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SCIENTIFIC CANADIAN
MECHANICS' MAGAZINE
AND
PATENT OFFICE RECORD

Vol. 8. MARCH, 1880. No. 3.

MECHANICS' SOCIETIES FOR THE PROMOTION OF TECHNICAL KNOWLEDGE.

We have much pleasure in calling the attention of mechanics to the subjoined letter from a "Canadian Mechanic" urging the mechanics of the Dominion, to draw closer together, not only for the diffusion of useful knowledge among themselves, and the improvement of their own status, and proper respect for their position, as very influential members of society, but, also, for the great good that would result to the whole Dominion from the dissemination throughout their body of the practical results of the organization proposed.

We have pleasure in informing the writer that, already the subject has been brought by the editor of this magazine, before the highest in the land, and he has no doubt that, ere long, effectual steps will be taken to aid mechanics in carrying out the views expressed by our correspondent. We may state that we have gone much further than this, the details of which we cannot enter into in the present number, and that ere long, the subject will be brought by us before every manufacturer and mechanic in the Dominion. For the past three years we have done our utmost to improve the character of the magazine, (the editorship of which is almost of an *honorary* character,) and it is a source of gratification to find that these improvements are thankfully acknowledged by many of our subscribers, but we find that we have not been able to devote to the magazine, half the time necessary to raise it in excellence and usefulness to what it might be under different circumstances. We require, in fact, the united aid of every manufacturer and mechanic in the Dominion to support us in our effort to benefit them, and this we must, and, no doubt under a proper organization, shall have. From hence forward, Canadian mechanics must enrol themselves together, and demand from the country a different education to that which their children are receiving in the common public schools; their education must be to a great extent technical, and particularly practical, and not superficial; and not only that, but the Government of the country must be called upon to afford substantial aid in this respect. And here let us call the attention of mechanics to the state of Mechanics' Institutes in Canada. Let us take, for instance, the Mechanics' Institute of Montreal, the first city in Canada. It is a delusion.—What right has it to be called a Mechanics' Institute when it declines the Government grant of $400 per annum, for reasons best known to the committee? This year this Institute strikes from its list of magazines and journals the *Scientific Canadian*, *London Builder*, *The Times*, and several useful journals. Here is a pretty example of encouragement from a so called Mechanics' Institute for the promotion of Canadian literature of a technical nature. In fact, its members are made up of civilians, there being only a mere sprinkling of mechanics. It is a matter of astonishment to us that the mechanics of this city do not unite and form a *real Mechanics' Institute*, and draw the grant from the Government, and commence at once to form, at least, the nucleus of a library.

But Montreal does not stand alone in this matter. We state it as a broad fact, that nearly all the Mechanics' Institutes in the country are a failure. They are nearly all supported by merchants, lawyers and clerks, who derive the benefit of the Government grant of $400 per annum for a purpose which was originally intended for the promotion of technical information to the industrial classes only. Several of these Institutes have been solicited to subscribe for the SCIENTIFIC CANADIAN, which is the only technical magazine published in the country, and have refused to do so. It is time that the Government looked into this matter, and before renewing the annual grant, demand returns of the actual number of mechanics who are supporters of these institutions, and how the money is expended.

It may be said, in argument, that the remedy to this complaint lies with the mechanics themselves, that if they came forward in a body and supported these institutions they could appoint their own officers, and act as they thought best for their own benefit. In answer to this it must be borne in mind that the education of the mass of mechanics, old and young, has not been of that character that creates a desire for knowledge. No taste for scientific and technical study has been created in early youth, they have never been taught to become prominent members of society in their own line of trade, and consequently feel indisposed to make the initiatory movement for their own benefit, and have left it for others to do so in no way connected with the trade and industries of the country; the consequence has been that, the control of the Institutes, to a great extent, has passed out of the mechanics' hands, and the benefit of a library and reading-room is more enjoyed by those in no way connected with the trades and manufactories than by the mechanics themselves.

It is time that this state of things should draw to a close, and that Canadian mechanics come forward voluntarily to assist in the formation of an organization for the promotion of their own benefit. Any communications to this effect will receive all attention if addressed to the editor, F. N. Boxer, P. O. Box 197, Montreal.

To the Editor of the *Scientific Canadian*.—Dear Sir.—I have been thinking of late that the mechanics of the Dominion ought to have an association, and the more thought I give the subject the more necessary does it appaar. If there was a society of mechanics of all trades, formed in every city, town, and village, in the Dominion, which could meet together every week, every second week, or every month, as they might agree upon, these meetings could be made interesting and instructive, by members of the society giving lectures, reading essays, and discussing scientific subjects. These essays, lectures, etc., could be forwarded to the *Scientific Canadian*, or whatever paper the [whole) "Dominion of Canada Mechanics Association" might adopt as their representative journal. It will be seen at once that such a large, varied, and well organized source of news supply would necessiate the enlargement of your journal, (if it should be chosen as their journal,) or better still, make it a weekly instead of a monthly edition. Such a course would bring every mechanic in the Dominion into intimate relationship with each other, and would certainly be the promoter of much good throughout our vast Dominion.

Of course, it would be necessary to have a general meeting at least once a year, such meetings to be composed of representatives of the various subordinate societies, it might also be found necessary to employ a lecturer to go from town to town and organize societies; but I will leave the filling up of details to some more competent person. I sincerely hope that the mechanics of the Dominion will take up this question and carry it out to a successful issue. Let us be up and doing, that we may have everything in working order' so that we can offer "the *Scientific Canadian*," some substantial inducements to come out as a weekly journal after Jan, 1st. 1881.

I will undertake to say for the Province of Manitoba that we can and will do our share towards the enterprise, and I have no doubt but that British Columbia will do the same. So much for the West, what says the East.

With thanks for the valuable space you have allowed me,

I remain etc.,

A Canadian Mechanic.

Portage La Prairie, Man., Feb. 6th., 1880.

THE FINAL COLLAPSE OF AMERICAN COMPETITION.

We ventured some months ago to say that "American competion had been the saviour of English manufacturing supremacy." For this statement we were soundly rated by many of the American papers. We bore the scolding with equanimity, and though they are still very cross with us we cannot forbear duoting a letter just received from a valued correspondent. He says: "Thanks for your quotation for American Locks, the prices have advanced so much since our customer last bought that we think he will use English in preference."

English manufacturers have had a scare we cannot but admit. Inflated by prosperity they "waxed fat and kicked," but when they found how matters really stood they buckled to with all their old energy and soon reduced to its proper dimensions the competition of a protected industry.—*Martineau and Smith's Hardware Trade Journal.*

THE TAY BRIDGE DISASTER.

To the Editor of the Scientific Canadian, *Montreal.*

On the 14th ultimo, I received, from a friend in England, the *London Daily Telegraph*, of the 30th of December last, giving some details of the Tay Bridge disaster. I penned a letter to its editor, giving my opinion of the cause of the accident which I herein embody. The letter alluded to I placed aside, trusting others nearer the scene of the catastrophe, or some professional engineer, would have advanced sounder views than I have yet met with, and entered upon theoretical arguments as to that which led to the destruction of the bridge and train. At present we have little beyond surmises and some crude notions; and, on this side the Atlantic, only odd scraps of intelligence so unconnected, as to render it no easy task to attempt a solution upon such meagre details. Various are the opinions I see advanced, none of which appear to me to have any force. I will allude to one. Dr. Talmage, in a sermon delivered in New York, shortly after the accident, observed, that "It will not be known till the last great day whether the whirlwind had removed the spans of the bridge, before the train reached them." I select this to show that we need scarcely despair of facts being brought to light ere long to settle this point; or we can consult common sense, to solve the doubt. If the wreck of the train overlays the *debris* of the superstructure of the bridge, the spans ahead of the train had been removed by the hurricane, and those in rear fell subsequently, almost instantaneously; but I am of opinion that the bridge had, up to the time of the disappearance of the train, withstood the force of the storm, and that the train was the cause of the accident, at a time and position when two opposing forces carried death and destruction before their mighty power, and what has taken place was inevitable. I am opposed to the idea that the train was forced off the rail by the wind, and that it collided with the lattice work of the bridge, for we have almost direct evidence to the contrary; the men, Barclay and Watt, and the gentleman and his grand-daughter, saw that which satisfies me on this point. The two men say, they saw the tail light disappear, but make no mention of what the others noticed, viz., a commingling of the side lights, and then a shower of sparks, this is all important; if they are correct it is direct proof there was no chasm before the train reached the fatal spot, had there been it would have plunged headlong into the open space, and the engine tender, and heavily freighted carriages would underlie the rear and lighter carriages, they would follow one after the other, there would not have been any commingling of side lights. My belief is the train and span fell simultaneously, and that the train, when the rails and their supports gave way, was doubled up as it were, the heavier portions falling first divided it into two unequal sections. Neither of the parties could have seen, under such circumstances more or less than recorded, if my supposition is correct. Had the train collided they could not have noticed what they did; Barclay and Watt saw no sparks, nor commingling of side lights; the gentleman and his grand-daughter no tail lights. There is anotner circumstance or two, which tend to show the train was doubled up, for we are informed the first-class carriage is uppermost, and that the mail bags, and the body of a female were washed ashore shortly after the accident. This proves that the first-class carriage, and the mail bags, and the woman, were in the lighter portion of the section and secondly that none of it could lie with the wreck of the rest of the train, and *debris* of the bridge, these carriages were undoubtedly thrown out from the line of the bridge, and in the exact direction of the *resultant of two forces*. I will endeavour to show this, and account for the accident by the laws of motion, and give a practical illustration of causes and effects.

At the time of the accident, the bridge had undoubtedly a vibratory motion—a gentlemen in a previous train felt or saw this before the hurricane was at its highest, for he describes the lurching as alarming; now this vibratory motion must have been uniform before any disturbance took place, there was no checking or conflicting force to interfere with the uniform oscillating motion, until the train came along at a snail-like pace, and as it approached towards the centre of the high portion of the structure, the oscillation was coming to the point of rest, which it would have passed, but for the dead weight of the train; had the train arrived in the centre and point of rest no accident would have occurred, but it had reached only the haunch of the structure, and did check the uniformity of the vibration; that check caused an entire change in the motion, it became deflected, in common parlance tortuitous, with an irregular succession of curves, and the whole structure fell like a pack of cards without their uniformity. The bridge could not resist this sudden and unequal strain; there were two forces directly antagonistic, the train running at right angles to the vibrations, their *resultant* within the lighter carriages, or lying away or out of the debris, and line of the bridge. Had the train collided, as some suppose, the wreckage of trains and bridge would be a heterogeneous, a confused mass of debris on one side the bridge, and scarcely beyond the outside line of it, for there would have been no *resultant* or any cause to throw it far away.

I have alluded to the law of forces, and shown the consequences; if, therefrom, I have defined the main features of the wreck it may be presumed I am not in error. I will now give a practical illustration, and the results of two opposing forces, which most of your readers will understand. I will take a child's swing, and so propel it that the oscillation shall be uniform; as the swing reaches the lowest point of the oscillating curve, if I apply a force (finger or stick) against the seat of the swing exactly central, there is no swerving either to the right or to the left; there is but one motion, the endeavour to go onward; there has been nothing to cause a deviation from the right line of the swing; but if I place the opposing force on one side the centre of the swing, it immediately flies round; if a weight was insecurely suspended on either side to the ropes of the swing, they would be propelled, one forward with *considerable force*, the other with limited, to the rear; these actions are the results of antagonistic and opposing forces; they are identical with those caused by the whirlwind and train at the Tay bridge, and every feature every principle which obtains in the swing obtained at the bridge.

This communication has extended far beyond what I contemplated, though the subject is by no means exhausted.

YOURS, etc.,

J. KILNER,

Major General Royal, late Bombay, Engineers.

FREDERICTON, N. B., 4th February, 1880.

We have felt much pleasure in giving insertion to Major-General Kilner's remarks on the cause of the falling of the Tay Bridge, and believe that the theory he advances is really the correct one, although there may have been other causes by which the calculated resistance of the bridge to high winds was weakened. One reason why we give much faith to our correspondent's theory is, that it is just the result ôf such *antagonistic and opposing forces* that would have caused the destruction of such a length of the bridge, both in rear and in advance of where the train fell through.

But one very important statement has recently been made, viz., that both the workmanship and ironwork were inferior. If such were really the case all calculations as to strength and resisting forces are utterly useless and deceitful.

We have not space to enumerate many such cases that have come to our knowledge, but we will give the following: In the construction of the Suspension Bridge over the Montmorency Falls, the contract for the ironwork was given, it was said, to a party who was totally incompetent to forge the quality of iron required for such a purpose. The plate-chains which were attached to the anchors were seven in number, seven feet long with knuckle joints resting upon iron templates. Three or four of these bars or plates broke on the east side a few days before the bridge was opened to the public. This the engineers and directors kept from the knowledge of the public, and they were replaced with new ones; but immediately after three gave way on the west side. The Engineer concluded that, as a lesser number were broken and that fewer sustained it before, he could also replace them without the knowledge of the public; but, in the meantime, the bridge was opened to travel and the old one closed, and on the very day it was opened the bridge went over the falls carrying with it three human beings.

Upon an investigation as to the cause of this disaster, which was presided over by Lieut.-Colonel Fenwick, Royal Engineers, no question was raised as to the correctness of the calculations as to what weight the bridge would support over and above any probable test it might be put to, as it was too evident that it was the bad workmanship and the materials employed (the iron being of the most inferior quality) which caused the catastrophe.

During the construction of the Victoria Bridge several rumours were afloat as to inferior workmanship in the tubes. It was also stated that the longitudinal timbers, on which the rails rest, were laid continuous instead of being disconnected, as the tubes are, at every second tube—no allowance having been made for contraction or expansion. It was even said that a similar blunder was made in covering the roof. If bad workmanship was made and such blunders did occur under such engineers as Stephenson and Ross, the most eminent engineers are likely to lose their reputation, and the public meet with another fearful catastrophe, from the want of proper superintendence over the most minute details and the use of inferior materials by the contractors.—ED. SCIENTIFIC CANADIAN.

DISINFECTANT FOR THE BREATH, ETC.—A very weak solution of permanganate of potash is an excellent disinfectant for light purposes, such as rinsing spittoons, neutralising the taint of diseased roots of teeth, cleansing the feet, and keeping the breadth from the odor of tobacco smoke. Permanganate is not poisonous.

THE TAY BRIDGE DISASTER.

Since the cable brought across the Atlantic the terrible account of the destruction of the Tay Bridge and the entire loss, with all the persons on board, of a train crossing the Frith of Tay from the south on its way from Edinburgh to Dundee, much of the mystery attending its sudden failure has been cleared. The technical journals of England, notably *Engineering* and the *Engineer*, have naturally taken up the subject with much earnestness and zeal. In view of the incompleteness of details, and also of the fact that an investigation by eminent experts is being made under the auspices of the Board of Trade, they have wisely abstained from committing themselves to any pet theory, and it would be manifestly unfair to attempt to pass judgment on this side of the Atlantic. We are not inclined to make this sad occasion one of retaliation for many slighting remarks which English engineers have too often ventured unwisely on American engineering skill and practice. The fall of a structure which has been long regarded as a crowning monument of modern engineering is a fearful warning which no one should affect to be able to disregard, and public confidence has suffered a severe shock which has given rise to earnest, though misplaced, expressions of distrust in this country also. We believe that the cry of "what next?" and the wholesale condemnation in which the daily press, notably, indulges so freely, is calculated to do much more harm than good. We shall confine ourselves for the present to as full a representation of the facts brought to light until now in connection with the catastrophe as we are able to obtain, reserving for a future occasion a summary of the conclusions to be drawn from it. For the data and the illustrations we now publish we are mainly indebted to the publications mentioned above. It appears that no complete account of the whole structure as finished has appeared in any of the transactions of technical bodies or in the journals devoted to engineering, because important changes were made both by contractors and engineers to meet unexpected difficulties. This is true not only as regards the position of the piers, and consequently the length of the girders, but also as to many of the details, which appear to have been modified as the expediency of alterations was suggested during the course of erection. As an example, we may state that, instead of the 13 large girders, each 245 feet in length, originally projected, 11 only were put in accordance with the first design, while two were reduced in length to 227 feet. This circumstance naturally introduces into all discussions possible at the present moment an element of uncertainty, which is much to be regretted. How far this deficiency may be met by records in the possession of the engineers and contractors connected with the building of the bridge, it is impossible to state at this juncture. As finally constructed, the bridge was 3,450 yards long, and consisted of eighty-five spans of the following dimensions: Eleven spans of 245 feet each; two spans of 227 feet each, lattice girders; one bowstring girder of 166 feet, one span of 162 feet 10 inches, thirteen spans of 145 feet each, ten spans of 129 feet 3 inches, eleven spans of 129 feet each, two spans of 87 feet each, twenty-four spans of 67 feet 6 inches, three spans of 67 feet, one span of 66 feet 8 inches and six spans of 28 feet 11 inches, all lattice girders—in all, eighty-five spans. In addition to which there are at the north end one span of 100 feet and three of 29 feet, plate girders. In the fifteen spans exceeding 145 feet, and on the 160 feet bowstring girders, wrought-iron cross girders have been used. In the rest of the structure, timber. In the case of the bowstring girders and the thirteen large spans, being those which fell, the roadway was carried on the bottom booms of the girders, while in the case of all the other spans it is carried on the top. Our engraving clearly shows how the juncture between the short and longer spans was effected. The girders were arranged in continuous groups, generally of four or five each. The greatest clear height from high-water mark to the bottom of the lower booms was about 87 feet. "Counting from the south end"—we quote from Major Hutchinson's report to the Board of Trade—"piers 1 to 14 are entirely of brick in cement; piers 15 to 48 are brick for 5 feet above high-water mark, finished with a stone belting, upon which are carried groups of cast-iron columns braced together; piers 49 to 77 consist of groups of cast-iron columns braced together, starting from the cylinders, and encased in brickwork to a height of 5 feet above high-water mark; piers 78 and 79 are cast-iron cylinders throughout, filled with concrete; piers 80 to 84 are cast-iron columns; piers 80 to 89, brick in cement. The permanent way is of double-headed rails fished at the joints in 24 feet lengths, 75 pounds to the yard, secured in chairs 3 feet apart on continuous timbers 17 inches wide, and varying between 7 and 14 inches in depth. Throughout the length of the bridge guard rails are provided. The floor of the bridge is of 3 inch planking." It will be seen that the bridge is an extremely heterogeneous structure—a conglomeration, in fact, of a great many bridges of various spans and types of girders and piers. The eleven 245-foot and the two 227-foot girders stood nearly in the centre of the bridge, and carried the load on the bottom booms. These are the girders which have fallen into the stream, and we may confine our attention entirely to this part of the structure. The girders were about 27 feet deep, and weighed each about 190 tons. The booms each consisted of a trough 15½ inches deep by 15 inches wide inside, the bottom of the trough being a ¾-inch plate 2 feet wide, while the sides were ⅝-inch thick, and were connected to the bottom by 3½ x 3½ x ⅝-inch angle-iron. Similar angle irons were also riveted along the upper edges of the sides. The girders were arranged in continuous groups, the thirteen largest spans forming two groups of four spans each and one group of five spans, roller bearings being provided when necessary to accomodate expansion and contraction. The width of the platform was 15 feet and carried with a single line of track. The piers upon which the large spans rested are placed on a foundation consisting of a caisson 31 feet in diameter and filled with concrete. Upon this was built a brickwork of hexagonal section 27 feet long in the direction of the axis of the river and 16 feet in the line of the bridge. On the top of this hexagonal mass of brickwork was a capping of stone in four courses, of an aggregate depth of 5 feet, while on this again was erected a pier composed of six cast-iron columns braced together, four of these columns being nearly vertical and placed under the girders, while the other two are cut-water columns. The two pairs of nearly vertical columns were 15 inches in diameter, and they were placed 9 feet 10 inches apart from centre to centre through all their length, in a direction transverse to the bridge, while in the other direction they were 12 feet apart at the bottom and 10 feet at the top. The two outer or cut-water columns were 18 inches in diameter, and they were placed singly, one on each side, 21 feet 10 inches apart from centre to centre at their basis, and 19 feet 10 inches at their summits, each of these columns having a rake of 1 foot only. Each column was made in seven 10 foot 10 inch lengths, united by flanges, although in some of the piers a less number of lengths was used. Horizontal bracing was introduced at each joint, and diagonal bracing between the lines of horizontal bracing. Each cut-water column was connected at its top to the adjoining pair of 15-inch columns by short girders, on which the girders of the bridge took their bearing; but there was, we believe, no through transverse girder fixed to the tops of the columns. The columns were filled with Portland cement concrete, and their average thickness appears to have been 1¼ inches, giving a sectional area of 66 square inches.

Adjacent columns were braced together with horizontal bars and diagonals, and there were also cross sets of bars, making altogether eight planes of bracing. The diagonals between two adjacent columns were of flat iron, single, 4½ by ½ inches, with cottered fish plates on their lower ends, and attached to the cast-iron columns close to the flanges by one 1⅛-inch bolt in a hole 1⅜ inches in diameter. The horizontal double bars were of pairs of channel irons 6½ by 2½ inches by ½ inch, placed back to back 2½ inches apart. In addition to these there were horizontal round bars placed diagonally between the four 15-inch columns, which according to *Engineering*, appear to have been an after thought, and were an attachment which was at least not very well planned. Each column springs from a foundation plate bolted to the masonry, and to which the column itself was fastened by eight bolts, which for the 15-inch columns were 1⅛ inches in diameter. In the case of the 18-inch outer columns the foundation plates were 4 feet square, while for the 15-inch columns they were 3 feet 10 inches in diameter. Each foundation plate carried a base about 22½ inches high, the base being stiffened by eight radial ribs, four of which were bossed to allow of the passage through them of the 1¼-inch bolts securing the foundation plate to the masonry, while in the case of two others provision was made for the attachment of the bracing. On top of the brickwork of the foundation four courses of heavy stone coping were laid, and to these the foundation plates of the columns were bolted.

It appears that an examination of the wreck shows, in some cases at least, that the bolts securing the foundation plates passed through the top course only, while the dowel bolts, holding together the various layers of stones, tied only the two uppermost layers, so that there was no connection between these and the first and second courses below them beyond that given by the cement.

Such are the brief details of the structure, which in connection with the data gathered by an examination of the wreck, to be

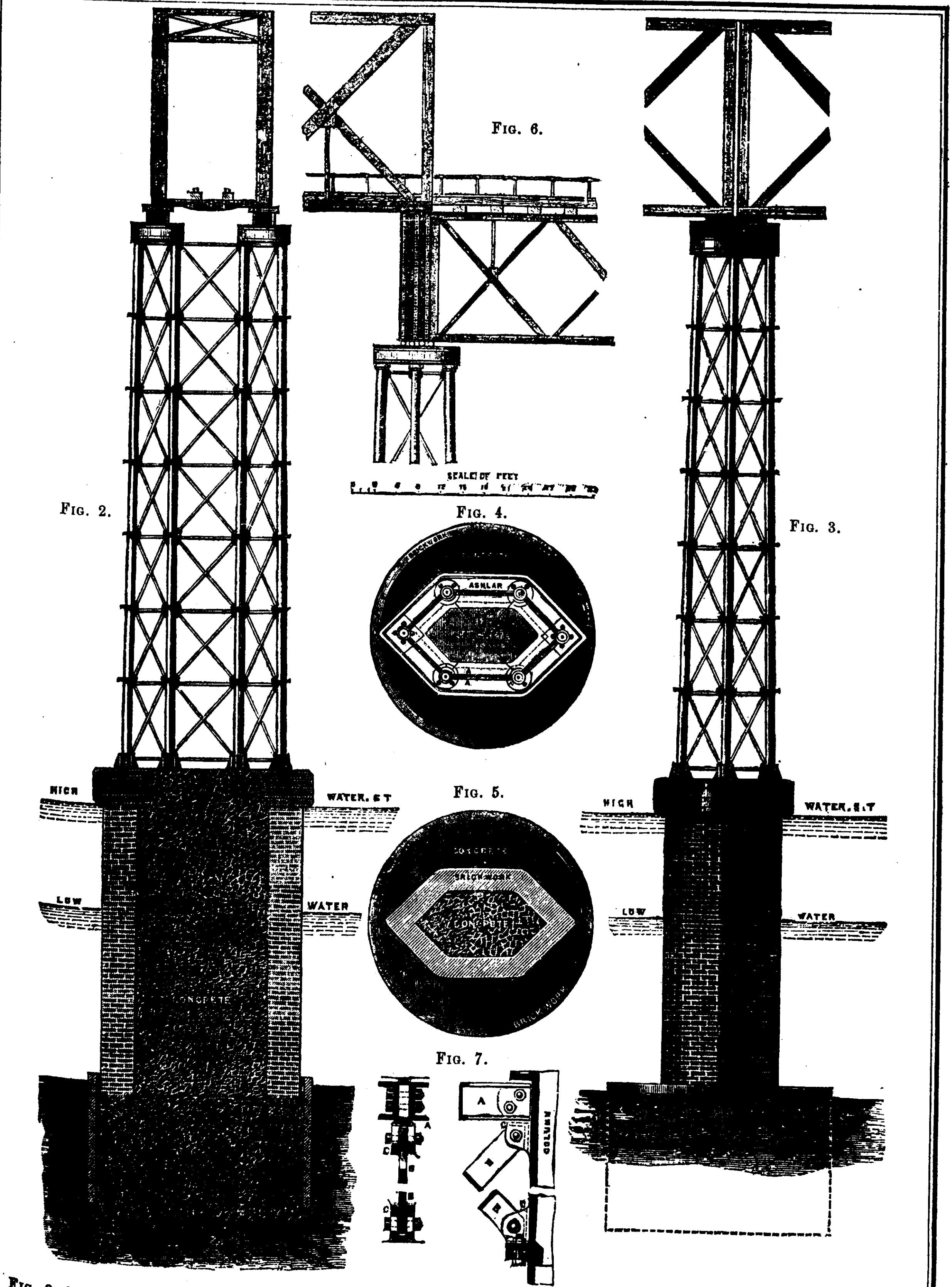


Fig. 2. Side Elevation. Fig. 3. End Elevation of Pier. Fig. 4. Plan of Pier. Fig. 5. Plan of Pier Masonry.
Fig. 6. Junction of Large and Small Spans. Fig. 7. Section of Column Joints.

