Technical and Bibliographic Notes / Notes techniques et bibliographiques

The Institute has attempted to obtain the best original copy available for scanning. Features of this copy which may be bibliographically unique, which may alter any of the images in the reproduction, or which may significantly change the usual method of scanning are checked below.

L'Institut a numérisé le meilleur exemplaire qu'il lui a été possible de se procurer. Les détails de cet exemplaire qui sont peut-être uniques du point de vue bibliographique, qui peuvent modifier une image reproduite, ou qui peuvent exiger une modification dans la méthode normale de numérisation sont indiqués ci-dessous.

- [ ] Coloured covers / Couverture de couleur
- [ ] Covers damaged / Couverture endommagée
- [ ] Covers restored and/or laminated / Couverture restaurée et/ou pelliculée
- [ ] Cover title missing / Le titre de couverture manque
- [ ] Coloured maps / Cartes géographiques en couleur
- [ ] Coloured ink (i.e. other than blue or black) / Encre de couleur (i.e. autre que bleue ou noire)
- [ ] Coloured plates and/or illustrations / Planches et/ou illustrations en couleur
- [x] Bound with other material / Relié avec d'autres documents
- [ ] Only edition available / Seule édition disponible
- [x] Tight binding may cause shadows or distortion along interior margin / La reliure serrée peut causer de l'ombre ou de la distorsion le long de la marge intérieure.
- [ ] Additional comments / Commentaires supplémentaires:

- [ ] Coloured pages / Pages de couleur
- [ ] Pages damaged / Pages endommagées
- [ ] Pages restored and/or laminated / Pages restaurées et/ou pelliculées
- [x] Pages discoloured, stained or foxed/ Pages décolorées, tachetées ou piquées
- [ ] Pages detached / Pages détachées
- [x] Showthrough / Transparence
- [x] Quality of print varies / Qualité inégale de l'impression
- [ ] Includes supplementary materials / Comprend du matériel supplémentaire
- [ ] Blank leaves added during restorations may appear within the text. Whenever possible, these have been omitted from scanning / Il se peut que certaines pages blanches ajoutées lors d'une restauration apparaissent dans le texte, mais, lorsque cela était possible, ces pages n'ont pas été numérisées.

SCIENTIFIC CANADIAN

MECHANICS' MAGAZINE AND PATENT OFFICE RECORD

Vol. 10. JANUARY, 1882. No. 1.

NOTE AND COMMENT.

AT the commencement of a New year we appear before our patrons and subscribers with a confidence engendered of our efforts during the past. We have endeavoured during the twelve months that have gone by to carry out the promises made in our prospectus of last January, and to meet as far as possible the wishes of our subscribers.

The year that has passed has been of some importance scientifically speaking. Foremost amongst discoveries of the day are the various uses of electricity which have been either introduced or perfected during 1881. The Paris exhibition has of course done much to bring into prominence the recent discoveries in this direction and the world at large has been more astonished at the knowledge of what has been already done, than they could be at the news of a really new discovery.

The question of the storage of electric power has been Fought out over the new "box of electricity" over which the papers went into such raptures, until compelled by the logic of plain facts to admit the absurdity of their former claims, while acknowledging a step in the forward direction.

The progress during the year has been most marked however, in a branch of science which closely concerns our every day life in the sanitary arrangement of our homes. The most important part of this progress has been in the education of the public as to the need for, and possibility of preventing sickness and death; it is the most important, because an educated and intelligent public opinion is essential to the success of all hygienic measures, for nearly all of these involve a certain amount of trouble and expense. People are now beginning to understand the value of pure water, the importance of so disposing of excreta and garbage as to insure that the air we breathe, shall be unpolluted by the products of their decomposition, and the fact that disease causes suffering and pecuniary loss, not only to the individual but to the whole community. Those who have learned this lesson are the patrons of the skilled plumber, of the competent sanitary engineer, of the schools where the health of the children is provided for, of the physicians who are known to take an interest in prevention as well as cure.

This educated public opinion is demanding more exact knowledge of the causes of disease, and the demand is creating the supply. Investigations are going on; registration of deaths, and to some extent of disease, is being established and made more complete; the effects of bad drainage, overcrowding, polluted water, and contagion, are becoming better known, and an epidemic is no longer considered to be an unavoidable dispensation of Providence, any more than a great fire, or a railway collision. And so fast as the causes of disease are understood, the ingenuity and technical skill of the nineteenth century is applied to providing the means of destroying these causes. The announcement by Pasteur, or Koch, or Burdin-Sanderson, of the discovery of a new fact in the life history of some minute and apparently insignificent organism, at once becomes a basis for means of disinfection provided by the chemist or engineer, or for legislation in preventing the spread of disease.

Many pseudo discoveries, false facts, and absurd theories, with regard to sanitation are now being announced, which to a superficial observer tend to bring discredit on the whole subject; but there is nevertheless a real advance, an advance which we welcome, and to the record of which we have devoted much space during the year past.

Space will not permit a more elaborate retrospect, even if such were desirable. The only use of dwelling upon the past is to urge us on to make still greater efforts for the future, and 1882 will probably bring forth the fruits of much that has been only sown in 1881.

To these, and all other discoveries throughout the year we think our readers have found that we have been alive. We have endeavoured, as we promised, to keep up a record of the doings of the scientific world, but in so doing we have been careful not to neglect the nearer interests of the mechanics of the *Dominion* which are bound up even more immediately with our own. As before, so now, we cordially invite correspondents to give us their views on the subject, and to suggest means of improvement. We would ask them however, not to be discouraged if they are not always carried out. Many valuable suggestions reach us by this means. But on the other hand, ideas which seem highly valuable to their originators, may be in fact impracticable to us, or again we may be waiting a more fit opportunity for carrying them out. We commence this new volume in all reliance on our subscribers good will, and we wish you, as the season demands, a "Happy New Year."

WHY ARE NOT GOOD ENGINEERS ALWAYS SECURED?

In endeavoring to answer the above question we will state first that many of the people employing engineers will not pay the price demanded by good engineers. When a person is under the necessity of putting in an engine and boiler, either to run an elevator or to furnish power for other miscellaneous work, the important questions arise: "Will I be required to hire an engineer?" and "isn't there some way by which I can avoid paying out the amount required to hire an engineer?" There are many plans resorted to under these circumstances by persons who look upon the amount spent upon engineers as money thrown away, and never consider the safety of their lives and property. The person owning the engine and boiler goes to the inspector or examiner of engineers, and states his case. He is told that he is allowed to have a fireman, but either the proprietor or some one about the place must pass examination as engineer. The proprietor, who used to be around machinery somewhat, and understands a little about the management of steam, concludes to be examined; so he submits to being questioned by the examiner, who is very lenient (for reasons best known to those who have been there,) and finally declares the gentleman proficient as an engineer. The certificate or license is made out, and a fireman hired at $1.25 or $1.50 per day. He receives a few instructions from his employer in regard to his duties, and is left with the injunction "that if any one calls to see the engineer, he (the employer) is to be called at once." Sometimes the fireman does not see his employer, the engineer, for a week at a time, so he is virtually the engineer in charge of the engine and boiler.

We have known men of this class who were fully competent to manage steam machinery, even more so than their employers, who had the license of an engineer; but such is not the majority of instances.

In a shop not a thousand miles from New York, the boiler is in charge of a blacksmith's helper. One day he became very much confused by drinking too strong tea at dinner time. In the course of the afternoon one of the workmen in the shop discovered water flowing from the ash pit, which, upon examination, proved to come from one of the boiler seams. The gauge cocks were tried, and no water could be found. The result was that the fire had to be drawn, and the boiler makers had a job for a week in repairing the overheated boiler; the shop standing idle in the meantime. When all was ready to start the same man was again put in charge, with the injunction that he would be discharged at once if he ever became intoxicated again. The employer says John is a good fellow when he is sober, and he never got into difficulty before; when the real truth is John fills the place of engineer and runs an 80 H.-P. engine at $1.50 per day. If a good, practical engineer was hired, he would have to be paid $2.50 to $3 per day.

A short time ago a firm advertised for an engineer, and among the other applicants for the situation a strictly first-class engineer answered the advertisement.

He was kept nearly three hours waiting in the office before he could see the employer, who did not seem to be uncommonly busy.

Just as the latter was ready to go home, he asked the engineer if he could run a lathe. The answer being in the affirmative, he was told that an engineer to fill the position in their concern "would be required to wheel his own coal and ashes, do his own firing and make his own repairs, not only upon the engine, but about the place at night and on Sundays, for which no extra time would be allowed." Besides this he was to run a lathe near the engine-room door. To do all this would require the engineer to get to the place at 5.30 in the morning, and leave at 7 in the evening.

For all this service the sum of $10 per week was to be paid. If under these circumstances the engineer, being overcome by fatigue, had fallen asleep and an explosion had been the result, would he have been to blame? He would have had to shoulder all the blame.

A vender of patent damper regulators stepped into a factory not long since and solicited an order. The proprietor observed that it was no use to go into any expense in that direction, for, said he, "I recently bought a set of oil cups for my shafting, so that it would require little or no attention, except refilling the cups every two or three months. One day, upon inquiry, the engineer told me they had been taken off because they would not work, so I think that anything of a scientific nature is of small use, and the money expended for such things is worse than thrown away. The fact is, the fellow did not understand those cups, and his head was so thick that I could not beat it into him." This is the office side of the circumstance. Let us take a look at the engineer, who is paid the enormous salary of $9 a week, and is on the verge of quitting, because the manufacturer across the way has offered him $10 a week, and will have all his coal wheeled to the fire room. We find that he is expected to make himself generally useful about the place, and it is regarded as the least important of his duties to run the engine. It is the exception, when a competent engineer can be procured at such miserly pay. A mechanic in the shop has nothing to divert his mind from his work, and when his eight or ten hours work is done he goes home, while the engineer has a stuffing-box to pack, a joint to make in some pipe, flues to sweep, shafting to put up, and on Sunday has to clean out the boiler, besides doing other work which must be attended to while there is no steam in the boiler. The only remedy for such practices is proper legislation and a strict enforcement of the laws. It has come to such a pass at the present day, that if a majority of the jury in trying persons censured for boiler explosions either own or are interested in using steam boilers, the whole case is quietly dropped by unanimous consent (so said.) On the other hand, owners of boilers are often censured for the carelessness or ignorance of their engineer, who they hire to take care of their engine and boiler, and are required to suffer loss of money and reputation thereby. So long as gross corruption among those who are selected to administer the law is condoned by the public, so long we shall have boiler explosions in abundance, and other lamentable accidents attending the use of steam.—*Am. Machinist.*

ELECTRICITY IN STEAM BOILERS.

