastime of England. Every rural village has its players; towns and counties all over the kingdom are pitted against each other in rivalry for the palm of superiority in the game. Commencing in school-days, the pastime is often carried on as the chosen recreation of mature years; and with real benefit to him who practises it. For cricket is a vigorous and manly game, free from abuses that attend some other field sports, and well calculated to refresh and strengthen the physical powers, while it has sufficient science in its elements to give a not unprofitable exercise to the mental faculties also.

Cricket, for so universal a pastime, is a very modern game. It owes its origin, in its present form, to a meeting in the year 1774, of some noblemen and gentlemen, who wished to improve the "bat and ball" of the period, and drew up a set of rules to fix the character of the implements employed, as well as the mode of play. These rules were subsequently amended and modified, and they gradually gained general acceptance. The first great cricket club was established at the close of the last century. It was called the White Conduit Club, from the circumstance of its play usually being held in the White Conduit Fields; and from this club the far-famed Marylebone Club of the present day took its rise.

There are two forms of the game of cricket — one known as single, and the other as double wicket. For single wicket only a few players are required; but for double wicket, it is necessary, to play the proper game, that two sides should be formed, with eleven players on each side. Any large open field, that is tolerably level, will do for the practice of the game; but a good cricket ground, fit for the set play of club against club should be — at least that portion of it between the wickets — as level and as well kept as a good bowling-green, or, as is sometimes said with but little exaggeration, "as a billiard-table."

The implements used in the game are bats, balls, and wickets. In single wicket one bat and one wicket only are necessary; for the double game there must be at least two of each, an extra supply being always advisable in case of an accident during the game. The form of the cricket-bat is, no doubt, familiar to all our readers; its length should be suited to the height of the player, and such that he may wield it readily and with good effect; but, by the rules of the game, no bat must be more than thirty-eight inches long, or more than four-and-a-quarter inches in the widest part.

The ball is made of leather, and as it has to undergo very hard usage, it is best if made with what is known as the "treble seam." Its size is fixed at not less than nine inches nor more than nine-and-a-quarter inches in circumference. It must weigh not less than five-and-a-half ounces, nor more than five ounces and three-quarters. Both sides in the game play with the same ball; but at the commencement of each innings either party may call for a new one. The player is not restricted as to the precise bat he may use, provided it be a cricket-bat within the dimensions above specified.

Each wicket consists of three stumps, usually made of strong and polished wood, and pointed at one end so as to be firmly fixed in the ground. The height at which they stand when set is fixed at twenty-seven inches out of the ground. There must be sufficient space between the stumps to prevent the ball from passing through. The top of each stump is grooved, and in the grooves, when the stumps are set, two small pieces of wood called *bails* are laid from stump to stump. The length of the bails is fixed at eight inches.

These are all the accessories that are actually required for the game. But padded gloves and leg-guards are frequently used by the principal players—the batsman and the wicketkeeper—to prevent injury to the hands or legs when playing. They are especially useful when the bowling is of the fast order which has become so much in vogue in recent times. One set is sufficient for a small club, or for a school party, for the common use of its members; but young players can do very well without them, when they have only beginners like themselves to contend against.

CRICKET.

We come now to the preparation and allotment of the cricket ground preparatory to play, confining our remarks at present to the usual game of double wicket. If only an ordinary field be available for the game, the most level portion of it, as near the centre as possible, is selected for the purpose of pitching the wickets. These must be directly opposite each other, and at a distance of twenty-two yards apart. A line six feet eight inches in length is drawn with chalk upon the ground at each wicket, so that the stumps stand in its centre. This is called the *bowling crease.* At each end of it another but short line is drawn at right angles behind the wicket, and this is named the *return crease.* The object of these lines is to mark out the space within which the bowler must be standing when he delivers the ball. In front of the wicket, four feet from it, and parallel with the bowling crease, another line, called the *popping crease*, is drawn. No precise length is defined for the popping crease, save that it must be at least as long as the bowling crease behind it. Within the space marked by these two creases is the batsman's proper ground, passing out of which he risks being put out of the game, by a touch of the wicket with the ball by one of the opposite side. The nature of the creases, and the ground marked out by them, will be made clear by diagram No. 1.

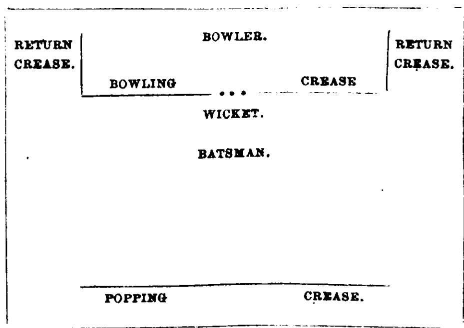


DIAGRAM NO. 1. THE BOWLING AND POPPING CREASES.

Before commencing the game, the two parties—divided, we will suppose, into the ordinary number of eleven on each side—select two umpires, whose duty it is to see that the rules of the game are adhered to, and settle disputed points that may arise in the course of the play. The umpires pitch the wickets, and the captains or leading members of the two elevens toss for innings; that is, which side shall first take the bat in the play. The winner's party generally go first to the wickets. The order in which they shall take the bat is decided by their leader. Two of the party station themselves, bat in hand, before the wickets, facing each other; and they are then ready for the game.

The opposite side select their bowler, and the captain of this eleven stations his men at the various points of the ground, according to his knowledge of their particular aptitude in *fielding*—that is, in catching the ball, stopping it, etc. The positions in which the fielders as a body shall be placed are fixed by custom, which is founded on experience of where they are most likely to be effective. These positions are occasionally varied to suit the character of the bowling, whether fast or slow; but as a rule the men are stationed for medium bowling nearly in the positions indicated by diagram No. 2.

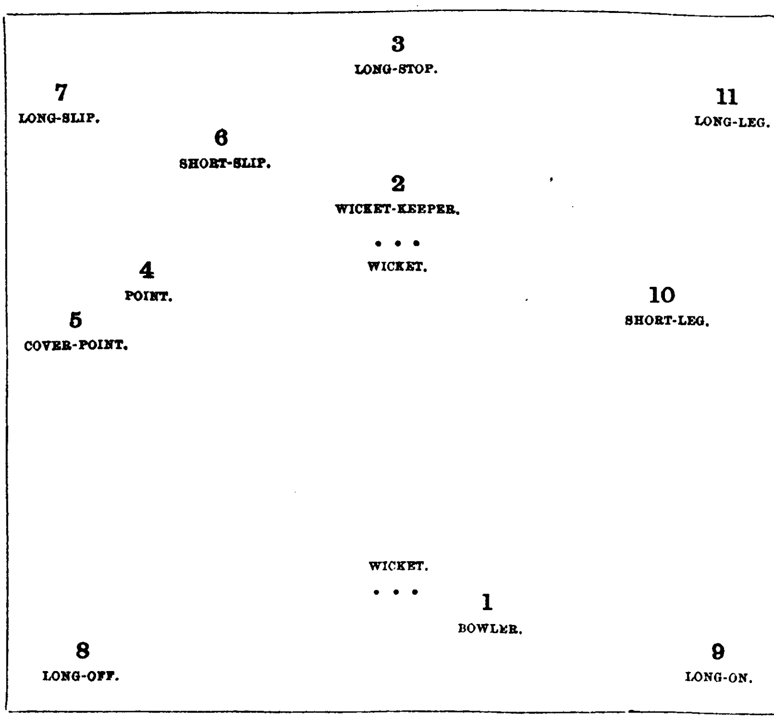


DIAGRAM NO. 2. DISPOSITION OF THE PLAYERS ON THE CRICKET FIELD.

All being now in readiness for the game, the bowler takes the ball, and, after calling "play" before starting, delivers the ball in the direction of the wicket farthest from him. His object is to strike it with the ball, and if he succeed in the attempt, the batsman stationed at that wicket is out. The object of the batsman obviously is to keep the ball off his wicket, and also, by striking it to a distance, to make one or more *runs* towards the game for his party. A run is scored when the batsman is able to pass from wicket to wicket without being put out before he comes fairly behind the popping crease, or places the end of his bat within it. If the batsman runs from one wicket to the other, and then returns to the wicket he started from, he counts two runs for his party, and so on.

When the ball is struck, the fielders, waiting in eager expectation, strive to catch it or otherwise stop it, and return it immediately to the wicket-keeper or bowler, that he may strike the wicket with it before the batsman reaches home. If this be done, or if the ball be caught in the first instance, the batsman is out, and another of his party succeeds him, until all the eleven have taken the bat in turn. The number of runs they have made between them is then counted up, and their opponents, now taking their innings, try to get a higher number if possible. Usually, in a game of double wicket, each side has two innings, and the party that can boast the highest total at the end of the play wins the game.

This is a brief explanation of the mode and the object of the play; but it may be as well to remark here that, besides the runs gained by the batsmen in the manner before mentioned, the side which has the innings are sometimes allowed to score runs through the negligence of their opponents. Thus, if the ball, instead of being fairly bowled, is thrown or jerked towards the wicket, it is called a "no ball," and the batsman's party score one for it. Again, if it pass over the striker's head, or so wide of the wicket as to be out of his reach, it is a "wide ball," and the *in* side score one. Or, if either the "no ball" or "wide ball" be not stopped by the fielders, the batsmen may run from wicket to wicket, as if the ball had been struck in their play, and count as many runs as they can make.

There are also other ways of the batsman's being put out than those mentioned in the foregoing description; but these will be found fully detailed in the laws of the game, which will be given in another paper. In this we shall also give a little practical advice to the young player, with illustrations of the proper attitudes in batting, bowling, etc.

CRICKET.

We come now to the practical part of the game, concerning which a few hints will be useful to the beginner. A good cricketer can only be made by practice, but it will assist the learner to have right principles before him at the outset.

The Batsman, at starting, should stand in the position shown in Fig. 1—his right foot firmly planted on the ground, and his left in readiness to move freely either to the one side or the other, as may be required in striking the ball. He grounds the end of his bat at a spot within the popping crease, and about the length of the bat from the wicket; and, in order that he may guard his wicket well, he is entitled to ask the umpire stationed near the opposite wicket to give him the correct line for the middle stump; that is, to inform him when his bat is so placed as to cover this stump, looking from the bowler's end. He marks this spot by an indentation with the bat, and is then in readiness for the ball. One general rule must be laid down for playing either fast or slow balls. If they appear to be coming straight into the wicket, they must be *blocked*, or stopped, and the player should not attempt to strike them.

Fig. 1.—The Batsman in Position.

In blocking, the bat is lifted only a short distance from the ground, and the ball is struck downward, so as to bring it to a dead stop if possible. For this purpose the handle of the bat should be sloped well forward, by which means the front of the bat is made to cover the ball, and prevent its rising from the ground. Otherwise, in blocking, the ball may receive just such a tip as will cause it to pass from the edge of the bat into the hands of "point" or "cover-point," who will be on the look-out for it.

The position known as "the draw," which is engraved in our second figure, is something between a block and a hit, partaking of the nature of both. It is the mode of meeting a ball when, after being pitched, it rises from the ground and is apparently coming straight in towards the top of the wicket or the bails. The bat is held straight before the wicket (Fig. 2), but the surface of the bat, instead of meeting the ball full, is turned slightly to one side, so that the ball, when it meets the bat, is turned off at an angle, and a run is frequently the result.

If the ball, when delivered, appears to be coming somewhat wide of the wicket, the batsman may play it freely, either by a "hit," a "cut," or a "drive." But it is frequently difficult to tell what line the ball is really taking, for, if you are playing against an expert bowler, you will probably find the balls come towards the wicket with a twist from the spot at which they were pitched, and, instead of pursuing a straight course, turning in to the stumps. The great art of bowling, indeed, is to be able to give this twist to the ball, as well as to direct it straight at the wicket. Nothing but practice, and quickness both of eye and hand, will teach the young batsman to guard effectually against this danger.

Fig. 2.—"The Draw."

In striking, hit the ball, if possible, between the line of the fielders, or wherever you see the field most open and unprotected. Strike low, so that you may not afford the opportunity of a catch to one of your watchful opponents. Do not be too eager to make runs; let your object rather be to protect your wicket as long as possible, waiting your opportunity for a good hit now and then at a ball delivered with less care than usual. Do not attempt a run after the ball is in the hands of one of the fielders, otherwise the ball may reach your stumps before you can return to the wicket, and you will be "run out."