THE LARGE PIERS OF THE FALLEN TAY BRIDGE.

given further on, will enable our readers to form as accurate an opinion in regard to the disaster as present information will permit. The precise nature of its failure cannot, we believe, be yet traced, as many details, notably those in regard to the quality of the material used and the exact position of the train and the girders, together with the shape of the wreck of the latter, are not yet clearly revealed. The Tay Bridge crosses the Frith in a direction almost due north and south, and it may be well to state that it serves as a connection between Dundee, situated on the north side of the Tay and Edinburgh, which lies 35 miles to the south of the former city. The Tay Bridge was not, as many have appeared to believe, a link between Scotland and England, but afforded uninterrupted connection between Edinburgh and the north of Scotland, having superseded the ferry used until its completion between Broughty Ferry and Ferry Port, some miles east of the present site of the Tay Bridge. The train which was precipitated into the river on the 28th of December last had left Edinburgh on its way north at 4.15 p. m. It consisted of an engine and one first-class, one second-class and four third-class carriages and the brake van, and was precipitated into the Tay together with the thirteen large spans forming the centre portion of the bridge. Present developments leave no doubt that the structure did not succumb in consequence of a derailment of the train, but because the bridge was too weak to withstand the pressure of a high wind upon it and the train moving on it at the time. We may mention, in this connection, that a passenger on the train which had been the last to pass the bridge in safety, testified that he experienced a strange feeling of oscillation, which goes to show that even then the bridge was in danger, and that possibly it may have been weakened by the fracture of some portions even at that time. It appears from the record kept by Prof. Grant, at the University of Glasgow, that at the latter city the storm reached a velocity of 72 miles at or about the time when the disaster occurred, and the inference is that the storm blowing at Dundee had at least attained that velocity. Its direction was W. S. W., and therefore str ck the bridge almost broadside. The death of every person on the train, and the lack of facts in the possession of those who saw the "shower of sparks," reduce the account of the accident to little more than nothing. On the days following the disaster parties of divers attempted to examine the wreck, but as their working hours were limited to the short period between two tides, and as the muddy nature of the water left them in utter darkness, the result of their groping is unsatisfactory. Their evidence is conflicting on many important points, and their explorations have not yet been sufficiently complete to enable a clear picture to be drawn of the present location and condition of the fallen structure. They have, however, succeeded in finding a portion of the train. The engine lies about 50 feet south of the fifth broken pier, counting from the south, a method of designating the various fallen piers which, we may add, is generally accepted in this case, and which we will follow in the following particulars. It is believed that the position of the three cars behind the engine is approximately known, while little more than traces of the others and the brake van have been found. How far east of the centre line they lie is not known, but present developments plainly prove that the bridge collapsed after the train had safely passed three piers, had partially gone by the fourth, and was approaching the fifth. It is a very significant fact that at this fifth pier was the junction of two groups of girders, and we shall have occasion in the following to refer again to this subject.

We may now pause to consider the condition of the wreck of the piers, an admirable description of which was published in a recent issue of *Engineering*. There seems to have been no connection between the portion of the bridge carried away and that standing except the rails and a gas-pipe hand-rail. The ends of the large girders rested on a kind of shelf on the ends of the shore span girders, and the former appears to have slipped off, partially injuring the shelf in falling. The guard rails at this north end project 9 feet, the end being curved toward the east, and a similar fact was noted at the south end. From the damage done to the standing pier at the north end it is evident that the diagonal bracing was that portion of the structure which first yielded to the strain, all but one of those in tension, by reason of the wind pressure from the west, being detached between the two 15-inch columns on the north face by the breaking of the cast-iron snugs to which their lower ends were attached. The fact that those between two adjacent 15-inch pillars were strained most, proves clearly that the two groups of three on each side of the centre line were strained in a different manner during the overturning of the structure. The three columns lying to the east of the centre line, on the lee side, were cracked and broken at the lower flange, and the direction of the cracks abundantly shows the working of the columns. The west column on the windward side has not cracked, but the stones to which the base is bolted have been moving. The condition of the piers which carried the fallen spans is highly suggestive, but we are unable to follow our contemporary in its accurate description of each, and will confine ourselves to giving the details of some of the more important ones of the series. We may state that in general only a few stumps of the columns remain, and that everything points to the strong movement of the bridge to the eastern lee side. Pier No. 4, counting from the south, upon which, it will be remembered, at least a portion of the train was when it fell, is all right as regards the foundation plates, but it makes an exception, as portions of the six columns hang over to the west or windward side, thus indicating that this pier failed at some height above the masonry, the lower lengths of the columns being pushed over in the opposite direction to that in which the chief mass fell. Pier No. 5 is of much interest, as above was the juncture of two groups of spans, and it is significant that this, as well as No. 9, another pier upon which a juncture took place, is exceptionally injured. While in most of the piers the stonework and the foundation plates are still in place, the two stones are moved that were at the west or windward corner, being lifted and still attached to the column base, while all the other stones are still in place. This is more pronounced yet in the case of No. 9, where the western and south-western columns are lying canted over, with their bases and two upper courses of stones attached, so that the latter lie on their edges. The stonework of No. 11 pier has also suffered very considerable damage, the entire foundation plates of the western and the two south-western columns, together with the two upper courses of stone, having disappeared entirely.

The facts just presented throw sufficient light on the subject to make the choice between the various modes of failure suggested an easy matter. These are (1) that the train should have been partially overturned or caused to leave the rails by the force of the wind, and that in so doing it should have so injured the lee girder as to cause the destruction of the bridge; (2) that the girders should have failed laterally; (3) that the girders should have been canted over on their piers and in falling have destroyed the latter; and (4) that the failure should have been due to the insufficient resistance of the piers to lateral strain, the piers first giving way and the superstructure then going over bodily. All the evidence points to the latter as the probable mode in which the structure failed, and we shall, therefore, following *Engineering*, briefly point out the three principal ways in which a pier constructed as those of the Tay Bridge could fail under lateral pressure. These are (1) that it should turn over bodily on the base of one of the outer columns; (2) that the outer column on the lee side should yield by bending or crushing, thus enabling the pier to turn over on the bases of the adjoining pair of columns, and (3) that the bracings should fail, thus allowing the pier to turn on the bases of all the columns. These three modes of failure might of course be also partially combined, or the columns, instead of giving way at their bases, might fail at some point above that level. *Engineering* calculates that, depending solely upon the weight resting on the pieces in order to secure stability of the structure, then 33 lbs. of wind pressure per square foot would suffice to upset the bridge, taking the weight of the columns and bracing at 90 tons, that of a pair of girders at 190 tons, and that of the engine and such portion of the train as could be carried on the length of one span at 120 tons. Assuming that each of the columns was so bolted down that it could not be lifted without carrying with it 5 tons of stonework, then the wind pressure required to overbalance the stability would be 35 lbs. per square foot. The compressive strain upon the lee columns, assuming the second to be the mode of failure, and taking into account the masonry fastenings, would be 2.39 per square inch of each of the three columns, while they would probably give way under any wind pressure exceeding 23.5 pounds per square foot. In the most favorable case, therefore, 35.5 lbs. per square foot would overturn the bridge, and, as it did not succumb in the way assumed in reaching that figure, there is little doubt that the pressure must have been less. We know, from an examination of the wreck, that there is evidence of at least a partial failure of the bracing, but it is impossible to ascertain, in the absence of figures on the subject, just at what pressure it was liable to give way. The maximum which it was able to resist was 35 lbs., and it may be of interest to note what were the estimates of those connected with the building of the bridge. In 1872, Mr. Edgar Gilkes, in a paper read before the Cleveland Institution of Engineers, made the following statement:

"A consideration of the action of the wind on this bridge will dissipate the oft-advanced theory that at some period it will be blown over. The exposed surface of one large pier is about 800 square feet, and of the superstructure which depends upon it, about 800 more, and so giving 800 feet for a train above, we have 2,400 feet; 21 pounds per square foot is the force of a very strong gale, but it would take no less than 96 pounds per square foot on the surface given to overturn the pier. Even the most severe hurricane on record would equal only one-half this resistant power." It will be noticed that in these remarks, Mr. Gilkes takes the area exposed by the superstructure of one span as that due to one girder only, but it is at least uncertain to what extent the girder on the lee side of such a bridge can be considered as shielded by that to windward. With a perfectly horizontal wind blowing at right angles to the bridge, the shielding effect of the windward girder might be considerable, while, on the other hand, with a wind inclined to the horizontal, its protective effect might be practically *nil*. This is a point on which further information is wanted. We may also point out that the train which was traversing the bridge when it failed last Sunday exposed considerably over the 800 square feet of surface assumed by Mr. Gilkes. Such an engine and tender as that on the train would expose about 370 square feet of side surface, while the surface exposed by each carriage would be fully 180 square feet, or 1,260 square feet for the seven vehicles, making a total for the train, including the engine, of 1,630 square feet. This is more than double the amount assumed in Mr. Gilkes' paper.

We may add that in the calculations leading to the results quoted above, *Engineering* assumes 400 square feet, or one-half, as the exposed surface of the lee girders, and 1,600 square feet as that of the train. Using Weisbach's formula—

$$T = 0.002252\ v_2 \text{ lbs.},$$

we find the pressure corresponding to a velocity (v feet per second) of 72 miles to be 24.6 lbs. per square foot. But, as the *Engineer* points out in a thoughtful article on the subject, the overthrowing effect of a gust of wind upon a structure depends much upon whether the oscillations caused by former more or less rhythmical gusts coincide or not with those oscillations. It is not the statical pressure which proves disastrous to such elastic structures, but the active dynamic pressure, made up of the maximum impact of the wind, together with the greatest moment of oscillation of the structure itself. These involve problems which have not as yet been approached, and the fall of the Tay Bridge is a frightful warning of how disastrous reliance upon simple rule of thumb may be. That the structure was exceptionally weak in this respect does not in any way impair the value of the lesson it teaches.—*Iron Age.*

METHOD OF STUDY IN DRAWING.

(From Mr. Poynter's Lectures on Art.)

There is no doubt that the simplest way of beginning is to make copies of drawings in outline, beginning with easy forms, and progressing to the more difficult; and the School of Design drawing-books by Dyce are admirably adapted to this purpose. But this course may easily be carried too far, and in my opinion is useful only at the very earliest stage, as a means of acquiring steadiness of hand. The youth who comes to a school of art to study may be supposed to have displayed sufficient fondness for drawing to have practised it in some form or other from his earliest years, and therefore to have acquired some elementary knowledge. The surest and best method, therefore, for him on entering the school, is to begin to make outline drawings from the round, that is, from solid objects, by which, under proper direction, he can attain as great steadiness of hand as he could from the flat. In pursuing this preliminary course, his object will be to train both eye and hand in an equal degree, by endeavoring to draw with certainty as well as with accuracy; that is to say, he should, after first adjusting on his paper the proportions of the object he is copying, try to make his outline at once clear and correct, and draw it with as firm and steady a hand as a young student can command under the difficulties with regard to accuracy which must beset him at the outset.

The object, then, of the student is first to attain to a definite conception of the form before him, and in this he will fail unless he can express it on paper with a definite outline; next, to acquire the power of expressing the form with certainty and rapidity, which he will never do if he acquires a habit of drawing inaccurately to begin with, though he may have the full intention at the time of altering his lines to get them right in the end. In the third place, he must acquire steadiness of hand. This he must gain by the habit of drawing his lines continuous from one determined point to another, without retouching, or, as it is called, painting the line,—a point as important in figure as in ornamental drawing; the quick, and at the same time certain, apprehension of the form he is copying, and the correct rendering of it on a flat surface, being the end the artist aims at throughout his whole career.

This much conceded, the question arises as to the best models for a beginner to work from. My answer would be that he cannot do better than to begin with what he intends ending with, that is, the study of the figure.* All else is usually but time lost; at whatever stage the drawing of the figure is taken up, the student will find it as difficult as if he started with it at first. At the same time I admit that what are called drawing-models, that is, solid geometrical figures in wood, may be of occasional use in the case of young or helpless students. If a student, placed before a cast of a statue or head, shows himself incapable of rendering it in any way intelligibly, he may well be set to do a few drawings in outline from geometrical models; when, if he does not soon show signs of progress, it is probable that he has mistaken his vocation; but this is, of course, a matter for the discretion of the instructor, some students being much slower than others. It would be dangerous, however, to devote too much to this stage of study, especially when carried to the extent to be observed in the schools of the Science and Art Department,* it involves a mere waste of time; and the student should practice by preference from casts of heads, hands, feet, etc., proceeding by degrees to full-length antique figures.

There is a danger, therefore, of the student acquiring a mannered way of seeing and drawing the muscular and constitutional indications, and it is much better that he should proceed as soon as possible to study them as they really present themselves to him—that is, in light and shade—than that he should confine himself to a hard and unreal outline. I may, however, remark in passing that a student may derive much benefit in this early stage, if he looks at, and in leisure moments copies, good outline drawings of the figures, such as Flaxman's illustrations to Homer and Æschylus, so as to learn how far it is possible in pure outline to express the markings of the muscles and joints in the nude figure.

These illustrations have another advantage in being excellent studies of compositions for beginners; and although Flaxman may sometimes be found to give to the faces of his heroes a somewhat exaggerated expression, through a mannerism, contracted apparently in the endeavor to impart to them something of the character of the ancient tragic mask, yet there is a knowledge of the human form, and a grace and purity of design displayed in the grouping of the figures and arrangement of the draperies, which is well worth the attention of the young student.

We suppose the student to have now arrived at the stage of what is commonly called "shading" his figures, and he enters upon the study of *tone* which is probably, of all the departments of study to which he has to devote himself, the most subtle, the most complicated, and the most comprehensive. I might almost go on to call it the most important, for it is so intimately bound up with the study of form and color, that it cannot be kept separate, and is, so to speak, continually interfering with the apprehension of them. It is, however, precisely the point to which our English students, teachers, and painters (always omitting from the latter category certain men of eminence, but including those who practise the most popular kind of work) appear to have the most imperfect appreciation. This I believe to be due entirely to the general system of education in our art schools. You will find that as a rule the pictures in our exhibitions are, in their several degrees, strong on every point but this one.

I have no hesitation in saying that I believe most of the want of perception of unity of tone among our artists arises from the common habit of laborious work with the chalk-point. This use of the point, at all events in the way which is prevalent in our art schools, not only involves loss of time, and the sinking of the study of form and tone in that of mere execution, but concentrates the attention of the student on minute details which blind him to the general effect. It is for this reason that I have always advised my students to make use of the stump, rather than of the point, in shading their drawings; for the former, while it allows of any amount of finish of modelling, lends itself particularly well to the production of broad effects of tone, and

* It must be understood that these remarks are throughout addressed to students of figure-painting for pictures. For ornamental design a more extended course of outline drawing from the first is necessary.

* As much time used to be wasted over highly-stippled drawings of cubes and cones in schools of art, as over the antique figures referred to in Lecture III.

is, moreover, much easier for a beginner to manage than the complicated method of shading with the point. There is, it is true, an intelligent use of the point in drawing which proceeds naturally from the study of the construction of the figure; but it should be contracted in actual drawing from the figure, and the lines made in shading with the point should always be indicative of the construction. Any student who shows a disposition to work in this way with the point should be encouraged in the use of it; but for the majority the stump is by far the best means of learning to shade. As there is doubtless a certain amount of mechanical difficulty to be got over in its employment, it is here again that drawing models may be made use of in teaching the beginner how to make flat and evenly-graduated shades; care being taken that he does not spend more time over this than is necessary to facilitate his work for the future.

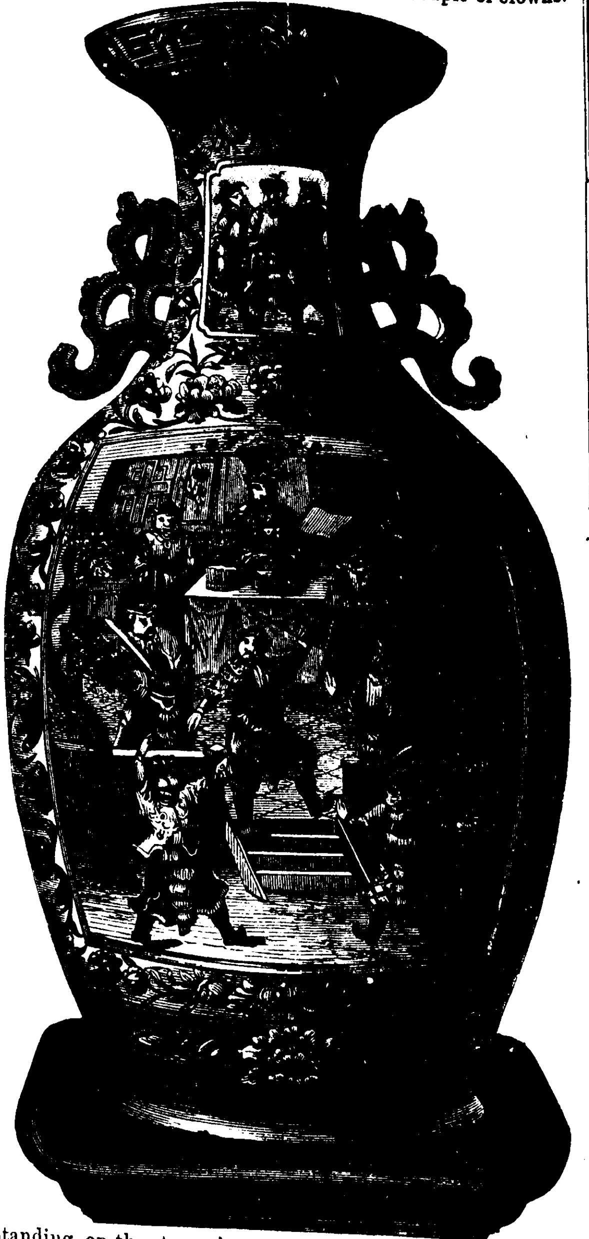
This first mechanical difficulty got over, the one main point the student has to attend to is the general tone or effect of the object he is working from, whatever it may be. And this he will find his great difficulty, not only as a beginner, but all through his course of study, and indeed through his life; it is so easy to see detail, and it is so difficult to subordinate it to the general tone. The student must constantly keep in mind his subject as a whole, while at the same time he does not omit to give all details their proper value. A prevailing fault with our students, and indeed with experienced painters, is that of making the reflections too strong, and therefore throwing the whole work out of tone. This fault arises among students from the desire to express distinctly everything that is seen; and in the process of doing this they forget the general balance of light and shade. With painters the desire is rather to give a spurious brilliancy to their pictures at the expense of truth. It is useless in making a study of a head, for instance, to have the proportions and features correct in outline, if in shading they are out of tone. A half-tint too dark, or a light too bright will destroy the unity of the work, and will cause it to present an assemblage of features, each in itself possibly right, but bearing no reference to the general roundness of the head.

There is also in connection with this subject another point to which attention must be directed. It is not only by dwelling on detail that a student may err in not giving the proper tone to his figure; the whole key of the drawing may be too dark or too light. The former is generally the fault of students who are in earnest about their work; this arises from their looking too much at the shades with reference to each other, without due reference to the surroundings; that is to say, from their paying attention only to their *relative*, and not to what for convenience I may here call their *absolute*, strength in the scale of light and dark. It is very common, for instance, to see the darkest shadow in a drawing from a cast made absolutely, or very nearly, black. Now with reference to other shadows in the figure it may appear to be so—still more with reference to the lightest parts; but let the student look at anything really black (as, for instance, the shadow under the sleeve of a black coat), and he will then find the real value of the shade he is representing in the scale of tones in the room where he is working. This want of reference to the surroundings is the real cause of the blackness so frequently seen in drawings; by bringing the darkest shade to its proper value in the scale from black to white you will then have to lighten by degrees the whole of the rest of the shading to bring it into proportion, and the drawing will gradually acquire its proper tone.

The importance of the correct perception of tone has given rise in France to a system of drawing by tone merely, to the ignoring of constructive drawing; the result is that there is no school where tone (or, as they call it, "*les valeurs*") is better understood; the absurdities and cruelties of modern English art in this respect being unknown there. At present the French devote themselves too exclusively to this side of art, and the result is that in their seeking after its subleties they have almost arrived at the conclusion that one object is as good to paint as another; a female head or a piece of raw meat being looked upon as equally suitable for the exercise of their skill in painting. There is no necessity for carrying matters to this extreme; the great Italian painters were none the less masters of tone because they devoted themselves to the study of form and to the higher points of construction and ideal beauty. But it must be kept in mind that no amount of anatomical or constructional knowledge of drawing is of value without a true perception of tone. A figure, which, as we say, is "all to pieces" in this respect, however correct the outline, will never stand the light of intelligent criticism. It is our want of perception on this point that makes foreigners laugh when they see our pictures, and with regard to most of our work of the most popular sort, the laugh is fully* justified.—*American Architect and Building News.*

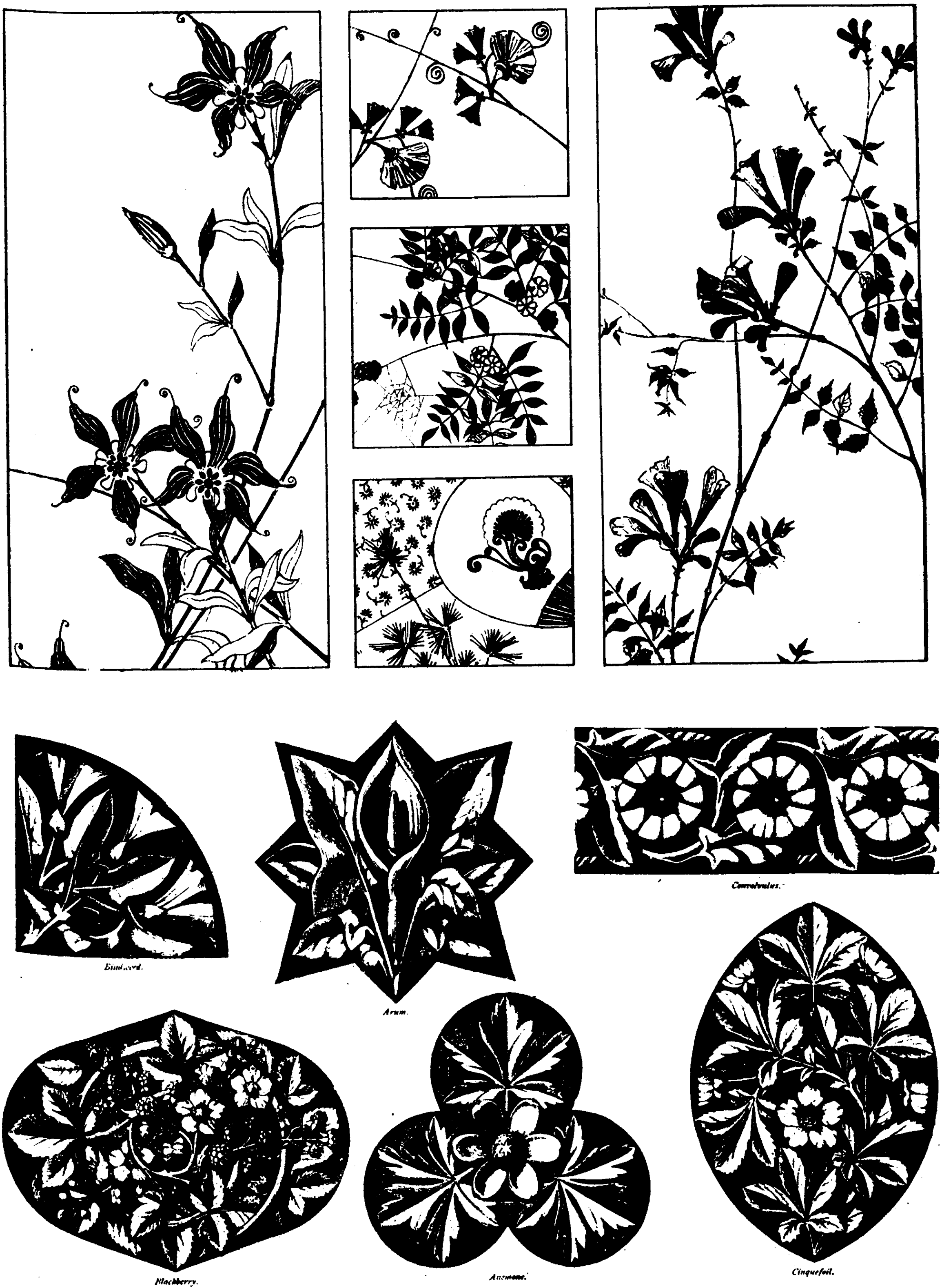
CHINESE PORCELAIN VASE.