A correspondent of the *American Machinist* says, experiments made a few years ago by some of our scientific men on the question of electricity in steam boilers clearly demonstrated that a steam boiler not only generates steam, but also electricity, the quantity of which is governed by the purity of the feed water. The discovery was made accidentally. The safety-valve of a steam boiler was blowing off, and the fireman, attempting to press the lever down with one hand while the other was in the escaping steam, felt as his hand approached the lever a strong shock and saw a spark. Mr. Armstrong having been informed of the fact made some experiments on different kinds of boilers, and found that escaping steam was charged with positive and the boiler with negative electricity, and that the generation of the spark was due to the friction of the globules of steam striking against any obstructions. He also further found, with the assistance of Faraday, that steam of water containing some fatty matters, as acid, showed no trace of electricity. Now, according to the experiments of a Belgian engineer on the same subject, it is found that steam of water, as commonly used in boilers, will generate an electrical spark when discharged against a red-hot or even dark-warm iron rod. The theory of the friction of the globules of steam applys well to the bursting of steam pipes, whose cold surface the steam strikes on entering the pipes, which, if charged with electricity, will generate the spark to ignite the explosive gases the pipes may contain or that has preceded the steam from the boiler. It is strange that a boiler which is in good condition, having but fifty pounds steam pressure, the water height all right, and everything in good working order, the damper closed for the dinner hour, upon starting up should all at once explode. There must be some unmeasured agent to ignite this gas, as the steam pressure could never cause such disaster. Some explosive gas is the agent, but the electrical spark is the generator.

Engineering, Civil & Mechanical.

STATIONARY BEAM ENGINE.

One of the engines driving the machinery at the American Institute Fair was a fine beam engine, the exhibit of Thomas F. Rowland, of the Continental Works, Greenpoint, Brooklyn, N.Y. It is an automatic cut-off beam engine, having a diameter of cylinder of 15 inches and a length of stroke of 30 inches. At 85 revolutions per minute, 80 pounds initial pressure, and cut-off at one-quarter, it is rated at 90 horse power. The diameter of the fly and pulley wheel is 8 feet, and it has a 30-inch face. It weighs 11,300 pounds.

The engine is very strongly built, the cylinder, column, and main pillow block resting on a heavy bed plate. The beam is of wrought iron, neatly ornamented. The cross-head, fitted with brass gibs, is carried in cast iron slides. The crank shaft is of the best hammered iron; the piston rod, wrist pin, beam centers, crank pin, and all wearing journals are of steel. The valve levers, and bell cranks, and smaller parts of the cut-off gear are steel castings nicely finished.

The valve gear combines all of the advantages of an automatic cut-off gear generally, with the particular merits of the well-known Corliss, and of other forms of valve gear of the disengaging type, with several points of special merit.

In this form of valve gear there are but two steam chests, from which the steam is admitted to and exhausted from the cylinder by means of a circular valve. The cut-off valve, also of the circular class, is located on the back of the main valve, and is operated through the hollow valve stem of the latter. The main valves are worked by bell cranks which receive a positive motion from a single eccentric. The cut-off valves are operated by levers which move simultaneously with the main valve cranks during the forward stroke through the intervention of a pawl which engages with a projection on the cut-off lever. This pawl is tripped, as in the Corliss gear, by means of a cam at a point of the stroke which is determined by the governor; the cut-off valve is at once closed by means of a spring attached to the main valve crank and acting upon the cut-off lever; a small air dash pot carried by the main valve crank serves to cushion the cut-off gear and prevents all undue jar. A fixed buffer stop arrests the motion of the cut-off lever as it travels with the main valve crank during the return stroke, and insures the proper opening of the cut-off valve and the re-engagement of its lever with the pawl at a definite point just previous to the beginning of the new stroke.

The power required to effect the cut-off is quite small, since the cut-off valve is balanced during the operation. The range of the cut-off is very liberal, and comes well within any demands that may be made upon it by variations in the load.

The entire valve gear is exceedingly simple and compact, and presents nothing that would make it liable to disorder. Engines with this form of cut-off have now been in continuous actual operation upward of two years. This valve gear is known as the Twiss Patent.

THE BURSTING OF SAW.

When the shaft of the Cunard steamship *Catalonia* recently borke, and the vessel was obliged to return to New York for repairs, the captain was interviewed, and asked to give an explanation of the cause of the accident. He could, says the *Northwestern Lumberman*, give no reason tor it. Mr. Roach, the superintendent of the iron works where the shaft was made, was also interviewed, and the conversation led to a general discussion of the lasting qualities of iron. Mr. Roach said that iron had its time of usefulness just as men and horses have. That time completed, the iron must be born again, as it were.

Railroad men understand this law, and know how much weight their freight cars will carry, and estimate how many miles they will run before the wheels and axles will give out. When the shafts run out their natural lives, they are thrown aside, though there may be no visible defect in them.

Iron has a way of crystalizing in the process of time, and often when a piece of it breaks, one can find no flaw in the material—no apparent reason for its giving away. It has been held by engineers and scientists that a constant vibration of iron disintegrates it, the infirmity becoming pervasive throughout the mass of metal. For this reason iron bridges have been supposed to have a limit of endurance and safety, and it has been predicted that the time will come when the Niagara suspension bridge, by reason of the constant vibration caused by passing trains, will outlast its cohesive integrity, and suddenly go down, probably while a weight of valuable life is passing over it.

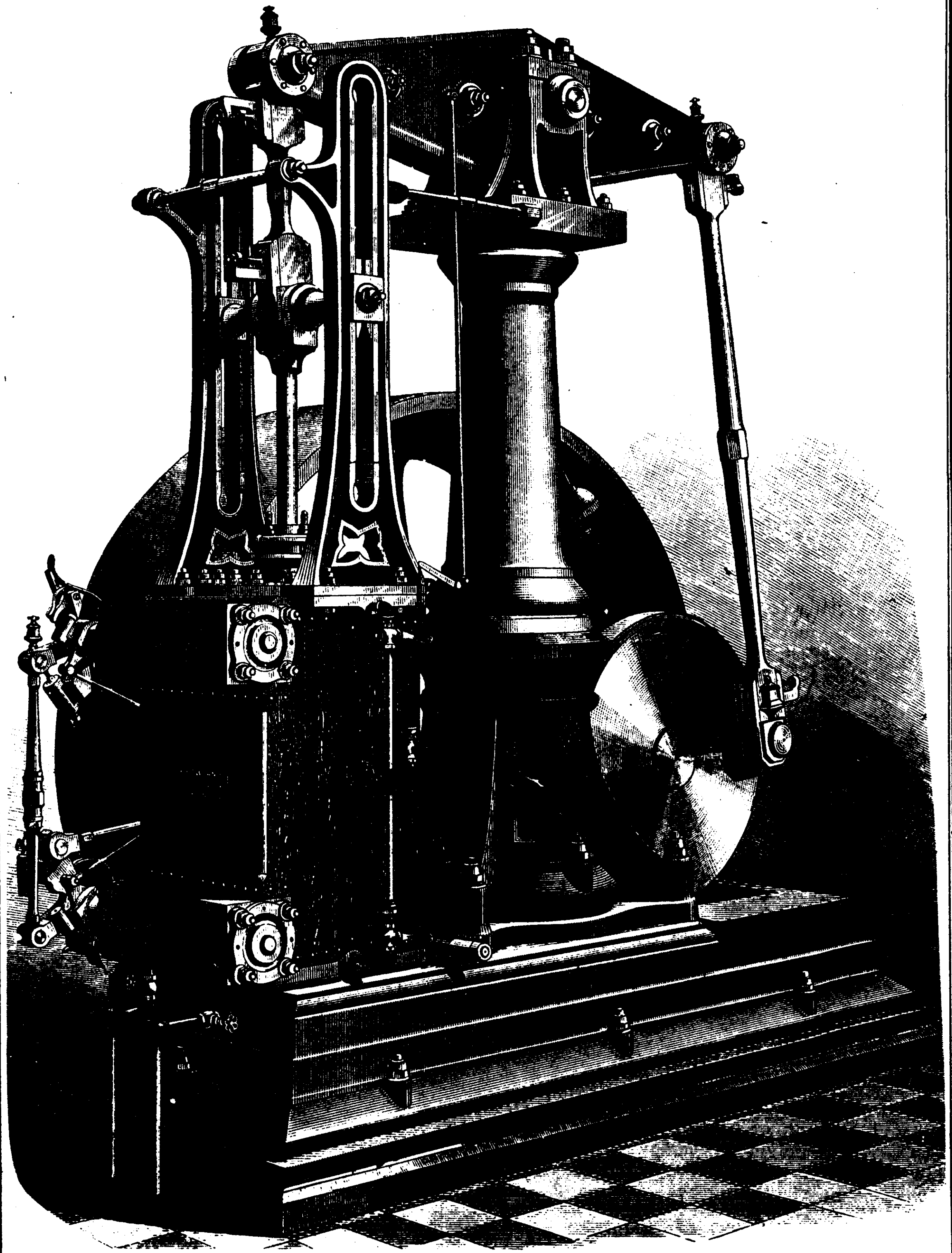
This mortality in iron and steel, under vibratory influence, may account for the bursting of circular saws, which often causes sad havoc of life and limb in mills. The intense vibration of the dizzy steel, by reason of its long use, at last brings the inevitable weakness, and it suddenly flies in pieces. If sawyers could arrive at some definite knowledge as to the life of a circular saw, as the railroad men do as to the endurance of axles and wheels, many serious accidents might be avoided.