If practice is necessary to the batsman, it is still more essential to make an expert Bowler. The learner should practise bowling at a mark, either in a field or in an outhouse. He should acquire both the fast and the slow styles, for it is of the greatest service in actual play to be able to vary the character of the bowling—to deliver a slow ball after a fast one, and *vice versâ*. Nothing is more embarrassing to the batsman than the uncertainty this causes as to the kind of ball he is about to receive. The bowler should acquire, also, the knack of twisting the ball in its delivery, to which we have previously alluded. The ball should be held in the fingers only, and not grasped in the palm of the hand. It matters not whether the style of delivery be "round-arm," or "under-hand"—that is, whether with a swing of the arm from the shoulder, or bowled in the ordinary meaning of the word. The learner should adopt that mode which gives him the greatest command of the ball and its direction. The round-arm style is more generally suited to fast, and the under-hand to slow bowling; but this rule has its individual exceptions. A few years ago, very little bowling other than in the round-arm style was seen in the cricket field. The under-hand fashion was regarded with some degree of contempt. Now, however, it has come again into vogue, and may be seen practised almost, if not quite, as frequently as the more modern round-arm delivery. Fig. 3 represents the attitude of the bowler when about to deliver the ball in round-arm style.

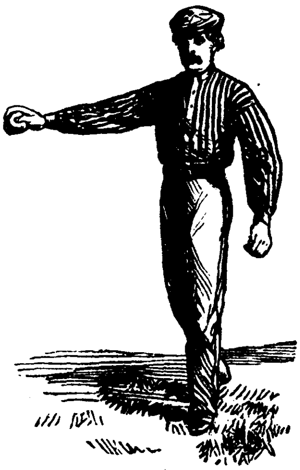


Fig. 3.—The Bowler.

Next in importance to batsman and bowler, in the duties he has to perform, comes the Wicket-keeper. His duty is to stop the ball, if he can, immediately it passes the wicket, and, if the batsman be not sufficiently guarded, or within his bounds, to knock the bails off before the striker can recover his proper position. He should also receive the ball after the fielders have secured it, and it is his place to throw it at the stumps before the batsman can complete his intended run. Therefore, the fielder who may stop the ball, instead of throwing it at once to the wicket, should deliver it as quickly as possible into the hands of the wicket-keeper; otherwise, if he miss his aim and the ball pass by the wicket, the batsman may run again, and make as many more towards the score as if the ball had been again hit. The hands of the wicket-keeper should be protected by padded gloves, especially if the bowling be of the fast order. The watchful and ready attitude of the wicket-keeper are depicted in Fig. 4.

Balls which pass the wicket-keeper should be secured by Long-stop, who is stationed at some distance behind him for that purpose, as indicated in the diagram of the relative positions of the players, given in our previous paper. The other duties of long-stop and the rest of the fielders may be described in general terms. They must be on the vigilant look-out when the ball is delivered, that they may catch it or stop it as soon as possible, if it should chance to be struck that way. Quickness of eye, a firm hand for a catch, and good legs, the power to throw a ball straight to the wicket-keeper, and judgment not to *over-throw* it, are the essentials to a good fielder. Such a player is often able to render his side quite as good service as either the expert bowler or the batsman.

Fig. 4.—The Wicket-keeper.

4. The Bowling Crease must be in a line with the stumps, six feet eight inches in length; the stumps in the centre; with a return crease at each end, towards the bowler, at right angles.

5th. The Popping Crease must be four feet from the wicket, and parallel to it; unlimited in length, but not shorter than the bowling crease.

6. The Wickets must be pitched opposite to each other by the umpires, at the distance of twenty-two yards.

7. It shall not be lawful for either party during a match, without the consent of the other, to alter the ground by rolling, watering, covering, mowing, or beating, except at the commencement of each inning, when the ground shall be swept and rolled. This rule is not meant to prevent the striker from beating the ground with his bat near the spot where he stands during the innings, nor to prevent the bowler from filling up holes with sawdust, etc., when the ground is wet.

8. After rain the wickets may be changed, with the consent of both parties.

9. The Bowler shall deliver the ball with one foot on the ground behind the bowling crease, and within the return crease, and shall bowl four balls before he change wickets, which he shall be permitted to do only once in the same innings.

10. The ball must be bowled. If thrown or jerked, the umpire shall call "No ball."

11. He may require the striker at the wicket from which he is bowling to stand on that side of it which he may direct.

12. If the bowler shall toss the ball over the striker's head, or bowl it so wide that, in the opinion of the umpire, it shall not be fairly within the reach of the batsman, he shall adjudge one run to the party receiving the innings, either with or without an appeal, which shall be put down to the score of "wide balls." Such ball shall not be reckoned as one of the four balls; but if the batsman shall by any means bring himself within reach of the ball, the run shall not be adjudged.

13. If the bowler deliver a "no ball," or a "wide ball," the striker shall be allowed as many runs as he can get, and he shall not be put out except by running out. In the event of no run being obtained by any other means, then one run shall be added to the score of "no balls" or "wide balls," as the case may be. Alls runs obtained for "wide balls" to be scored to "wide balls." The names of the bowlers who bowl "wide balls," or "no balls," in future to be placed on the score, to show the parties by whom either score is made. If the ball shall first touch any part of the striker's dress or person (except his hands), the umpire shall call "Leg bye."

14. At the beginning of each innings the umpire shall call "Play." From that time to the end of each innings no trial ball shall be allowed to any bowler.

15. The Striker is Out if either of the balls be bowled off, or if a stump be bowled out of the ground;

16. Or if the ball, from the stroke of the bat, or hand, but not the wrist, be held before it touch the ground, although it be hugged to the body of the catcher;

17. Or if, in striking, or at any other time while the ball shall be in play, both his feet shall be over the popping crease, and his wicket put down, except his bat be grounded within it;

18. Or if, in striking at the ball, he hit down his wicket;

19. Or if, under pretence of running, or otherwise, either of the strikers prevent a ball from being caught, the striker of the ball is out;

20. Or if the ball be struck, and he wilfully strike it again;

21. Or if, in running, the wicket be struck down by a throw, or by the hand or arm (with ball in hand), before his bat (in hand) or some part of his person be grounded over the popping crease. But if both the balls be off, a stump must be struck out of the ground;

22. Or if any part of the striker's dress knock down the wicket;

23. Or if the striker touch or take up the ball, while in play, unless at the request of the opposite party;

24. Or if with any part of his person he stop the ball, which, in the opinion of the umpire at the bowler's wicket, shall have been pitched in a straight line from it to the striker's wicket, and would have hit it.

25. If the players have crossed each other, he that runs for the wicket which is put down is out.

26. A ball being caught, no run shall be reckoned.

27. A striker being run out, that run which he and his partner were attempting shall not be reckoned.

28. If a "Lost ball" be called, the striker shall be allowed six runs; but if more than six shall have been run before "Lost Ball" shall have been called, then the striker shall have all which have been run.

29. After the ball shall have been finally settled in the wicket-keeper's or bowler's hand, it shall be considered dead; but when the bowler is about to deliver the ball, if the striker at his wicket go outside the popping crease before such actual delivery, the said bowler may put him out, unless (with reference to the 21st law) his bat in hand, or some part of his person, be within the popping crease.

30. The striker shall not retire from his wicket and return to it to complete his innings after another has been in, without the consent of the opposite party.

31. No substitute shall in any case be allowed to stand out or run between wickets for another person without the consent of the opposite party; and in case any person shall be allowed to run for another, the striker shall be out if either he or his substitute be off the ground in manner mentioned in laws 17 and 21, while the ball is in play.

32. In all cases where a substitute shall be allowed, the consent of the opposite party shall also be obtained as to the person to act as substitute, and the place in the field which he shall take.

33. If any fieldsman stop the ball with his hat, the ball shall be considered dead, and the opposite party shall add five runs to their score; if any be run, they shall have five in all.

34. The ball having been hit, the striker may guard his wicket with his bat, or with any part of his body except his hands, that the 23rd law may not be disobeyed.

35. The Wicket-keeper shall not take to ball, for the purpose of stumping, until it shall have passed the wicket; he shall not move until the ball be out of the bowler's hand; he shall not by any noise incommode the striker; and if any part of his person be over or before the wicket, although the ball hit it, the striker shall not be out.

36. The Umpires are the sole judges of fair or unfair play; and all disputes shall be determined by them, each at his own wicket; but in case of a catch which the umpire at the wicket bowled from cannot see sufficiently to decide upon, he may apply to the other umpire, whose opinion shall be conclusive.

37. The umpires in all matches shall pitch fair wickets, and the parties shall toss up for choice of innings. The umpires shall change wickets after each party has had one innings.

38. They shall allow two minutes for each striker to come in, and ten minutes between each innings. When the umpire shall call "Play," the party refusing to play shall lose the match.

39. They are not to order a striker appealed to by the adversaries;

40. But if one of the bowler's feet be not on the ground behind the bowling crease, and within the return crease, when he shall deliver the ball, the umpire at his wicket, unasked, must call "No ball."

41. If either of the strikers run a short run, the umpire must call "One short."

42. No umpire shall be allowed to bet.

43. No umpire is to be changed during a match, unless with the consent of both parties, except in case of violation of the 42nd law; then either party may dismiss the transgressor.

44. After the delivery of four balls, the umpire must call "Over," but not until the ball shall be finally settled in the wicket-keeper's or bowler's hand; the ball shall then be considered dead; nevertheless, if an idea be entertained that either of the strikers is out, a question may be put previously to, but not after, the delivery of the next ball.

45. The umpire must take especial care to call "No ball" instantly upon delivery; "Wide ball," as soon as it shall pass the striker.

46. The Players who go in second shall follow their innings if they have obtained eighty runs less than their antagonists, except in all matches limited to only one day's play, when the number shall be limited to sixty instead of eighty.

47. When one of the strikers shall have been put out, the use of the bat shall not be allowed to any person until the next striker shall come in.

NOTE.—Complaints having been made that it is the practice of some players when at the wicket to make holes in the ground for a footing, the committee are of opinion that the umpires should be empowered to prevent it.

THE LAWS OF SINGLE WICKET.

1. When there shall be less than five players on a side, bounds shall be placed, twenty-two yards each, in a line from the off and leg stump.

2. The ball must be hit before the bounds to entitle the striker to a run, which run cannot be obtained unless he touch the bow-

ling stump or crease in a line with his bat, or some part of his person, or go beyond them, returning to the popping crease as at double wicket, according to the 21st law.

3. When the striker shall hit the ball, one of his feet must be on the ground and behind the popping crease, otherwise the umpire shall call "No hit."

4. When there shall be less than five players on a side, neither byes nor over-throws shall be allowed, nor shall the striker be caught out behind the wicket, nor stumped out.

5. The fieldsman must return the ball so that it shall cross the play between the wicket and the bowling stump, or between the bowling stump and the bounds. The striker may run till the ball be so returned.

6. After the striker shall have made one run, if he start again he must touch the bowling stump and turn before the ball cross the play, to entitle him to another.

7. The striker shall be entitled to three runs for lost ball, and the same number for ball stopped with bat, with reference to the 28th and 33rd laws of double wicket.

8. When there shall be more than four players on a side, there shall be no bounds. All hits, byes, and overthrows shall then be allowed.

9. The bowler is subject to the same laws as at double wicket.

10. Not more than one minute shall be allowed between each ball.

FRACTURES, DISLOCATIONS AND ACCIDENTS.

It is often evident to a bystander that a fracture or dislocation exists, without knowing what can be done in the interval which must elapse before the arrival of competent professional assistance. Of course no one but a very ignorant and bold man would attempt to do more than make the sufferer *comfortable* in the meanwhile.

In instances of suspected fracture or dislocation of the lower extremity, the injured parts should be placed in a comfortable position, and as well supported as possible, to prevent the *twichings* of the leg from the spasmodic action of the muscles of the injured extremity. If necessary to remove the patient to his home or the hospital, from the spot where the accident happened the arrangement of the limb should be made after he has been placed on the stretcher or substitute.

If found necessary to carry the injured person some distance, and a litter for the purpose cannot be had, the arrangement of the fractured limb against the other, and kept there by handkerchiefs, as shown in the cut (*a*), is often of great comfort to the sufferer.

If the general character of the injury is evident, in sending for the surgeon it is best to tell the messenger, so that, as far as possible, the necessary appliances can be provided before leaving the office.

In the meanwhile, under no circumstances should the bystanders be permitted to handle the affected part beyond what is absolutely necessary. As a general rule, a much longer time than is commonly supposed, by most people, may pass between the occurrence of the accident and the arrival of the surgeon without serious injury to the patient or ultimate disadvantage to the fracture. Many persons, thinking that the broken bone must immediately be "set," are apt to accept the services of the first person arriving asserting himself qualified to do it. Such an individual necessarily makes a more painful examination than is necessary, applies the splint—perhaps not at all the most useful—which the surgeon, arriving later, is obliged, out of consideration for the condition of the sufferer, to acquiesce in.

If the injury is to the upper extremity, the part should be placed in a supporting sling, and kept in a comfortable position.

WOUNDS.