The large porcelain vase shown on this page is of Chinese manufacture. The body, neck, and lips of the vase are covered for the most part with a fine vine and flower scroll pattern down in polychrome, but the front portion is occupied by medallions painted with figure subjects. What the subject of the upper design is, is uncertain, though it might very well represent a high official beset by rival office-seekers. But the lower picture tells its own story. Here is a grand Mogul seated at his ease, surrounded by his courtiers, watching the performance of a couple of clowns.



Standing on the steps, just outside of the Mogul's court, is the master of the clowns, urging the poor fellows on to renewed ex-

* That there has been great improvement in English art in this respect within the last decade there can be no doubt. The particular garish look that was common to English exhibition-rooms is much modified of late; and French artists remarked on the great general improvement in English art in the Paris Exhibition of last year (1878), compared to what they saw of it in 1867. I was gratified to hear from a French artist of distinction an opinion which is a confirmation of my own, that our art has improved and will continue to improve, because the English take what is good from other schools without sacrificing their originality. He compared it with the art of the Belgian, Italian, and other schools, which they can only imitate.



STUDIES FROM NATURE.—From the *Art Workman.*

ertions, while on either hand, keeping him, the master, to his work, are two courtiers, one expostulating with him kindly, and the other standing silent, with drawn sword, and a most sinister look on his face—an action more potent than words.

This picture is a very good illustration of Chinese pictorial art. It is full of character and action. It is not fine art, considered by our canons of good drawing and perspective, but it shows more artistic perception and ability to portray the salient points of a situation than many European artists possess.

Sanitary Items.

CAUSES OF INSANITY.

A table in the last report of the Utica State insane asylum, giving the occupations of the patients, shows that by far the largest number (282 in a total of 410) whose occupation was known were farmers' housekeepers, meaning, we suppose, farmers' wives, laborers and domestic servants. This illustrates that a monotonous and toilsome life, with little or no relaxation or recreation, is more liable to unsettle the mind and destroy the reason than a life of greater mental and social activity. Most of the patients were native Americans, and married. Their ages, in the main, were from 20 to 40 ; very few were illiterate ; but few also had more than a common-school education. In 427 cases but 122 inherited any taint of insanity ; 205 patients remained not over six months, and 141 not over two months, showing that the malady was not severe. Intemperance was a minor cause—11%. Female disorders caused about 12%, while the prime cause in the largest number of cases was ill-health stimulated by over-work, grief, anxiety and sleeplessness. To the causes cited above which would encourage mental disturbances, we would add dyspepsia, due to poor or ill-cooked food. In this connection we would refer to the admirable paper on the health of Massachusetts farmers, by Dr. J. F. Adams, of Pittsfield, in the report of the Massachusetts State Board of Health for 1874, in which a large amount of interesting data is given regarding the ill-health of the farmers, and especially of their wives and daughters. Overwork, exposure, poor food, unsanitary dwellings, impure water, unventilated bedrooms and insufficient recreation, are all mentioned as the chief causes of sickness among this class. It is denied that farmers are specially liable to insanity, yet it is added that causes of insanity are not altogether wanting, as shown by the 81 farmers admitted to the asylums the year before. The farmer lives amid more natural conditions than the artisan, business or professional man ; but, while he escapes intellectual strain, he labors too incessantly and joylessly ; and frets and worries about his crops, his stock and his mortgages. The remedy is more recreation and less work. Then the farmer may lose his reputation for chronic grumbling.—*Sanitary Engineer.*

ART IN A COTTAGE.—The mission of At to the cottage is one of exaltation, of refinement, of far-reaching enfranchisement ; it is to open the doors of the kingdom of knowledge, to touch fresh springs of sensibility ; to place the humblest soul in its right relation to the universe. The true artist would rather be what David and Bunyan and Shakespeare are to the cottage, as the type of what is the humblest and lowliest amongst us, than find himself the secret joy of a bibliomaniac, the priceless treasure of a Medici, the awful *sacrosanctus*, visible only to monk or nun. Art is no cabala, no esotory, intended only for a class, a caste ; its magic and its mystery are keys to the inner room of every human spirit, though the doors be rarely opened and the rooms themselves be unswept and ungarnished. The mission room from the cottage, too, is always wanted, and wanted as much in the palace as anywhere else. "Paint us as an angel, if you can, with a floating violet robe, and a face paled by the celestial light," writes George Eliot, in "Adam Bede ;" "paint us yet often a Madonna turning her mild face upwards, and opening her arms to welcome the Divine glory ; but do not impose on us any æsthetic rules which shall banish from the region of Art those old women scraping carrots with their work-worn hands ; those heavy clowns taking holiday in a dingy pot-house ; those rounded backs and stupid weather beaten faces that have bent over their spades and done the rough work of the world ; those homes with their tin pans, their brown pitchers, their rough curs, and their cluster of fine onions. In this world there are so many of these common, coarse people, who have no picturesque, sentimental wretchedness. It is so needful we should remember their existence, else we may happen to leave them quite out of our religion and philosophy and frame lofty theories which only fit a world of extremes. Therefore, let Art always remind us of them ; therefore let us always have men ready to give the loving pains of a life to the faithful representation of common-place things—men who see beauty in these common-place things, and delight in showing how kindly the light of Heaven falls on them." There is beauty in this sea-ringed island of ours as well as in the sunnier lands, ; in English heaths and hills, as well as in Swiss mountains and Italian farms ; in heavy featured, sombre-clad labourers as well as in the ribboned brigands and ragged lazzaroni. There is as ample a poetry of suggestion in a cottage arm-chair as in a curule throne ; and the tragedy which plays itself out in the life of labour and homely retirement is as full of romance as are the metaphysics of crime or the ecstacies of the saints. It is perhaps less to be caught by pure literary excogitations, and hence it is less attractive and less easy to discover. It cannot be gathered up into intellectual power by much dwelling in the studio, by ostentatious fidgeting along the beaten tracks of Art. The novel, in short, is competing with other forms of Art in this double mission, but pencil, chisel, and brush must not accept the ostracism or the petalism the pen would thrust upon them. Pre-Raphaelitism has done much to increase our regard for minute and honest workmanship, but there is yet needed a dash of Dutch simplicity without its coarseness, a revival of the broad, human, tender spirit which would make the artist as tremulous to life in a cottage as if its inmates were kings and queens in disguise, sheltering from the troubles which are passed, waiting for the reverential greeting and the royal raiments which are near.—*E. Goadby, in the Art Journal.*

A WRITER to the *English Mechanic* on coldness says :—Eat any wholesome food you like, and do not trouble yourself about what you eat, unless you are subject to dyspepsia, and then only so far as to avoid over-rich and well-known indigestible things. Physical exercise is conductive to health, and also spends the heat of the body ; wholesome life means due expenditure and supply ; keep within the bounds of real fatigue, physical exercise is wholly beneficial by setting the organs of the body in active healthy operation. Do not wash your feet before going to bed, though there is no harm in fairly warming them, but keep them in good condition by frequent bathing in warm water ; it is evident that the querist has a sluggish circulation, which his occupation does not stimulate, so that he requires frequent brisk walks. For cold feet on going to bed there is nothing like putting on a pair of warm woollen socks some sizes too large, so as to be loose ; but it is well to take them off when the feet are found to be warm, either before going to sleep or on any occasion of waking ; it will also be found an advantage to lie on a thick double blanket instead of on a sheet. This will be found invaluable to any one subject either to chillness or to sciatica ; it prevents the absorption of the heat from the body which happens with sheets, and which it often takes a long time to restore, while the effects of the chill remain.—SIGMA.

TOXIC EFFECTS OF TEA.—Dr. W. J. Morton, in a paper upon the above subject, read before the recent annual meeting of the American Neurological Association held in New York, arrives at the following conclusions in relation to the use of tea : 1st. that with it, as with any other potent drug, there was a proper and improper use of it. 2nd. That in moderation it was a mild and pleasant stimulant, followed by no harmful reaction. 3rd. Its continued and immoderate use led to a very serious group of symptoms, such as headache, vertigo, ringing in the ears, tremulousness, "nervousness," exhaustion of mind and body, disinclination to mental and physical exertion, increased and irregular action of the heart, and dyspepsia. 4th. The mental symptoms were not to be attributed to dyspepsia. 5th. It diminished the amount of urine, and retarded the metamorphosis of tissue. 6th. Many of the symptons of immoderate tea-drinking were such as might occur without a suspicion of the real cause.

A HYGIENIC LIQUEUR.—A friend of mine who has just returned from Germany, invited me to a dinner party last week, and, at the close of the dinner—which was a singularly good one—an unknown liqueur was handed round, which was particularly recommended by the host and which no one could name. It turned out to be a new "German notion" of applied science to germandize. The liqueur was a "pepsin essenz," invented by Prof. Oscar Lubruck, of Berlin, capable of digesting cast iron, and which the epicureans of the German empire propose to insure that good digestion shall wait upon appetite. On this occasion it did so, but whether the cook or the professor must bear the palm I cannot decide. I have seen an alderman include dinner pills among his dessert, and over this the "pepsin essenz," which has the flavor of a delicate hock has some obvious advantages.—*London Truth.*

Sanitary Matters.

REMARKS BY A CORRESPONDENT

To the *Sanitary Engineer*.

In the August 1st number of your paper I notice an editorial on the recommendation of Commissioner Campbell, for the ventilation of the city sewers through our house drains. The comment upon it in the article quoted appeared complete and well put.

If gentlemen who stand in authority and possess the power to have such recommendations carried out were first to devote a few hours to the careful perusal of such standard worka as Bailey Denton's and Baldwin Latham's *Sanitary Engineering*, I doubt very much whether they would often be guilty of such grave errors as are frequently committed.

What can possibly be the advantage of admitting the very elements of contagious and preventive disease into every ramification of a system of house draining to lurk there, impatient of restraint at every trap-overflow and waste, ready to enter at the first opportunity into the living and sleeping rooms of our houses? It is like admitting an enemy within the one main entrance of a city aud trying to overcome him when aided by every sheltering barricade and redoubt.

The germs of disease have the dreaded power of multiplication to a frightful extent in a short space of time; and the object of traps and sanitary appliances is not the mere exclusion of the majority of these germs, but it is the single germ which must be debarred from effecting an entrance. That the simplest and best method of accomplishing this, is by a total disconnection from the sewer by a trap outside of the house, and as near the sewer as possible, is now a pretty well established fact. This trap is very properly considered the main safeguard of the house. Is there anybody who has not been annoyed by the nuisance, at some time or another, of running water on the upper floors of our brown stone houses and how often after a summer drought, do we not discover that the water from the mains refuses to rise to its accustomed height? In every such case we can be sure that the traps in waste and overflow pipes have dried out by evaporation, and then where would our safety from the infection of tainted sewer air be were the soil pipe doing duty as a shaft ventilator for the public sewer after the fashion recommended by Messrs. Campbell & Towle? A condition is almost always found at some time or another during the day, which tends to draw the air from the drain or soil pipe into the room, were it not prevented by the interference of the water seal. Take as an example, the case where there is an insufficiency of air supplied to the open grate fire, through open doors, etc. Here it would be the simplest thing for the open trap to supply the deficiency to the imminent risk of the very lives of the inmates of the rooms.

On the other hand it requires but little reflection to understand that the trap in the main drain is the least liable to become dry of all the traps in a house, since it is placed in such a position that every drop of liquid wastes of the house is compelled to pass through it. It requires but a few gills of water each week to prevent unsealing by evaporation, and when this is not supplied there is probably not much need of any trap at all, since the house would in that case be empty probably. Besides this, the rain falling upon the roof tends to keep the trap sealed. But the use of this trap need not be discussed here; its utility is too well understood and admitted by all sanitarians, to require any additional testimonial.

I have not the slightest doubt that the introduction of numerous manholes with perforated covers into the sewers of the city, have been found to have a "marked effect." In the present state of sanitary knowledge, it is pretty generally admitted that the system of open manhole ventilation for sewers, on a plan somehow similar to the London method, is both the simplest and best as well as most economical. If, as in some few cases, the sewer is under the edge of the walk, there is no reason why inclined manholes extending to the middle of the street from the crown of the sewer, should not employed as in some other cities under similar circumstances.

In any event it is to be sincerely hoped, that it will be impossible to "obtain legislation that will require owners of property to make such provision for ventilation (of the sewer), as may be necessary.

W. G. E.

The trap outside we do not recommend for this climate.
—Ed. *Scientific Canadian*.

SANITARY SCIENCE AS APPLIED TO WORKSHOPS.

The greatest discomfort in our workshops in summer is caused by exposure to an excess of sunlight and a deficiency of ventilation. The first may be corrected by awnings, shades, curtains, or, what is best of all, by foliage, when the circumstances for its growth are favorable; and all this may be accomplished at so trifling an expense as to be nothing compared with the resulting benefit to the workmen. The second may be corrected by the use of fans or blowers, which, notwithstanding they are more expensive by reason of first outlay and continuous cost of running, pay their expenses many times over and over again when we consider the advantages derived from an increase in the products of labor, as well in quantity as in quality. A workman cannot possibly do his best in a hot and stagnant atmosphere, and it is useless to expect it. A blower like Sturtevant's, or any other good blower, changes all this. Fresh air blown into a workshop is a great advantage, and in many instances this can be done at no great expense. Workshops are often made very uncomfortable on account of low ceilings, or low roofs upon which the sun beats down, converting the room beneath into a furnace. Sometimes this can be remedied by roof tanks, sometimes by a false roof on top, or, in other cases, by a space between the roof and the ceiling of the room below. In mills where there are furnaces, water screens are a great advantage, and we are pleased to state that their use is spreading, as well as many other little contrivances, which, trifling as they seem, may add greatly to the improvement of the material as well as the mental condition of the workmen.

Employers begin to realize more and more that it does not pay to treat their employees as mere machines, and that besides wages, there ought to be another incentive to encourage the workmen if the maximum value of the products of labor is desired. We, therefore, again call the attention of owners, managers and foremen of workshops to this important subject.

COMMON DEFECTS IN HOUSE DRAINS.

BY ELIOT C. CLARKE, C.E.

[The following interesting paper is from the Tenth Annua Report of the Massachusetts State Board of Health for 1879:]

The purpose of this paper is to state what are the common defects in house drains, and to show the usual forms and condition of such drains as they exist in our cities and towns to-day. The statement is chiefly based on observations made in Boston while constructing intercepting sewers; but it is assumed that examinations in other cities and towns of the Commonwealth would reveal a condition certainly no better, and probably worse. Some testimony will be offered from those whose occupation has given them opportunities for observation; and, while it is not intended to cite exceptional cases of defective arrangement or construction, a few characteristic examples will be given, such as investigation would prove to be very common.

What are the essential conditions of an efficient house drain, one or more of which must be violated to constitute a defect?

Briefly stated, they are: That the drain must be of size and shape to concentrate its flow, smooth inside, suitably inclined, tight, properly connected with the house pipes and sewer, strong and durable in material. It is of great importance that the portion of the drain within the house should be always in such a position as to admit of ready inspection at any time; it should be in sight,* and not concealed. Let us see what proportion of Boston drains reasonably fulfill these conditions.

Existence is perhaps the most essential condition of a drain; and, by a Hibernicism, non-existence may be termed its most serious defect. Naturally, non-existence was not observed in digging for the intercepting sewers, but there is sufficient evidence that it is not unknown.

The writer has seen a case where a drain pipe from a dwelling ran through the walls and there ended; several simi'ar cases have been reported to him; and another, where a block of six expensive houses, occupied for months with all the customary apparatus in the way of plumbing and waste pipes in full operation, had no drains beyond the walls to the street sewer. Such cases are rare, and generally reveal themselves quickly; but it is more common to find drains which are so solidly filled with earth, grease and other matter, to exist only in name, and which, for any good they accomplish, might just as well not exist at all. One, examined by the writer some months since, had apparently had nothing through it for years, the whole waste from the soil pipe having

* The same rule applies, of course, to soil pipes, although that part of the subject does not come within the scope of the present enquiry.

accumulated beneath the cellar floor. The same state of things was lately found to exist below the Rockland Bank Building in Boston. A case has been mentioned to the writer where it is thought that three deaths can be directly traced to the stoppage of a drain which was so clogged as not to act. Almost every one who has been led into this line of inquiry has some similar instance to relate, and evidence could be multiplied indefinitely. Of the house drains crossing the intercepting sewer trench during its construction last season, fully 25 per cent. were almost or entirely choked with sludge.

An example of semi-existence, observed while digging for the sewer in Charles street, is worth nothing, as showing the intelligent judgment sometimes exercised in doing this kind of work. It will be understood by referring to the sketch (Fig. 1). The drain was one for surface water; and the drain layer, in digging from the house toward the sewer, came upon a log lying across his trench, and here stopped short, chopped a hole in the log, found it hollow, and connected his drain to it without going further. It is true, the log led to no outlet, but then it saved trouble—to the drain layer.

As to the question of size of drains, it was found that of 113 observed while building sewers the past year,

11	were about	4	inches	in diameter.
4	"	5	"	"
21	"	6	"	"
5	"	7	"	"
27	"	8	"	"
8	"	9	"	"
11	"	10	"	"
26	"	12	" or over	"

The sketch above (Fig. 2) illustrates the wide range of this diversity. Most of them drained single dwellings similarly situated; and if the small ones were large enough, the others must have been unnecessarily large and *vice versa*.

But what is the proper size?

Probably nine engineers out of ten would answer, "By no means larger than 6 inches," and nine drain layers out of ten would now say, "Never smaller than 8 inches." The former argue that the drain need only be large enough to pass through it all that it can reasonably be expected to carry, and that anything beyond this tends to make the ordinary flow spread thinly over a broad bottom, without sufficient depth to carry solid matters along with it. The latter reply that, in fact, a drain never does receive only what can be reasonably expected, and that the larger the drain the more storage room for the unreasonable accumulations of clothing, tin and glass ware, dead animals, &c., usually found in it. "In practice," they say, "large drains take longer to choke up than small ones, and are therefore better."

Their facts are correct, but their conclusions may be doubted. In building a drain the object should be to prevent the beginning of a deposit; and this is much easier in a small drain than in a large one, as will be understood from Fig. 3, where an equal quantity of water is supposed to be flowing in a 4-inch and a 12-inch drain. It might be thought (by one who thought at all about such matters) that the discharge of a great volume of water, as from a bath-tub, would tend to scour out and clean a drain. So it might, a very small one. But in such a structure as our sketch represents, with a flat bottom 12 inches wide, the stream caused by such a discharge would probably meander over the bottom of the drain, and be nowhere over a quarter of an inch deep. Let a deposit once begin, and subsequent accretions as surely choke a large drain as a small one, only it takes longer to do it. And it may even be questioned whether it is an advantage to be able to use, for an additional year, a drain nearly full of putrescent filth, or whether it is not better to have the evil disclosed and remedied as soon as possible. It may safely be said that three-quarters, at least, of the house drains in Boston are too large, because, even if some of them perform efficient service, small ones would do as well, and be less liable to get out of order.

In respect to form, there is almost as much diversity as there is in size. Figs. 4 to 10 give the more common shapes.

The first three must be condemned at once, on account of their flat bottoms. The water, passing through them, spreads out into a thin sheet, which does not readily wash along solid matters. Floating matters also tend to stick in the angular corners more than they would on rounded surfaces. That this is so, is shown by the record. Of the 113 house drains whose condition was noted, 45 were constructed with flat bottoms; and of these, 26 were choked, or nearly so, with sludge; 19 were reasonably clean. Of the remaining 68, which had rounding bottoms, 12 were full, or partly so, of sludge; 56 were reasonably clean. The common appearance of these flat-bottomed drains, as they were uncovered, is shown in Figs. 11, 12 and 13. Fig. 13 represents the condition of a drain, now disused, which came from the City Hospital grounds.

The shapes shown in Figs. 7, 8, 9 and 10 are unobjectionable, although, in fact, these drains were often too large and had other defects. Fig. 8 is a kind of construction which was in vogue 25 years ago, and, except for liability to open joints, its angular bottom and its size, is passably good. Our facts seem to show that 40 per cent. of the Boston house drains are defective in shape.

A drain should be smooth, so as to afford no prominences for solid particles to lodge upon. Planed wood, slate and brick are smooth enough. In use they become covered with a film of slime that makes them very slippery. Unplaned wood, which until recently has been somewhat used, is apt to be rough, and to have splinters pointing against the flow, which catch solids moving upon them. The chief difficulty in making a brick drain smooth is the care required to see that no mortar is left projecting into the drain. Fig. 14 shows the manner in which such work is often finished.

It is possible to strike each joint of the lower half of the drain so as to leave a reasonably smooth surface, but a difficulty harder to avoid is caused by portions of the mortar, uniting the arch bricks, falling when the supporting centres are removed. These lumps of cement, indicated in the sketch, adhere to the bottom, and, unless carefully scraped off, harden and form serious obstruction to the flow of sewage.

Pipe drains, whether cement, clay or iron, are smoother than those of brick. Glazed clay pipes are especially smooth. In these, however, it is very common to find the mortar uniting the several sections of pipe projecting into the interior, forming a series of little dams which obstruct the flow. Fig. 15 illustrates this. This can be avoided by carefully cleaning the interior of each pipe, after laying it, with a swab or hoe—a simple precaution, but often neglected by a careless drain layer. It will not be an exaggeration to say that three-quarters of existing drains are defective as to their smoothness.

The best rule in practice for the inclination of a house drain, is to give it as much pitch as is possible, and in few cases is less than one-half inch to the foot safe. A great many drains are faulty in this respect. The actual inclination of drains crossing the trench of the intercepting sewer the past year was not taken; but of the 113 met with, 9 are recorded as level and 14 as pitching the wrong way—that is, toward the house. One of these, coming from a public school building, was about 7 inches lower at the street curbstone than at the sewer. The condition of such a drain is shown in Fig. 16.

The water stands in the depressed portion of the drain to the height of its connection with the sewer, and, having little motion, deposits are apt to occur. In the case referred to, it is but fair to say that the school drain was clean so far as seen. Very possible an abundant use of water or recent heavy rains had scoured out any deposit that may have taken place. It is possible that most of this inclination in the wrong direction occurs in the street near the sewer. The drain layer frequently begins to put in his drain simply with reference to the house, without enquiring what is the elevation of the sewer into which it is to empty. He digs his trench toward the street, and lays his drain on a slope which he judges by his eye to be sufficient. This in itself is a deceptive matter, as a trench generally seems to slope down toward the observer. When the sewer is reached, it is found to be higher than the portion of drain already laid. What is to be done? It is not the drain-layer's fault that the sewer is too high; he cannot take the trouble to dig up his pipe again; it is only a few inches anyway; and the pipe is run up and connected, the trench back filled, and "out of sight, out of mind."

It was stated that one of the essentials of an efficient house drain is that it shall be tight. Mr. Ernest Bowditch has called the writer's attention to a condition in which, at first sight, a leaky drain might appear better than a tight one. He says: "It is sometimes noticed, where plumbing is from 20 to 25 years old, and where all the drains outside the cellar walls are of open stone (technically, French drains), the soil pipe not being ventilated, that there is no perceptible leakage of sewer gas into the house. It is reasonable to suppose, in these cases, that the gas generated outside the house works up through the soil rather than forces the traps in the house. The modern method of tight drains and cesspools tends to drive all gases into the house. It

Fig. 1.

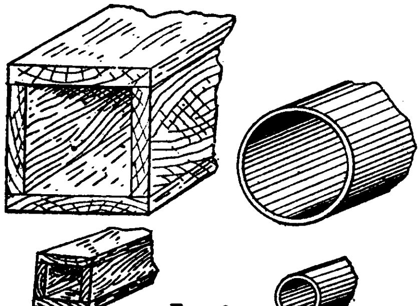


Fig. 2.

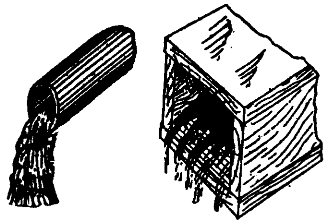


Fig. 3.

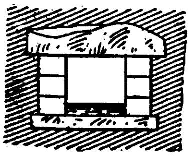


Fig. 4.

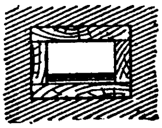


Fig. 5.

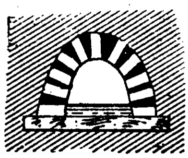


Fig. 6.

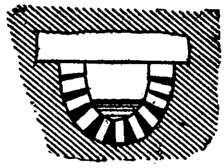


Fig. 7.

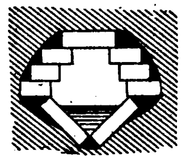


Fig. 8.

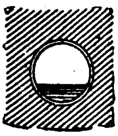


Fig. 9.

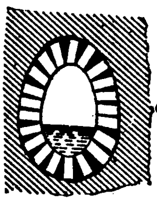


Fig. 10.

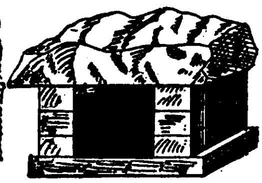


Fig. 11.

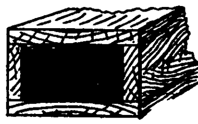


Fig. 12.

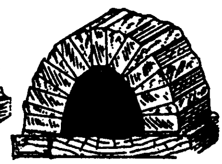


Fig. 13.