THE EAST RIVER BRIDGE.

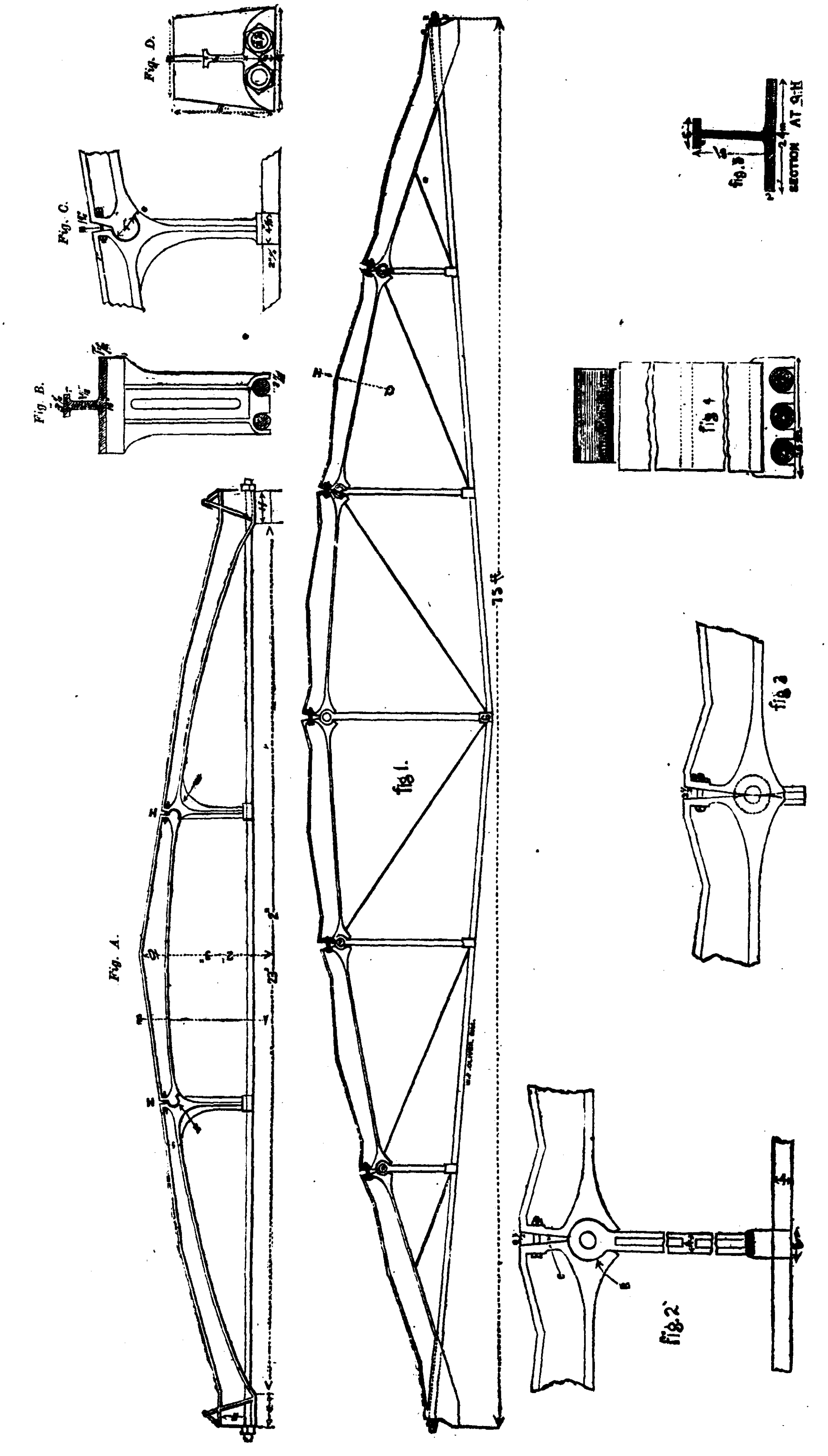
When the contract was made for the steel work of the East River Bridge the amount named was 5,000 tons, which by mutual consent was agreed to cover 5,500 tons. This has been taken as the maximum weight of this portion of the superstructure. Naturally, therefore, there was not a little surprise when it was announced recently by the engineers that 1,200 tons more would be required, increasing the weight of steel in the superstructure to 6,700 tons. The principal reason given for this increase of weight is the need of strengthening the bridge to enable it to carry heavier loads than were contemplated at first. According to a statement by Assistant Engineer Martin, who has had charge of the practical work of construction from the first, the growth of the cities to be connected and the preparation of the elevated roads to carry freight trains have made it probable that direct railway connection will be made between the Long Island roads and the roads entering New York from the East, the North, and the West. At any rate, in anticipation of such traffic, the bridge plans have been modified to enable regular passenger and freight cars to run over the bridge, and the weight had to be correspondingly increased. As reported by the *Evening Post*, Mr. Martin said, in pointing out the chief instances in which increased weight had been made necessary to get increased strength:

"The bridge will consist on each side of four massive steel beams, one on top of the other, into which are bolted the transverse beams upon which are laid the floor girders of the bridge itself. When it was decided to increase the strength of the bridge, the method adopted was to run what are called "over-floor-stays" wire cables which run down from the top of each tower at an angle of about 45°, and are fastened to the longitudinal steel beams which form the sides of the bridge. It follows that, when weight is put upon the bridge at the point where the overflow stays are fastened to the bridge, the strain falls upon the stays instead of the main cables and tends to press the bridge against the tower. In order that the bridge may resist this "back pressure" the steel girders between the tower and the point where the overflow stays reach the bridge have had to be stiffened and increased in size. This is is the chief item of increase, and will reduce the weight upon the cables by about one-fifth. In the next place the pullman cars are nearly three feet higher than the cars originally intended for bridge traffic, and that fact necessitated increasing the height of the 2,800 upright posts which divide off the steam tracks from the passenger and carriage roads. Thirdly, it may be assumed that all the castings used in the bridge are between two and three per cent. heavier than the contract calls for, because the contractor prefers that to running the risk of having them rejected, as they are of no value except for bridge purposes. "There are other considerations," said Mr. Martin, "which have caused the engineers to alter different parts of the steel work in the bridge, but they would not be understood without long and technical explanations. I repeat that the 1,200 tons extra weight of steel have materially increased the strength of the bridge instead of weakening it, as the public seems to suppose."

To remove bolts that have rusted in without breaking them, the most effectual remedy that is known to the *Boston Journal of Commerce* is the liberal application of petroleum. "Care must be taken that the petroleum shall reach the rusted parts, and some time must be allowed to give it a chance to penetrate beneath and soften the layer of rust before the attempt to remove the bolt is made." Bolts and studs on which the nuts are fixed with rust are broken off through impatience. In most cases a small funnel built round a stud or bolt end on the nut with a little clay, and partly filled with any of the searching petroleum oils, and left for a few hours, will enable the bolt or nut to be moved.



NEW BEAM ENGINE BUILT AT THE CONTINENTAL WORKS, GREENPOINT, BROOKLYN, N. Y.



DETAILS OF NEW FORM OF IRON GIRDER.

A NEW FORM OF GIRDER.

EXPERIMENTS AT THE ROLLING MILLS WITH JACKSON'S CAST-IRON GIRDER.

Some interesting experiments were conducted the other day at the Pacific Rolling Mills, with a new form of cast-iron girder, the invention of P. H. Jackson, late Chief of the Bureau of Iron Construction, Department of Buildings, in New York. The experiment was really one on a mode of using cast-iron when subject to transverse strain, by which its whole cross section is compressively employed without taxing its comparatively feeble resistance. Before describing the girder, it may be well to bring forward for consideration some points on girders generally.

Cast iron possesses the enormous compressive resistance of 93,000 lbs. to the square inch, while its tensile strength is but from 14,000 to 15,000 lbs. The ratio computed by Mr. Hodgkinson is about 6½ to 1.

The object attained in this construction is a perfect girder. When employed the bottom or tie rod is tention, and the arch is in compression in every part with no tensile strain whatever; the latter an object not before attained. The antagonistic force of compression to resist the tensile strain of the tie rod is exerted at the bottom or intrados of the arch, and this force is increased in the ratio of the increment of the load on the arch. The remaining part of the arch above the bottom is naturally compression due to the load. A summary of the peculiarity of this arch is as follows:

It is in effect a device for employing cast iron compressively, neutralizing the tensile strain due to transverse strain. The tensile strain on the tie rods is reciprocally utilized in compressive resistance at the intrados of the arch, thus destroying tensile strain in every part of its cross section. Another advantage in construction of a metallic girder made in sections of its lengths is, that should the tensile strain at the intrados of the arch, exceed that of compression by the action of the tie rods, the deflection of the arch is limited to the length of a bay only. For instance, in a girder 150 ft. in length, made in 10 bays, each 15 ft. long, the deflection that would injure the strength of the material of the arch is limited to the length of a bay of 15 ft., instead, as in other constructions, its weakness, by deflection, would extend over its whole length.