For systematic study, wounds may be classified according to their direction, or depth, or locality; but for our purpose they may be arranged after the mode of their infliction: (1.) Incised wounds, as cut or incisions, including the wounds where portions of the body are clearly cut off; (2.) Punctured wounds, as stabs, pricks, or punctures; (3.) Contused wounds, which are those combined with bruised or crushing of the divided portions; (4.) Lacerated wounds, where the separation of tissue is effected or combined with tearing of them; (5.) Poisoned wounds, including all wounds into which any poison, venom, or virus is inserted.

Any of these wounds may be attended with excessive *hemorrhage* or *pain*, or the presence of dead or *foreign* matter. As all wounds tend to present several *common* features, a few words will be said about them before describing the distinctive characteristics of each.

The first is hemorrhage (bleeding). This depends, as to *quantity*, upon several conditions, the chief of which is the *size* of the *blood vessels* divided, and, to a degree, upon the *manner* in which it has been done. A vessel divided with a *sharp* instrument presents a more favorable outlet for the escape of blood than one that has been divided with a *blunt* or serrated instrument, or one that has been *torn* across. Except in the first named, the minute fringes or roughness necessarily left around the edges of the vessel at the point of division *retard* the escape of blood, and furnish points upon which *deposits* of blood, in the shape of clots, can take place. Hence, all other things being equal, an incised wound is usually attended with more *hemmorrhage* than contused or lacerated wounds.

Personal peculiarities of the patient, and the health or disease of the wounded part of the body, may exert much influence upon the hemorrhage. Usually it ceases in a short time by the coagulation (clotting) of the blood in the severed extremity of the vessel, without further attention than the application of cold, which favors *contraction* of the blood vessel divided, as well as those leading to the injury part. Should an *artery* or branch have been divided (indicated by a *spurting* of a spray of bright blood at each beat of the heart), the bleeding may not cease at once. To stop it, the firm pressure of the finger for some time to the point of division (*b*), should be used, to diminish the size of the vessel at that point, until a clot is formed there.

Sometimes, pressure to the supposed seat of the injured vessel does not *reach* the artery. In such a case the pressure must be used to some known trunk between the original supply of the blood and the injured branch. Thus, if the finger or the toe is the seat of the arterial hemorrhage, firm pressure applied each *side* of the finger, close to the hand (as in the cut *c*), or toe, close to the foot, compresses the arteries passing along to be distributed to the extremity. If the hand or foot is the seat of injury, pressure on the wrist, over the point where the artery is felt for the "pulse," or at the inside of the ankle, will materially retard the passage of the blood beyond those points. Should pressure by the thumb at these suggested points not answer the purpose, the main trunk of the artery, higher up, should be compressed by a tourniquet. Before this is done, it is always well to place the person injured flat on his back, and hands in a perpendicular position for a time, as the heart will then be unable to throw the blood with its usual *force* to the extremity. Pressure applied by the fingers, with broken ice in a towel bound round the arm, in conjunction with the elevation of it, will often stop the hemorrhage, or retard it, until professional aid is secured. If the foot is the seat of the injury, elevate the whole limb in the same way, applying pressure and pounded ice on the same principle.

In wounds of the scalp there is usually much loss of blood, owing to the abundant blood supply of that part. The firm skull below offers a good point for pressure, and the vessel rarely fails to be compressed if the thumb is applied over the point of division of the severed vessel.

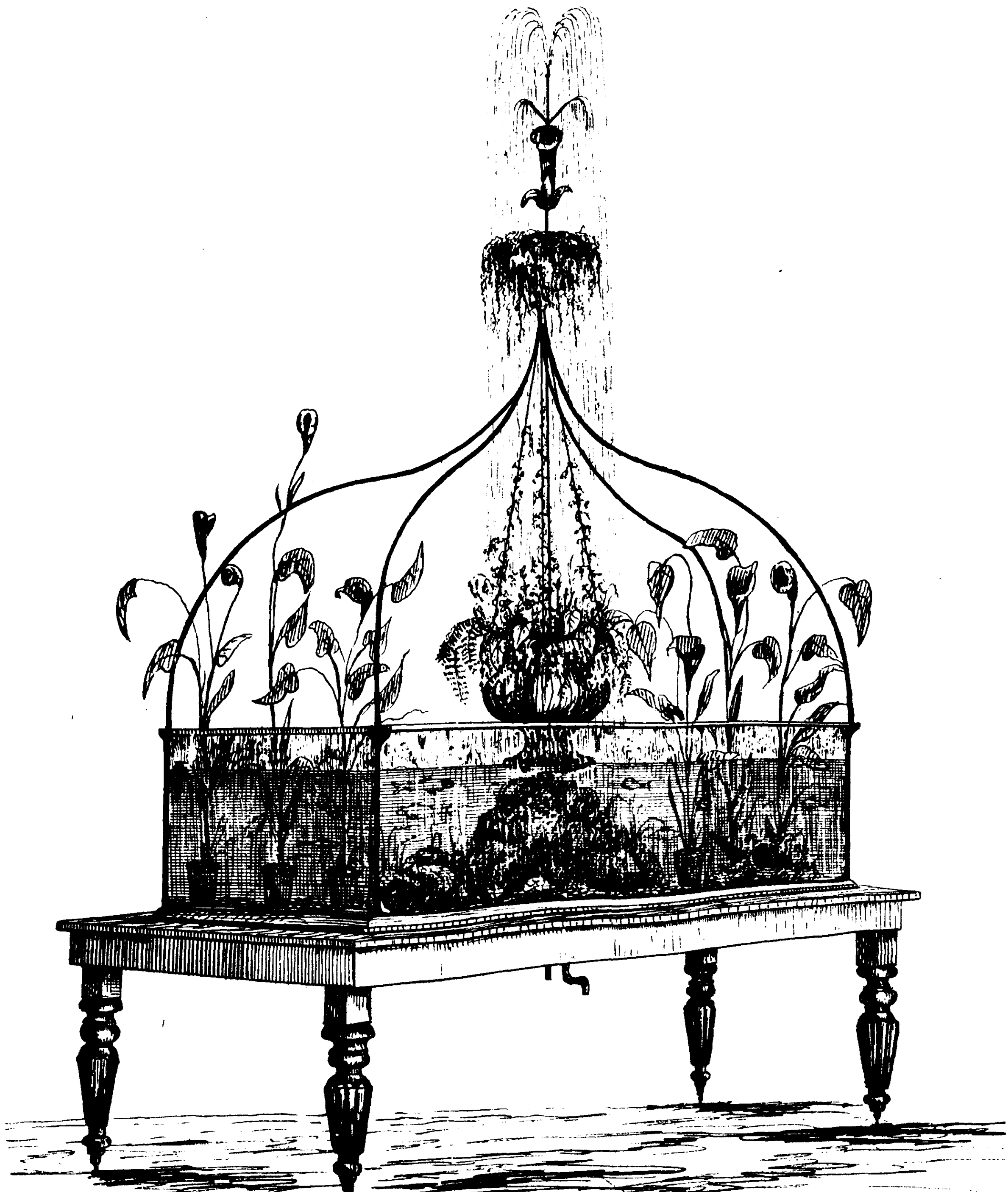
The *amount* of blood actually lost is apt to be much overestimated. Quite a *small* quantity will seem "a half pint" if distributed over the clothing, and a gallon of water requires no great amount added to it to give it quite a blood-red color. It is estimated that about one-eighth of the weight of the entire human body is blood; in other words, the quantity of blood in a human body weighing 144 pounds would be about 16 or 18 pounds. Of course, this amount, nor half of it, perhaps, can be withdrawn from the vessels without fatal results; but it is merely mentioned to show that the entire quantity asserted to exist by physiologists is *much larger* than is popularly supposed. When hemorrhage from a divided blood vessel is seen, there is usually much more apprehension and excitement about it than is warranted.

Figure (*d*) shows the method of exerting pressure by the fingers along the course of the brachial artery; between the divided vessel and the heart.

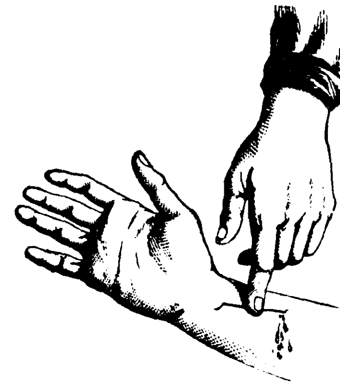
If the wound should be in the arm, above the point indicated by the fingers, or in the axilla ("arm-pit,") pressure could be made at E, by the thumb, a blunt stick, properly protected, or the handle of a door key upon the sub-clavian artery, which passes, as the name suggests, along under the clavicle ("collar-bone") and down the arm, where it is called brachial artery —just spoken of. Further down the arm at the elbow, this vessel is sub-divided into two others, each following a bone of the fore-arm to the wrist. At the wrist, over one bone, near the surface, the pulsation of the heart is sought by the finger of the physician.

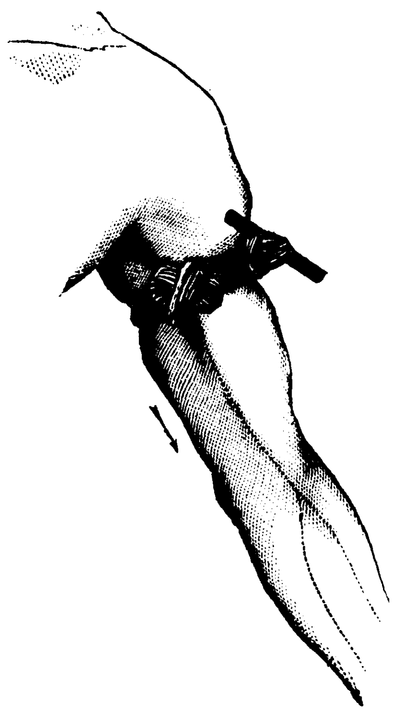
Permanent pressure being exerted by means of a temporary tourniquet to the brachial artery spoken of on the other page, a

FRESH WATER AQUARIUM.



HOW TO STOP THE EFFUSION OF BLOOD AFTER AN ACCIDENT.





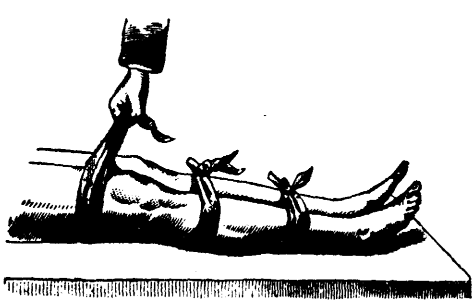
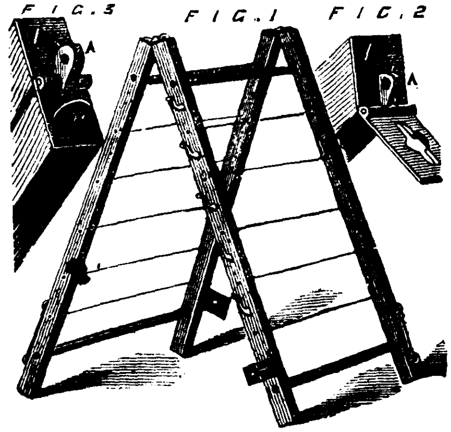


FIG. 3 FIG. 1 FIG. 2



common folded handkerchief, with a firm, sharply-defined knot tied at the middle, a long strip of muslin torn from a shirt sleeve, or a suspender, with a suitable knot in it, is rather loosely tied around the arm, and the slack taken up by twisting with a cane or stick until the knot, kept over the vessel, exerts enough pressure to prevent the passage along it of the blood.

This is easily done if you proceed to it quietly, without talking; especially if previously practiced once upon the extremity of a friend.

(To be continued.)

NOTE.—The arm and fore-arm. with dotted lines, indicate the course of the arteries, and points at which pressure can be most judiciously applied.

The arrow points the course of the current of the blood of the artery, from the heart to the extremities.

IMPROVED CONTROLLING NOZZLE.

(See page 182.)

We illustrate herewith an improved nozzle, adapted to fire extinguishing apparatus and for other purposes, whereby the size of the stream, and consequently the volume of water projected, may be easily controlled, or the jet be altogether shut off. There are many advantages attending this arrangement, which will suggest themselves to all conversant with the demerits of the ordinary nozzles. Perhaps the most important advantage (and the one that will especially commend itself to insurance companies) is that the device is calculated to prevent the indiscriminate flooding of warehouses, and the consequent large damage, by water, to buildings and to valuable stock. The reduced stream suffers no diminution of force, and can be thrown as far as, if not farther than, a jet projected from a common plain or ring nozzle. Consequently, in small fires, the quantity of water necessary for their extinguishment can be applied, and any surplus drenching avoided. The controlling mechanism opens and closes the nozzle very uniformly and gradually, so as to avoid the shock due to sudden starts or stoppages of water. The hose is thus prevented from bursting, while the apparatus is rendered safe for use on hose or hydrants carrying high pressures, and on hose connected to fire engines equipped with relief valves. Greater facility is also afforded in handling hose, by closing down the nozzle and reducing or cutting off the back thrust of the stream.