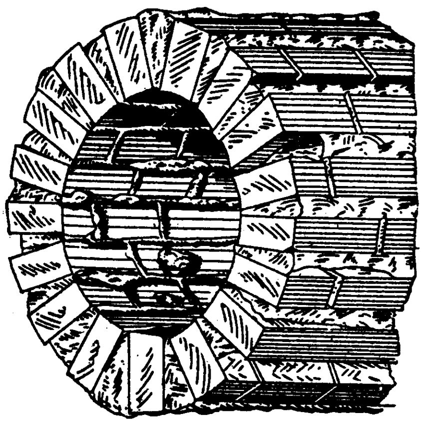


Fig. 14.

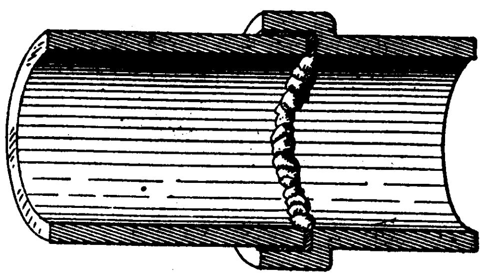


Fig. 15.

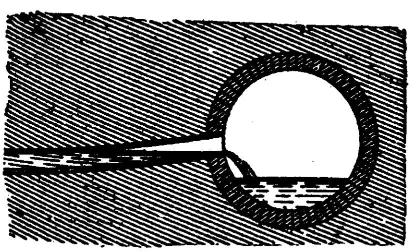
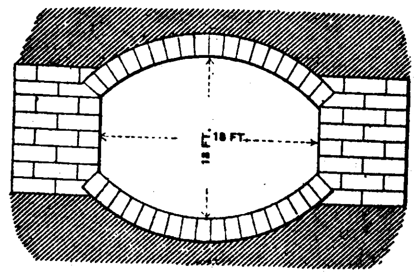


Fig. 16.



Worcester's Sewer.—Section of the Large Sewer in the City of Worcester, Mass.

COMMON DEFECTS IN HOUSE DRAINS.

is frequently more important, therefore, that recent plumbing should be ventilated than that of older date."

Both tight and open drains tend to produce evils; but those arising from a tight drain can be obviated by proper ventilation of the house pipes, while the evils from leaky ones are irremediable. Therefore we say drains should be tight, that sewer gas (or, what is worse, matters capable of producing sewer gas during a long decomposition) may not escape, and also that the water may not leak out, leaving the solid contents of the drain stranded.

This want of tightness is the commonest defect of all, and probably three-quarters of the annoyance from drains is due to it. In the annual report of the Boston City Board of Health for the year ending April 30, 1878, is given the result of examinations of 351 house drains in different sections of the city. Of these, 193, or 55 per cent., are reported as defective, and in nine cases out of ten the defect consisted in the drain not being tight. This defect, more than others, affects the better kind of houses.

We feel that we are performing a proper duty in bringing constantly before the public sanitary discussion, and exposing the inferior way in which sanitary work is generally performed. We now mention that in one of the main sewers in Ottawa, which we had an opportunity once of inspecting, the interior of the sewer presents exactly the appearance of Fig. 14, page 77, owing to the work being hurried through in winter, when the cement froze, as fast as laid, to the centreing of the arch. In the tile drains laid in Quebec, many of the joints are as Fig. 15, and we believe that one reason why the water power is so slight in the upper town of Quebec, compared with its head at Lorette, is because it meets with so much friction from the protrusion of lead at the joints, and of which we were an eye-witness when the pipes were being laid.—Ed. S. C.

Scientific.

THE MOON'S SHAPE.

The moon is the nearest, and, next to the sun, the most brilliant of all the heavenly bodies; yet it presents more perplexing problems than any other. Whatever theory has been adopted and however carefully worked out, there are deviations and perplexities which cannot be accounted for or explained.

One of the most difficult puzzles appears to be the strong and somewhat peculiar grasp which the earth has upon the moon, differing quite materially from what it should be if that body was a sphere, or as approximately as the earth is to such a form. If we examine carefully a stereoscopic photograph of the moon—and such pictures are very common—it will be seen that the shape bears a much stronger resemblance to an egg, when viewed endways and looking at the smaller end, than to a sphere. By careful observation it will be perceived that there is a careful rounding away of the body of the moon from its point nearest the earth to a certain distance, when the surface appears to fall away in a nearly straight line. When this plane or surface is tilted by libration, first upon the one side and then upon the other, the true perspective can be readily observed.

This peculiarity in its shape may be accepted as an explanation why one side only of the moon is always turned toward the earth. With its longer axis pointed directly to the earth's centre, our planet's grasp upon her satellite is so strong as to admit of a diurnal revolution, comfortable only to the moon's revolution around the earth—thus keeping the same face or pole of the moon toward the earth—the only variation from this fixity of position being the slight swinging or pendulum motion of the mass, which is known to astronomers as the "moon's libration."

It is by means of this libration that it has been possible to get a true stereoscopic view of the moon. The artist, instead of moving his instrument to get the stereoscopic effect, waits for the moon to move, the change of motion between the one libration and the other, being sufficient for his purpose. In no other way can this peculiarity of shape be made visible to the eye. Intsruments, however perfect, fail in this direction. Proctor says: "It need hardly be said that no instrumental means in our possession can show the eliptieity of the lunar disc."

How this peculiar shape was brought about is explained in the following manner: ".When the moon was a molten mass, the centrifugal force at the equator was so slight that there was no bulging, but the earth's attraction drew out the mass, lengthening it in the direction of the polar axis, and keeping that axis forever directed towards the earth's centre."

SINGULAR CASE OF LIGHTNING STROKE.

A paper was read at a late meeting of the Clinical Society, London, by Dr. G. Wilks, of Ashford, on a remarkable case of lightning stroke which occurred on June 8th, 1878. A farm laborer was struck by lightning while standing under a willow tree, close to the window of a shed in which his three fellow workmen had just taken shelter from a violent storm of rain. His companions found the tree partly denuded of its bark, and the patient's boots standing at its foot. The patient himself was lying on his back two yards off, and though he was fully clothed previously, he was now naked, with absolutely nothing on except part of the left arm of his flannel vest. He was conscious, but much burnt, and his leg was badly broken. The field around was strewn with fragments of the clothing; the clothes were split or torn from top to bottom, the edges of the fragments being often torn into shreds or fringes; they only showed evidences of fire where they came in contact with metal, such as his watch and the buckle of his waist belt. There was no laces in the boots. The left boot was torn and twisted into fantastic shapes, but the sole was uninjured, and there were no signs of fire upon it; the right boot had the leather much torn and the sole rent and burnt. The watch had a hole burnt through the case, and the chain was almost entirely destroyed. The stockings were split down the inner sides; the hat was uninjured. The patient stated that he was struck violently on the chest and shoulders, became enveloped in a blinding light, and was hurled into the air, coming down on his back, "all of a crash," and never losing consciousness. The hair of his face was burnt, and the body was covered with burns. Down each thigh and leg was a broad crimson indurated band of burning, passing along the inner side of the knee, and ending below the left inner ankle and the right heel; a lacerated wound, with a comminuted fracture of the os calcis. The bones of the right leg were fractured, and the tibia protruded through the skin in the course of the burn. He was discharged healed twenty weeks after the occurence. Dr. Wilks remarked on the almost complete exemption of the nervous system and on the probability that the clothes being wet acted as good conductors, and so diverted the electric current from the great nervous trunks, thus saving the man's life.

ACTION OF AMMONIA ON BRASS.

John Y. McLellan, of Glasgow writes to the *Chemical News*, as follows: While experimenting on the action of liquor ammonia on various metals and alloys, with a view to determine the most suitable for the contraction of a certain part in an ammonia plant, I have met with a reaction on brass which, so far as I know, has not before been recorded, and of which this note is a preliminary notice. If a small piece of brass or a few brass turnings be covered with liquor ammonia, specific gravity 0·880, in a closely-fitting room stoppered bottle, and placed aside for a few days, it will be found that the ammonia has acted on the copper of the brass to such an extent as to produce a solution of a more or less characteristic violet color, due to the presence of oxide of copper held in solution by ammonia. If this solution be still allowed to remain undisturbed for a few days longer free from contact with the air, this violet color will gradually disappear, leaving a colorless solution, which, however, is no sooner brought into contact with the air by removing the stopper than the violet color is reproduced, and by again stopping the bottle and leaving it aside the same reaction occurs and may be reproduced over and over again.

The production of the violet color from a colorlesss solution on exposure to the air does not seem to be the result of oxidation, as on opening the bottle in an atmosphere of carbonic acid the same reaction takes place.

I am at present working up this subject in the hope of finding in what state this colorless solution of copper exists.

PROFESSOR HUXLEY ON SNAKES.

The opening lecture at the London Institution for the season was delivered by Professor Huxley, F.R.S., to very crowded audience, his subject being "Snakes," than which he said, there were, in the popular apprehension, few animals more symbolical of degradation and horror. Quoting the primeval curse in Genesis, he remarked that no creatures seemed more easily destroyed by man and few less able to defend themselves. Few wounds would be less harmful than a snake's bite were it nothing more than the sudden closing of the teeth. Yet there were not many animals gifted with so many faculties. It can stand up erect, climb as well as any ape, swim like a fish dart forward, and do all but fly in seizing its prey. The destructiveness of snakes to man was illustrated by the fact that 20,000 human lives are yearly lost in India by their poison, and it might safely be said that they are a more deadly enemy to our race than any other beasts of the field. Professor Huxley spoke first of the three classes indigenous to our own climate—the ringed snake, the coronella, and the viper. Of these the viper alone was venemous, which the difference between its structure and that of the harmless British snakes helped to explain. It might be that the reason there were no snakes in Ireland was the multiplicity of its other plagues. Everybody must be struck with the beauty of the harmless snakes, which formed the overwhelming majority—especially the grace with which they wreath their bodies into circles, and their fine eyes. The venomous snakes were not so beautiful. None admired our native viper, with its yellowish scales. To adults its bite was far seldomer serious than to the young. Passing to snakes in general, of which there were many hundreds of distinct species the lecturer illustrated in great detail the adaptation of their organization to its manifold work. Very graphic was his description of the manner in which some of the more destructive snakes dart suddenly on their prey, twisting themselves round its body, crushing it into a shapeless and writhing mass, and at last swallowing it whole. He pointed out some very curious arrangements in the anatomical mechanism and jaw-bones illustrative of the statement that the snake cannot properly be said to swallow his prey; he holds on to it rather, gradually working it down his throat in a most leisurely manner, but never letting it go. He would take a sleep for six weeks before giving up his task, and if the morsel were really to big would sometimes die in the effort to get it down. Of course, the snake required a very fully-developed and effective apparatus of salivary glands for this purpose. The poison-bag of the venemous snakes was nothing but a modification of the salivary glands of the harmless species, the structure of both kinds being in almost all respects not only parallel throughout but almost identical. As another instance of the close relationship, it was shown that the sharp channel-needle which conveys the poison of the cobra and its congeners is nothing but the developement of the tooth which these murderous reptiles possess in common with innocuous snakes. The fact that the salivary glands was the poison laboratory of the deadly snakes, as well as the known properties of the saliva of dogs or other living creatures affected with rabies, appeared to Professor Huxley to point out the direction in which lay the solution of the difficult problem of the cause of snake-poisoning, and of a possible antidote against it. At present there was no man living who could heal the bite of the cobra, except by cauterisation in very fresh cases.

THE PROBLEM OF SOLAR RADIATION.

One of the most stupendous problems staring the modern physicist in the face, is to explain how it is possible that the solar energy, which reaches us in the form of heat, can pass through millions of miles of that space through which the earth is being driven by its momentum, and in which space a most intense cold prevails.

If the earth had no heat of its own, this solar radiation would be incompetent to heat its surface to such a degree as to make organic life possible. This is proved by the perpetual snow on high mountain tops, which loses so much more by radiation than the valleys and plains, that the interior heat of the earth cannot keep them at a temperature above 32° Fah. It is proved by the low temperature prevailing on the surface of the moon, which, being so much smaller than the earth and possessing little or no atmosphere, has long since lost the heat required for organic life. It is also proved by the fact that the mean temperature of the ground is always a little higher than that of the air, and increases with the depth, and finally, the 200 active volcanoes on the earth's surface, with the numberless hot springs, are the most potent proofs that the earth's interior must be very hot, and loses this heat only very gradually.

That this terrestrial heat is, at the present stage of the earth's existence, utterly incapable of developing organic life, is proved by the low temperature prevailing at the poles, where the formation of ice is due to the deficiency of solar heat, while on mountain tops it is due to the insufficiency of terrestrial heat.

Still, however, evident and clear is the action of this terrestrial heat, the transmission of the solar heat through millions of miles of a medium so attenuated as to surpass the best vacuum we can produce in our air pumps, is, at the present condition of our knowledge, an apparently insoluble puzzle, and has become more so since the discovery that heat is merely a mode of motion, and, like light, a mere vibration of material molecules. The question is, how can the motion of that interplanetary medium, which is apparently a mere nothingness, evolve through such enormous distances the stupendous energy on our terrestrial surface, which energy is consumed in the raising of water into clouds, and its return as rain and water-power; it is consumed in raising winds and storms, in evolving vegetable and animal life, in short, in performing all the functions pertaining to a live planet. How is this stupendous energy, or latent motion, transmitted through a mere nothing? That is the question.

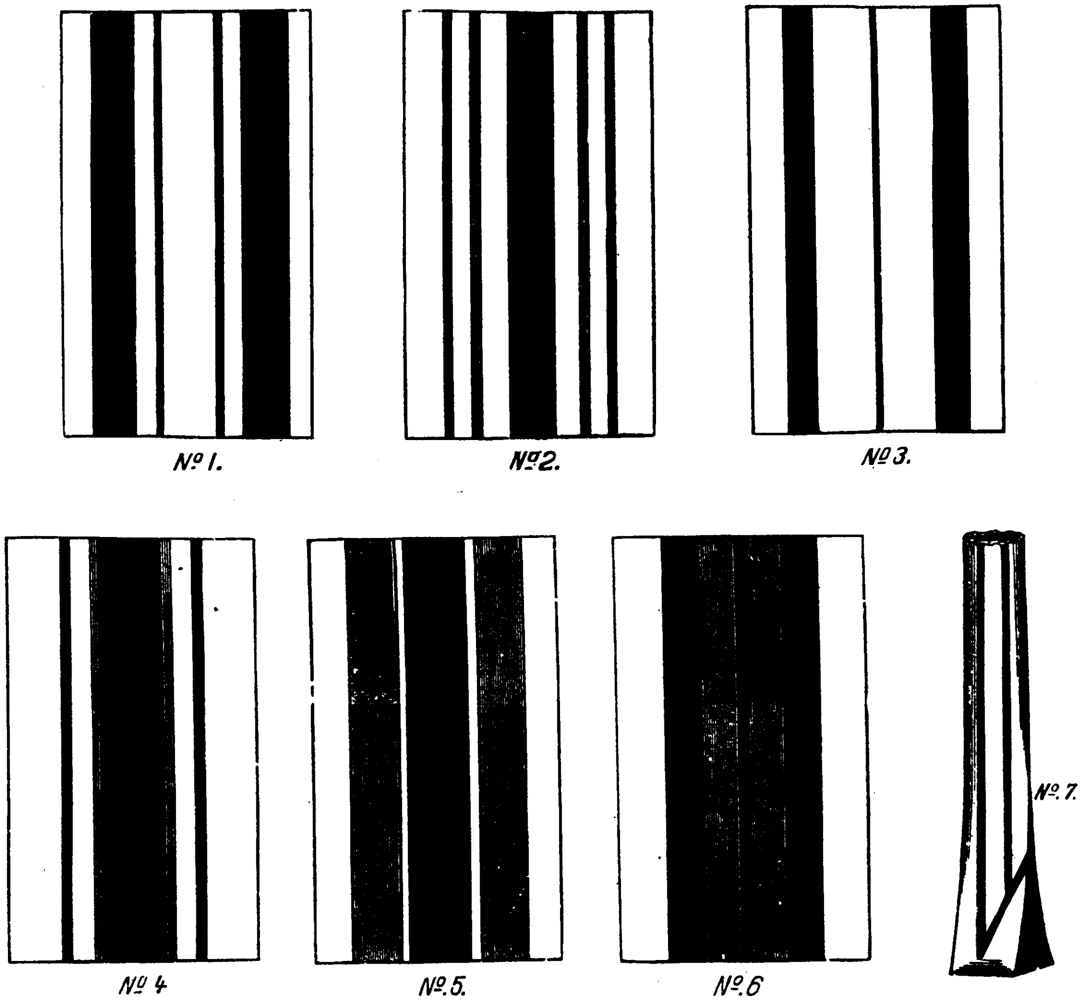
Those Dangerous Scientists.—The *New York Herald* in its usual sardonic style, makes the following remarks in regard to the danger to which science exposes the modern condition of this world in a religious as well as in a secular aspect. We reprint it for the sake of a few well-deserved hits. Says the *Herald*:

"Modern science has its advantages and its disadvantages. It is all very well to tell the sun that he needn't trouble himself to rise any more, because we can light up the world with electricity; but when it comes to the use of the telephone in such a way that the Christian ministry is in danger of abolition, the matter becomes serious. In Lowell, the telephone is attached to a certain pulpit and then carried into the houses of the parishioners, who sit in their easy chairs or puff away at the friendly cigar, while the voice of the preacher resounds through the room. If this thing is carried much further Othello's occupation is gone. Dr. Storrs can be hired to preach to the entire continent. Sitting in his study, he can deliver a discourse to a large bundle of wires connecting with every house this side of the Rocky Mountains, and the rest of the ministers will have to engage in some honest but respectable employment. However, there would be a compensation for even that misfortune, for Dr. Talmage would have no use for the clerical trapeze, and even Dr. Fulton would be compelled to be civil. These two advantages would make the world seem brighter, and we are almost inclined to hope that Mr. Edison may complete his invention."

Where the Cold Waves Come From.—Meteorological observations have now become so extended that evidence is rapidly accumulating to enable us to determine positively the source of the cold aerial waves which sweep across our country during the winter season. The indications are that we owe them to the great area of high barometer in northeastern Siberia, where the pressure sometimes exceeds 31·50 inches, and the temperature falls as low as 76° below zero. The pole of greatest cold is in the neighborhood of Yokutsk, on the Lena, where the average thermometric reading in January of 41° below zero, and where the severest cold exceeds by 10° that experienced by explorers in high arctic regions. This is also the region of the highest barometric pressure known in winter; and from it, doubtless, proceed the waves of intense cold which play so large a part in our winter experiences.

The Earth's Day Increasing.—In a recent lecture on "Eclipse Problems," Prof. Charles A. Young of Princeton, said, with reference to the observed increase in the rapidity of the moon's motion, that the discovery led at first to the opinion that the moon's orbit was growing shorter, and that ultimately the moon would come down upon us. More accurate calculation, shows, that there is no danger of so disastrous a result. The moon is not coming nearer, but our day is growing longer, owing to the friction of the tides upon the earth's surface. The tides act like a brake, and slowly diminish the speed of the earth's rotation.

To Soften Putty.—Slake three pounds of stone quicklime in water, then add one pound of pearl-ash, and make the whole about the consistence of paint. Apply it to both sides of the glass, and let it remain for twelve hours, when the putty will be so softened that the glass may be easily taken out of the frame.



SAMPLES OF STRIPING FOR CARRIAGES.

SAMPLES OF STRIPING FOR CARRIAGES.

We present below our first instalment some samples of striping, selected for carriages, beginning with heavy work. Our illustrations show the full width of the spoke, and the width of the stripes and distances between them have been carefully reproduced. The colors are described below.

Fig. 1. is reproducedfrom an Eight-spring Victoria exhibited by Jas. B. Brewster & Co., of Twenty-fifth street, New York. The body is painted black, striped with one broad and one fine line of lemon chrome. The carriage-part is painted with lemon chrome, and striped with two broad and two fine lines of black, in the manner illustrated. The juxtaposition of the lemon chrome and black on the carriage-part seems to us unfortunate, as it has the effect of giving to the yellow a greenish cast.

Fig. 2. represents the striping on the Vis-à-vis exhibited by Desouches, of Paris. The body is painted dark brown, and the carriage-part black; and the latter is striped with one broad and two fine lines of tan color, separated by two fine lines of straw color. Our engraving shows the straw color in tint.

Fig. 3. is from the five-glass Landau exhibited by Brewster & Co., of Broome street, New York. The body is painted dark green, and striped with a fine line of "New York red" (dark vermillion glazed with carmine). The wheels, and these only, are painted with deep vermilion, and striped with two broad lines of black, centre with one fine line of same. The stripes on the rims are discontinued at the felloe-plates, and the outer stripes connected at these points by a cross-line, as per small cut. The remainder of the carriage-part is painted with very dark green, and striped with two broad and one centre fine line of "New York red." This style of painting is original in appearance and very attractive.

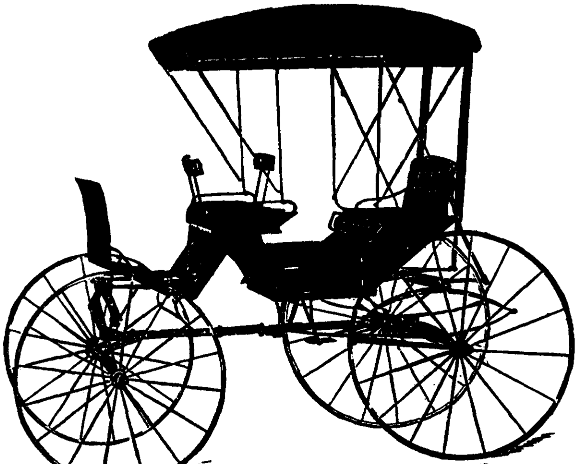
Fig. 4. Taken from five-glass Landau exhibited by Million, Guiet & Co., of Paris. The carriage-part is painted umber brown, and striped with one broad and two fine lines of black, the broad line being edged with fine lines of orange. The orange lines are shown in tint on our cut.

Fig. 5. From an English Stanhope Phaeton. Ground color of spoke, dark green, with broad centre stripe of black, and two quarter-inch stripes of light green.

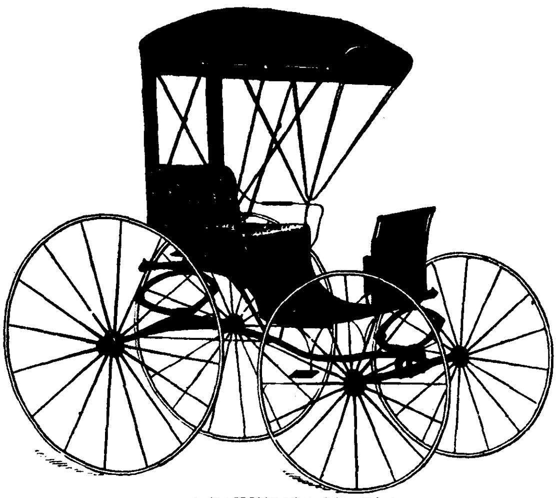
Fig. 6. From Eight-spring Brougham exhibited by McNaught & Smith, of Worcester, Eng. The body is painted black, with mouldings of brown tan. The carrriage-part is painted with what English painters also call "brown tan"—a color mixed with yellow ochre, black, white, and a very little red—and striped with a $\frac{7}{8}$ stripe of black, split by a $\frac{1}{2}$ inch line of very light buff, and the latter is again split by a fine line of black, as illustrated. The colors used are peculiar, and the effect a little cold, but the finish of the carriage displayed by this firm is beyond criticism—perhaps the best shown on any of the English carriages.

Fig. 7. The carriages exhibited by H. Killam & Co., of New Haven, show a novel manner of striping spokes at the butt, which we here illustrate. Our drawing is reproduced from a face.

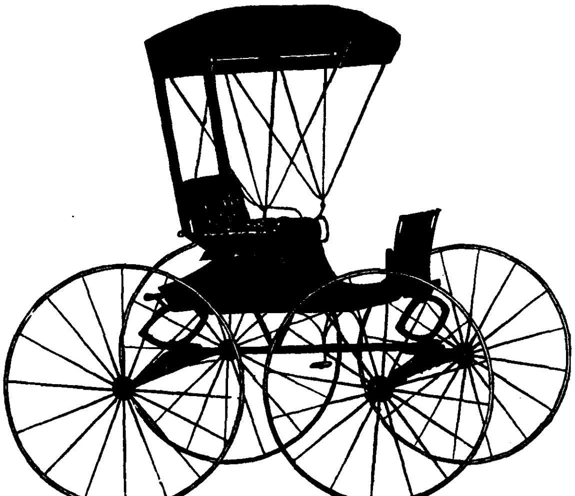
The wheels are painted with "New York red," and striped with two 3-16 stripes of black, $\frac{1}{4}$ inch apart, and at the butt of each spoke where the "French face" cuts an angle, the two black stripes are cut off and joined by one angular stripe of the same colour, as illustrated.—*Carriage Monthly.*



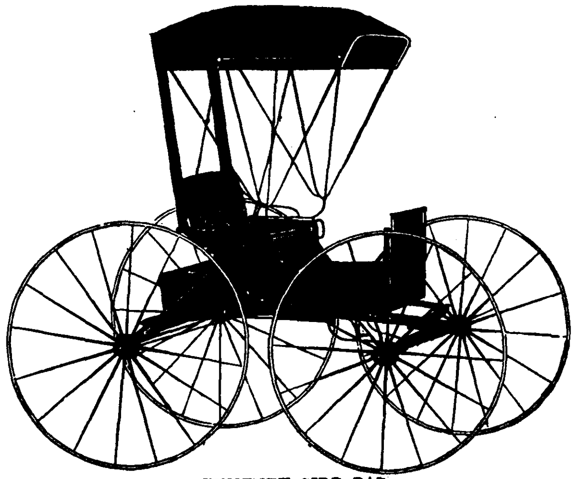
PARK PHÆTON.