The neutral axis of this girder exists between the tie rod and the bottom or intrados of the arch, or midway between the antagonistic forces. With the segmental arch in one piece and the tie rod to resist the neutral axis, is near the bottom of the arch, and travels upward as the load is increased; as the neutral axis will exist wherever the two opposite forces cease to exist, being indifferent to either force. The economy in the use of this neglected material, cast iron, for long spans when subject to cross strain, is in the employment by which its tensile strength is not called into play; also another grave objection is by an unequal distribution of the metal, causing weakness in the casting when forming from the molten to the solid state, and from that condition until cold. The heavy parts in contraction, control the thin or weaker parts, or if the formation of the mold is such that the ends of a long casting set deep in it and offer a resistance to the contraction of the metal when forming from a liquid to a solid state, both of these adherent weaknesses continue and increase until cold. The weaknessss are entirely due to separation or taxing its comparatively feeble tentile strength, and not in the least injuring it in its compressive resistance, as cast iron is never in a contracted state other than cold; and as long as cast iron is used compressively, it makes no difference how many pieces it may be in of its length, providing its abutting parts squarely or equally meet and are kept in line. Take, for instance, the area of the abutting parts of the 25 ft. girder shown in the engraving or the cross section of the bottom flange in the center of a bay, which is 16 inches wide by 1⅛ inches thick, which equals 18 inches.

Eighteen inches multiplied by 93,000 lbs. to the inch equals 1,674,000 lbs., or 746 tons; taking it at one-fourth when employed, we have the resistance of 186 tons as a safe employed load. The area of the tie rods to resist this compression at 8 tons working strain per inch, providing the arch has suitable rise, would be 23¼ inches, or more than 3 of 3 inches diameter rods. Tie rods are cheap—merely bars of wrought iron with threads and nuts. When a railroad train enters on a bridge borne by these girders, the opposite end to the train is prevented from raising by the abutting parts on the bottom of the arch compressively exerted. There is no part of the arch in which tensile strength is employed.

The object of this device was to construct a perfect girder, the whole arch resisting compression, the tensile strain necessarily exerted by the ties, and using this essential resistance to render indifferent a most destructive force to cast iron, viz.: The tensile strain due to cross strain, showing an economy in this mutual antagonism, an equilibrium and forces negatived.

The inventor has endeavored to make a continuous arch embodying the principle of the Voussoir arch. Mr. Jackson's is a sectional, continuous arch employed compressively over its entire cross section.

A Voussoir arch is composed of many blocks to make up its length, and without the use of cement or mortar between the blocks. With the exception of friction of the blocks as they slide downward, taking a more compressed position as the load upon them is increased or the abutments yield, there is no tensile strain whatever, upon them, and the calculation has only to be made as to the strength of the material in its compressive resistance. With a continuous segmental arch, made in one piece of its length, there is, at every point, a bending moment and a thrust force; therefore, a continuous arch brings into play both compression and extension as that of a straight girder, but with more of compression than extension. See page 9 of W. Airy's book on iron arches.

With an iron arch in one piece of its length, the wrought iron tie rods elongate in the ratio of 1-1000 of its length to every 10 tons tensile strain per square inch of cross section, and this elongation is considered the measure of the elastic force of the metal.

At this strain the elongation would be for a 25 ft. girder same as shown in the drawings, 3-10 of an inch. 25 ft. equals 300-1000 inches, equals 3-10 of an inch. At this elongation of the rods, be the material of the arch either of cast or wrought iron, the arch loaded will have so far straightened as to cause great tensile strain at the bottom, giving free play to the tensile strain caused by the load.

By this formation of cast iron into girders for long spans, using it compressively in the manner of employing cast iron columns, having a resistance of 60% in excess of wrought iron, (that is comparing the tensile strength of wrought iron at 25 tons to the inch, and the compressive resistance of cast iron at 41 tons, or the compressive resistance of wrought iron at 18 tons to that of cast iron) 41 tons is equal to 227%. It is so shaped that its defective strength for long spans may be made in as short sections as desired, and the tensile strain on the rods as increased is utilized to destroy the power of the load to rupture the arch. The prime cost of the 25 ft. girder was $150. The girders in common use in this city to sustain 100 tons and 25 ft. long, supported only at the ends are sold at about $350 each.

Fig. A, of the engraving, is an elevation of a girder experimented on. Length, 25 ft.; distance between supports, 23 ft. 2 inches; height, from bottom of tie to under side of arch, 2 ft. 3 inches. The cross section of arch (see Fig B) was 16 inches wide by 1⅓ inches thick at bottom, and the greatest height 10 inches. Two of 2½ inches diameter wrought iron tie rods sustained the tensile strain. Figure C shows the knuckle joint, the round cast on the center piece, and the socket cast on end pieces, and with the strut cast on same piece, this latter resting on the bottom on the tie rods. Fig. D shows end of girder. At the top of the arch will be seen a space of 1¼ inches. Whatever may be the deflection, no parts of the arch, excepting the knuckle joint, touch, so that compression is only exerted on the line of the bottom flange. The cross section of arch (see Fig. B), is of the Hodgkinson form for straight girder and made to sustain a 16-inch brick wall; consequently, from its broad bearing for the wall, it is largely in excess in compressive resistance to the tensile capacity of the rods. The following is the cost of this girder in San Francisco where materials and labor are higher than in the Eastern cities and in Europe:

Weight of arch casting, 3,080 lbs., 3¼c	$100.10
Weight of tie rods and nets, 902 lbs., 4½c	40.59
Fitting 4 bolts and lead	5.50
Drayage and painting	3.00
	$149.19

Had this been made to sustain 186 tons as a safe load, the breaking load, three times greater—the same casting to be used, but to have three of 3-inch diameter rods, it would have cost:

3,080 lbs. casting, as before	$100.10
3 3 inch rods, 1848 lbs., 4¾c	87.78
Other expenses	9.50
	$197.38

Difference .... $48.19.

In the experiment at the Pacific Rolling Mills, the other day, this girder was loaded with 117 tons and 1,741 lbs. of railroad iron, the length between the supports. Under the weight it deflected at the joints a quarter of an inch below the true arc. The foundation on which the girder rested settled seven inches, so that loading had to be stopped. I have no doubt it would have carried 225 tons, or until the rods broke. At each of the abutting ends a lamina of lead was used to fill in between the castings, which were not nicely fitted, as the strength at this place was so much in excess of requirements. This was to make up for the irregular surfaces, the draft of the pattern making it fuller in the middle in each piece. To make up for the closing up part of the lead when the compressive force was exerted, as well as to straighten the tie rods, when loaded, the arch was cambered three-quarters of an inch at the joints above the true arc. The same rule applies to each one of these three sections as that of a continuous arch in one piece of its length; that is, they are subject to a bending moment and a thrust force, and both compression and tension are brought into play, as that of a straight girder, but less of tension than compression, being of arch form, as mentioned in a previous part of this article. But it must be borne in mind that the compressive force exerted on each of these three short arches or sections of the long arch, equivalent to three small girders, each 7 ft. 9 inches long, is equal to the compressive force of the whole length, 23 ft. 3 inches.

While the compressive and tensile force transversely exerted is only due to the load on a length of 7 ft. 9 inches, therefore the compressive force to resist the tie exerted on a single section of 18 ft. 9 inches, consisting of 8 bays, making the entire length of girder 150 ft., is eight times more than it would be if the girder was only 18 ft. 9 inches, so by a proper number of bays suitable to the length, this may be so regulated as may best suit any desired end.

Fig. 1, 2, 3, 4 and 5 are for a railroad bridge which may be made 500 ft. in length, and of a suitable number of bays. It will be seen that the top of strut is round and the ends of arch are socketed to meet the round of the strut. Provision is made to prevent the girder raising by being loaded only on one end with a tendency to raise at the other, as that of a railroad train on the one end. This is effected by the bottom edges of casting pressing together. It will be seen that the ends of arch on outside enclose the strut. Provision against lateral deflection is made for long spans by widening the ends where they abut and enclose the strut. To sustain the bridge floor wrought iron rods, or suspenders, may run inside or on outside of the cast iron strut, or a wall on top and floor beams laid on it.

This construction weighed in all its bearings Mr. Jackson thinks will be found to be much cheaper for equal strength, than any now in use. Girders of long spans for a bridge can be made as it were in a day, and taken to the place of destination and readily put together. By this mode of construction Mr. Jackson is convinced he has found a means to apply for the world's use the heretofore universally condemned cast iron, when used for long spans and subject to cross strain, as well as overcoming the inherent fault caused by the unequal distribution of the metal causing weakness if not positive rupture unobservable, made to exist by contraction of the metal in cooling. The 25 ft. girder is in front of premises, 231 First street, where it can be examined. Mr. Jackson respectfully invites discussion of the engineering world respecting the merits of the device described. —*Mining and Scientific Press.*

SECOND-HAND BOILERS.

F. B. ALLEN.

It will, of course, be conceded that occasionally great bargains may be obtained in buying second-hand material. Such cases sometimes occur through the bankruptcy of large manufacturing companies, or from other business causes. In cases of this kind it is easy to find out who furnished the plant, the length of time it has been in service, and the manner in which it has been used, with perhaps satisfactory assurances of its present condition. Opportunities of this kind are few and far between.

Ordinarily, he who buys second-hand goods, realizes when it is too late, he has made a bad investment, but consoles himself in the thought of having obtained a valuable experience, in some cases, dearly bought. The purchaser of a second-hand boiler is peculiarly liable to be victimized, and is not only in danger of losing his money—but in most cases runs an additional risk of losing his life.