An exterior and a sectional view of the invention are given in the annexed engravings. The nozzle barrel, A, is screwed into an end piece, B, which has its discharge orifice, C, opening into a valve guard tube, D, in which are air inlet holes, E. A long pointed cone valve, F, placed concentrically with the nozzle, has its stem, G, accurately fitted, but free to move in a small tube, H, which is supported by two thin feather-edged wings, I, fixed transversely in the barrel. A long narrow slot, K, is formed through the wings and barrel, in which slot traverses a flat bar, L, which is fixed to the valve stem. Said bar has rack teeth on its end, which engage the screw threads of a milled sleeve, M, which revolves freely on the barrel, A, and which moves the cone valve out and in from its seat at the discharge orifice, to regulate the size of the stream or to shut off the same. The water forms on the cone a solid round jet, which does not fill or touch the tube, D. A spraying attachment (not shown in the engraving) is made by placing in the outer end of the tube, D, a disk perforated with divergent holes, which is secured in place by a suitable cap. When this disk is placed in one position it throws a spray, and when it is turned over it throws a solid stream, in both cases backing the water up in the tube, D, and making a rear spray from the holes, E, which protects the pipeman from smoke and heat.

The nozzles are made in three sizes, respectively of capacity to throw a stream of 1⅛ inches, 1 inch, and ⅞ inch in diameter. These are adapted to all requirements, including those of hotels, warehouses, factories, steamships, etc., up to the largest pumping engines, and are likewise capable of throwing jets as small as ¼ inch.

CEMENTS FOR UNITING NON-METALLIC SUBSTANCES TO METALS.—Take thin-made carpenter's glue, and mix into it enough finely powdered wood-ash to give it the consistency of a thick varnish. The ash must be added gradually to the glue during ebulition, with constant stirring. The cement must be used hot; as soon as it cools it shows great powers of adhesion. Another cement of similar properties is made from carpenter's glue, gum ammoniac, and sulphuric acid. The glue and gum are dissolved to equal volumes at a boiling heat, and the sulphuric acid added. The proportions should be as follows:—1 kilogramme glue, 62 grammes gum ammoniac, 62 grammes sulphuric acid.

CLAY-GRINDING MILL.

OUR engraving on page 185 represents a strong clay-grinding mill, with a fixed pan 9ft. in diameter, 16in. deep, and four revolving rollers 4ft. in diameter, constructed by Messrs. Hind and Son, Central Tool Works, Nottingham.

The machine is driven by an overhead level wheel and pinion 2½in. pitch, containing 117 and 26 teeth respectively. Two of the rollers are 18in. wide on the faces. They are cast solid, and weigh three tons each. They revolve on solid plates near the centre of the pan, grinding the clay. The other two rollers are 13in. wide on the faces. They are cast hollow, and weigh one ton each, and revolve near the outer part of the pan, and force the clay through perforated plates. Both the solid and the perforated plates are 2in. thick, loose, and quite independent of the bottom of the pan, so that they may be readily replaced by new ones as the old ones wear. The clay is raised by a scoop elevator, driven by mitre wheels above the mill, and then slides down a shoot into the pan, where it is ground; after which it passes at once into barrows or trucks down an inclined plane of wrought or cast iron plates.

METAL CASTS OF NATURAL OBJECTS.—Such objects as flowers, leaves, twigs, insects, &c,, are used by Abbas to form a matrix for the preparation of a mould. If it be desired to get a casting of a beetle, for example, this is placed in position, and the feet bound with an oval ring of wax, which is useful afterwards in joining and pouring. The object is placed in a pasteboard or wooden box, and held in its place, but so as to stand free, with fine wire. Pieces of stouter wire are laid from the sides of the box to the object, to make air holes. On the top is placed a piece of wood, cut away on the under side, to serve as a feeding head. The box is filled with the moulding material, which consists of three parts plaster Paris and one of fine brickdust, mixed up to a paste with alum and ammonia water. The body of the insect should also be painted over with this material, to form a coating which will prevent the formation of air-bubbles. The plaster being set, and the sides of the box removed, there remains a mould, in the centre of which is the insect. The mould is all in one piece, and the insect is removed by incineration. After drying gradually, the mould is gently heated and then ignited. The mould stands fire well, but the cooling should be gradual. To get rid of the ashes, the mould is washed out several times with quicksilver. The wires are removed, and the mould, when warm, is ready for use. Silver is the best metal for such castings, but gold and other metals may be made use of. The mould has to be broken carefully away to free the casting, and the oval ring and feeding head worked out. Occasionally the mould may be made in two parts.

THE ST. GOTHARD TUNNEL.—On March 1st the length of the galleries perforated was, for each extremity: Göschenes (north end), 2891 metres, Airolo (south end), 2808 metres. The mechanical perforation, which had to be suspended in the northern galleries on Nov. 23, 1875, in consequence of meeting with loose schists which needed planking, was begun again in the latter part of last month, and the perforation has been continued at the rate obtained in 1875, *i. e.*, an average of from 200 to 210 metres per month. As the tunnel measures 14,920 metres, there remains a little more than nine kilometres to perforate before the two branches meet.—The St. Gothard Railway Company have presented a report to the Swiss Federal Council concerning the future construction of the line (163 miles, from Lucerne to the Italian frontier), showing a deficiency of £4,080,000, or 120 million francs. Several newspapers have confounded the railway with the tunnel; and we (*La Nature*) therefore point out that the two enterprises are distinct, and that the prosecution of the works of the tunnel is assured, even if those of the railway are temporarily suspended.

RUSSIA has forbidden the importation of all aniline colours, crystallised fuchsine alone excepted. The importation of artificial alizarine is also proscribed, apparently because the Russians wish to protect the cultivators of the madder plant.

VARNISH GILDING.—A variety of oil gilding applied to equipages, furniture, mirror and picture frames, &c. The surface is highly polished and varnished before it receives the size gold color, and after the gilding has become quite dry, a coat of spirit varnish fumed with the chafing-dish is applied, followed by two or three more coats of the best copal varnish at intervals of three or four days each. The whole is lastly carefully polished with tripoli and water.

FRESH WATER AQUARIA.

(See page 180.)

Some years since, when a boy, the writer wished to start an aquarium for his amusement, and for the sake of economy, procured for that purpose, from a seed store, one of the ordinary bell glass covers used for fern-cases and also for protecting young melon plants, &c. Spurred on by the success he met with, he determined to make a better and more convenient tank; eventually perfecting one which answered all purposes and of which the above engraving is a sketch. Finding that wood was liable to swell from the moisture, and if made strong enough to stand the pressure was too clumsy, he had an iron bed moulded from a wooden pattern, having a groove running around the ledge in which to insert the glass, with holes bored in each corner through which the frame was bolted and having two outlet, in the centre, one for carrying the surplus water from the surface by means of a tube soldered to the necks of the outlet and the other for drawing off the water, the bottom having a slight slant to the centre, and being secured by a tap such as is used for molasses barrels. The frame he made of brass cylinders through which upright and lateral rods passed; bolting it tight in all directions, the cylinders being opened to receive the glass, Bohemian plate being considered the best, and filled with marine cement made as follows:

2 parts of litharge,
2 parts of plaster of Paris,
2 parts of dry white sand,
1 part of finely powdered resin.

Sift and mix to a putty with boiled linseed oil, when it should be used immediately. It will dry in 3 or 4 hours. This cement is perfectly water tight, does not crack, and when hard can be painted any color required. Mineral paints being the most preferable, as they have no injurious effect on the fish. The corners of the frame can be covered with ornamental caps moulded in lead and painted or gilded. Having the tank completed and dried, he next made a false bottom of zinc, having for feet copper rivets soldered on at intervals of 2 or 3 inches. The zinc should be perforated with holes and the space between the two bottoms should be about an inch, much of the impurity accumulating in the water will settle there and will be drawn off by the water. He then made a wire stand, corresponding with the length and width of the frame, and coming to a coarse shaped point, on which he placed a wire basket, lined with mots and filled with gardener's earth, in which he planted climbing plants, such as the wandering dew, Mesembry anthemums, Coboca scandens, &c., whose pendant creepers overhung the edges of the basket and covered the junction of the frame, from which was suspended by brass wires another and larger basket immediately over the surface of the water and filled with Lycopodiums, Farns, Hyacinthes, tariegated leaved Geraniums and the prettiest and most suitable plant of all, a Cupressus alternifoliatus tariegata. Having covered the false bottom with a layer of broken pieces of marble, of various colors interspersed with shells and coral, and having built around the waste water pipe in the centre a grotto with the larger shells, pieces of rocks and coral, the next thing was to make it a balanced aquarium, travis, to have plants growing in it which would absorb the impurities, thereby keeping the water fresh. The best for that purpose he found to be the Calla Lilly Ranunculus-aquasilis and valisneria spiralis. Plants, when growing in earth, have tap roots with fibres running from them. By putting the pot in water, these will rot off and water roots will grow; these are straight and have a spongy terminal point through which the water is absorbed. By exercising a little care in shaking the plants up and down, the earth will be washed out and the water roots will soon fill up the vacant space in the pot. It only then remains to place them in the aquarium and the formation of new leaves will keep paces with the amount of impurity extracted from the water. When in fair working order, some difficulty will be at first experienced in keeping the glass and minerals free from the green conferua. This can be kept down by water snails. No trouble need be caused by the fish eating one another, provided they are properly fed with either worms or liver, care being taken not to drop pieces among the shells. The proportions of the above aquarium are

A to C 20 inches.
A to b 40 "
D to I 30 "
B to K 20 "
Table 30 " high.

JOHN H. MILLER.

A SIMPLE BLOWPIPE APPARATUS.

(See page 185.)

One of the Berlin technical journals illustrates the annexed form of blowpipe, which, as drawn, or with any of the modifications which readily present themselves, will be found handy by those requiring a continuous blast for a short time. It will be seen that the apparatus can be arranged in all sorts of places, and is easily constructed out of the fittings of an ordinary laboratory. A couple of gallon bottles are connected, as shown, by means of a rubber tube, and fitted with perforated rubber "corks" or stoppers. One of these bottles is filled with water and placed on a shelf or other elevation above the cable; to the other is attached the blowpipe, as shown, by means of the bent tube fitting the perforated stopper. The blowpipe is mounted on a stand by means of a universal joint, so that by means of a movable Bunsen burner the flame can be applied in any desired direction. Two bottles of the size mentioned will, properly fitted, give a constant current of air .016 in diameter for a period of 10 minutes, at the end of which time it will be observed it is merely necessary to reverse the positions of the bottles, and shift the bent tube, to obtain a further supply of blast for another period of ten minutes. If the upper bottle is placed about a yard above the lower one, a reducing flame as much as 3¼ in. in length may be obtained, with an oxidising flame of 2½ in. to 3 in. It is obvious that by means of a tap or a pinch-cock the flow of water, and consequently the current of air, may be regulated to suit the purposes of the operator.

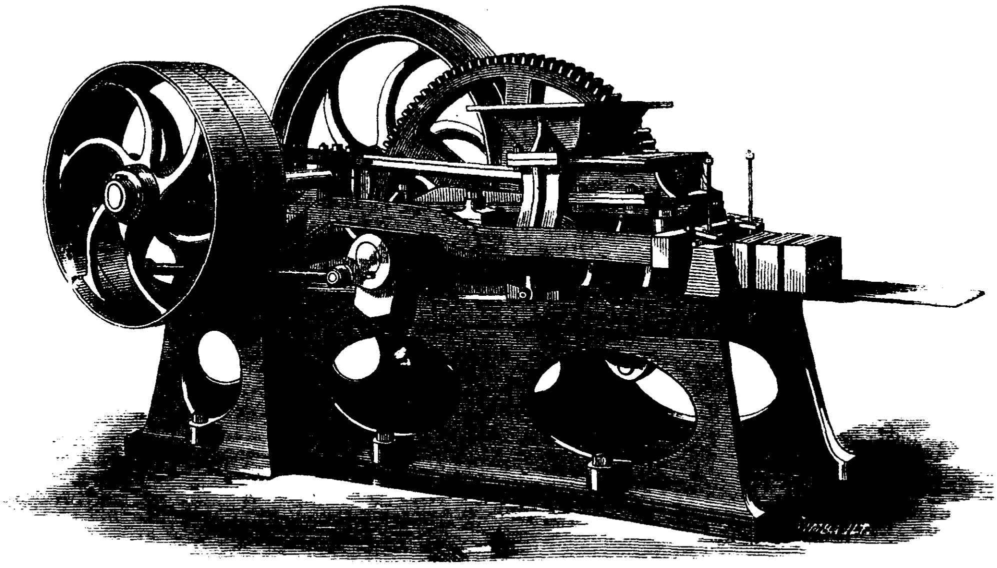
PATENT LAW REFORM.