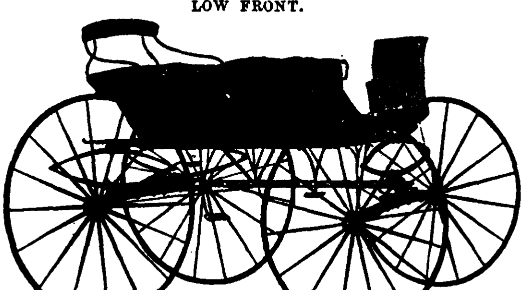
THE FAVOURITE PHÆTON.



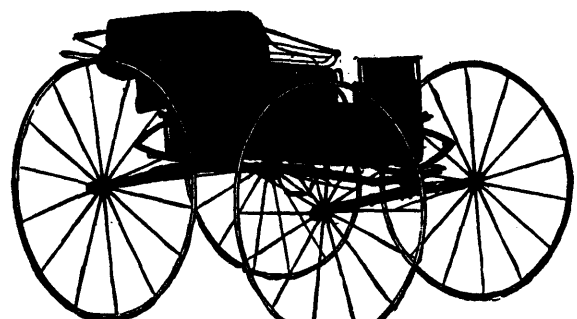
LOW FRONT.



WHITNEY SIDE BAR.



OPEN PLEASURE CARRIAGE.



BLACK'S SIDE BAR.

NEW DESIGNS FOR CARRIÂGES.

PRIZE ESSAY ON "DEVILTRIES OF PAINT AND VARNISH."

I do not wish to dictate, but I am under the impression that if the subject before us had been abridged, or arranged in smaller divisions, and smaller prizes offered, it would have called out more writers on the different subjects, as any subject in this list, in order to be handled rightly, and go into details, should form an essay by itself.

BLISTERING is caused by the action of heat on work that has not properly dried. There is also what I will style "dry blistering," of which I will say, in explanation, that I have seen work blister standing in the repository in mid-winter. This blistering occurs only when putty or plaster is applied (especially where red lead is used), mixed with an insufficient degree of binding quality, and used over a non-elastic surface, or where such putty has been previously applied. As to the ordinary blistering, when paint is applied, there is always more or less air beneath it, which, by the covering of a coat of mineral or other heavy paint, cannot escape (except its oxygen, which is absorbed) until the paint is thoroughly dried. If, by reason of the work being hurried, a coat of paint has been improperly mixed, causing it to oxidize on the surface, and remain gummy beneath, it acts upon the subsequent coats even to the surface, and must either crack, standing in the shade, or, if brought under the action of the sun, it will generate a gas that will push the paint out and cause blisters. The remedy consists in building up the surface on a substantial plan, namely, *elastic throughout;* but elasticity amounts to nothing if each coat is not perfectly dry. When blisters first make their appearance, by sticking a pin in them and letting the air out, they may be pressed back with the thumb. After blisters have made their appearance, scrape off the paint in the holes, make a few indentures with a brad-awl in the wood; then give a coat of shellac, and finish with about three puttyings, over as many coats of lead.

CRACKING is a sort of *half-brother to blistering.* The majority, if not all the cases of cracking, are caused by introducing non-elastic with elastic paint, except where paint cracks from not being well dried, or from using poor varnish; but these varnish cracks can be distinguished from paint-cracks, as they affect the varnish surface only. I firmly believe that if a job be painted elastic throughout, with the single exception of one non-elastic coat, *this one coat has the percentage in its favor of cracking all the rest.*

REMEDY.—Where care is taken to have the coats of paint uniform throughout and well dried, there need not be any fear of cracking. The above suggestion does not apply to impure paints containing barytes, but it is made on the supposition that all the ingredients are at par.

FATTY AND LIVERY PAINT.—There can be no doubt that fatty or livery paint is caused by oxidation. When paint becomes fatty, it may be remedied by adding turpentine and running it through the mill; but when it comes to the state known as "livery," it is done for, so far as turpentine, oil, or benzine is concerned, as it then becomes insoluble. It is, however, soluble in laudanum: but the cost of the cure would then be more objectionable than the disease. I think that this subject, as well as the remedy, belongs more properly to the chemists, for painters, as a class, have to work much and experiment but little. The only remedy, so far as I know, consists in grinding our own lakes, etc., and in grinding no more than is to be used at the time; or, if prepared colors are preferred, get them fresh by ordering a small stock at a time. A recent letter received by me from Charles Moser & Co., manufacturers of colors, gives the following facts in this connection:

"DEAR SIR: Yours of the 22nd inst. is received and contents noted. *Some of the lakes will naturally liver in a comparatively short time when ground in japan; or, in other words, when incorporated thoroughly with other chemicals.*"

FADING OF COLOURS.—Barytes or other adulterations in paint will cause it to fade.

BEING GRITTY is caused from not being thoroughly mixed or ground fine.

CLOUDING OF LAKES, ETC., is due to the fact that there is not enough varnish used, to dry with sufficient gloss.

CRAWLING AND DRAWING.—Paint and varnish will both crawl and draw on work that is cold, and, in some instances, in warm weather, where the surface has not been previously rubbed. Rubbing the places over with a damp chamois will obviate the difficulty, but the work must be gone over immediately. I will now refer to varnish troubles.

SWEATING, GOING GREASY AND GLOSSY.—Varnish that is rubbed before it is dry will, in most cases, produce the above-named results.

GOING SANDY OR SEEDY.—Varnish that does not contain the oily qualities requisite for durability has a tendency to go sandy or seedy. This is especially true when turpentine is used for thinning purposes.

GOING-IN, SINKING-IN, OR SADDING-DOWN.—I believe I am safe in saying that *thirty per cent. of all the work painted in the United States results in sinking-in.* Green timber will produce it; but then, as most timber is dry, this would not make up the full thirty per cent. I think the cause lies in the foundation for the paint, which is not mixed with a sufficient degree of binding quality, for compactness of body after oxidation takes place. Paint, that does not contain these qualities, soon has its life and elasticity sucked up by the hungry wood. Then, in consequence, a draw is made on the varnish surface, for life to sustain the under-coats. The varnish, being insufficient to supply so many coats, must give way. *What is wanted is uniformity of coats throughout, all being made elastic,* for by this means only can varnish be made to stand out well.

PITTING.—The causes of pitting I am not able to point out in full, but I am satisfied that a damp current of air will produce pitting in some instances, and also an over-damp room.

CHIPPING AND FLAKING.—Is it not suggestive when I say that varnish will not chip or flake on an elastic surface?

EMPLOYERS TO BLAME.—Employers are, in many instances, to blame for the tricks of paint and varnish. Let us take the case of a painter working in the city, in an old-established shop, where they have ceased to buy goods of every commercial agent that happens in and claims his goods superior to all others. Experience is a dear school-teacher: they have found out that "all is not gold that glitters;" thus they buy their varnishes and paints from reliable firms, and of grades which they have tested and know to be good. The painter works with these classes of goods for years, and knows under just what circumstances and conditions they will act best. Now, place him in a country shop where he has, perhaps, *twenty brands of varnishes and japans* standing around in cans—each one is better than the other, and at every arrival of fast freight, new lots are added. He is told to help himself. He remonstrates, saying that he prefers using something he has tested, but is met with the reply that "the stock on hand must be used up first!" There is no alternative; but the long train of evils which follows is not unexpected by him.

PERISHING FROM AMMONIA.—In the cases of perishing by ammonia that have come under my notice, I have observed that the majority and the worst cases were painted with chemical paints, lakes, etc., while those that were painted with mineral paints withstood its action much better. About three months ago, a job came under my notice that had been painted with mauve or purple lake six months previously. The color was gone—that is, its original color had departed, leaving it the shade of a drab-yellow. The varnish hung to the surface in broken patches, and in passing my hand over the panels, it fell off almost entire, in the form of resinous dust. The gearing was painted black, and although the varnish gloss was gone, yet it showed no signs of flaking as the body did. I interested myself enough to go to the stable where this vehicle was kept, and found that it was in close proximity to the manure heap and horse-stalls, and that it had no floor, and there was an odour of dampness. There are two livery-stables within a hundred feet of our shop. In one, they keep their vehicles on a ground floor and close to a manure heap, and the consequence is that all their jobs soon lose their varnish lustre, and, also, I have noticed that they are not washed off after coming in from a trip, but are run into the house regardless of mud, etc. For this stable we built three piano-boxes last spring, and have repaired not a few, and to-day they look as though they were at least half-a-dozen years old, the varnish lustre having all gone. In the other stable, they keep their carriages on a plank floor, but close to the stalls; I have never known them to miss washing off their jobs after being out, and they also take great pains to chamois them dry. For this stable we built one piano-box and three light buggies last spring, besides repainting ten other jobs, and all of them to-day look as bright and fresh as the day when run out—felloes and scratches, of course, excepted.

A few remarks, and I will close. As regards perishing of varnish, it matters not whether in close proximity to ammonia fumes or not, if a carriage is kept in a damp house, not ventilated, and not washed often and well chamoised, it will lose its lustre, besides clouding and turning blue. The only remedy for this, where carriages must be kept in damp houses and stables, is frequent washing, and, more particularly, chamoising dry, together with as much exposure to the air as possible. If the carriage-making fraternity would air this subject a little more, they would, perhaps, come to understand that *varnish-makers* and *painters* ought hardly to be held responsible for the laws of nature.—*Boston Hub.*

JAPANNED WARE.—The important manufacture of japanned ware can claim a high antiquity, the art of japanning having been practiced in China and Japan for an indefinite period before our first intercourse with those countries. This beautiful lacquer or varnish not only preserves the iron from rust and gives it a cleanly surface, but at the same time affords opportunity for the most elaborate and varied ornamentation. Articles in this ware frequently owe by far the greater part of their value to the decorator's art. Japan painting is, in fact, a distinct artistic profession, and has in its time educated more artists than any other. More than one Royal Academician has graduated in the japanner's *atelier.* As with tin ware, the early productions of this class were, no doubt, clumsy and ugly enough, and for the same reason, that it was difficult to get iron that would bear bending and twisting, or that would be sure to keep a good even surface. The modeller and stamper has now free play, and the decorator has no reason to fear that his work will be spoiled. Tea trays, waiters, coal-vases, canisters, &c., are among the staples, and the production is enormous. In Wolverhampton alone, which is the chief seat of the manufacture, as many as 100,000 trays and waiters, will be turned out in a week, when trade is good. Most of these, however common, used to be painted by hand, with a celerity of execution that would put Wardour street to the blush. It was said that a "skilled artist" could with ease paint two gross of landscapes in a day. Most of this common decoration is now effected by the new method of transfer printing, for which probably porcelain decoration suggested the idea. The pattern or picture is printed by the lithographic process on fine tissue paper, which is laid face downward on the japanned plate, and adheres to the sticky varnish with which it has been treated. After a time the paper can be wiped off but the colours remain and are afterwards fixed by stoving. A new decorated tin has come into the market printed in the sheet, it is laid, directly on the metal, with such permanency as enables it to be made up afterwards into canisters and other articles without injury, and this has very much cheapened the production of those articles. Generally speaking a much better taste prevails now than formerly, and the monstrosities that so delighted cur forefathers are rapidlv disappearing. "Abraham in red, sacrificing Isaac in blue, on a green altar with a black ground," is no longer the highest ideal of tea-tray art..—*From " Great Industries of Great Britain".*

PEARL INLAYING ON IRON.

The method by which pearl inlays are made upon enamelled or japanned cast or sheet iron is very simple, and at the same time the results obtained are very striking.

Cast and sheet iron and *papier maché* are the materials upon which pearl is generally inlaid. If the article be of cast iron, it is well cleaned from the sand which usually adheres to the casting, and is blackened with a coat of varnish and lampblack. When this is thoroughly dried, a coat of japan or black varnish is spread evenly upon it. Before the varnish becomes too dry, pieces of pearl cut in the form of leaves, roses or such flowers as the fancy of the artist may dictate, or the character of the article may require, are laid upon the varnish and pressed down with the finger, and they immediately adhere to the varnished surface. The sheets of pearl may be obtained so thin as to be more like paper than anything else. After the pieces are in place the work is put into a heated oven and kept there for several hours, or until the varnish is perfectly dried. It is then taken from the oven and another coat of varnish applied indiscriminately on the surface of the pearl and the previous coating, and again placed in the oven till dry. This process is repeated several times, until the thickness of the varnish is such that top of the pearl is level with the body of the varnish, which is then scraped off the pearl with a knife, and the surface of pearl and the varnish around it are found to be quite even. The pearl is then rubbed with a piece of pumice-stone and water, and tbe surface of the varnish is rubbed smooth with powdered pumice-stone, moistened with water.

It is in this unfinished state that the pearl has the appearance of being inlaid, and from which it derives its name. It is, in fact, inlaid in the varnished surface, to which it adheres with surprising firmness. Its final beauty and finish depend altogether on the skill of the artist under whose hands the shapeless and almost unmeaning pieces of pearl are made to assume the form of beautiful flowers, leaves, &c. The artist traces the stems and leaves of the flowers with a camel's hair pencil dipped in a size made of varnish and turpentine; upon this he lays gold leaf, which adheres where there is size, and the superfluous gold is carefully brushed off with a piece of silk. The flowers and leaves are then painted in colors, and when dry the picture and surface of the article are covered with a coat of refined white varnish. One point should be observed, which is too frequently forgotten by those who paint upon pearl in this country, and that is to use only transparent colors when painting on the pearl itself. This is the secret of the great brilliancy obtained in most of the European work upon pearl.

The kinds of pearl used are three—mother-of-pearl, in the pearl oyster, or white pearl, as it is called by the artist, and it is known by its clear white surface; aurora shell, which can readily be told by its wrinkled appearance and its various prismatic colors, and is made from the shell of the genus of *Mollusca* known as the sear-ear or ear shell, and known to the conchologist as *Haliotis;* the green snail shell, which can be told by its glistening colors of light and dark green, or soft yellow and bright and beautiful pink, blended together.

To manufacture the pearl ready for inlaying, the workman cuts the rough shells in pieces with saws, and then grinds the pieces upon both sides upon a common grindstone until they are of the requisite thinness. Out of these pieces the artist cuts the forms of leaves, flowers, &c., with a pair of common scissors preparatory to placing them in the varnished surface. The necessary forms may be cut from the thin pieces of pearl by means of a punch and dies, with power applied by the foot of the operator. When a number of pieces are required of the same size, the pieces may be fastened together with glue as one solid plate, and then the required form marked upon the outside one; then these being held in a vise, the form can be carefully sawed out with a fine saw. By placing the cemented pieces in warm water, the glue softens, and the shells are easily separated and the glue washed off. The artist is no longer under the necessity of preparing the shells for himself, as they can be obtained all ready for use at almost any artist's material store in the country.

The art of inlaying is not confined to the representation of flowers alone; landscapes, with houses, castles, trees, churches and bridges are very easily made, and when represented as being seen by moonlight are very beautiful. The rising moon can be represented surrounded by clouds of gold and silver bronze, and when pieces of pearl are placed in certain positions to reflect their colors, the moonbeams are represented as glancing over the landscape in alternate light and shadow.

A varnished surface can be ornamented by transferring drawings or engravings to it, and the process is quite simple. A thin coat of copal varnish is spread upon the surface of the article, and when nearly dry the engraving is applied with its face downward and carefully pressed to exclude all air bubbles. When the varnish is sufficiently dry, the paper is thoroughly moistened with a sponge dipped in warm water, and the paper can be rubbed off, leaving all the lines of the print upon the varnished surface. We have sometimes seen an engraving very successfully transferred bodily, paper and all, to a varnished surface. The paper seemed to be inlaid in the varnish somewhat as the pearl is in the process just described. Its appearance was of course much better than that from engraving laid upon the varnish while soft and then varnished over in the usual way. It should be noted that if the paper is to be mounted under the varnish it should be sized to permit the "striking through."

ON THE SO-CALLED "CRY STALLIZATION OF CANADA BALSAM" AND HOW TO MAKE ORNAMENTAL PICTURE FRAMES.

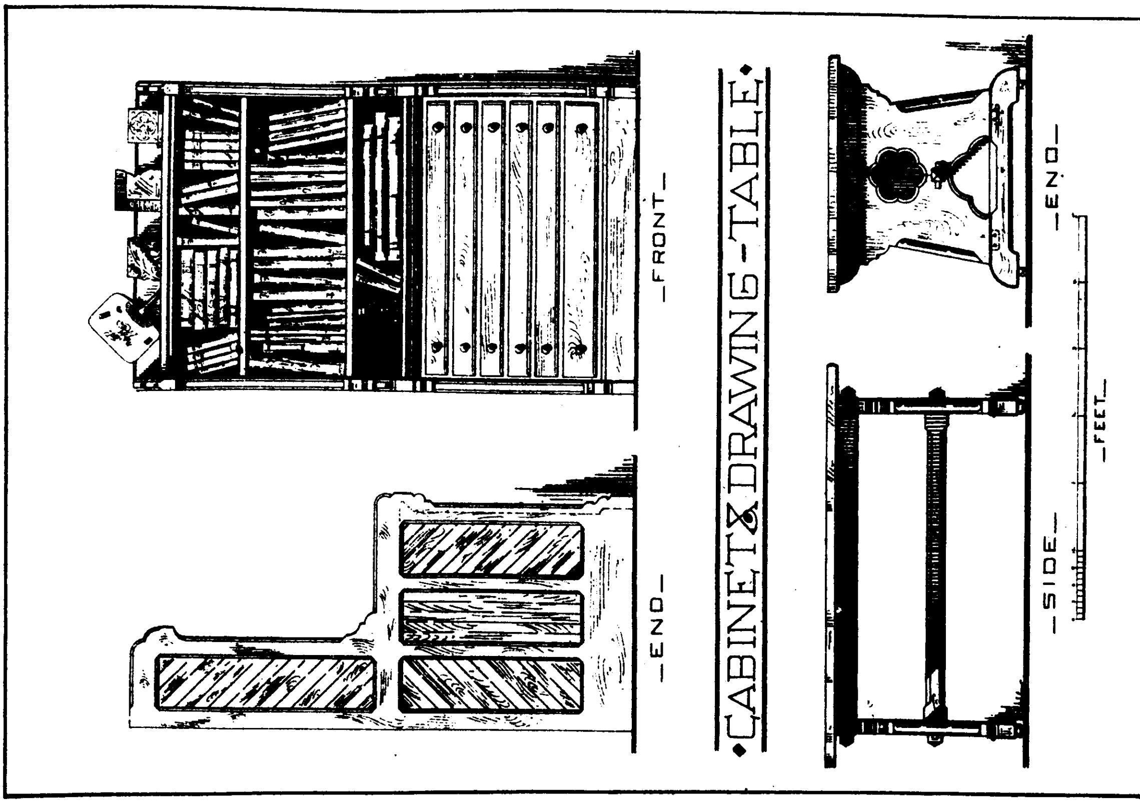
To the Editor of the Scientific American:

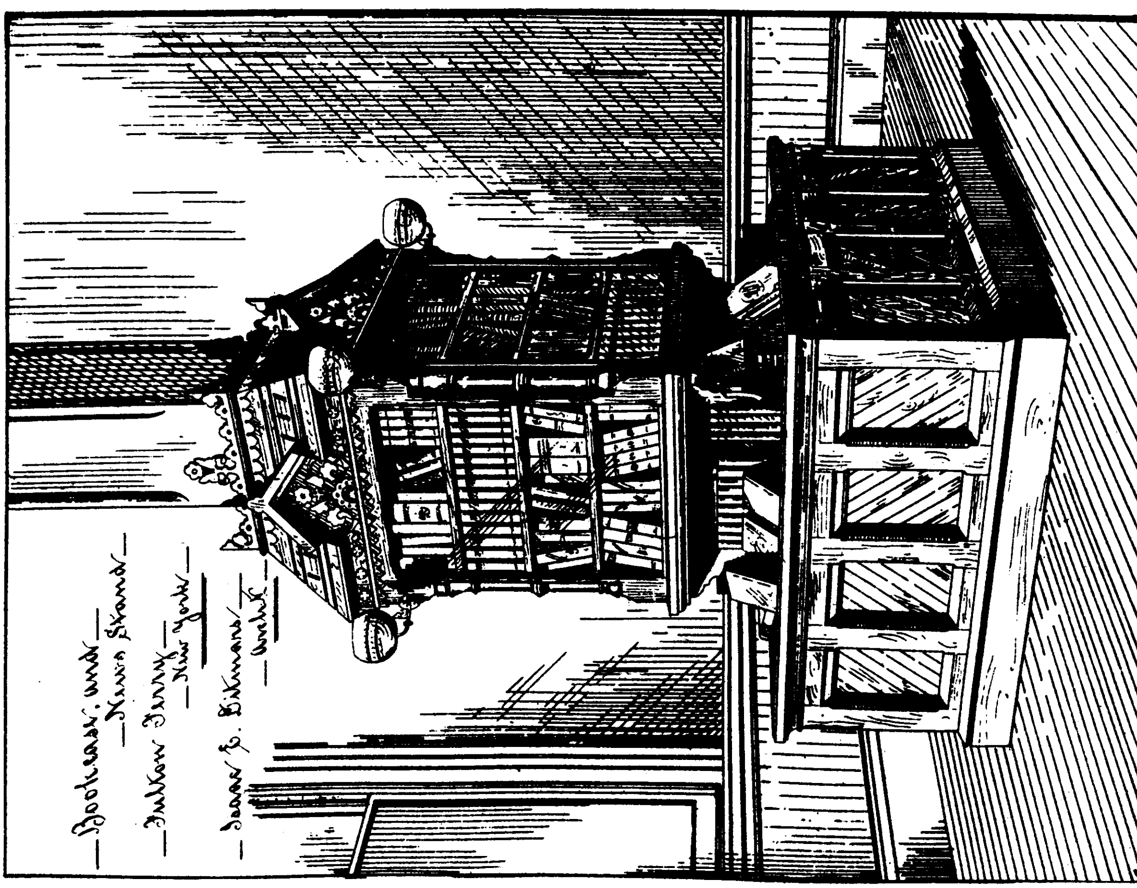
In your last issue you publish an article by Mr. Geo. M. Hopkins, who, writing on the above in answer to a statement made by Professor Barker, holds that he does not "think that the beautiful arborescent forms are anything more than cohesion figures," in which he is right. Some years ago, when I was employed in a picture frame factory, one of the mechanics, a Mr. Jackson, who was working there with me, said he knew a German who used to make picture frames from glass, the process of which he tried to keep a secret, but which was captured from him by Mr. Jackson; and as I think it might be of some amusement and practical utility to some of your numerous readers if you publish the same, I will give you the process:

After having agreed upon the length and width of the frame, get four strips of glass, and after having cleaned them take one of these strips and pour some pure asphaltum, which has been dissolved in turpentine by heat, on the entire length of the strip; and if now you take another of the strips and lay it on the asphaltum, and then press the two strips together with your fingers, you can produce as many "ferns and cacti" as you please by holding the strips between you and the light. After having produced some of these "ferns and cacti," which you wish to retain, apply a knife between one of the ends of the strips and gently pull them apart and lay them aside, so that they may become hard or dry; now proceed with the remaining two strips in the same manner as described, care being taken to match the "ferns or cacti" as near as possible to the one on the two first strips. After having become hard or dry, apply any colour or colours that you may fancy on the asphaltum, and let this also dry; then apply some thin composition smoothly with a knife over the coloured parts of the strips, this composition being the same that they employ for ornaments for pictures frames, etc. When this has also become hard, cut the ends of the strips with a diamond to the proper angle and length, and glue them on four strips of wood which are also of the proper angle and length, and nail them together; the sides of this frame may then be encased with gold or other mouldings.