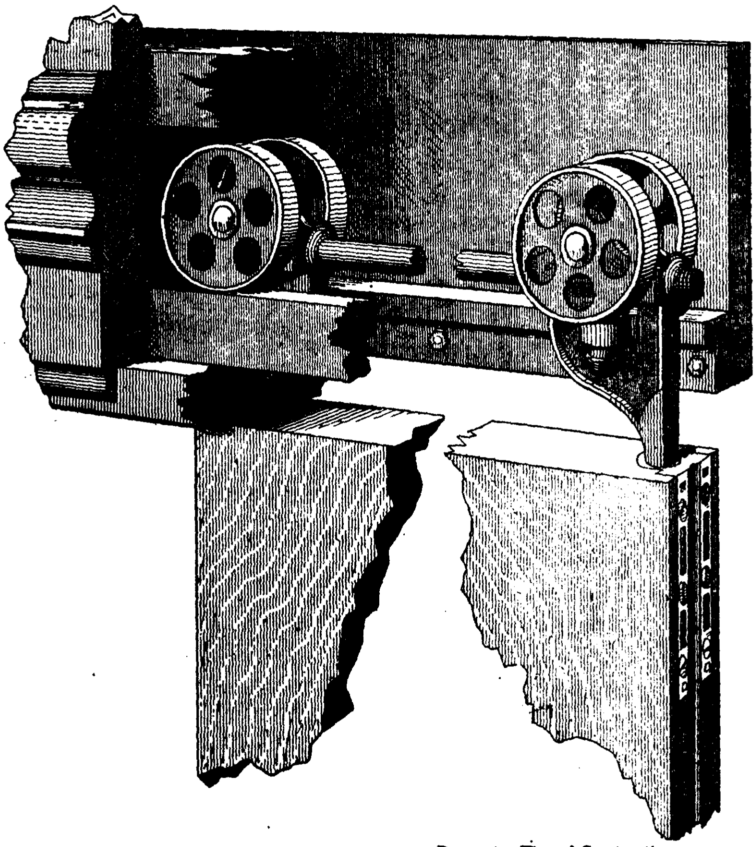
Engaged in the business of buying and selling second-hand machinery, are many honourable men who, understanding their business, are careful to buy only fit and salable articles, and thus they avoid the necessity for misrepresentation in selling again. The dealer is not alone to blame for the gross misrepresentations sometimes made. The average buyer of second-hand machinery is not content to buy the article for what it really is, and his evident desire to be humbugged stimulates unscrupulous men, who in the trade are largely in the majority, to make a shrewd calculation as to the manner of man with whom they are dealing, and cook up a story most likely to serve their purpose. Many tricks are resorted to by the latter class of dealers to sell their second-hand boilers. It is doubtful if they ever handled anything that had been used over a year, and was not built by days' work, if we may believe their story. One of these worthies sold from his stock for several years, each customer being assured that particular boiler was one of a number made by him for a large and well-known manufacturing company in a distant part of the State, who when the boilers were nearly finished changed their plans, had him build larger boilers, and retain those first ordered. Tubular, fine, upright and locomotive boilers were alike sold from that order, and for aught I know to the contrary, he may be filling orders yet from the same mythical stock.

One of our assured who had just bought a new boiler under some such representation, notified us to make an inspection before he began using it. In the report of inspection after describing the location of certain defects there was a further recommendation from the inspector as to the bestmeans to be employed in cleaning the boiler of scale. Our friend did not understand how a new boiler could have so many defects, and his astonishment and indignation were further increased when he read that part of the report concerning the removal of scale. He returned the report to our office with what was meant to be some very caustic comments, ironically suggesting that he must have, by some mistake, received somebody else's report. It could not refer to his boiler, for it had never been used before. He was sure of that. It had to be finished after he bought it.

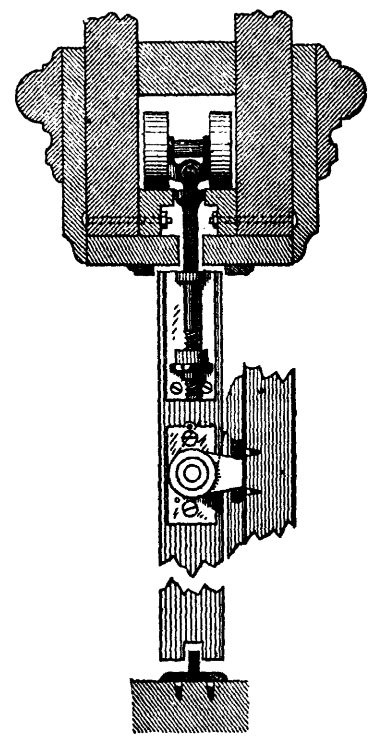
On investigation it transpired the alleged new boiler had not only been used for a number of years, but it had been grossly abused by firing up on it without any water, and burned so badly it was thought unprofitable to repair it by the boiler-maker, who sold a new boiler in its stead. The burned boiler next passed into the hands of a second-hand dealer for about the price of old iron. He had it repaired, shortening it up by cutting off the worst ring of plates. In setting it up again in the brick work, it was though advisable to turn the boiler end for end. This, of course, left new holes to be drilled and tapped in the boiler head for gauge cocks, water gauge, etc. This was the proof relied upon by our friend to convince us, as it did him, that the boiler was a new and unfinished one at the time he purchased it. He now realizes the truth of the old adage which teaches "appearances are sometimes deceptive," and feels it has a special application to that class of boilers.

In second hand boilers the accumulation of sediment and scale on some inaccessible part during a period of years, greatly reduces the value of its heating surface. Therefore such boilers are necessarily more expensive in fuel than new ones. In some localities where fuel is abundant and cheap, the matter of economy is of little importance. As a rule, boilers are only removed for some sufficient cause affecting the safety or economy, and they will be found on examination, when this is the case, fatally defective in some important particular. It may not be an easy job to make a careful examination of a boiler after it has been scraped and heavily painted. The most careful, painstaking examination under such circumstances, may be very unsatisfactory in failing to detect incipient fractures in the sheets, the first external evidences of crystallization. The paint pot imparts a freshness and bloom of youth to the jaded boiler of twenty years' service, that is well calculated to stagger one's belief in "wear and tear," and doubt if there is any such thing as "fatigue in metals."

The poorest (?) specimens of second-hand boilers in this market are bought up and shipped to Mexico and Cuba; at least, the buyers report that as their destination. In view of recent disclosures it's not beyond the range of possibilities that the patriots who disburse (if they ever do) the "Irish Skirmishing Fund," may be surreptitiously buying these deadly instruments for shipment to England, Canada or Australia. The attention of the proper authorities is most respectfully called to this view of the case as entirely worthy their consideration.—*The St. Louis Miller.*

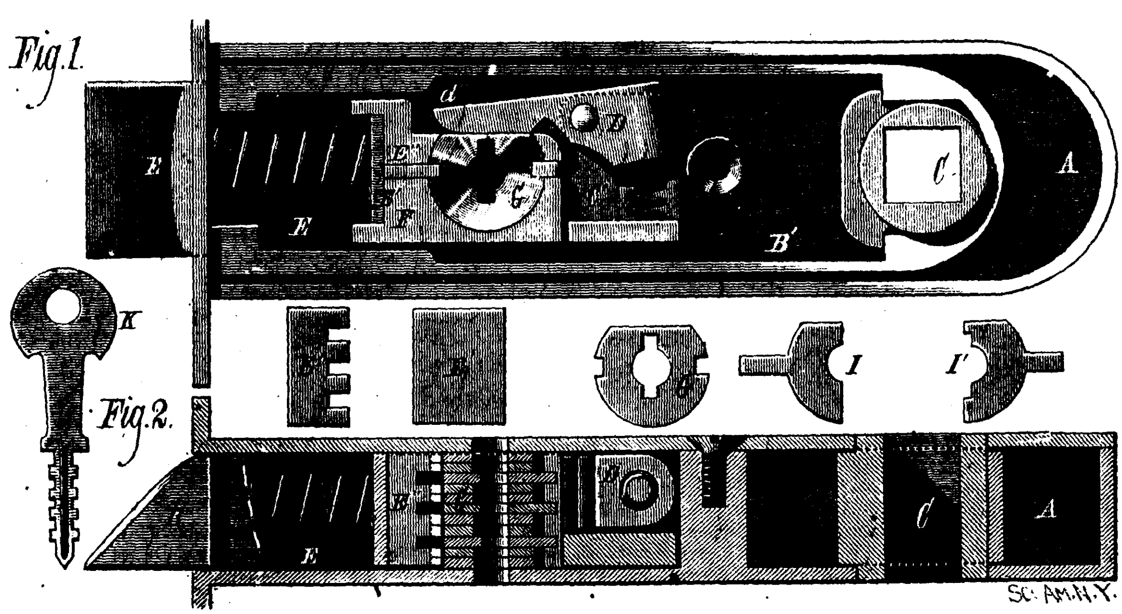


Perspective View of Construction.

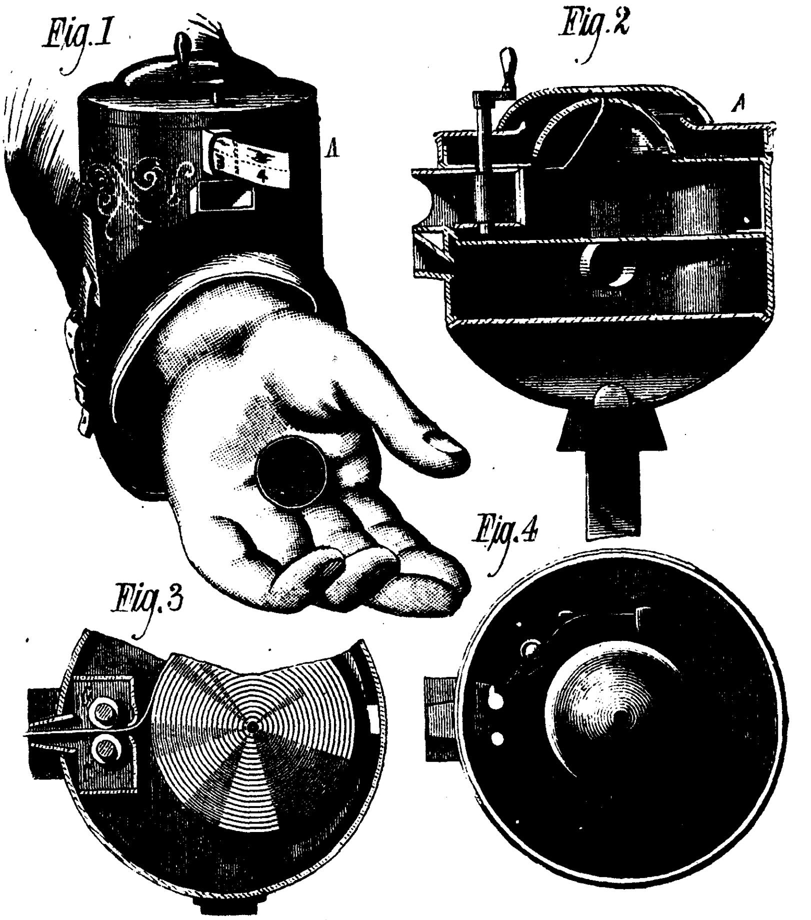


Adjustable Door Hanger.