The following petition has been presented to the House of Commons by the National United Trades Congress at Glasgow. The document sets forth: "1. That the patent laws of this country require immediate and thorough reform in the interests of the national industry and in justice to the numerous inventors amongst the working classes, and your petitioners therefore humbly pray that a Bill be introduced next session of Parliament embodying the following general provisions. 2. In order to enable working men to obtain protection for their inventions, letters patent should not cost more than ten pounds sterling, and should be altogether free from either annual or periodic taxation. 3. The term of the patent should be extended to twenty-one years. 4. Every application for a patent should be examined as to whether the invention is new, as it is absolutely necessary that the scope of the patent should be clearly defined and a tangible property constituted, otherwise working men can never be safe from the unjustifiable encroachments of capitalists. This examination should take place at the first stage of the patent, and upon the provisional specification, in order to relieve inventors from the unnecessary burden of paying the whole of the agents' fees before knowing whether their inventions are new. 6. The examiners should be thoroughly efficient men, and sufficient in number for the work to be performed, and their duty should simply be to report to the inventor the result of their searches, and let the applicant himself judge whether he shall take the patent, thus avoiding litigation or appeals of any kind against the finding of the examiners. 7. The "notice to proceed" stage should be abolished, and also the present cumbrous and unwieldly great seal. 8. The licensing of the use of patented inventions should not be compulsory except in cases where it can positively be shown that the inventor fails to supply the public demand for the patented article."

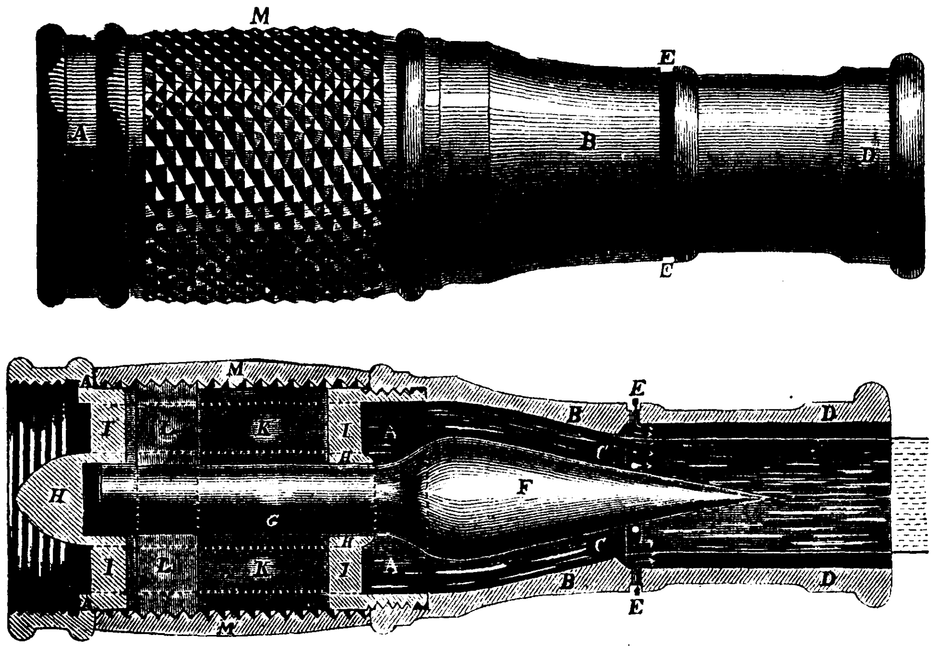
"THE TERROR TO WESTERN NATIONS."—China has determined to take its place as one of the great naval Powers of the world, and has built a man-of-war, which it has christened *The Terror to Western Nations.* The Western nations have, however, as yet no cause to be terrified, since the constructors of the *Terror* are at present exercised in endeavouring to solve the problem of how to start the vessel on her mission. In the first place, there was a difficulty in launching her, the officials declining to allow sufficient grease for the "ways." When she was fairly in the water she was motionless, the engines refusing to work the screw. The Chinese are said to have arrived at the conclusion that the ship is "bedevilled." They intend to wait till the devils have left her, and meanwhile the Western nations may keep their minds easy.

THOME de Gamond, the well-known French engineer, and the originator of the Channel Tunnel, is dead. He was born in 1798, and died on the very day that the commissioners took the first step for the consummation of his great idea.

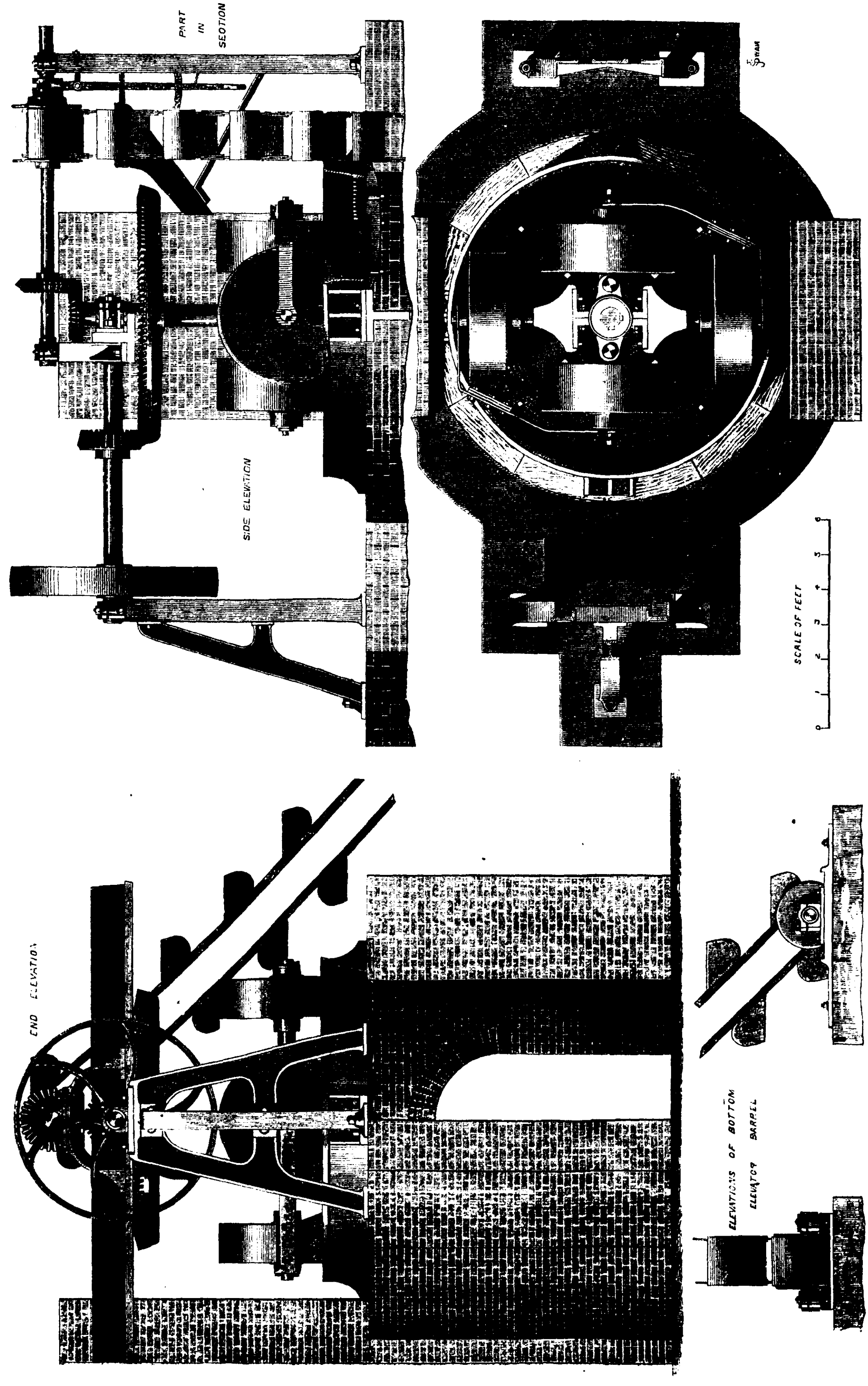
DURANT AND MARAIS' BRICKMAKING MACHINERY.



IMPROVED CONTROLLING NOZZLE.



IMPROVED CLAY GRINDING MILL.



USEFUL RECEIPTS AND GENERAL INFORMATION.

A SPIRIT VARNISH.—Take 1 gallon of alcohol, 1 lb. of gum sandarac, ½ lb. of gum mastic, 2 lbs. of best white resin, and 3 lbs. of gum benzoin ; cut the gums cold. When they are thoroughly dissolved strain the mixture through fine muslin, and bottle for use; keep the bottle tightly corked. This is a beautiful varnish for violins and other musical instruments of wood, and for fancy articles, such as those of inlaid ivory. It is also well adapted for panel-work, and all kinds of cabinet furniture. There is only one flowing coat required, and it produces a very fine mirror-like surface. Apply this varnish with a flat camel's-hair or sable brush. In an hour after application the surface is perfectly dry.

FRENCH POLISH RECEIPTS.—1. One pint of naptha, 3½ ozs. of orange shellac, and 1½ oz. aleme. Darken with red sanders wood.—2. To 1 pint of spirit of wine add ½ oz. of gum shellac, ½ oz. of seed lac, and ¼ oz. of gum sandarac ; submit the whole to a gentle heat, frequently shaking it, till the various gums are dissolved, when it is fit for use.—3. Shellac 6 ozs., naptha 1 quart, sandarac 1 oz., and benzoin, ¾ oz.—4. Shellac 3 ozs., gum mastic pulverized ½ oz., and methylated spirits of wine 1 pint added ; let it stand till dissolved.—5. Shellac 12 ozs., gum elima 2 ozs., gum copal 3 ozs., and spirits of wine 1 gallon ; dissolve.—6. The following must be well mixed and dissolved : Pale shellac 2¼ lbs., mastic 3 ozs., sandarac 3 ozs., and spirits of wine 1 gallon. After the above is dissolved add 1 pint of copal varnish, 1¼ ozs. of shellac, ½ oz. of gum juniper, ½ oz. of benzoin, and ½ pint of methylated alcohol.—7. Gum mastic, seedlac, sandarac, shellac and gum arabic, 1 oz. each ; pulverize and add ¼ oz. of virgin wax. Dissolve in 1 quart of rectified spirits of wine.

OAK VARNISH.—Pale clear resin 3½ lbs. and oil of turpentine 1 gallon, dissolved. Lampblack added will darken the color.

The following receipts for staining were communicated to the *Furniture Gazette* by a practical workman :—

EBONIZED BLACK FOR EBONIZING MOULDING FRAMES, &c.—Take 1 gallon of strong vinegar, 2 lbs. of extract of logwood, ½ lb. of green copperas, ¼ lb. of China blue, and 1 oz. of nut-gall. Put these in an iron pot and boil them over a slow fire till they are well dissolved. When cool the mixture is ready for use. Add to the above ½ pint of iron rust, obtained by steeping iron filings in strong vinegar. The above makes a perfect jet-black, equal to the best black ebony, and the receipt is a valuable one.

A CLEANSING AND RENOVATING POLISH.—Take of olive oil 1 lb., of rectified oil of amber 1 lb., spirits of turpentine 1 lb., oil of lavender 1 oz., and tincture of alkanet root ½ oz. Saturate a piece of cotton batting with this polish, apply it to the wood, then, with soft and dry cotton rags, rub well and wipe off dry. This will make old furniture in private dwellings, or that which has been shop-worn in warerooms, look as well as when first finished. The ingredients should be put into a jar or jug, well mixed, and afterwards kept tightly corked. This is a valuable receipt, and not known, he believes, outside of the writer's practice.

A CHEAP BUT VALUABLE STAIN FOR THE SAP OF BLACK WALNUT.—Take 1 gallon of strong vinegar, 1 lb. of dry burnt umber, ½ lb. fine rose pink, ½ lb. of dry burnt vandyke brown. Put them into a jug and mix them well; let the mixture stand one day, and it will then be ready for use. Apply this stain to the sap with a piece of fine sponge ; it will dry in half an hour. The whole piece is then ready for the filling process. When the work is completed the stained part cannot be detected even by those who have performed the job. This receipt is of value, as by it wood of poor quality and mostly of sap can be used with good effect.