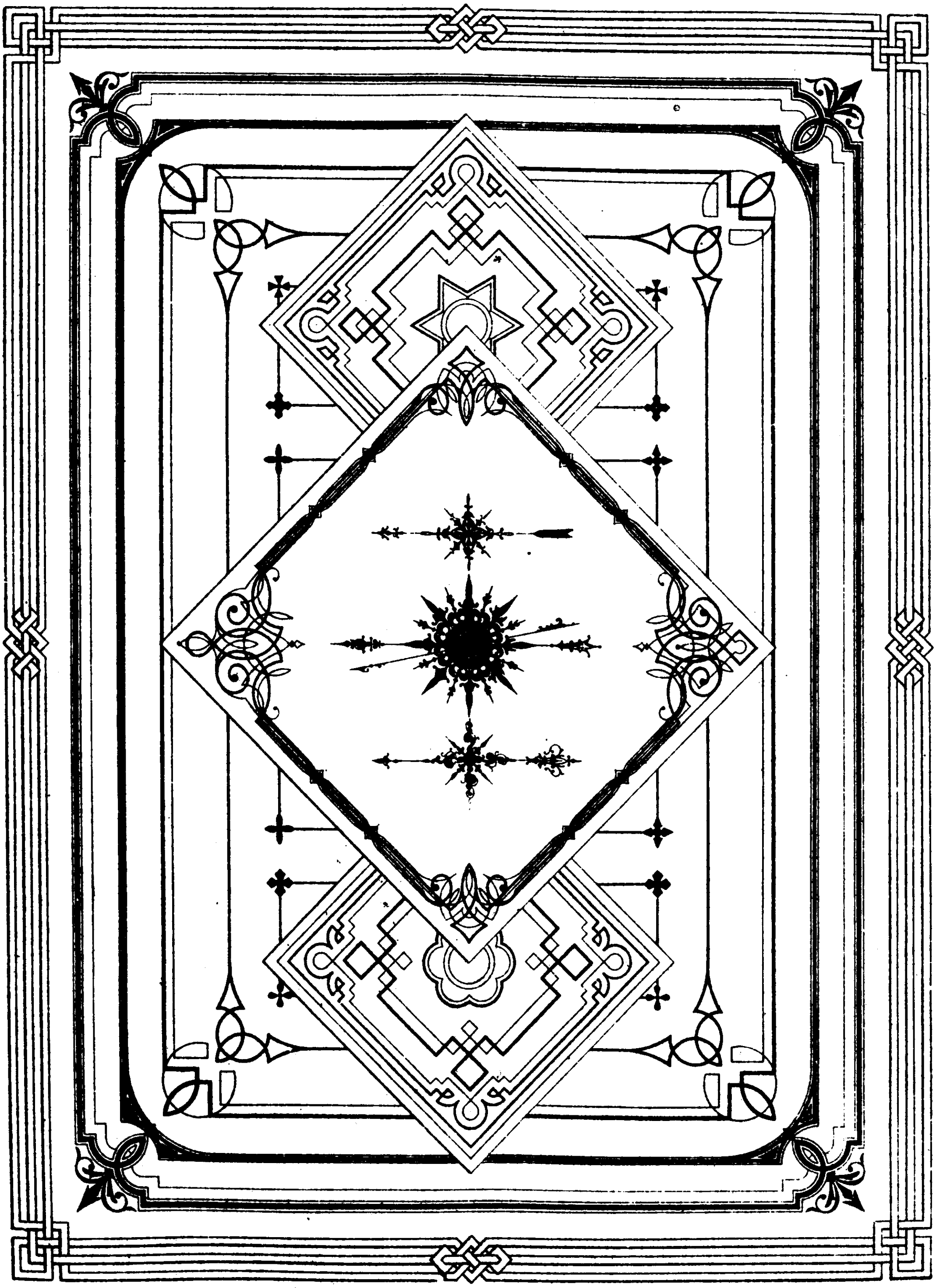
F. E. FORSTER.

New York, February, 1880.





NEW DESIGNS FOR FURNITURE.—From the *Wood-worker*.



DESIGN FOR FRESCO FOR A CEILING.

Practical Hints.

How Old is Glass?—The oldest specimen of pure glass bearing anything like a date is a little moulded lion's head, bearing the name of an Egyptian king of the eleventh dynasty, in the Slade collection at the British Museum. That is to say at a period which may be moderately placed as more than 2,000 years B. C., glass was not only made, but made with a skill which shows that the art was nothing new. The invention of glazing pottery with a film or varnish of glass is so old, that among the fragments which bear inscriptions of the early Egyptian monarchy are beads, possibly of the first dynasty. Of later glass there are numerous examples, such as a bead found at Thebes, which has the name of Queen Hatasoo or Hashep, of the eighteenth dynasty. Of the same period, are vases and goblets and many fragments. It cannot be doubted that the story preserved by Pliny, which assigns the credit of the invention to the Phœnicians, is so far true that these adventurous merchants brought specimens to other countries from Egypt. Dr. Schliemann found discs of glass in the excavations at Mycenæ, though Homer does not mention it as a substance known to him. That the modern art of the glass blower was known long before, is certain from representations among the pictures on the walls of a tomb at Beni Hassan, of the twelfth Egyptian dynasty; but a much older picture, which probably represented the same manufacture, is among the half-obliterated scenes in a chamber of the tomb of Thy, at Sakkara, and dates from the time of the fifth dynasty, a time so remote that it is not possible, in spite of the assiduous researches of many Egyptologers, to give it a date in years.

Preventing Accidents.—An ingenious arrangement to prevent accidents with circular saws, which require incessant watchfulness on the part of the operatives, has been invented. The guard consists of three pieces, viz., the mortise-plate, secured by three bolts to the fence; a radial arm, which is secured and adjusted vertically into the mortise-plate by means of nut and collar; and the covering plate, which is secured and adjusted laterally in the radial arm, in conformity with the adjustment of the saw-fence by means of the thumb-screw. Where several saws of various diameters are used in the same bench, it is advisable to have two or three covering plates, graduating in size to cover the whole series of saws. The apparatus, as described, is in its mode of fixing exceedingly simple. It is to be recommended on account of its simplicity, its cheapness, its immovability when fixed, and for its perfect freedom from being obstructive to the sawyer.

Spontaneous Combustion.—Recent experiments produced spontaneous combustion, with 17 grains of wadding and 67 grains of strong oil varnish, in thirty four minutes; while 200 grains of washed cotton waste, of which a portion was saturated with 750 grains of strong oil varnish, and the remainder wrapped about it, required almost fourteen hours. These materials were placed in a well-sheltered spot, and subjected to a heat from 40 deg. to 65 deg. Fah. Silk did not flame up, but slowly charred. Sponge and wood dust saturated with oils, etc., and subjected to the test, did not ignite.

Treatment of Wood.—Mahogany is a beautiful wood for furniture. Age improves its color, and it may well be left to time and its own natural beauty. When pine is used, it is well to paint it in flatted color, rather than to grain it, and to make it seem what it is not. When pine is stained and varnished it must remain so, but when paint gets shabby it can be renewed. Indian red and slate gray are good colors for ordinary domestic fittings. These may be relieved by patterns and borders of yellow and white. Sometimes a mere line to show the construction or to define an angle will be found very effective.

Saw.—To take the buckles out of a saw, lay it on a hard level surface—the end of a piece of hard timber is best—then take a bar of lead or a sheet of brass or copper, or any other soft metal, or even a tough piece of wood, say half an inch thick, and lay it on the saw over the buckle. Then with a heavy hammer, strike a blow sufficiently heavy enough to straighten the saw under it. By a little practice and experience all the kinks and buckles can be taken clean out. Never strike a saw with the face of a hammer, or it will stretch the blade and make a "kink" in it where it is not required.

Transferring Impressions of Ferns to Wood.—First, well dry your fern-leaves between blotting-paper, then soak them in standard aniline dye (the color you want), take them out, and re-dry them nice and flat, then damp your wood, and lay the fern leaves upon it, and apply pressure. Some beautiful impressions have been taken in the same way.

BELTING.

Upon this subject, so important to mill and machinery men, the Cincinnati *Artisan* has this to say: Among the valuable elements entering into belt depreciation may be mentioned its length, width and thickness, strain, friction or power to transmit tension, proper adjustment and temperature. It the belt is of leather and oak tanned, it will last one-third longer than a chemical tanned, The manner in which belting is laced or joined together makes a great difference in the wear. Having each end of the pieces to be joined cut off true and square, and laced not too tightly, the wear of the belt may be decreased 20% per year. Some of the methods used to prevent a belt slipping on the pulley are detrimental to its wear, among which may be mentioned powdered resin or pitch which soon penetrates the leather and rots the belt. Roughing the surface by filing is another source of wear. Running a belt too tight on a pulley will generate heat, decompose the oil and organic matter in the belt, and hasten its decay. In having a belt sufficiently tight to convey the power and not slip on the pulleys, or so accurately arranged as to just do the work only, the depreciation on the machine may be decreased 2% a year, and on the belting over 20%. This is further seen when we consider that a three-sixteenth-inch leather belt, three inches wide, has a breaking tension of 2,400 pounds, and an ordinary machine with this size belting can be successfully worked with a permanent tension of 180 pounds. Doubling the tension, whilst it could not break the belt, yet the additional force constantly employed—being an increase of about 1-13 of its breaking tension—is so much useless friction to be overcome, and an additional strain on the entire machine, expended to resist the former and a consequent added element of actual wear.

A belt of unequal thickness will not only run badly, but wear much faster than one of equal thickness thoroughout. Rubber belts depreciate faster than leather. Frequently a few minutes quick motion will roll the gum off in such quantities as to entirely destroy the belt. During freezing weather, if moisture finds its way into the seams, or between the diffrent layers of canvas in rubber belts and becomes frozen, the layers soon tear apart and the belt is ruined.

Using leather belts in damp places, or where steam comes in contact with them, materially hastens depreciation; fully 10% faster than when run in a dry place.

THE DENTAPHONE.

An instrument of very different shape, but used for the same purpose and acting on the same principle as the audiphone, illustrated and described on page 7 of our former number, is the dentaphone, represented in the subjoined wood-cut. It is only the size of a large old-fashioned watch; its hollow interior contains a delicate diaphragm, easily put into vibration by the vibrations of the air, in the same way that the diaphragm of a telephone is vibrated by the sound-waves of the air impinging on its surface, which in fact is also the same as the sound-waves impinge upon the drum of the ear. In place, however, that in the ear these vibrations are communicated by the small bones to the auditory nerves, they are in the dentaphone communicated to those nerves by the teeth and facial bones, and so reach the auditory nerves imbedded in the bones of the skull. There is a mouthpiece attached to the little instrument, which is held between the teeth, and in this way human speech can be conveyed to any deaf person who has not his auditory nerve destroyed, and whose deafness is caused by some other obstruction or imperfection in the channel by which sounds are ordinarily perceived. It has been long known, and it constitutes an interesting experiment, that when a poker or fire-tongs are suspended by a string which is held between the teeth, then any vibration given to the poker or tongs reaches the ear by means of the stretched string, teeth and jaw-bones, and gives the impression of the ringing of a large bell. The motion of the piston and valves of a steam-engine may be heard by pressing a wooden stick with one end against the cylinder and holding the other end between the teeth; and even the ticking of a watch may be heard better by holding it between the teeth than by holding it in front of the ear. The experience gained with the vibrating membranes of the telephone and phonograph have shown how every modulation of speech can thus be communicated to a proper membrane capable of vibration, and the dentaphone is an instrument intended to communicate these vibrations to the organ of hearing without the use of ears.

The instrument is a Cincinnati invention. In that city the American Dentaphone Company has been formed, intended to introduce it in the institutions for the deaf and dumb, and the experiments made there and elsewhere have shown already that it has enabled some of the unfortunates in these institutions to hear and repeat words spoken to them. Those who have seen the results have given their endorsement, and there is no doubt but that the instrument will work a revolution in the ways of educating the deaf and dumb, by making most of them hear lectures, and enabling them to speak in place of having them always take recourse to writing on the slate.

MYSTERY IN MECHANICS.

The Boston *Journal of Commerce* justly observes that there is a class of mechanics who affect great mystery about their work, and appear to imagine they can convey the impression that there is something occult or hidden in the processes they use and the materials they employ. Inventors are peculiarly sensitive about making known what they intend to do or the way they intend to do it, as though the world stood agape, ready to wonder and admire as soon as the letters patent were issued. Perpetual motion mongers are justified in keeping secret their experiments—they usually keep secret the result. But in nine cases out of ten the inventor could obtain the money assistance he requires simply by trusting his proposed improvement in detail to judicious friends, and he might with safety and advantage take a brother mechanic into his confidence.

A short time ago a carpenter, in assisting to move some heavy machinery, had occasion to go into a room where the soldering of preserving cans was being done. He wanted to bore a hole through the floor through which to pass an eyebolt. He was refused admission until he solemnly promised not to notice the work which, with some handy appliances, was performed very rapidly. A visitor to a white lead manufactory was refused admission to a room where the pig lead was cast into sheets previous to being acted on by the acid. Yet there was absolutely no secret in it. The melted lead was simply thrown in small quantities on a sort of shovel of sheet iron, where it congealed to a thin film. The worsted braid used largely for the trimming of ladies' dresses a few years ago is as smooth as silk, without fuzziness, although the yarn is full of projecting fuzz. A certain company kept its process a great secret, but an examination of the braid under the microscope showed it was simply singed. Some temperers of steel profess a great secret in the preparation of their hardening pickle, a secret as patent as though described on a page.

There are very few manipulations or manufacturing processes which are truly secrets, and in many of these cases the secret consists in the quality of the material used, a material perhaps not readily obtainable otherwheres. If a secret process involves much mental calculation or expertness of handling, a chance visitor must have rare observing faculties if he can carry it away with him and reproduce it at will from his memory. The laws of the science of mechanics are open to all investigators, and what one man has learned of them may be learned by another man. It is an absurd and ridiculous pretension generally that assumes that one man knows alone what many are anxious to learn, that the finished article carries no suggestion of the processes through which it has passed, and that on one man's will and life depends the success of some important manufacture.

USES OF EUPHORBIA GUM.

The London *Times* says: Some few years since a survey was being carried out in Natal for the Colonial government, during which it was discovered by one of the officers engaged on the work, that when certain plants belonging to the natural order *Euphorbiaceæ* were cut with the clearing knives, the gum which exuded from the plants adhered firmly to the blades, and was very difficult to remove. It was, moreover, found that the knives so coated did not rust, and this led to further experiments being made with the view of utilizing the gum as a preservative material. Iron plates were coated with the gum and subjected to immersion in the waters of South Africa, which are stated to be proverbial for their foulness and for the rapidity of the growth of vegetation. The euphorbia in Natal grows in close contiguity to the sea-shore, so that there was ample opportunity for securely testing its value as a protective covering for iron against corrosion and marine growth. The experiments proving perfectly successful, it was then sought to put the discovery into a practical form. To this end the gum was dissolved in a preparation of spirits, and this was found to be a ready means of applying it as a coating for ships' bottoms and for ironwork generally requiring such protection, the spirits evaporating and the gum being left on the surface of the metal. With this preparation experiments were made a few years since by Sir Andrew Clarke, C. B., who had a sheet of iron coated with it and placed in the waters in her Majesty's dockyard at Chatham, where anything immersed becomes rapidly fouled. At the end of two years the sheet of iron was taken out and was found to be quite clean, and free from fouling and corrosion. The composition has also been successfully tested in Africa against the ravages of the white ant. This success is attributed to the circumstance that the gum of the euphorbia, which forms the base of the fluid, is of such an intensely bitter nature that it paralyzes the efforts of all insects to attach themselves to it, or to bore into any substance coated with it. These successes have led to its adoption in practice for the purposes above indicated, and it is now being introduced in England. We have examined several applications of this composition, which gives a glossy coating alike impervious to air or moisture, while, according to results, its own peculiar protective property remains unimpaired.

CEMENTS, MASTICS, AND CONCRETES.

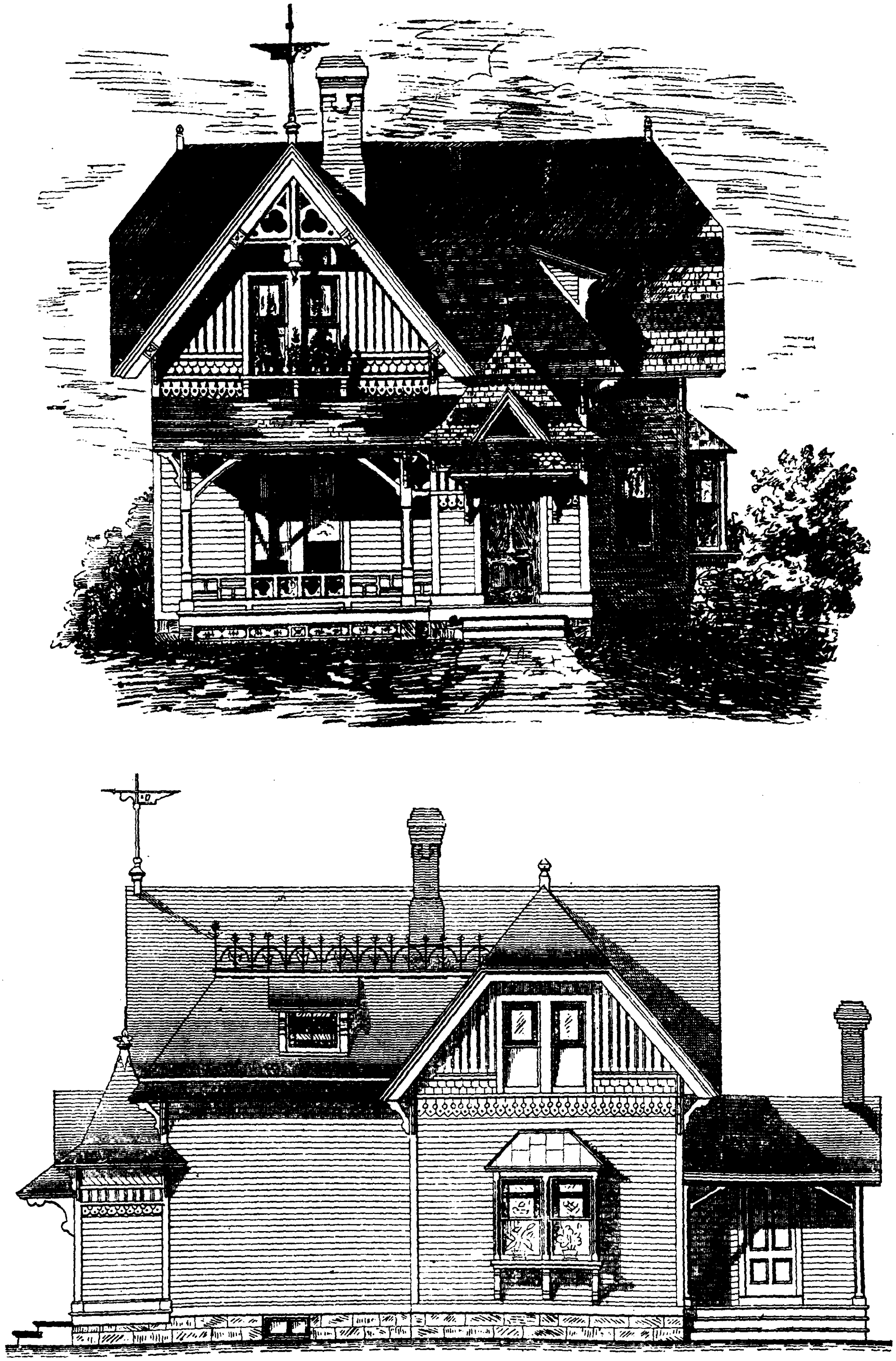
Many of our readers have occasion to use cements or mastics, especially in putting down cellar floors or making old walls tight. They will find the following hints upon the subject valuable:

A cement of one part sand, two parts ashes and three parts clay, mixed with oil, makes a very hard and durable substance like stone, and is said to resist the weather almost as well as marble.

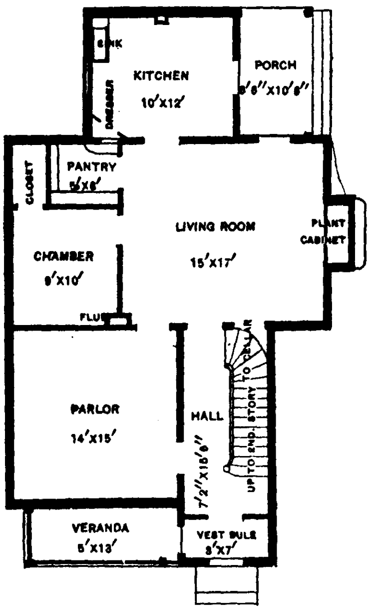
Damp brick walls are common, especially in houses in the country where they are exposed upon the north and east sides. So common is this, that in many places in the country a strong prejudice exists against brick houses on account of their constant dampness. Last year a gentleman having a brick house exposed on all sides, and suffering from dampness in the kitchen, which was in a wing upon the most exposed side, tried an experiment which has proved very satisfactory. A barrel of the best English Portland cement was purchased, and a common tin wash-basin used for mixing it. The cement was mixed with water until about the consistency of cream, and then applied thickly with a large paint brush. Of course the mixture had to be constantly stirred to prevent the cement from settling to the bottom; and on account of its very rapid settling it could only be mixed in very small quantities—half a gallon being about as large a quantity as can be readily handled at a time. When first dried it seemed somewhat of a failure, because it could be so easily brushed off, but after it had had 24 hours to harden it formed a strong and durable coating. The color is a neutral tint, something like Ohio stone. This coating kept the wall perfectly dry, and as it is inexpensive and does not require skilled labor in its application, ought to be extensively used. The gentleman who put on the cement suggests that a damp, foggy, or misty day is best for its application. The coating should be brushed into all the crevices and openings of the work, and it may be found desirable to apply two coats in order that all the openings may be completely closed.

Cement is much stronger than mortar, and can be used to great advantage in many places instead of lime, even in the face of the fact that it is much more costly than the latter. The usual proportions are 1 part of hydraulic lime to 5 of sand. In pointing, the proportion is sometimes as low as 3 parts sand to 1 of hydraulic lime or cement. Coarse clean sand—almost pebbles—can be used to the extent of 3 parts to 1 of cement. Some recommend mortar, to be allowed to set and then wet and worked again. This course will not answer with cement, which is generally injured by such a method of working. The greatest enemy of both mortar and cement is frost; the power with which the water expands at the freezing point is practically unlimited, and where it penetrates into the crevices and pores of mortar and freezes, or when wet mortar is allowed to freeze, its strength is destroyed.

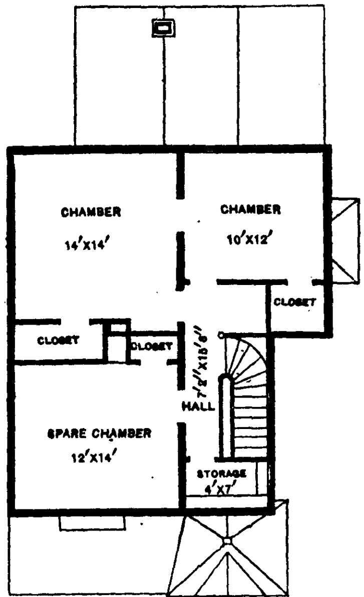
For making floors, the following method is said to produce very desirable results: Four parts of coarse gravel or broken stone and sand, and one part each of lime and cement, are mixed in a shallow box, and well shovelled over from end to end. The sand, gravel and cement are mixed together dry; the lime is slaked separately and mixed with just enough mortar to cement it well together. Six or eight inches of the mixture is then put on the bottom, and when well set, another coating is put on, consisting of one part of cement and two of sand. This will answer for making the bottom of a cistern that is to be cemented up directly upon the ground without a lining of bricks; it will also form a very good cellar floor.—*Manufacturer and Builder.*



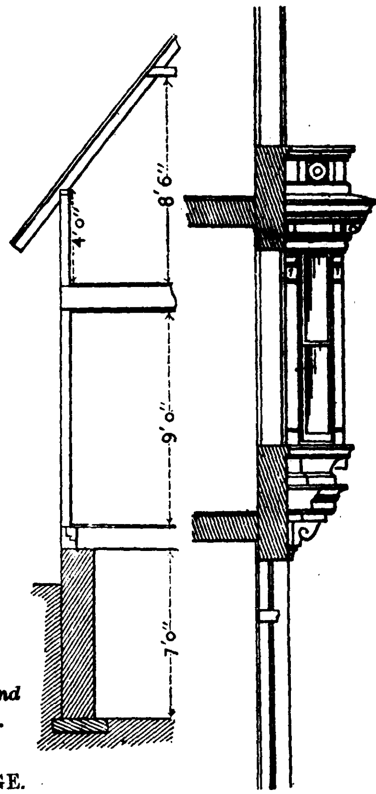
DESIGNS FOR COTTAGES.



Moderate Priced Dwelling.—Fig. 4.—*First Floor Plan.—Scale*, 1-16 *Inch to the Foot.*



Moderate Priced Dwelling.—Fig. 5.—*Second Floor Plan.—Scale*, 1-16 *Inch to the Foot.*



DESIGNS FOR A MODERATE PRICED COTTAGE.

INVENTIONS WANTED TO UTILIZE SAWDUST.

The mill owners of Minneapolis are greatly perplexed by the volume of sawdust they produce, and not a little alarmed at a threatened law forbidding the present disposition of such waste by dumping it into the river. It is calculated that the sawdust from the summer cut of logs converted into boards at that place amounts to something like 300,000 cords—enough to furnish constant work for 150 teams to cart away. The millers say they cannot afford so heavy a burden of expense, and the river communities can as ill afford to have the river spoiled by the rapidly accumulating refuse. Even the steam mills are unable to burn all their waste, and the owners of them would no doubt gladly unite with their water-using neighbors in turning over the surplus sawdust gratis to whoever would agree to cart it away. Three hundred thousand cords a year of good fuel is certainly worth an effort to save, and this is the product of but one locality.

Who will invent an economical mode of making sawdust marketable? And who will devise new applications for such materials? Most likely there are hundreds of easy ways in which such materials, now a burden, could be turned to profit if our inventors would only take the trouble to think of them and work up their practical applications. Such simple devices for utilizing waste products are often the source of large profits.