WARNER'S ADJUSTABLE DOOR HANGER.



KIMBALL'S LOCK AND REVERSIBLE LATCH.



LOCKE'S TICKET REEL AND RECEPTACLE.

NOVEL TICKET REEL AND RECEPTACLE.

The engraving shows a machine for tallying, recording, or indicating the number of fares collected upon cars or other public passenger vehicles. It is of the class employing, in connection with a locked box or receptacle carried by the conductor or collector, duplicate, double, or sectional tickets, one portion or section of which is given to the passengers when the fare is collected, while the other section or duplicate is deposited in the box, so that as the conductor is compelled to deposit a ticket or check in the locked box as each fare is collected, a tally or record is made of the amount to be accounted for, and fraud and cheating is prevented.

Fig. 1 shows the apparatus as fitted and secured to the conductor's arm in a convenient position for its operation and for the deposit of the tickets or checks by the hand of the opposite arm; Fig. 2 is a vertical section; Fig. 3 is a horizontal section showing the roll of tickets, and Fig. 4 is a top view with the cover removed showing the alarm bell.

The casing, A, is of the shape shown, having a curved bottom, *a*, to fit the arm. Near the top of the casing is a transverse partition plate, A_1, which separates the casing into two compartments, the upper and smaller one, B, being for the reception of the alarm bell and its striking mechanism, while the lower compartment, B_1, is for the checks or sections of the tickets, which are to be deposited in the receptacle, one for each fare as collected. The curved bottom, *a*, of the ticket or check receptacle is hinged at one side of the body of the casing.

The alarm bell is fastened in the center of its compartment, B, to the partition plate, A_1, and is covered and protected from external blows by the cover of the casing, which fits upon the upper end of the cylindrical body. The striking mechanism consists of a hammer acted upon by a spring and tripped by a crank or handle outside of the case. Secured to or forming part of the shaft of the crank or handle inside a small compartment, there is a roller, C, which, in conjunction with another roller, C, constitutes feed rollers for the tickets. These tickets are formed in strips, or are in what is commonly known as "ribbon form," and wound into a compact roll, as shown in Fig. 3, the roll being then placed in the apparatus, just back of the feeding rolls, upon a removable partition plate, A, in the ticket compartment. Each ticket is joined to the contiguous one by a readily separable connection, the tickets being formed, for example, in a long strip, and separated partially by a series of transverse perforations. Each ticket is a double or two-part ticket readily separable.

The operation of the apparatus is as follows:

It having been fitted to one arm of the conductor and secured by a strap, and the tickets having been placed in the machine with the first one between the feed rolls, upon receiving a fare the conductor turns the crank to the extent of one revolution, which projects a ticket from the delivery spout and rings the bell. The ticket is then separated from the strip. The section or portion with the number upon it is then deposited by the conductor in the locked receptacle, and the other section handed to the passenger, to be retained as evidence of the payment of the fare. At the end of the trip the apparatus is handed to the proper person, who inspects the tickets that remain unfed from the apparatus, and also counts the checks deposited in the box. If the number of tickets fed from the machine does not correspond with the number of checks in the box the dereliction in duty of the conductor is made apparent, and dishonesty exposed; while if the checks and tickets disposed of correspond, the amount to be accounted for is ascertained. This invention was recently patented by Mr. C. S. Locke, of Chicago, Ill.—*Scientific American.*

Mechanics.

WARNER'S ADJUSTABLE DOOR HANGER.

Illustrations of a new adjustable door hanger, now being introduced by Messrs. E. C. Stearns & Co., of Syracuse, N. Y., are shown over. A general view of the hanger is presented in Fig. 2. Fig. 3 shows one of the hangers fitted with an astragal plate for the front edge of the door; Fig. 1 is a vertical section taken near the back of the door, showing the back hanger as fitted and the construction employed for the track. The front and back hangers are connected by a rod shown in broken Fig. 2, thus making the running gear substantial and adequate for the work it is to perform. The hangers are made of wrought and malleable iron, and, in a measure, overcome all the objections hitherto pertaining to the running of sliding doors. An important feature is the adjustability. The doors may be raised or lowered by means of the ratchet nuts on the rods of the hangers. One of these is clearly shown in Fig. 1, while that used on the front of the door is indicated in Fig. 3. By this means the door may be raised so as to clear the carpet, or to overcome any sagging or settling of the building after construction. A double track is employed, and by means of a universal joint in connecting the hanger, the carriage is made to conform at all times to the track, causing an equal bearing on both rails. The tracks are made of hard wood, bolted in position as shown in the engravings. The bearings of the hangers being finished and lined with anti-friction metal, are noiseless and require no oiling. No track is required upon the floor, and carpets may be extended through the opening. Short guides are placed in the pockets into which the door slides. A section of one of these is shown in Fig. 1. A special feature of this apparatus is the gravity stop used upon the back edge of the door, and shown below the hanger in Fig. 1. The object of this device is to prevent the doors running too far into the opening. By inserting a knife blade between the jamb and the door the stop may be raised, allowing the door to be drawn into the opening for the purpose of adjusting or removing. A rubber bumper is provided for the stop to strike against and is indicated by the dark shaded portion under the stop in Fig. 1. The dotted lines show how the stop may be raised by the knife-blade, as mentioned. In framing for the reception of these hangers, the general plan followed is indicated in Figs. 1 and 2. A header, as shown, is inserted between the beams, in order to keep the studding from spreading or contracting, and to maintain a uniform space between the tracks to prevent binding, the small friction roll clearly shown in Figs. 1 and 3. A pocket is provided in framing the track, into which the hangers are inserted when being attached to the door. A special casting accompanies the hangers for use in the construction of this pocket, but which is not shown in the engravings. – *Iron Age.*

COMBINED LOCK AND REVERSIBLE LATCH.

The engraving shows an improved reversible lock of simple and novel construction, adapted to a wide field of combinations and changes. It is small and compact in form, and arranged by a peculiar method of operation to be practicably non-pickable.

Fig. 1 is a plan view with the top plate or cover taken off. Fig. 2 is a plan view, with the tumblers, wards, and the slotted or toothed plates removed. Fig. 3 shows the tumblers and wards.

The case or frame, A, in which the lock mechanism is inclosed, is provided with a removable top or plate. The door bolt, B, serves the twofold purpose of bolt and door latch, its yoke-shaped shank B', extending beyond the hub, C, through which the knob spindle passes, and having its inner walls provided with projecting abutments, with which lugs, formed on the hub, C, engage, operating, when the hub is turned, to reciprocate the door bolt, B, and lock or unlock the door.

A spring-pressed dog bolt, D, is secured by pivot to a block, C', attached to the bottom plate of the case frame, the dog bolt being operated by the rotating tumblers to engage the abutment d'', situated on the forward portion of the yoke shank, and lock the door bolt, each of the rotating tumblers being provided with a cam face, which, when simultaneously presented to the lower face of the dog bolt, will allow it to drop and release its engagement with abutment d'', and unlock the door bolt. A spiral spring presses the toe or point of the dog bolt down upon the tumblers. A spiral spring, interposed between the rear face of the door bolt and a thin bearing plate held between two flanges formed in the forward portion of the socket block F, has the twofold function of throwing the locking bolt forward when it has been withdrawn, and of holding the toothed plate, E''. which is fitted in a vertical slot in the socket block in engagement with the tumblers G.

The tumblers, G, are, in this instance, provided with two peripheral slots at points directly opposite each other, the slots engaging with the spring-pressed toothed plate, E'', and having one or more cam faces with which the toe or point of the dog bolt, D, engages each tumbler being also perforated for the reception of the lock key, K. Between these tumblers, which in this combination are arranged in pairs, a series of twin wards are interposed, which are called the right and left hand wards, according to their position. These wards H' (shown in the detail views) are each provided with an outwardly projecting arm. These tumblers and wards may be easily disposed in a variety of different arrangements and combinations, and arranged to fit several different keys accompanying each lock, each of which is adapted to fit the lock in one of its different combinations. The owner thereof may, therefore, by removing the cover or plate of the lock and redisposing the wards and tumblers to act with the different keys, have in effect several locks; or in the event of losing a key he may change the combination to another key, and obtain a lock which the lost key will not open, without the trouble and expense of buying a new lock or getting a new key made.

The key after being inserted in the key hole, slips easily by the first pair of tumblers, and its further progress is arrested by the projecting left-hand ward. However by exerting a slight pressure the wedge-shaped point of the key will operate to force the ward back by overcoming the tension of the spring, which presses the toothed plate, E'', in engagement with the tumblers and allows the key to pass the next pair of tumblers, the next obstructed ward being forced back in the same manner as the first, and so on through the series, the tension of all of the wards being removed when any one has been moved back. As before described, the laterally projecting arm of the left-hand ward, 1, is received in and extends to the bottom of a slot in the toothed plate, E'', which latter has engagement with the peripheral slots of the tumblers. It will therefore happen that when the ward is forced inwardly by the ribbed key it will overcome the tensional force of the spring and carry the tooth plate back flush and thus release its engagement with the slots in the tumblers which may now be rotated to the right or left, to present the cam faces of the tumblers to the dog bolt, allowing it to fall and release its engagement with the abutment, d''.