A WALNUT STAIN TO BE USED ON PINE AND WHITEWOOD.—Take 1 gallon of very thin sized shellac ; add 1 lb. of dry burnt umber, 2 lb. of dry burnt sienna, and ¼ lb. of lampblack. Put these articles into a jug and shake frequently until they are mixed. Apply one coat with a brush. When the work is dry sand-paper down with fine paper, and apply one coat of shellac or cheap varnish. It will then be a good imitation of solid walnut, and will be adapted for the backboards of mirror frames, for the backside and inside of case work, and for similar work.

THE quantity of quicksilver produced on the Pacific Coast of the United States in the year 1875 amounted to about 54,000 flasks. This is wholly the fruit of California mines ; none of the other Pacific States or Territories have yet made any quicksilver, though cinnabar in small quantities has been found in some of them. The total production of this metal throughout the world now reaches about 100,000 flasks, of which California is at present turning out fully one-half. In a few years more the yield of this State will be likely to greatly exceed that of all the world besides. The new Almaden mine produced in 1873, 13,648 flasks of 76½ lb. each, or 1,054,062 lb. in all; being an increase of 30 per cent. over the product of 1874.

THE following particulars of the first American locomotive were given in the *Hartford Post*. In 1828 Mr. Cooper was in business in New York, his native place. His mother and grandmother were both born on the present site of St. Paul's Church, Vesey-street and Broadway, and his mother remembered seeing the stockade still standing which had been erected to keep the Indians out of infant New Amsterdam. Mr. Cooper had bought as a speculation the entire magnificent tract in Baltimore, now owned by the Canton Company. Baltimore was then a city of seventy-five thousand people, rich and prosperous, and had entered upon the railroad era. On July 4th, 1828, the corner stone of the Baltimore and Ohio road was laid with imposing ceremonies by Charles Carroll, of Carrolton. It was pushed energetically—a little too much so—for when thirteen miles had been finished it was found that, in turning the rocks to save cutting, such short curves had been introduced that the then experts declared the line utterly useless. It could not be used by steam. Five per cent. had been paid in, and shares had been sold at seventeen, such was the zeal and confidence of the people. But the chill was immense, and everything stopped. Mr. Cooper, then thirty-eight years of age, saw new disasters to himself in the depreciation of his track should the road fail. He proposed to the directors to construct an engine to be available on their line. They were willing, but incredulous. He brought down from his glue factory in New York an engine with 3½ in. cylinder and 14 in. stroke, procured wheels and other appliances from the railroad company, and presently rolled out on the track the first American railway engine. The trial trip was to take place the next day. That night a thief stole all the copper and brass from the infant machine, and this caused some further delay. The trial trip was run, Mr. Cooper himself acting as engineer ; and when his wheezing little baby locomotive threatened to lose too much steam he held down the safety-valve with his own hands. The run was made with thirty passengers, thirteen miles in one hour, and Baltimore was happy. Compare the little engine of forty-seven years ago with the ponderous machines of to-day, and yet they follow on the pathway the little engine opened.

THE coal produced in America in 1835 is said to have been 632,750 tons, and that produced in 1875 is over seventy-one times that amount namely 45,000,000 tons. The iron produced in America in 1830 is given as 500,000 tons, and in 1875 this had increased to four times that amount, namely 2,000,000 tons. 1875 produced less iron and coal than was produced in 1873—considerable loss. The reasons for the vast increase of coal trade beyond that of iron is obvious, being used in all departments of domestic and manufacturing affairs. The whole population are coal consumers, but are not all iron consumers. While in an increase of 1,000,000 in the population perhaps one-third to one-half would be immediate consumers of coal, the same increase of population might only find one-tenth or one-twentieth to be consumers of iron.

A PUBLIC exhibition of another "new gas" took place recently in London. This time the gas is made from sewage and any kind of oil, in the proportion of about a gallon of liquid sewage to a pint of oil. The inventor is a Mr. Bray, or Braid, and the gas is said to cost less than a shilling per thousand cubic feet, and to give a brilliant light superior to that obtained from the gas ordinarily supplied to our principal towns. The oil, which it seems is only the refuse and drainings of the oil-stores, all kinds being mixed together, runs through a funnel in company with the sewage into a retort made of cast-iron pipes. There the mixture is heated by means of coke or coal, and being vaporised travels through a condenser, washer, scrubber, and so on, to the gas-holder, whence it goes to the burners in the ordinary way. From a pint of oil and a gallon of sewage 500 cubic feet of 22-candle gas is alleged to be produced at an expenditure of 7½ lb. of coal, a total cost for material of 5d. per 1,000 cubic feet, as the liquid sewage is at present of no commercial value. The plant exhibited was on the small scale, producing rather more than 100 cubic feet per hour, but it is stated that one man can attend to a much larger plant, so that the cost of labour will not be a material item in the sewage gas works. The gas is said to keep well and to travel well, and if the above figures are correct, it is cheaper than coal-gas; but we should like to see the new gas practically tested on a good scale, for it is not the first attempt to make gas from sewage, and schemes for making gas have been frequently introduced recently.

STAINING GROWING WOOD.—Professor Stebbing in a letter to one of the photographic journals, declares that, ere long, we shall be able to have all our furniture—even articles of common deal—of such a beautiful colour as to throw out of fashion mahogany and other foreign woods. A Frenchman has discovered a new method of compelling the tree to colour itself. He operates upon it at the moment when the sap is rising after its winter's repose to give life and vitality to the branches. He introduces a chemical (how ?) into this vivifying agent, and it distributes the colouring composition through every pore and fibre of the tree ! When the colouration is terminated the knots and veins contain such a multitude of shades, harmonising one with the other, that furniture made of it has at once a strange and fascinating appearance.

M. ADOLPHE Brongniart, the distinguished French botanist, died in Paris on Feb. 19. He was born in 1801. Besides his many botanical works, Brongniart is known as one of the first to discover the pollen-tube, and the important nature of the offices performed by it in the fertilization of plants.

PHOTOGRAPHING MACHINERY.—The use which manufacturers make of photography is shown by the circumstance that some of our larger firms retain the services of a photographer, whilst others have so much work to do that a studio and photographer, form portion of their establishment. For some time past Krupp, the well-known cannon manufacturer at Essen, has availed himself of photography to a large extent, and has, indeed, gone so far as to adopt the Lichtdruck process, for the number of copies frequently required of one plate or another is so large that their production would necessitate a long time, if printed in silver. In securing records of models, or of finished work, before it is sent out of the workshops, photography is found to be extremely useful, and such firms as Penn and Sons, of Greenwich, Sir Joseph Whitworth and Co., and Sir W. Armstrong and Co., of the Elswick Ordnance Works, employ the art frequently in this connection. Photographing machinery is by no means an easy matter to the beginner, for it is difficult at one and the same time to show intricate mechanism on the under side of a machine, while the high lights are not solarised. The hand mirror is sometimes very skilfully made use of in work of this kind.—*Photographic News.*

A ROSEWOOD STAIN OF A VERY BRIGHT SHADE.—Take 1 gallon of alcohol, 1½ lbs. of cam-wool, ½ lb. red sanders, 1 lb. of extract of logwood, and 2 ozs. of aquafortis. When dissolved it is ready for use. This makes a very bright ground. It should be applied in three coats over the whole surface. When it is dry, sand-paper down to a very smooth surface, using for the purpose a very fine paper. The graining is then to be done with iron rust, and the shading with asphaltum, thinned with spirits of turpentine. When the shading is dry apply one thin coat of shellac, and when this is dry, sand-paper down, as before, with fine paper. The work is then ready for varnishing.

IMITATION MARBLE.—Pichler, gilder and decorator, of Vienna, communicates the following simple method of preparing imitation marble for all sorts of decorative purposes. Mix 1 lb. finely powdered lime into a thick paste with water, and add ½ lb. of colaphane, or, what is better, Venice turpentine. Allow the mixture to stand for some time, and then work up with it suitable quantities of fine white chalk and various colored earths, adding a few drops of olive oil if necessary. A soft mass is thus obtained, which can be moulded, like plaster of Paris, to any desired form, or it can be rolled out on a warm metal plate, or pressed under wooden rollers, into thin sheets, which can be glued to the surface to be decorated, like ordinary veneers, and left to harden. It hardens and takes a good surface. Any cavities that appear must be filled up with some of the composition mixed with oil of turpentine. The composition will keep fit for use for some time, if covered up with a damp cloth while moist.

FURNITURE PASTE.—If it is required to keep the wood its natural color, scrape a quarter of a pound of beeswax into half a pint of turpentine. Linseed oil will darken the wood.

Six ounces of pearlash in a quart of hot water, and add a quarter of a pound of white wax, and simmer for half an hour in a pipkin. When cool the wax will float on the top, which must be taken off, and, with hot water, worked into a paste.

WHITE FURNITURE CREAM.—With the following receipt the vinegar must be mixed with the linseed oil by degrees, and the bottle well shook up. The spirit of antimony must afterward be added, and well mixed. Six ozs. of raw linseed oil, three ozs. methylated spirit, three ozs. white wine vinegar, half an ounce of butter of antimony.

CABINET-MAKING.

(See page 172.)

We furnish in this number, on page 172, designs of chairs for which we are indebted to the *Boston Cabinet Maker.*

It is our intention in future numbers to give one page of illustration to this branch of mechanical labor, which we have no doubt will be appreciated by cabinet-makers in country places, who have not the same advantages as those residing in large towns.

Figs. 1 and 2 are cuts of a very comfortable chair, with a foot rest and a unique little slipper box attached to it ; is a most desirable chair for invalids.

Fig. 3 is a design for a camp and folding chair.

Fig. 4, a rocker, with an attachment which gives a long easy movement avoiding the short jerking movement so unpleasant in other platform rockers.

Fig. 5, another form of rocker.

Fig. 6, a piano stool, the upright back is of much advantage to keep pupils in an upright position.

Figs. 7 and 8, folding chairs.

Fig. 9, an easy chair.

Fig. 10, an invalid cabinet and reclining chair which embraces every convenience and comfort for the sick-room.

ANSWERS TO QUERIES.

[1012.]—Brewster should let a shower of very fine sand fall on his fish in the Aquarium, and they will rub themselves clean on it. It is better first to remove all the fish out and clean the tank of all decaying matter, and replace the gravel with fresh washed stones. Fish kept in bad water before you obtained them might be diseased and affect all the rest.

[1013.]—Pipe bends are made either by filling the pipe with resin or lead first, and after they are bent running it out again. The flexible mandril, however, is coming into general use ; it is a spiral wire which is introduced into the pipe, and after the bending is performed, it can be screwed out without any difficulty.

NOTES ON CURRENT TOPICS.

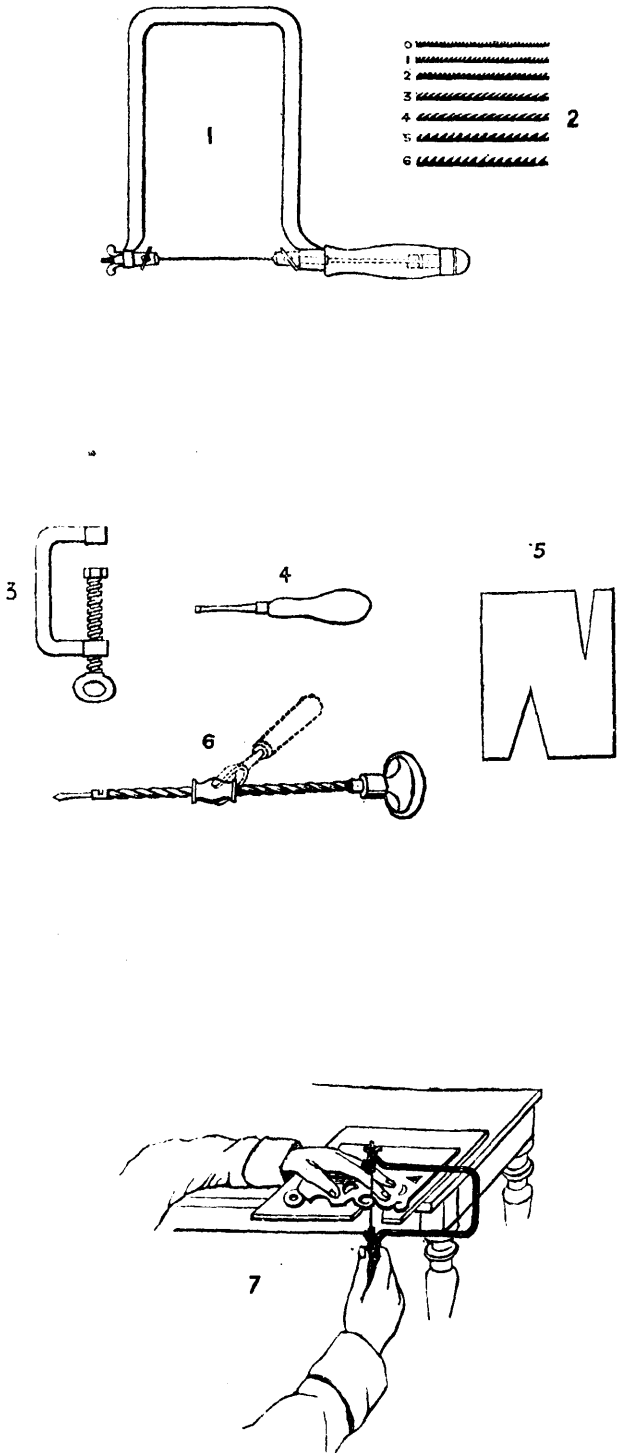
TROPICAL AFRICA.