The New Thames Tunnel.—The construction of a tunnel under the Thames from Greenwich to Millwall has been authorized by a late Act of Parliament. The importance of this work will be evident when we consider that the population of these two metropolitan districts amounts together to 259,000 persons. When the ferry-boats do not ply across the river, as is the case in the foggy weather, which not unfrequently prevails, a detour of some twelve miles has to be made in order to get to the opposite side of the river by way of London Bridge. The new subway will therefore prove of great public utility. The old Thames Tunnel, constructed by Brunel, 1833-45, and which connects Wapping with Rotherhithe, is situated at a distance of about a mile and a half from London Bridge. At a meeting recently held at Greenwich, it was resolved that the course of the projected tunnel under the Thames should be from a point near the Ship Hotel at Greenwich to the side of the Great Eastern Railway station at Millwall. The new subway, which, when completed will be the fourth tunnel beneath the Thames, will be situated rather more than six miles below London Bridge; its length will be 580 yards, or about a third of a mile. The descent at the Millwall end will be by means of a flight of 15 steps, and by one of 24 steps at Greenwich.

Care of the Eyes.—The care of the eyes is urged by Arthur Chevalier in a new French work. The use of the eyes, he says, should be regulated by their strength, and they should never be overtaxed. A habit of resting them often during work is recommended. Thus in reading or writing stop from time to time and allow the eyes to wander over surrounding objects. To persist in working after symptoms of fatigue appear is foolish. As soon as the eyes begin to itch, or grow red, or any pain is felt in the eye-balls, work should be discontinued and cold water applied. Do not pass suddenly from darkness into bright light. All artificial lights are injurious. The author adds:

"If a person cannot tear himself away from close work, he can at least vary his occupation. Let him close his eyes from time to time, and take a turn round his room, or what is better, take a walk in the fresh air; this, even if it be but for a few minutes only, will do him a great deal of good.

Railway Accidents in 1879.—The Board of Trade summary of accidents and casualties which have been reported to the Board as having occurred upon the railways in the United Kingdom, during the nine months, ending September, 30, 1879, states that the total number of persons killed by accidents on railways during that period was 655, and the number injured, 2,420. The total number of passengers killed was 53, and the number injured 882. No passenger was killed by any accident which occurred to trains, rolling stock, or permanent way. Thirty-one persons were killed and 1,586 injured by accidents on the premises of railway companies, but in which the movement of vehicles used exclusively upon railways was not concerned; and thus the total number of personal accidents reported to the Board of Trade by the several railway companies during the nine months amount to 686 persons killed and 4,006 injured.

Mechanics.

A NEW PISTON PACKING.

A paper was lately read before the Institution of Engineers and Ship Builders, of Scotland, by John Turnbull, jr., in which Lockwood's new piston packing was referred to. This packing has a spring ring, designed to press the packing rings outward against the walls of the cylinder, and at the same time to press the rings apart against the flat faces, each motion being independent of the other. In plan, it represents a series of contiguous segments of a circle, and in section a single segment of a circle. It is made of steel wire equal in section all through, and in one piece for any diameter of cylinder, thus rendering it equally elastic at all points. The ends are secured together by means of a double-ended bolt, having a solid washer between ; and the bolt is made long enough at both ends for additional washers being put on at any time after the ordinary tear and wear of the cylinder and packing rings requires increased tension on the spring ring. The latter is considerably lighter than both the ordinary cast-iron or the helical coiled spring rings. The packing rings have a continuous cavity round their outer circumference, not so much to reduce the friction as to form a receptacle to retain the lubrication and moisture from the walls of the cylinder. Such an arrangement is especially suited for engines having separate exhaust ports, and whose cylinders are horizontal. The inner edge of each packing ring is made parallel for some distance toward the faces, so that the spring ring can enter easily and without any compression ; while by the gradual screwing up of a junk ring, the packing rings are brought closer together, and permitted just to touch each other by their inner edges and not to press unduly. During the operation of screwing up, the packing rings are gradually distended by the points of the spring ring acting on an inclined plane, until it comes upon the protecting flanges, when compression downward begins. After the junk ring is firmly screwed up, a hoop-iron gland may be applied round the packing rings to draw them into the diameter of the cylinder, so as to enable them to enter. The gluts or tongue-pieces are made the whole of the width of the face, so that they cannot get out. In the discussion which followed, several engineers present gave the results of their experience, which was pronounced to be favourable.

RENEWING BURNT STEEL.

It is generally believed that steel, when once burnt, is absolutely unfit for any purpose whatever, and it seems a difficult matter to convince people that such is not the case. Messrs. Bauer & Co., of New York city, have for some time been engaged in accumulating proofs to the contrary, and show that with the aid of "steeline," a compound which they prepare, burnt steel may be restored, and that, in fact, overheating of steel and subsequent cooling in steeline offers many advantages in working. We witnessed recently some experiments made with the compounds which prove its efficiency. One end of a steel bar was heated and tempered in the usual way, exhibiting a good fracture, the other end was then burnt, cooled in "steeline," an oily, semi-fluid mixture, heated again to a somewhat lower heat than usual, and then cooled in water. A fracture of the burnt steel showed the open granular fracture which would lead to its immediate condemnation, while the same burnt material, after treatment, had all the characteristics of a steel superior to the metal originally treated. We are assured by a firm, whose reputation ranks among the highest in this country, that they found the steel work easier by its application, and that it is less liable to break in hardening. Messrs. Bauer & Co. have commenced an interesting series of experiments looking to the use of ordinary Bessemer rail steel for cutlery, saws, files, etc., by a treatment with "steeline." They have succeeded thus far in obtaining creditable results, having made files, saws and knives which rank well. From better qualities of steel they show excellent specimens of springs, so that the results thus far are very encouraging, and may be considered as strong proofs of the correctness of their method of manipulating steel, strongly at variance as it may appear with accepted notions.—*Iron Age.*

CARE IN EMPTYING STEAM BOILERS.

In regard to emptying and blowing-off steam boilers, a French contemporary gives the following useful hints: "those who possess externally-fired boilers, working only by day, have all observed that the fire being covered by night, and the doors closed, the pressure rises during the night, often sufficient to open the valves. This shows that the masonry, being at a much higher temperature than the boiler which it envelops, imparts to it some of its heat. The same effect of heating the boilers is produced, to a less degree it is true, but nevertheless to some extent on the outer jacket of internally-fired boilers. It is, consequently, injurious to empty boilers soon after having stopped them, because after emptying, the plates would be heated by the action masonry. It is well to admit a current of air through the flues some hours after the stoppage of the generator, and not to empty it before the flues become cooled to a temperature below 300°. When the flues are not too hot, no serious inconvenience is experienced in emptying the boiler under pressure. We do not say at high pressure, as for a boiler the pressure of which would be 10 pounds, the temperature of the water being 304°, a greater quantity of steam would be generated during the process of emptying ; we think at a pressure of two pounds the boiler could very well be emptied. In internally-fired boilers, as there is no masonry to cool in the furnace tubes, it would be well to admit the current of air intended to cool the masonry behind the boiler, as in this case the furnaces would be cooled more rapidly than the jacket. We have sometimes seen owners empty their boilers almost immediately after the fires have been extinguished, clean them with cold water as soon as they were empty, and keep up a current of water so that the workmen might work there. Boilers of small dimensions sometimes resist such treatment, but in large boilers it will be seen that unequal contractions must take place, causing the rivets to burst."

PHYSICAL CHANGES IN IRON AND STEEL.

Amongst the many questions that have been discussed in our columns are those relating to the hardening and tempering of steel, the expansion of iron with increase of temperature, the changes it undergoes between the molten and solid state, and the phenomenon of a piece of solid iron floating in a bath of molten and necessarily less dense metal. Lately some elaborate and instructive experiments have been made by Mr. Thomas Wrightson, of Stockton-on-Tees, with the view of determining (1) the changes in wrought and cast iron when subjected to repeated heatings and coolings ; (2) the effect upon bars and rings when different parts are cooled at different rates ; and (3) the changes occurring in molten iron when passing from the solid to the liquid state, and *vice versa.* The results were embodied in a paper read before the Iron and Steel Institute, which, with the tables and diagrams accompanying it, will take first place in the literature of the subject. It contains, in fact, the only really scientific attempt to settle some of the mooted points that, as far as we know, has been published, and it is to be hoped that it will be issued in a separate form after it has appeared in the transactions of the Institute. The reason that so little has been done hitherto in the accurate observation of the physical properties of iron is twofold—first, the molecular changes of the metal is so slow at ordinary temperatures, and under ordinary conditions of strain, that trustworthy observations, which must of necessity have extended over long periods, are difficult to obtain ; secondly, when the temperatures are high —at which times the greatest and most rapid molecular changes are occurring—the difficulties of observation are increased to such an extent that the results lack the scientific accuracy which characterise the chemical methods of examining iron. Hence, probably, chemical analysis has been employed almost to the exclusion of physical methods. However, to take the first heading, the changes effected by repeated heating and cooling, we have only to point to a steam boiler to see how important it is that we should understand these charges not only as they affect iron, using the term in its generic sense, but also as they affect the different qualities and various makes.

In the case cited we have one side of the plates subjected to a fierce heat, while the other is at a comparatively moderate temperature approximating to that of the steam and water. Where a riveted seam occurs the conducting surfaces of the metal are thickened, and the results are not unfrequently seen in what are known as seam rips. Mr. Wrightson cut some strips from the plates of two long egg-ended boilers which had exploded by ripping at the seams, and found the iron had become brittle, was apparently crystalline in fracture, and had but small tensile strength. Strips taken further from the seam showed that in both cases the iron had been less injuriously affected. Chains are rendered brittle by the strains to which they are alternately subjected, and they are periodically annealed to avoid any danger from the change in the tenacity of the iron. Mr. Wrightson found that a similar treatment of the strips from the boiler-plates restored the fibrous character of the iron, as well as its ductility and tensile strength. The facts mentioned afford an excellent example of the importance of the physical effects produced by repeated changes of temperature. The change effected by one heating and cooling is so small that a cumulative test is the only method by which a really useful result can be obtained. If a wrought-iron bar is heated expansion takes place; if the bar is then suddenly cooled in water it contracts, and the amount of the contraction exceeds that of the previous expansion, so that the bar is now smaller than it was before being heated. If these operations are repeated, the contraction increases during many successive operations. Thus a bar 1⅛ in. square by 30·05 in. long, heated to a dull red and cooled in water, contracted after first cooling ·04 in.—after 15th cooling ·68 in. or a percentage of 2.26 in fifteen operations. That was common iron; the best gave the same degree of contraction for the first two or three operations, but on the 15th cooling was found to have contracted only 56 in. or 1·86 per cent. of its length.

Similar bars heated to redness and allowed to cool in air do not exhibit any change in dimensions, but if they are raised to a white heat a slight contraction does occur. Some wrought-iron hoops welded up from bars of the same section as the iron employed in the previous experiments yielded almost identical results—the contraction progressing steadily during twenty-five coolings. Pieces of wrought plate planed up into a nearly accurate rectangular form, were then tested, with the result that after cooling in water a reduction of specific gravity was discovered amounting to 1 per cent. after 50 coolings, and 1·57 per cent. after 100; further heatings and coolings not appearing to effect any change. A reduction of the surface takes place after each heating and cooling, due to two causes, viz., scaling, which amounts to ·00057 in. reduction of thickness after each immersion in water; and a persistent contraction, which takes place vigorously after each immersion up to fifty, and probably to a much greater number. Bulging is noticed in the case of plates, which thicken towards the centre, while the edges are thinned. Professor Stokes has explained the bulgings, the scaling is well understood, but the contraction can be accounted for only on the supposition that a molecular change in the iron occurs when the red-hot metal is suddenly cooled. Cast-iron bars, on the contrary, whether cooled suddenly in water or gradually in air, expand slightly, while cast-copper rods exhibit no change when cooled in air, but expand slightly after being several times suddenly cooled in water. Some of the most valuable and interesting of Mr. Wrightson's experiments were made upon bars and rings partly immersed only when being cooled. From the results recorded above, it would be imagined that if a thick hoop, or portion of a hoop, were cooled by partial immersion, the portion in the water would contract, while that allowed to cool in the air would exhibit no change. Such a conclusion, however, is entirely erroneous, for when a hoop 18 in. in diameter, forged out of iron 3½ in. broad by ½ in. thick, was half immersed in water, it showed, after twenty successive heatings and coolings, that the water-cooled edge had increased 1·24 in. or 2·14 per cent. in length, while the air-cooled half had contracted 7·9 in., or 13·65 per cent., so that the hoop had become a section of a cone. To ascertain whether the form had anything to do with this curious result, a wrought-iron bar 3½ in. deep, by ½ in. thick by 28·4 in. long, was treated in a similar manner, when the dipped edge was found to elongate, while the upper edge cooled in air contracted—so much so that the originally straight bar became curved, the water-cooled edge becoming convex, while that in the air became concave. After the twelfth immersion the lower edge was found to have expanded 44 in., while the upper had contracted 1·96 in. An experiment was also made to test the effect of reversing the bar. A similar bar to that previously described after five coolings was curved so that the reversed side of its air-cooled edge measured 1½ in. The concave edge was then placed in the water, and five immersions brought the bar within an ⅛ in. of the straight, and the eleventh cooling threw the concavity on the other side of the bar.

These experiments were subsequently repeated in a more elaborate manner with steel and wrought-iron hoops actually turned and bored, and immersed to varying depths. The explanation was furnished by Col. Clark, R.E., some years ago, after similar experiments made at Woolwich. The immersed portion, being quickest cooled, is the stronger metal, and tends to pull in the upper part, which, besides, contracts as it slowly cools, so that the excess of contraction rests with the air-cooled portion. Col. Clark does not appear to have noticed the expansion of the water-cooled edge. These experiments are unquestionably of value, and the knowledge gained by them may be utilised in the arts; hence it would be advisable to issue the tables and the diagrams, together with the descriptive matter, in a separate form. In making the experiments above noticed, Mr. Wrightson's attention was naturally drawn to the changes occurring in cast-iron when passing from the solid to the molten condition, and *vice versa*. It is well-known that a piece of cold cast-iron will float upon a bath of molten cast-iron, and much has been written to account for the apparent anomaly that cast-iron which has in cooling contracted about 1 per cent. from the original size of the mould in which it was cast, should, with a presumably higher specific gravity than the molten metal, float in the same. The ordinary way in which the experiment is performed is to take a small piece of cold iron and throw it into a ladle of molten metal. It sinks at first, and then rises buoyantly to the surface. The assumption is made that the sinking is due only to the momentum acquired in falling; but the fact is, the cold iron sinks because it is heavier, and rises to the surface as it becomes heated and expands—the density being thus diminished. Mr. Wrightson had spheres cast, 1 in., 2 in., 3 in., 4 in., and 5 in. in diameter, which were lowered, not thrown, into the molten metal, and he devised an instrument which registered the amount of sinking and of flotation, below and above a line of equilibrium. The diagrams obtained with this instrument show that in every case the ball sinks when first lowered into the metal, the duration of the sinking period being, as a rule, longest with the smaller balls. The outside surfaces of a ball expanding only to a small degree affects the volume more in proportion as its diameter is larger (the surface varying as the square and the volume as the cube of the diameter). Hence, as a rule, five or six seconds may be sufficient to expand a five-inch ball to the floating point, while a two-inch ball would require a much longer time before it would float. Thus the index, at the moment the ball enters the metal, crosses the line of equilibrium and sinks below it; then it rises gradually until it attains its maximum above the line, and then falls again as the ball melts until it reaches the line, the fork and spring holding the ball being adjusted to remain in equilibrium. It may be reasonably assumed that the diagrams read backwards convey a correct impression of the changes going on when molten iron is cooling to the solid. The mould is usually made about 1 per cent. larger than the casting is required to be, and the metal when poured in is always supposed to expand; hence the sharpness of the impressions. This expansion is marked on the diagrams by the quick rise of the line between the molten point and the point of greatest volume. Mr. Wrightson says that in carefully observing the cooling of a casting it will be noticed a considerable contraction takes place some minutes after the iron is partially set. A few minutes after the "git" is closed and congealed there is a sudden breaking open of the same, and a sponging out of the hot liquid from the interior, as though the internal part had suffered a sudden squeeze. This phenomenon is indicated by the sudden fall of the line on the diagram, and indicates in this case the passage from the plastic to the solid state.

WORCESTER'S GREAT SEWER.

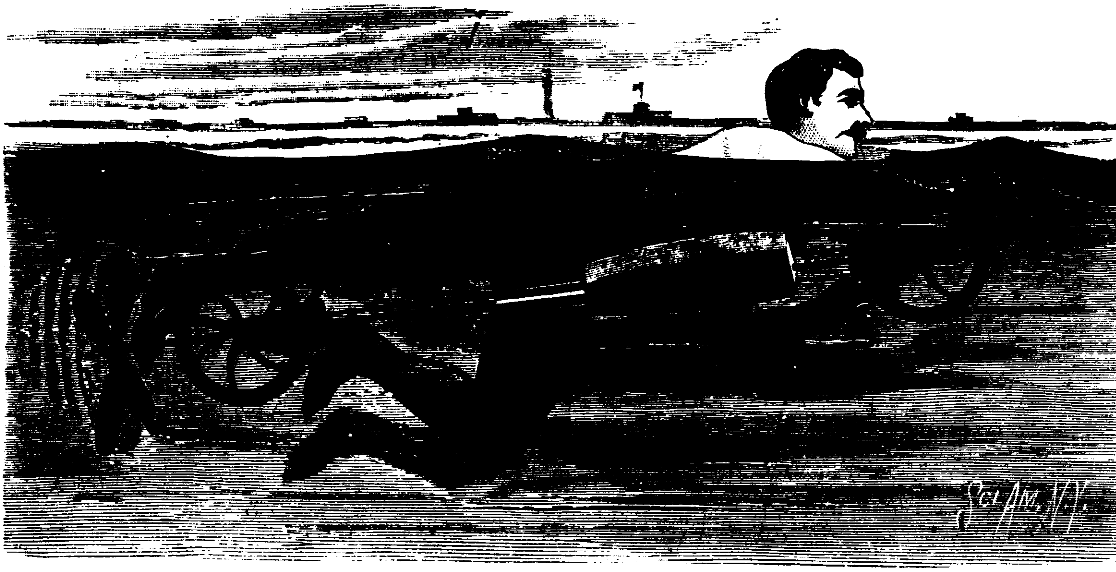
The following, from the Worcester *Gazette* of the 22nd of November, gives an interesting account of a very large sewer, which has been built in that city at a heavy expense. It is in many respects a remarbable engineering work. Its extraordinary form appears to be due to the fact that it has a large amount of storm water to carry off in addition to the sewerage and water of the brook mentioned:

The section of sewer now so near completion consists of a covered arch of 18 feet span and 13 feet high in the centre; the structure really consists of two walls and two arches, one of them inverted, substantially as shown by the above diagram.

The side walls have an inside face of 5 feet and are 5 feet in thickness. The upper arch springs from a beveled face near the top of the wall, and has a rise of 4 feet and a span of 18 feet. It is of rough ashlar work laid in cement. The bottom of the sewer consists of an inverted arch of stone and concrete, with the same span and radius.

As there has been considerable correspondence of late in relation to the best form of sewers, we give the above with illustration, which may help to elucidate the question.

Testing Cellars for Dampness.—Provide yourself with a thermometer, a glass tumbler filled with water; and a piece of ice; then notice how low your thermometer, when placed in the tumbler, has to sink before any moisture begins to show itself on the outside of the vessel of cold water. The lower the temperature to which the thermometer has to sink before any moisture is precipitated, the less there is of it in the moisture of the cellar.



RICHARDSON'S SWIMMING APPARATUS.

NOVEL SWIMMING DEVICE.

We illustrate herewith one of the most novel applications of machinery that has come under our notice. It is a singular craft without hull or engine, but nevertheless apparently correct in principle and capable of practical application. This swimming apparatus consists essentially of a light frame, carrying a float and a longitudinal shaft, having at one end a small screw propellor and provided with gearing for running the propellor.

The swimmer reclines on the float, and grasping one of the hand cranks in each hand and placing his feet on the two foot cranks, proceeds rapidly and easily, with the head far enough above the surface of the water to be comfortable without extra exertion.

The inventor asserts that a swimmer with one of these machines can, under favorable circumstances, make from four to five miles an hour without undue exertion.—*Scientific American.*

IMPROVED AXE WEDGE.

Every one who has had occasion to use an axe, has observed the difficulty of securing the handle firmly in the eye, ordinary wooden and iron wedges being very likely to work loose. We illustrate herewith an improved wedge made of malleable iron, and provided with teeth so arranged as to hold the wedge securely in its place, when once it is driven in. The head of the wedge is polished and lacquered to prevent rusting, and is constructed large enough to entirely cover the end of the handle, and as it tapers towards the edge an exceedingly neat finish is produced. Blacksmiths who are called upon to make wedges, will no doubt be glad to know that they can procure so thoroughly efficient and practical a wedge as the one described, at a trifling cost. The manufacturers, Messrs. Porter & Wooster, Boston, Mass., inform us that already thousands of these patent wedges are being used in the lumber regions of the east and west. Further particulars can be obtained by addressing the manufacturers as above.

HOW TO MAKE TIGHT TARRED PAPER ROOFS.

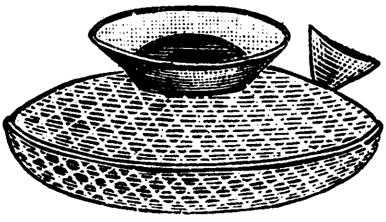
Have the lower layer of paper that comes next to the boards without tar or dressing of any kind (*plain paper*) then over that three layers of tarred paper. When the tarred paper is laid on the boards of the roof it adheres firmly to the boards and when they come to shrink (as they always do) the paper is torn at the joints between the boards, especially if wide lumber is used the the fracture is greater. Plain paper does not adhere to the boards, and they are allowed to shrink or expand without damaging the roof. I have tried it and know that a roof put on in this way will remain tight more than twice as long as when the tarred paper is laid next to the boards, besides it entirely prevents the dripping of tar through the cracks of the roof in hot weather. The extra expense is a mere trifle, not 25 cents each square of 100 feet.

TANGYE'S LATHE.

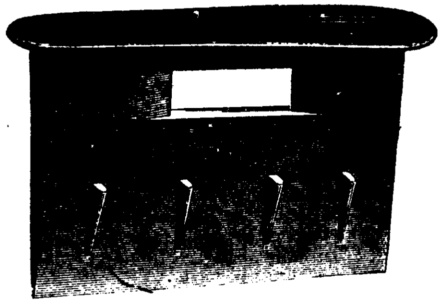
We illustrate a capital and beautifully-finished turning lathe, shown on this stand. This handy tool which is manufactured by Tangye's Machine Tool Company, Limited, has been specially designed for the use of amateurs, and those requiring a small and cheap lathe. It is at once simple and compact, supplied with all the usual accessories, and exhibits true honest workmanship throughout. This lathe is manufactured by Tangye Bros., Birmingham, England.

Patent Water-Heater.—The patent Water-heater, shown in the subjoined engraving, is a valuable and economical gas apparatus for instantly heating water to any required temperature. It is manufactured by Messrs. E. Siddaway and Sons, of West Bromwich, the patentees, and appears to be specially suited for baths, lavators, domestic use, hotels, clubs, and public institutions. This patent water-heater (No. 4 size) will heat two gallons of water per minute, or supply a hot bath of forty gallons to 100 degrees of temperature in a little over half an hour. The advantages claimed for this heater are: (1) The gas is not in direct communication with the water, as in ordinary heaters; (2) the interior being of copper retains a maximum of heat with a minimum of gas burnt; (3) the gas burners being on the Bunsen principal, burning both air and gas, are exceedingly economical; (4) as there are no confined spaces in the interior, there is no risk of explosion under any circumstances; (5) the interior cannot be affected by calcareous deposits which are found in some hard waters; and (6), as the apparatus is complete in itself there is little or no expense in fitting. Practically, with this heater, the supply of hot water is absolutely instantaneous, thus obviating the necessity for, and expense of, maintaining a continuous supply of hot water for domestic emergencies, sudden illness, or cases of accident. The price of Siddaway's Patent Water-heater is sufficiently moderate to bring it within the reach of most households.