This lock was recently patented by Mr. E. A. Kimball, of Champaign, Ill.

THE WORLD'S DEBT TO THE MECHANIC ARTS.

Perhaps the greatest gift for the civilization of man has been the printing press. One whose triumphs are bloodless; one which has enabled the pen to take the place of the sword, and has supplied both the "fulcrum and the lever" whereby one man can "move the world." This has been done by the art of printing.

Could we call up before us the library of an English monastery in the olden times, we should see the monks seated at their desks, their ink, pens, brushes, gold and colors before them; one busily employed in furnishing some richly illuminated initial; another slowly adding letter to letter and word to word in translating or copying the ancient manuscript before him. From day to day, and month to month, would he proceed, slowly and painfully forming those thick, angular, "black-letter" characters; with no rest, save to attend his meals, his prayers, and his scanty sleep; pausing now and then, to erase with his knife some slip of his pen, and happy that no untoward accident has destroyed in a moment the labor of his life. Thus was the toil of years often expended upon a single copy of a book.

Few men, in those days, were capable of reading or writing, except the monks. Even kings and men of the highest rank were often obliged to employ a mark or a seal in giving their signature. Hence the laboriousness of the work, and the few able to engage in it, enhanced the value of these manuscripts to an incredible amount. A single copy of some rare manuscript has been known to be exchanged for a principality, with all its revenues. A few dozen such could not be commanded by the wealth of an emperor. A single copy of the New Testament, which now can be purchased for ten cents, and thousands of which are yearly distributed gratuitously by the Bible Society, constituted the sole library wealth of many a rich abbot, or powerful noble. These were locked up from profane eyes and thievish hands, in iron chests, for their value was too great to leave them exposed.

But a mighty change was to come over this state of things. In the year 1440, in the city of Mentz, three men of obscure origin gave to the world the greatest discovery of modern times. They were Faust, Guttenberg and Shaefer, names no longer to be obscure, but to descend to posterity with the proudest triumphs of human art. They soon separated; Guttenberg went to Strasburg, and Shaefer to Haarlem, each establishing and improving the art in these three cities, and hence the disputes, not yet completely settled, for the honor of being the cradle of this art in its infancy.

Time would fail me to trace the progress of this king of inventions to its present wonderful condition of improvement or power. But think of the change which society has experienced from this single invention, and its kindred one of paper; and let it be remarked that the invention of paper was an indispensable condition to the utility of such an art as printing, and must be taken into important account in the result. Had the monk who toiled in his cell for years to produce a single copy of the Scriptures been told that the time would come when a single hand would multiply a thousand such copies in a single hour, he would have looked upon it as the statement of sheer madness. Had the munificent patron of letters, who gave the revenues of a province for a single copy of a classic, been told that the time would come when the same would be sold for the poor pittance he threw to a beggar, he would have taken it as an insult to his credulity. There are newspapers in our own country which contain as much reading matter as a decimo volume, printed at the rate of 12,000 copies per hour, and whose circulation is over 100,000 a day, whereby, in less than four hours, over 40,000 speaking messengers of power are produced to move the moral sense and intelligence of the community. There are editors in this country who have the means of governing the convictions and directing the thoughts and actions of 500,000 readers every week! No mere military chief or emperor ever wielded such power. The Press alone renders it possible for one mind to move a million. Those thoughts sublime and beautiful, those cogitations profound and prophetic, which genius addresses to the hearts of men, can now reach the minds of millions, where formerly they touched but the favored few.

How soon do we lose the sense of wonder concerning these things by familiarity therewith! A common clock filled the courtiers of Charlemagne with terror; and it is still a wonderful thing, though shorn of its terrors in the hands of a Yankee pedlar; for there is scarcely an agent in the civilized world that governs and directs so many minds, with such implicit obedience, regularity and order.

One of the most wonderful revelations that can be made to a savage, is to show him the transmission of thought by the mute signs of writing. These marvels are now common to the great mass of mankind. But to the thoughtful mind, everything is wonderful, everything is mysterious, everything whispers to his soul the awful presence of an all-pervading intelligence of which man's most ingenious works are but a feeble rendering.

Let us speak, briefly in this connection, of another great mechanical agency in the civilized progress of man—the steam engine.

The discovery of the use of steam as a motive power is nearly two thousand years old, having been pointed out by Hero, of Alexandria, 120 years before Christ. But it seems to have slumbered for 1,700 years before any application for practical purposes had been made. It is now about two centuries since steam was first used to raise water out of a mine in England. The honor of the discovery seems to be in dispute between the Marquis of Worcester, an English nobleman, and Solomon De Cause, an eminent French mathematician who lived in the reign of Louis the XIII. It is pretty certain, however, that we are indebted to a French philosopher named Papin for the idea of transmitting power by means of a piston working in a cylinder, which is the basal principle of the steam engine. It would be interesting to trace the improvements and different applications of this mighty power during the last one hundred years. In 1765, it was reconstructed and vastly improved by Watt, who thus has associated his name with its proudest triumphs. Our own country has the honor of making the first successful experiment in steam navigation, though other imperfect experiments are recorded before. This was made by Fulton on the Hudson River, in 1807. Its first application to the press was in the *Times* office in London, in the year 1814. In 1819, the first ocean steamer crossed from Liverpool to New York in 26 days, a voyage now accomplished in less than one-third the time. In 1830 the first railroad was opened at Liverpool, and the wonders of the locomotive began to be realized.

It is indeed a wonderful thing, whether viewed by the eye of science or ignorance. Here is the very genius of physical power put into harness and made subservient to a little child. The tremendous energy, moral as well as physical, which this agent has thrown into society is incalculable. Every element therein partakes of its powerful stimulus. No one who has the least spark of imagination can stand in its presence without feeling his heart swell and his mind expand with the contemplation of its power, and with an increased reverence for the God-given faculties which gave it existence. In every form of its varied applications, whether driving the huge vessel through the ocean wave or turning the little spindle that draws the attenuated thread, the steam engine is equally a miracle of strength and of art. To quote from a description thereof, from the pen of Dr. Arnot;—

"The steam engine, in its present improved state, appears to be a thing almost endowed with intelligence. It regulates, with perfect accuracy and uniformity, the number of its strokes in a given time, and, moreover, counts or records them, to tell how much work it has done, as a clock records the beat of its pendulum. It regulates the supply of water to the boiler, the briskness of the fire, and the quantity of steam admitted to work; opens and shuts its valves with absolute precision; oils the joints; takes out any air which may accidentally enter into the parts where a perfect vacuum is required; and when anything goes wrong which it cannot of itself rectify, it warns its attendants by ringing a bell. Yet with all these talents and qualities, and even when possessing the power of 600 horses, it is obedient to the hand of a child. Its aliment is coal, wood, charcoal, or other combustibles; but it consumes none while idle. It never tires, and wants no sleep; it is not subject to any malady when originally well made, and only refuses to work when worn out with age. It is equally active in all climates, and will do work of any kind. It is a water pumper, a miner, a sailor, a cotton spinner, a weaver, a blacksmith, a miller; and a small engine, in the character of a steam pony, may be seen dragging after it, on a railroad, a hundred tons of merchandise, or a regiment of soldiers, with greater speed than that of the fleetest horse. It is the king of machines, and a permanent realization of the *genii* of eastern fable, whose supernatural powers were occasionally at the command of man."

What wonder then, I say, that this agent should be working great changes in our world. Even war shakes his gory locks and smiles grimly at this new ally. Armies can be sent across a continent so swiftly that their approach can be heralded only by the telegraph. Thus, in one of the late revolutions in France, 500,000 soldiers were concentrated in Paris in one day.

But, better than all, this giant of force has bowed his neck to the yoke of industry. Commerce and the arts have felt the impulse of his strong hand. The very elements are conquered by its mighty agency; the winds and the tides may oppose, but still the vessel ploughs through the waves as if instinct with life and power. This giant thrusts his arms into the bowels of the earth and throws up its treasures by thousands of tons, emptying all her dark caves of wealth; then, leaping on the surface, he blows with his hot breath upon the weighty metal and melts it into a liquid; then lifts up his strong arm and beats it into massive bars, or drawing it through his crushing fingers makes it thinner than the spider's web. He turns with equal facility from the most stupendous to the minutest requirement of his master, man. He lifts rivers upon mountain tops, and stamps the wreath of flowers upon the flimsy cotton. Wherever opposition and difficulty spring forth to defy man, here comes this "Giant Briareus" with his "hundred arms" to sweep them from his path.

Nor must we omit, in this connection, the wonderful application of steam to the fire-engine. It has revolutionized the fire department in all our large cities, and has introduced order and decency, as well as efficiency in the conduct of its members. Before the introduction of the fire-engine, the fire organizations of most of our cities were often disgraced by conduct that many of them, a scandal and an offence, tolerated only on account of the felt necessity of having their services. The engine company's quarters were the ruin of many of our youth, and the frequent fights among the companies were the terror of the peaceable citizen.

Thus the steam engine is equally inestimable as an agent of moral reform, as well as a mighty instrument for the saving of property.—*Industrial News.*

WORKSHOP SKETCHING.

BY JOSHUA ROSE, M.E.

I.

It is not necessary to be an expert at free-hand drawing or to be a mechanical draftsman in order to be able to convey by sketches all the information necessary to enable a workman to make a piece of work from a sketch.

Upon free-hand sketching as an art, as well as upon mechanical drawing, there are numerous and well-written books. But nearly all—indeed all with which I am acquainted—require a teacher to explain them; whereas, in my humble opinion, "a book should be its own teacher."