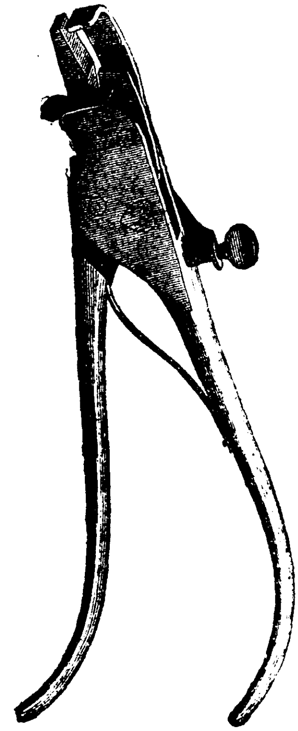
LIEUT. CAMERON, who arrived in Liverpool last month, has, in one journey, done, perhaps, more and better service to geographical science in Central Africa than any single explorer, with the exception of Livingstone. In one important respect, in the accuracy of his observations, he excels them all. After thoroughly surveying the lake Tanganyika, Lieut. Cameron started northwestward and explored the head waters of the Congo, an immense river system, one of the feeders of which is the Lualaba, which drains Lake Tanganyika into the Congo, and which Livingstone erroneously believed to be a tributary of the Nile. Twelve hundred miles of this journey were over wholly undiscovered country, which is described as well watered, healthy and extremely fertile, capable of colonisation by Europeans, and rich in gold, iron and copper. The extent to which the Congo and its tributaries are navigable is very important. They constitute, Lieut. Cameron considers, one of the most magnificent systems of internal water communications in the world. As to the wealth of the newly-explored country, he describes it as unspeakably great, adding the opinion that from its mineral resources and agricultural capabilities, it will become one of the granaries of the world, a centre of civilisation and productive trade, and the scene of iron manufactures when other parts of the world have been exhausted. It is interesting that this tract of equatorial Africa, so long a blank on our maps, and believed to be an arid waste, or at all events a region of fen and swamp, should turn out to be one of the most inhabitable parts of the globe.

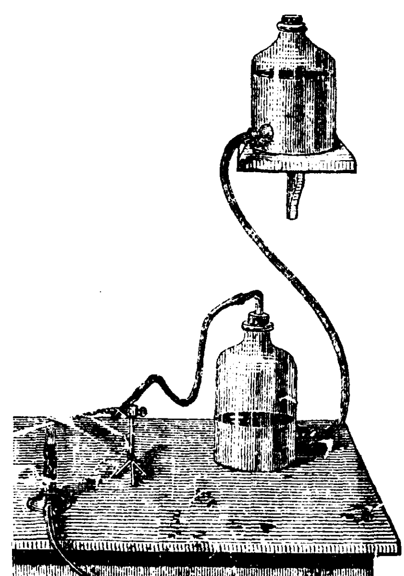
THE number of degrees conferred in the United States last year proclaims the Americans the most fearfully and wonderfully educated people in the world. There were 3,520 degrees in course ; 441, honorary ; 362, agriculture ; 563, female, and 630 divinity—8,859 degrees in all.

MOTHS IN CARPETS.—Moths will work in carpets in rooms that are kept warm in winter as well as in summer. A sure method of removing the pests is to pour strong alum water on the floor to the distance of half a yard around the edges before laying the carpets. Then once or twice during the season sprinkle dry salt over the carpet before sweeping. Insects do not like salt, and sufficient adheres to the carpet to prevent them alighting upon it.

WOOD CARVING AND FRET WORK.







BLOW PIPE APPARATUS.

THE HEXAGON COLUMN FURNACE-BAR.

AN important desideratum in furnaces has long been a modification of bar which, while allowing the ingress of as much air as possible, will at the same time offer the greatest possible obstructions to the dropping out of the unburnt coal. This Mr. M. Holroyd Smith, of Halifax, seems to have pretty effectually supplied by the bars which we here illustrate, and which appear also to possess several other subsidiary advantages.

This grate bar is made with the lower part of the ordinary shape, but the upper surface is composed of short hexagonal cones considerably wider at the top than the bottom. The introduced by which they can be made to rock from side to side, the hexagons in that case coming together like the teeth of a stone-crushing machine, and breaking up the clinkers without mixing them with the good fuel. A special application for coke fires, where intense heat is obtained, is in contemplation. Here the air-spaces and hexagons will be larger, and instead of the hollows the centre of the hexagon will consist of a plug of fire-clay; indeed, we are informed that the adaptability of this form of fire-bar to the varying requirements of different kinds of fuel, constitutes one of its marked features. The advantages claimed for the Hexagon Column bar include nearly all the elements of

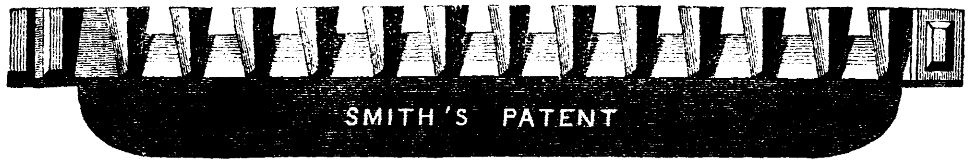


FIG. 1.

upper or fire surface of each, which is 1½ inch diameter, is hollowed, forming a little saucer for the reception of fine ashes, thus preventing the adhesion of clinkers. The cones stand seven-eighths of an inch above the connecting webbing, which is bevelled to insure the falling of the ashes. The size of the hexagons and their distance apart are regulated by the kind of fuel used; in some cases nearly three quarters of the furnace floor can be air-space. The advantages of this are self-evident, and we believe that under no other arrangement can more than excellence appertaining to this part of a furnace, including great air-space well distributed, small cinder openings, great durability, and non-liability to warp or twist. To test the bars in these and other respects careful and extremely successful experiments have been made.

The form of the hexagonal bar offers considerable difficulties to the founder, and it may be interesting to state how these have been overcome. The method adopted is as follows:—A series of boxes of suitable shape having been constructed, a piece of

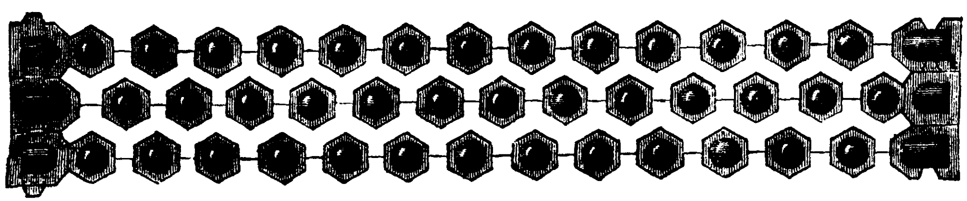


FIG. 2.

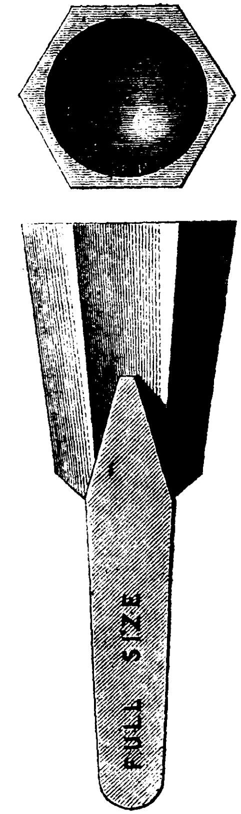


FIG. 3.

DOMESTIC READING.

REGULATING THE BOWELS.

It is best that the bowels should act every morning after breakfast; therefore, quietly remain in the house and promptly attend to the first inclination. If the time passes do not eat an atom until they do act; at least not until breakfast the next day, and even then do not take anything except a single cup of weak coffee or tea and some bread and butter, or dry toast, or ship biscuit.

Meanwhile arrange to walk or work moderately for an hour or two each forenoon and afternoon, to the extent of keeping up a moisture on the skin, drinking as freely as desired as much cold water as will satisfy the thirst, taking special pains as soon as the exercise is over to go to a good fire or very warm room in winter, or, if in summer, to a place entirely sheltered from any draft of air, so as to cool off very slowly indeed and thus avoid taking cold or feeling a "soreness" all over next day.

Remember that without a regular daily healthful action of the bowels it is impossible to maintain health or to regain it if lost. The coarser the food the more freely will the bowels act, such as (Indian) bread eaten hot, hominy, wheaten grits, bread made from coarse flour, or "shorts," graham bread, boiled turnips, or stirabout, or grapes, or dried figs, or stewed tamarinds. A handful or two of raw or boiled chestnuts eaten during the day; a tablespoonful, more of less, thrice a day of white mustard seed swallowed whole, in water or otherwise; eating freely of parched corn; taking on rising a tumblerful of cream which has been allowed to stand until it has thickened, whether sweet or sour, are means which are sometimes successful in keeping the bowels acting freely once a day, without the necessity of taking medicine. When *one* fails to keep up a good effect, try another, in the hope that when the bowels have got into a habit of regular action, it may be kept up by the judicious employment of such daily food as observation may show is best adapted to the object. The habitual use of pills, or drops, or any kind of medicine whatever, for the regulation of the bowels, is a sure means of ultimately undermining the health, in almost all cases laying the foundation for some of the most distressing of chronic maladies. Hence, all the pains possible should be taken to keep them regulated by natural agencies, such as the coarse foods and exercises above named, or stewed prunes, or a glass of water on rising, into which has been stirred a teaspoonful of salt or a heaping tablespoonful of corn meal. Reliance on injections is disastrous eventually.

If the bowels act more than twice a day, live for a short time on boiled rice, farina, starch or boiled milk. In more aggravated cases keep as quiet as possible on a bed, take nothing but rice, parched brown like coffee, then boiled and eaten in the usual way; meanwhile drink nothing whatever, but eat to your fullest desire bits of ice swallowed nearly whole, or swallow ice cream before entirely melted in the mouth; if necessary wear a bandage of thick woolen flannel, a foot or more broad, bound tightly round the abdomen; this is especially necessary if the patient has to be on his feet much. All locomotion should be avoided when the bowels are thin, watery or weakening.—*Hall's Journal of Health.*

A NEW CLOTHES-HORSE.

(See page 186.)

A useful form of clothes-horse, recently patented by Mr. G. A. Brooks, of Norwich, Connecticut, will be found serviceable in many homes in this country. In the illustration, Fig. 1 shows the horse standing as an inverted V, but by an ingeniously contrived hinge it is easily converted into the ordinary form. The construction of the hinge will be understood from Figs. 2 and 3. One portion of it has apertures through which the attaching screws pass; the other has a slot to accommodate a button which, when inserted and turned, as in Fig. 1, fastens that side of the hinge. There is also a stop, A, which prevents the hinge from opening too far, and also has an aperture through which a cord is passed to afford additional accommodation for the clothes. The location of the hinges is apparent from Fig. 1. Two at the upper extremities of the vertical pieces of the frames connect the latter together, so that they may be adjusted as shown. When it is desired to set the frames up, clothes-horse fashion, one of the upper hinges is disconnected, and the vertical bars being brought together, their lower parts are fastened by the hinges shown near the bottom.

To Preserve Lamp Chimneys. — A lamp chimney may be made almost indestructible by putting it in a vessel of cold water over the fire, and letting it remain until the water boils. It will be found that boiling toughens in this case.

FRETWORK.

Much of the leisure time of many amateurs, ladies and gentlemen, is spent to but little purpose, and they have little or nothing to show as a specimen of their abilities or industry, either in useful or ornamental work. In many cases this is not for the want of inclination or ability, but because their energies have not been directed in the right direction. That these remarks are correct may be inferred from the fact that both ladies and gentlemen oftentimes in seeing the beautiful work of some of their friends at once make particular inquiries as to the process and tools, and forthwith set themselves to work to try their ability and skill in producing something beautiful, which, perhaps, will be a "joy for ever" to them, and which they will show with pardonable pride. It may be a drawing or an exquisite pattern deftly worked in worsted or silk, perhaps ornamental articles of rosette work, or a musical instrument, as we have known mechanical amateurs construct an harmonium or chamber organ.