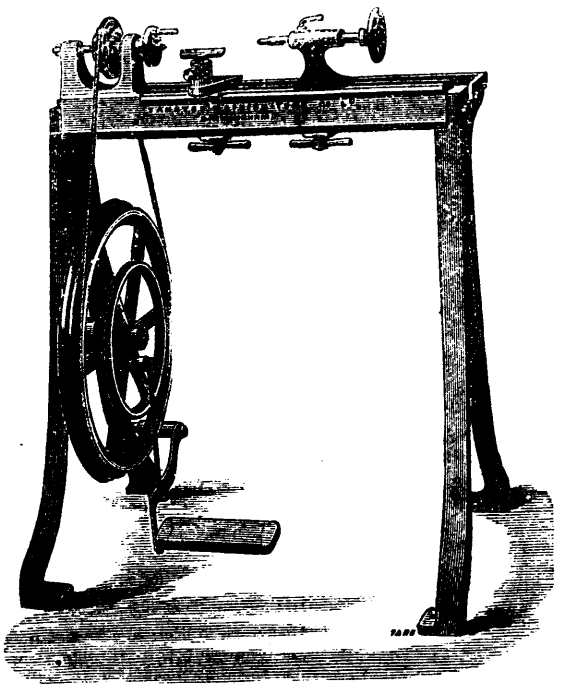
Ventilating Bedrooms.—A simple device for ventilating bedrooms is within the reach of every one having an ordinary window in his room, by which fresh outer air can be admitted in small quantity with such an upward current as will prevent its being felt as an injurious draft by the inmates. It is particularly adapted to sleeping rooms when the weather is too cold to admit of an open window. Thus, start both top and bottom sashes of the window half an inch, which is not quite enough to clear the rebate or stop-beads at top and bottom, but which leaves an opening of an inch between the meeting rails, through which a current enters, but diverted upward by the glass as it should be, so as not to fall directly to the floor, as its coolness might otherwise induce it to do. It thus becomes well mixed with the air of the room without being felt.—*The Plumber.*



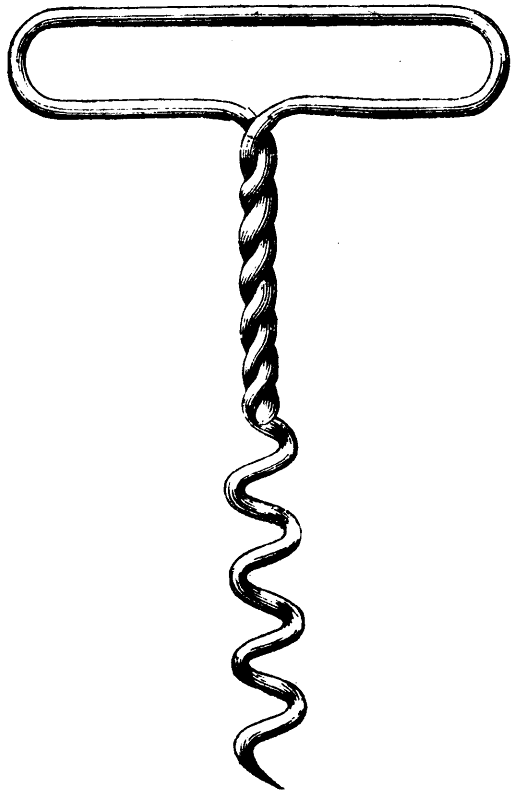
THE DENTAPHONE.
(*See page 86.*)



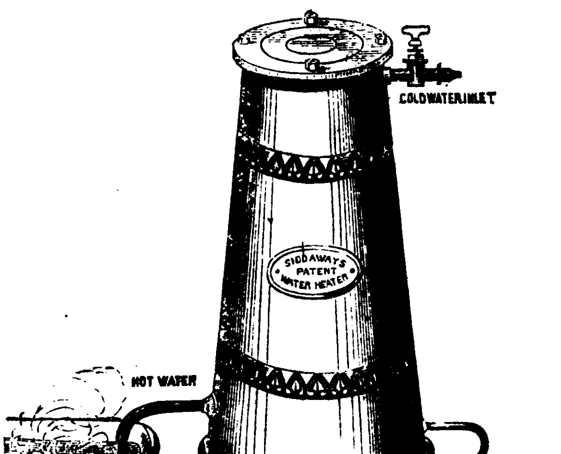
AXE WEDGE.



TANGYE'S LATHE.



A CHEAP CORKSCREW.



PATENT WATER-HEATER.

A Cheap Corkscrew.—A novel corkscrew has been introduced by Messrs. Nettlefolds, the well-known screw and wire manufacturers, of Birmingham, which is well deserving the attention of the retail trade. As it will be seen from our engraving, it is made of twisted wire, ingeniously fastened so as to afford all the strength and convenience necessary in the drawing of corks. The form of the screw is of the simplest character, and there is nothing in the implement itself that can get out of order, for the twist is so pitched that each downward pressure or turn of the screw actually increases the power of the corkscrew. It is obviously designed for "the million," and since the article is sold retail for a penny, it will probably soon become what we venture to designate it.—"Everybody's Corkscrew."

How to Obtain Sleep.—The following is recommended as a cure for sleeplessness: "Wet half a towel, apply it to the back of the neck, pressing it upward to the base of the brain, and fasten the dry half of the towel over so as to prevent the rapid exhalation. The effect is prompt and charming, cooling the brain and inducing calmer, sweeter sleep than any narcotic. Warm water may be used, though most persons prefer cold. To those suffering from over-excitement of the brain, whether the result of brain-work or pressing anxiety, this simple remedy is an especial boon."

Miscellaneous.

Evaporating Pans on Stoves.—An almost universal practice in winter is to place on the stove a pan of water, with a view to purify the air by absorbing the carbonic acid contained in it. Dr. Polli, of Milan, who has long been engaged in investigations on this subject, is wholly opposed to this system. According to him, the water does not absorb carbonic acid, but, on the contrary, adds to it by the decomposition of the carbonate of lime contained in all drinkable water in greater or less proportions. The white encrustations found on the sides of the vessels are, in fact, formed by the deposit of subcarbonates and sulphates of lime, produced by the evaporation of the water, and the principal part of the carbonic acid having been given off to the surrounding atmosphere. M. Polli proposes instead to place on the stove pans, containing quick lime, which after a few days augments in volume and is transformed into carbonate of lime by absorbing the carbonic acid in the air. By this means the atmosphere is constantly purified, but at the same time is rendered very dry. To obviate this inconvenience, vessels containing water may be placed about the room in positions where they are not subject to the immediate action of the fire, and they will give off by their evaporation sufficient humidity to render the air agreeable, without adding to the quantity of carbonic acid already present.

Welding Steel Hammers.—A correspondent in the *English Mechanic* asks if it is possible to weld a face on a cast steel hammer. The answer given is as follows: "I suppose to make it heavier; this cannot be done even with sheer steel. Many men will assert that they have seen it done many times. Files may be put together very easy and to look sound, but as to their being welded I doubt it very much. Sometimes old swords can be put together to look sound, still they are not so. Many workmen are not aware that there is a kind of steel made, called welded steel; this will account for so much cast steel being welded. I know one firm that sent an order for 100 tons of sheer steel to one of our best steel makers, and they, not having it in stock, sent welding cast steel, and it gave great satisfaction, and as the order came from a Sheffield firm no doubt it was tested very severely as to its welding property. Of course, the firm it was for took it for sheer steel, and no doubt had the order been for cast steel the same would have been sent, that is if no other was in stock. I have some cast steel and I know it is the right sort, and I should like to give anybody a piece who would try to weld it. I have seen this kind of thing tried in many of our best workshops and by some of our best workmen, hundreds of times, and welding files I regard as an old tale."

China Painting.—Herewith is a list of tools, &c., necessary for painting of glazed china, and a few directions how to use them:—Paints and flux, oil of lavender, turpentine, fat-oil, brushes, palette knife, small muller, 1 piece of glass to grind and mix colours on. First, be sure the china is perfectly clean and free from grease, then draw the outline of whatever is to be painted on the china with Indian ink mixed with water, carefully but slightly, which will disappear in the firing. Put some colour on the palatte with a little flux, and grind it thoroughly with a little turpentine using the muller; then add to this a little oil of lavender and a drop of fat oil, and mix well with palette knife. If wanted thinner, use a little turpentine. The colour should be used thin enough to flow easily, but not to run. You can paint one colour over another without firing, if the first is left a day or two to dry, but for elaborate things several firings will be necessary. There is also a useful little book, viz., "A Hand-book to the Practice of Pottery Painting," by J. C. L. Sparks, published by Lechertier, Barbe, and Co., 90 Regent street, price 1s., where also the paints, &c., can be got.

A Cheap Composition for Steam Covering.—A French firm is using a composition for covering boilers, steam pipes, and similar articles, which is certainly cheap and said to be very effectual. The surfaces are covered with sawdust mixed with flour paste. If the paste is not very liquid, the mixture being used in the form of moderately stiff dough; and the surfaces of the boilers or pipes have been well cleaned from grease, the adhesion is perfect and the material is free from cracks. Five layers of this composition are recommended, each about one-fifth of an inch thick. It is said that one inch of this composition will give better results than double that amount of the materials usually employed. The paste is composed of rough flour without the addition of starch. The mixture can be applied without a trowel, and if there is much exposure, two or three coatings of tar will render the composition impervious to water. Copper tubes should first be treated to a hot liquid solution of clay so as to increase the adhesion of the sawdust.

Concerning Celluloid.—The correspondent of the *Saturday Evening Post*, who not long ago called attention to a popular error that prevailed respecting this substance (the said error being that celluloid contained gun-cotton for one of its constituents), is called on to explain the recent disastrous explosion, attended with loss of life, that occurred during the past week. His explanation of the constitution of this article, to the effect that it was composed of tissue-paper and camphor subjected "to a chemical process," was as lucid as any one had a right to expect of a correspondent who occasionally dipped into science; and his positive assertion that celluloid contained no gun-cotton is substantiated to the fullest extent by the testimony of one of the manufacturers who was interviewed since this latest explosion, and who is reported to have asserted that no *gun-cotton* was employed in any part of the manufacture, and that the only materials used in its production were tissue-paper *treated with a mixture of nitric and sulphuric acid* and camphor!

A New Method of Making Steam Boilers.—An English engineer, named Whitehead, recently exhibited at Owlestan, near Sheffield, a boiler made on a new plan. In making this boiler, a ring of steel is cast and heated; then it is placed upon a large roller, and by the aid of smaller rollers it is enlarged to the requisite dimensions. The ring is run from one end of the roller to the other, and is returned by reversing the machinery. The hads necessary for the completion of the boiler are subsequently put on with bolts. The machinery is rather expensive, and its cost is said to be the point upon which the success of the invention hinges. The inventor claims that within six hours he can construct the shell of a boiler of a more durable nature than those now made with iron or steel plates riveted together. There is no doubt that such a boiler must be stronger, as the danger of tearing the seams on the cylindrical surface, where the strain is the strongest, is done away with by the total absence of such seams.

Making Solder Wire.—Solder in the form of wire is very convenient for a great many purposes. To make it, take a sheet of stiff writing or drawing paper and roll it in a conical form, rather broad in comparison with its length. Make a ring of stiff wire to hold it in, attaching a suitable handle to the ring. The point of the cone may first of all be cut off, to leave an orifice of the size required. When filled with molten solder it should be held above a pail of cold water, and the stream of solder flowing from the cone will congeal as it runs, and form the wire. If held a little higher, so that the stream of solder breaks into drops before striking the water, it will form handy, elongated "tears" of metal; but, by holding it still higher, each drop forms a thin concave cup or shell, and as each of these forms have their own peculiar uses in business, many a mechanic will find these hints very useful.

The Band Saw Action.—The teeth of a circular saw act at varying angles on the grain of the wood; those at the top of a log being ripped, striking the fibres at a more acute angle, and consequently to better advantage than those at the bottom. The band saw teeth, on the contrary, all meet the fibres at the same angle; and this as the table is ordinarily arranged, is as squarely across them as is possible. To remedy this, Mr. Pryibil, of New York, inclined the table of one of his band sawing machines about 23½°, so that the board to be ripped was fed up-hill, and the teeth met it at a considerable acute angle. He reports that the traction, or effort of feeding, was lessened by one-third, as measured by spring balance. The cutting action under these circumstances was undoubtedly much more favorable than when the teeth struck square across, but no dynamometrical test was made.

An Effective Glue.—A very effective glue mixture is said to be employed by Turkish artisans in the nice work of attaching diamonds and other jewels to their metal settings. In the production of this substance the method pursued is to dissolve five or six bits of gum mastic, each of the size of a large pea, in as much spirits of wine as will suffice to render it liquid; in another vessel as much isinglass—previously softened in water—is dissolved in brandy as will make a two-ounce vial of strong glue, adding two small bits of gum ammoniac, this being rubbed until dissolved. The whole is then mixed with heat, and kept in a vial closely stopped; when it is to be used, the vial is set in boiling water. This cement resists moisture, and will indissolubly unite two surfaces of polished steel.

WOOD FILLER.—From E. P. M., *Greenville, Ohio*.—Answering "H. P.'s" enquiry concerneng a wood filler, I recommend the following: Take three papers corn starch, one quart boiled linseed oil, two quarts turpentine, one-quarter pint japan; cut in half the turpentine before mixing; it will not cut perfectly otherwise. For dark woods add burnt umber to color. When nearly dry rub off with cloths. The above mixture must be used fresh, as it is of no value after it is four or five days old. The cloths used in rubbing as above mentioned should be destroyed immediately after used, as spontaneous combustion is likely to ensue from the ingredients employed.

TO REMOVE OLD PAINT.—A writer to the *English Mechanic* says: The cheapest and best solution that I know of I accidentally discovered, and it may be worth while to tell how, though very likely some may know of it. In trying experiments for press-copying some old letters, amongst others I used successfully a solution of one table-spoonful of vinegar and one ounce of washing soda to a half pint of water. A little of this was spilt on the painted window-sill, and in wiping it up the paint came entirely off, leaving the bare board quite clean. Try it; a gallon will not cost fifty cents.

KEY-HOLE SAW.—The Japanese hand saw cut on the pull-stroke; so no matter how hard the wood or dull the saw, they will not bend or buckle. It is rather more difficult to saw to line with such saws than with ours, but they have their advantages. Take one of our key-hole or compass saws, cutting on the push or shove stroke, what an aggravating limber thing it is. Now point the teeth the other way, and you have a tool that will keep stiff no matter how many knots it encounters, or how dull it gets, In other words the pull-stroke of 3,000 years ago is the best for such thin, narrow blades.

WOOD PANEL.—Mahogany can be used to much advantage as panels, by varnishing some parts more than others, so as to shade the wood without using any other paint than what is necessary for the main decoration. This should be a face, the lines and natural flesh tints of which are the only colors used. The dress, bust, and background are done entirely with varnish, except a few touches of gold to strengthen the outline. If the panel is sawed into circular shape, so as to give the head as a medallion, it is ery effective.

GLUE TO FASTEN LEATHER TO IRON.—For a recipe for making glue to fasten leather to iron, in order to cover iron pulleys, take the following:—One part of crushed nutgalls is digested six hours with eight parts distilled water, and strained. Glue is macerated in its own weight of water for twenty-four hours, and then dissolved. The warm infusion of galls is spread upon the leather, the glue solution upon the roughened surface of the warm metal; the moist leather is pressed upon it and then dried.

COLORING BRASS-WORK.—Cleaned-up brass-work, if left in damp sand, is said to acquire a fine brown color, which, when polished with a dry brush, remains permanent and requires little cleaning. Black, much used for optical brass-work, is obtained by coating the brass with a solution of platinum, or with chloride of gold mixed with nitrate of tin. The Japanese are said to bronze their brass by boiling it in a solution of sulphate of copper, alum, and verdigris.

CHESTNUT GLUE.—Remove the brown coating, grind the kernel into flour, form paste with water, and pass through a sieve to separate the woody fibres. Wash the floury mass so obtained with clear water several times and settle. The starch so deposited is dried, treated with chlorine water, washed again, and made into glue in the same manner as ordinary starch glue. This glue requires no fire to keep it in readiness for use.

MIXING QUICK DRYING PAINT.—Venetian blinds should be painted to dry dead, then varnished; but few take this trouble. Mix the paint as under: White lead, boiled oil, and the least drop of turps; mix sufficient of each to form a creamy mixture; then add about 1 oz. patent driers to each 1 lb. of paint. If you want the paint darker use enough burnt umber to give the required tint. If you want to varnish, omit the oil and use turps.

CLEANING GILT FRAMES.—If possible remove the glass, lay the frame on a table or work-bench, well wash with warm water and white card soap, using a tooth brush, but use no soda; clean off with cold water, and dry with an old silk handkerchief, refix the glass, and if your frame was of any account it will look nearly equal to new.

NEW KIND OF PLATED SHEET IRON.—In Iserlohn, Westphalia, thin sheet-iron is plated with alloys of nickel or cobalt and maganese. A half of one per cent. of maganese makes cobal and nickel a very malleable fluid when melted, and ductile. The p lates, which are already in the market are beautifully white and brilliant.

STEEL VS. IRON.—Some authorities predict that in a few years, steel will supersede iron in naval architecture, to as great an extent as iron has supplanted wood.

THE TREATMENT OF DIPHTHERIA.

Dr. Thomas Gurney, senior physician to the City Dispensary, London, makes the following contribution to the *Lancet*: "Since I have held the position of physician to the City Dispensary I have had considerably more than one thousand cases of diseases of the throat under my care, many of which, both in public and practice, have been cases of diphtheria. About this, by far the most serious diseases of the throat, we have much to learn. The stiffness in the neck, the disturbance of the circulation, the rapid rise of temperature, before any affection of the throat is observed, all point to its being a blood poison calling for prompt and decisive treatment.

"The two questions that arises when called to a case of diphteria, as, indeed, in all disiases, are: How does the disease tend to kill the patient? and, how does nature endeavour to rid herself of the disease?

"Diphtheria tends to kill by suffocation and by its poison exhausting the vital energy. Suffocation may be either accidental, or as a natural result of the throat affection—accidental if, when the membrane is thrown off, it becomes lodged in the larynx; natural if the swelling inside the throat shuts off the supply of air to the lungs. Nature will attain the mastery over her enemy if the strength be kept up and the deposits arrested. With these points to guide us we know that the arrest of the disease and nutritious support are our great aim. To succeed in this I have adopted a respirator made of the ordinary shape and size, the front being minutely perforated. Inside of the respirator I have two or three perforated plates inserted, between which I place common tow (not cotton wool); I then drop on each of the layers of tow ten to twenty drops of a solution of carbolic acid, creosote, and glycerine. Should the patient tire of these, I use turpentine or iodine. I place the respirator over the mouth, and keep it continually applied. My next idea is to provide the patient with warm moist air. To do this I have two kettles of water kept boiling on the fire; attached to the spouts of the kettles I have an elastic tube of an inch caliber, at the end of which is a spray-like nozzle, which I put immediately under the mouth of the patient. By this means I get my disinfectant remedies carried moist to the throat. As a sedative to the pain I know nothing so comfortable to the patient. Previous to this I take care to give an active purge, which usually removes offensive stools of effete, poisonous matter. Internally I give aconite in frequent small doses— two to four minims of the tincture; at the same time freely supporting the strength with milk, cream, and eggs, with or without brandy, and beef tea *ad libitum*. As a drink I recommend patients to take as much chlorate of potash in solution as they can without vomiting. I have found chlorate of potash highly beneficial in all cases of a low typhoid character. If this is objected to, I advise the juice of lemon to be taken—by many thought to be a specific for diphtheria. Should the system be very weak, I prescribe belladonna instead of aconite; but I find better results from the latter. As soon as the urgent symptoms have subsided I order strychnia, with or without nitro-hydrochloric acid— this not only being the best tonic, but also preventing the paralysis which so often follows diphtheria. I have found this treatment to be highly beneficial, but, knowing the tendency there is to rheumatism after this terrible disease, I never forget our friend the bicarbonate of potash."

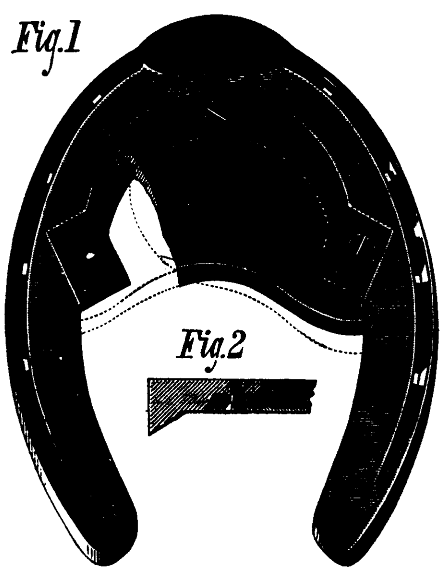
GILDING STEEL.—An old process, which, however, is by no means universally known, is as follows:—By shaking a solution of gold leaf in aqua regia with ether or naphtha the gold will leave the acids to combine with the other liquid. Polished steel surfaces, such as knives, scissors, &c., on being plunged in this solution, when dry become covered with a coat of gold, which is an excellent preservation from rust. Letters, designs, &c., may be traced by means of a pen, pointed stick, or brush, and as the ether evaporates the gold will remain fixed.

NEW WEIGHTED HORSESHOE.

The annexed engraving represents an improved weighted horseshoe invented by Mr. Eugene E. Seixas, of Galveston, Texas. The improved horseshoe is designed to be used in training a horse to trot rapidly by causing him to extend his strides. It squares his step, and may be used for preventing him from striking his knees with his feet.

In the engraving a part of the weight is broken away to show the form of the shoe under the joint, and Fig. 2 is a section of a portion of the shoe and weight taken through the joint. The weight is fitted to a rabbe or recess formed in the shoe and is held in place by three screws, so that it may at any time be removed if required.

When it is necessary to use the device for preventing the horse from striking his knees with his feet the weight is made to extend farther back upon one side than the other, as shown in the dotted lines in Fig. 1.



SEIXAS' WEIGHTED HORSESHOE.

THE HOUSE MOTH.

Of all the household pests the carpet moth, or the *tinea tapetzella*, is certainly the most powerful and persistent, and how to prevent its encroachments is a problem worthy of study. It extends its operations rapidly, taking possession of every nook and cranny, aud when it comes in contact with woollen goods or furs its appetite is simply voracious ; carpet dealers suffer much from its ravages, and many a fine Moquet or Wilton which has been "shelved" for a season, on being brought to light is found to be utterly ruined. It is only by the most careful and frequent inspections, that carpet and furniture dealers are able to hold their own against their wily enemy ; floors are thoroughly scrubbed, cracks and crevices are cleared of lint and filled with naptha, and so the warfare constantly goes on.

Those dealers who make a business of storing furs during the summer months, and who insure them against the ravages of the moth as well as from loss by fire, (the rate of insurance being five per cent. on $100) pack their goods in camphor— an excellent preventative but useless as a cure.. Valuable furs that are moth-infested are often sent to the "trader" to be worked over in sawdust and butter by the process employed in skin-dressing, and which has the desired effect in destroying the vermin.

Now the question arises, is there no exterminator in existence which we can apply to moth-ridden household articles generally ? Of course in every case prevention is better than cure, and thorough cleanliness, yearly or semi-yearly beatings of carpets, frequent overhaulings of furniture, and the liberal use of camphor, will do much to rid our houses of these pests ; but when they once have fastened themselves upon us with an evident disposition to stay, how are we to be saved from the destroyer ?

Some relief for the afflicted may be found in the fact that some four or five years ago a cleansing process was discovered, which is called the "Naptha bath," and is thus described : A large tank, with a capacity of fifteen or twenty barrels of naptha, is filled with that fluid, and heated at 180° by the introduction of a steam coil. Into this the articles to be cleansed are plunged and allowed to remain four or five hours ; when taken out not only has every perceptible vestige of the moth disappeared, but any minute larvæ which the article may have contained is effectually destroyed. Sometimes cold naptha is used in this process, but the time required for the operation is much longer.

By this process, which seems to answer in every particular the purpose for which it is intended, the finest fabrics are not injured in the slightest degree. Several concerns are engaged in the naptha cleansing business in New York, Boston and Chicago.

PROSPEROUS FRANCE.

France is affording fresh proof that she is one of the most wonderful nations on the face of the earth. The disasters of the Franco-Prussian war, and the payment of five milliards of francs as the further penalty for entering upon that war, would have crippled an ordinary nation. But France is not an ordinary one, and the result is that she has not only cast off her burden, but contemplates an outlay in internal improvements such as the most prosperous country could alone entertain It will be remembered that M. de Freycinet, the new Prime Minister of France, before leaving his old department, drew up an elaborate report embodying a gigantic scheme for the creation, extension, and union of railways and canals throughout the country. The estimated cost of these improvements is nine milliards of francs, or £360,000,000 sterling ; but France is not deterred thereby, and in twelve years the scheme is to be worked out in its entirety. Already France is noted for the completeness of her railway system, which, with her rivers and canals, afford a means of communication apparently leaving little to be desired ; but she is impressed with the belief that improvement is possible, and she is going to add 16,000 miles to her railways, and 900 miles to her rivers and canals. This fresh burst of enterprise on the part of France can have but one effect, and that is increased prosperity in the great industries already stirred into activity by the demands of India, America and the colonies. Rumour is already busy, says our excellent English contemporary *Capital and Labor* with the names of English firms about to contract with the French Government, while the iron and steel trades in America and Belgium must also benefit

THE PHYSICAL CAUSE OF INTERMITTENT FEVER.

The July number of the *Zeitschrift*, edited by Professor Klebs, contains some particulars of an investigation into the physical cause or poison to which marsh or intermittent fever is due. The inquiry was conducted by Professor Klebs, of Prague, in conjunction with Signor Tommasi, Professor of Pathological Anatomy at Rome. The two investigators spent several weeks during the spring season in Agro Romano, which is notorious for the prevalence of this particular kind of fever. They examined minutely the lower strata of the atmosphere of the district in question, as well as its soil and stagnant waters, and in the two former they discovered a microscopic fungus, consisting of numerous movable shining spores of a longish oval shape. This fungus was found to be artificially generated in various kinds of soil. The fluid matter obtained was filtrated and repeatedly washed, and the residuum left after filtration was introduced under the skin of healthy dogs. The animals experimented on all had the fever with the regular typical course. After explaining minutely the results of their various investigations and experiments, these gentlemen are of opinion that they have discovered the real cause of the disease in question. As the fungus grows into the shape of small rods, Tommasi and Klebs have given it the name of *Bacillus malariæ.—Medical Times and Gazette.*

USING INDIA INK UPON TRACING LINEN.

By rubbing the India ink in fresh water each time any considerable quantity of tracing, or, in fact, any work, is to be done, the lines will be sharp and clear. Should the latter not be the case, rub a brush upon some soap, or add a few drops of clarified ox-gall, and mix thoroughly.

None but the very best India ink should be employed in making tracings ; that which has an odour of musk on being wet is the best.