In the present chapter it is proposed to give instructions in an art at once fascinating and useful that may be practiced by either ladies or gentlemen in a private room without being inconvenienced by a lot of heavy tools or the shavings and dirt of the workshop.

The art of fretwork cutting is one which is easily acquired, and the tools few and inexpensive, and one that will give amusement in leisure hours in producing most beautiful work in brackets, card trays, paper knives, reading desks, picture frames, panels for furniture, book slides, envelope boxes, blotting cases, table mats, flower pot covers, ornamental book shelves, door plates, parts of ornamental boxes and cabinets, letter weights, and a host of other articles both ornamental and useful.

With the instructions we shall give, any person with ordinary ability may produce the most intricate pattern in any of the articles mentioned, and a mechanical genius will take a pride in producing new patterns adapted for articles from their own designing.

A description of the necessary Tools will now be given, and instruction in their use, also a description of the new machines now in use for ladies' and gentlemen's use.

TOOLS.

Fret-Saw.—This saw is sometimes called a Buhl-saw, and in small sizes the frame is made of iron as in Figure 1. The saw is held on each side by means of screws, and drawn up tight by a screw worked at the end of the handle, as seen in the illustration. The saw is fixed with the teeth towards the handle. A medium size would be suitable for general work, and would be found convenient for a learner.

Fret-Saw Blades.—Engraving Fig. 2 represents the different degrees of fret-saws. As may be supposed, the finest are used for small and tender work, while the coarser saws are used for larger work and thicker wood, and do their work quicker. The finest is 0, and the number runs to 6.

Brad Awls.—These need no description. They are used for making an entrance for the saw.—See Fig. 4.

Archimedian Drill.—This is a very handy tool, and easy and pleasant to use. It is fitted with drills of various sizes for the work. Fig. 6.

Cramp or Holdfast.—Useful for securing the work to the table. Fig. 3.

Another necessary appliance is a *horse* to support the work, as represented in Fig. 5. It is a piece of pine about three-quarters of an inch thick, and 15 inches by 18. The shape indicated in the engraving has been found handy by the writer to support the work, the saw working between the cut edges. Where large work is in progress the largest opening is suitable, and in finer work more support is offered by the smaller opening.

A sheet or two of fine glass paper will be found useful in finishing off, also two or three half-round files and a small glue pot for glue.

SUITABLE WOOD.

As remarked in a previous chapter, it is most important to see that the wood selected for use is well seasoned, and it is annoying to find a good piece of work ruined by the wood shrinking and splitting. There should be no knots or blemish visible, and a close, even-grained wood will be found to facilitate the work. Several classes of wood are used for fretwork.

Walnut, lime, oak, mahogany, chestnut, pear tree, box, ebony, and rosewood are used. The last three mentioned are used for fine work. The above woods are in general use, but many other close-grain tough qualities are suitable. Soft wood, however, such as deal, is not suitable for fragile patterns.

LECTURES TO LITTLE FOLKS.

In our last number we gave illustrations of the attraction of all matter towards the Earth's centre. In the present chapter we will treat on the *Mechanical* properties of bodies.

Suppose you were to be asked whether a piece of wood or an iron bar were all solid matter, what would be your reply? You might naturally answer, certainly they are; do we not feel that they are hard and solid? Cannot wood be sawn into small pieces, and a stone broken into fragments, each of which is solid? Doubtless they so appear to you, but in reality such is not the case. A portion of each is empty space; the wood is full of small cavities or pores, and the iron bar has small cavities in it, but less of them, therefore there is more space in the piece of wood than in the iron bar. This difference is expressed by saying that the iron is *denser*, or more compact, than the wood. The empty spaces in the interior of bodies are called *pores*, which are visible in many substances, for example, in sponge, cork, and some kinds of wood. The larger visible pores contain air, and the more minute—in even the densest substances—contain a very subtle ether, which also fills all space.

All matter is capable of being divided into smaller and smaller parts without any apparent limit. There are two ways in which matter can be sub-divided:

1st. *Mechanically*, that is, by pounding, grinding, &c.
2ndly. By *Solution*.

The sub-division of matter by solution can be done in the following manner: Take a grain of blue vitriol, smaller than the smallest pea, and put it into half a gallon of water containing 20 drops of spirits of hartshorn, and it will give the water a blue tinge. Now in this half gallon of water there are no less than 250,000 drops, consequently you will be able to prove that this little bit of blue vitriol, not so large as a pea, has been so subdivided as to have given a portion of its substance into 250,000 drops of water, which again may, by a further dilution, be sub-divided still further. Chemistry, however, informs us that there is a limit to these subdivisions of matter, and that there are last particles that cannot be any further divided; these indivisible particles are called *atoms*—every body of matter is made up of them. But although a piece of wood, stone, or iron, may appear to be a solid mass of atoms closely pressed together, in reality they are not in actual contact with each other, but stand apart, each atom being pulled towards the other, or attracted, just as a magnet attracts a piece of iron that is brought near it, and this attraction between atoms is called *cohesion*. The reason why the atoms do not rush together, and all bodies become solid, is because the heat collected between them or around the atoms exerts a *repulsion*, and keeps them a certain distance apart. The way we know that heat has this effect is from the fact that if the heat be increased the particles are forced farther apart, and if it be diminished they draw nearer together. The forces of attraction and repulsion exerted between the atoms of bodies is enormously great. Iron wire, of one-quarter of an inch thick, could not be broken by the united strength of five horses. This will illustrate to you the force of attraction of the atoms towards each other composing the wire. The power of *repulsion* will be readily understood by you from your acquaintance with the explosive power of gunpowder, which will project a cannon ball of great weight to a long distance, and rend the hardest rocks into fragments.

All substances have different mechanical properties; for example, iron is *hard*, and chalk *soft*; glass is *brittle* and gold is *malleable*. There are other malleable metals which can be hammered out into leaves or rolled into sheets, such as silver, lead, aluminum, tin, copper, zinc, platinum and iron. Some metals are called *ductile*, that is, when they can be drawn out into a wire or thread. Platinum, silver, iron, copper and gold are ductile; zinc, tin and lead are also ductile in an inferior degree. Melted glass is very ductile—it can be drawn out or spun into fine threads.

Another mechanical property of matter is *elasticity*. For instance, a piece of indiarubber, when stretched, will fly back if left to itself, because the particles, when displaced, tend to recover their original positions. When we squeeze a rubber ball in one hand, or bend a piece of whalebone, the same elastic tendency is observed. Glass, ivory, steel, air, and all gases, are highly elastic.

Matter exists in the liquid states—*solid*, *liquid*, and *gaseous*. A stone is solid; water is liquid; and air is gaseous. Some substances may be made to pass from one of these states to another, merely by increasing or diminishing the amount of heat which it contains. Water is converted into vapour by heat, and ice by cold.

Another mechanical property is that of *attraction of adhesion*, or simply *adhesion*. Suppose two polished plates of glass or metal are laid one on the other, and slightly pressed, it will be found that, if you undertake to separate them, they will stick together by the force of adhesion. Common window glass will not do this, because the panes are not smooth enough to come in contact; but if water is placed between them, so as to fill up the inequalities of their surface, the adhesion will be very strong. Another illustration of adhesion is the marks made in writing with chalk, or lead pencil, or on dust on the walls of rooms. If you dip your finger into water it becomes wet, because a film of water adheres to it.

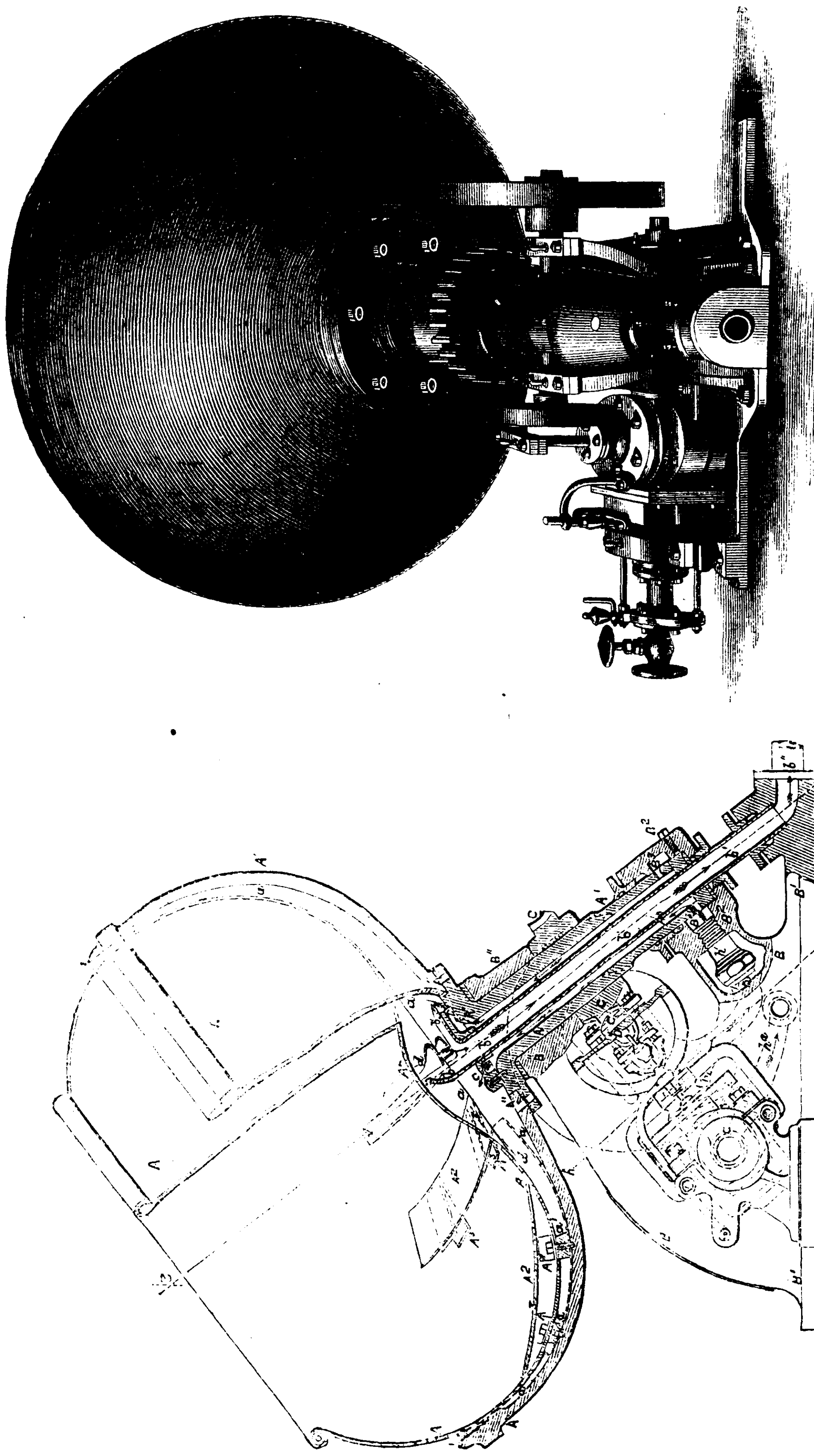
Attraction is another mechanical force which we particularly alluded to in our last lecture, and it manifests itself between bodies at a distance, as well as between those which are in close contact. The Earth attracts all bodies, and causes them, if unsupported, to fall towards its surface.

I hope, "Little Folks," that you will carefully read this introductory lecture on the Mechanical properties of bodies, as it will help you to better understand further illustration on Natural Philosophy, which we purpose continuing in future numbers.

When a teaspoonful of any medicine is prescribed by a physician, it should be borne in mind that the quantity meant is equal in volume to 45 drops of pure water at 60° Fah. It is a good plan to measure off this amount in water in a small wineglass, and mark on the latter the exact hight of the fluid. This will give an accurate and convenient standard for future use. Teaspoons vary so much in size that there is a very wide margin of difference in their containing capacity. It is well to remember, also, that four teaspoonfuls equal one tablespoonful or half a fluid ounce. A wineglassful means four tablespoonfuls, or two fluid ounces; and a teacupful, as directed by cookery books, indicates four fluid ounces or one gill.

Gold Varnish.—16 parts shellac, 3 parts gum sandrach, 4 parts mastic, 1 part crocus, 2 parts gum gamboge, and 140 parts alcohol.

Another.—8 parts gum seedlac, 8 parts sandrach, 8 parts mastic, 2 parts gamboge, 1 part dragon's blood, 6 parts white turpentine, 4 turmeric and 120 alcohol.



BROWN'S PATENT EXHAUST STEAM CONFECTION PAN AND ENGINE.