Furthermore, it is not my purpose to give any instructions upon an expert or scientific basis; all I shall aim at will be to assist such as may desire, and as may require it, in making sketches and simple drawings that will be intelligible to any workman. I hope to give sufficient information to enable those who may so desire, to further pursue the subject in the works of more competent authors upon the subject of mechanical or perspective mechanical drawing.

The most useful thing that I have found for general workshop sketches that do not require to be preserved is a piece of board planed on one face with a hole in the top by means of which it can be hung up. The planed surface should be chalked, and the chalk well rubbed down, so that the pencil lines will show plainly and can easily be rubbed off when necessary.

Now take as an example a simple key for a wheel, and it may be presented in two ways. In the first (Fig. 1), two views are necessary, thus:

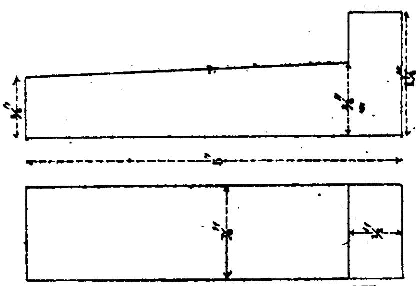


FIG. 1.—SKETCHES OF A KEY FOR A WHEEL.

It is unnecessary, so far as imparting the required information is concerned, to let the sketch be drawn to scale, although it is better to endeavor to do so, as near as the eye can judge, because this educates the eye and leads to more rigid proficiency. In marking the dimension figures, the aim should be to mark them all standing the same way, so that the reader may not have to turn the sketch around to decipher them. This is shown in Fig. 2, which presents the same key.

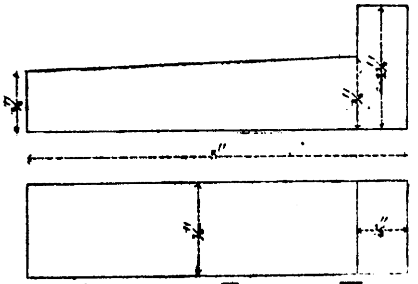


FIG. 2.—SKETCHES OF KEY FOR A WHEEL.

It will be seen at once that there are here two systems pursued. In the first (Fig. 1) the dimension figures are placed, when possible, or convenient, outside of the sketch and all standing one way. In the other (Fig. 2) the figures are placed as much as possible within the sketch and in each case at a right angle to the location of the dimension marked. The former is obviously the plainer and easier to read.

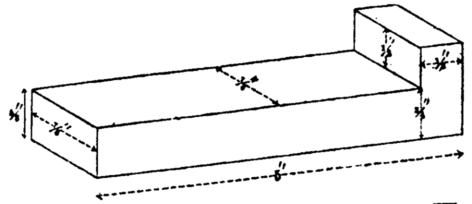


FIG. 3.—PERSPECTIVE SKETCH OF KEY FOR A WHEEL.

The second method of presenting such a key in a sketch is shown in Fig. 3, which is drawn in perspective. Here the eye is greatly assisted by the form of the sketch in grasping the shape of the object; but the sketch is more difficult to make, and for this reason perspective sketches are not employed for working drawings; that is to say, drawings that are to be worked to.

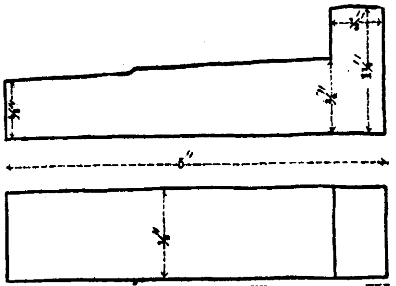


FIG. 4.—ROUGH SKETCHES OF KEY FOR A WHEEL.

In making sketches the learner will at first find some difficulty in drawing straight lines; but this is of no consequence, because it is understood that where any variation of dimension occurs it must be marked on the drawing; hence in the absence of such a figured dimension the lines are assumed to be straight. In Fig. 4, for example, is a rude sketch of the same key, and in Fig. 5 is another one having two steps to it.

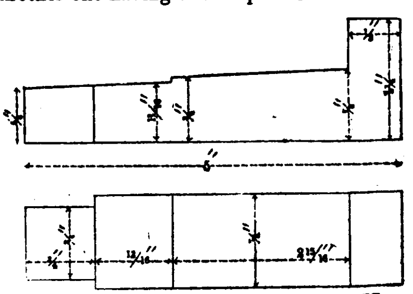


FIG. 5.—SKETCHES OF ANOTHER FORM OF KEY FOR A WHEEL.

Wherever there is a step there must be a line as well as a dimension figure to denote the size. In the case of a curve a curved line will appear, and the centre from which the curve is struck must be marked as is shown in Fig. 6.

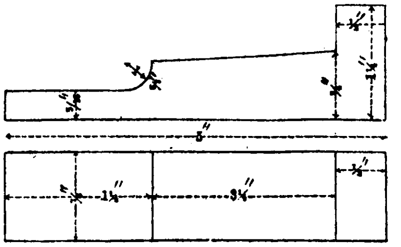
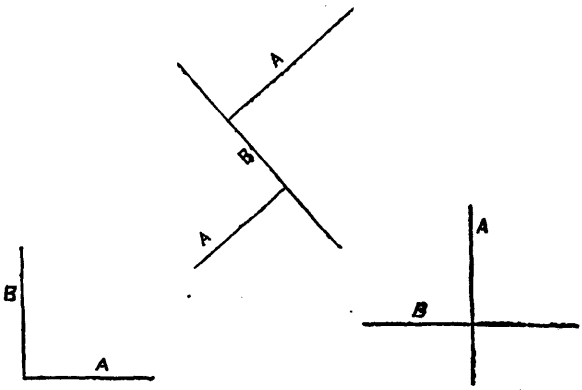


FIG. 6.—SKETCHES OF STILL ANOTHER FORM OF KEY.

Thus the dot shows the centre from which the curve is struck, and the figure 1 its distance from the curve.

The shortest distance between two points is termed the radius, and in the case of a circle the radius is the distance measured in a straight line from the centre to the perimeter of the circle.

The dotted lines thus (- - - - - - - -) indicate the place at which the dimension is taken.



FIGS. 7, 8 AND 9.—SHOW LINES PERPENDICULAR TO EACH OTHER.

Dimensions in feet are denoted by a single dot above the figures; thus 2' is 2 feet. To denote inches two dots are used, 2" means 2 inches.

A straight line is in geometry termed a right line.

A line at a right angle to another is said to be perpendicular to it. Thus in Figs. 7, 8 and 9 lines *A* are perpendicular to *B* and lines *B* are perpendicular to *A*.

A point is a position or a location supposed to have no dimension or size, and in cases where it is necessary it is indicated by a single dot.

Parallel lines are those equi-distant one from the other throughout their lengths. Thus lines *A B*, in Fig. 10, are parallel. Lines may be parallel, although not straight, as in Fig. 11.

FIGS. 10 AND 11.—SHOWING PARALLEL LINES.

The boundary line of a circle is termed its circumference or periphery, and sometimes the perimeter.

FIG. 12.—SHOWING AN ARC OF A CIRCLE.

A part of this circumference is termed an arc of a circle or an arc. Thus Fig. 12 represents an arc. The term arc simply implies that the form is a part of a circle, and when this form is supposed to have breadth and thickness it is termed a segment. Thus Figs. 13 and 14 represent segments of a circle.

FIGS. 13 AND 14.—REPRESENTING SEGMENTS OF CIRCLES.

A straight line cutting off an arc, or a portion of a circle, is termed the chord of the arc; thus in figure 14 the line *A* is the chord of the arc.

A quadrant of a circle is one-fourth of the area of the same, bounded on the sides by two straight lines running from the periphery to the center, as in Fig. 15.

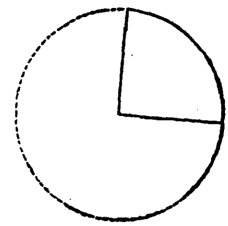


FIG. 15.—REPRESENTING A QUADRANT OF A CIRCLE.

When, however, the area inclosed within these lines is more or less than one-quarter of the whole area inclosed within the circular, the figure is termed a sector. Thus, in Fig. 16, *A* and *B* are both sectors.

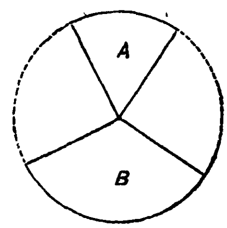


FIG. 16.—SHOWING A SECTOR OF A CIRCLE.

A tangent is a straight line touching the perimeter of a circle, and the point at which it touches is that to which it is tangent. Thus in Fig. 17 line *A* is tangent to the circle at point *B*.

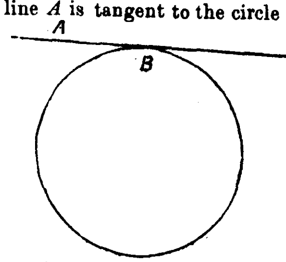


FIG. 17.—REPRESENTING A TANGENT.

A common tangent is a line representing the means or average tangency of two tangent lines. Thus in Fig. 18 let *A* be tangent to curve *B*, and straight line *B* tangent to curve *F*, then *C* is the common tangent, its lying midway between the two lines *A* and *B* and at an equal angle to both.

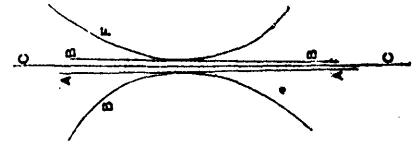


FIG. 18.—SHOWING WHAT IS MEANT BY A COMMON TANGENT.

These are but a few of the designations of the lines used in mechanical sketching, but they are sufficient for our present purpose.

Home Industries.

FARMING AS AN OCCUPATION.—I.

BY HON. GEORGE GEDDES.

From time to time I have received letters asking advice in regard to Farming as a business—and very many personal applications which I have been compelled to refuse, have been made to me, to take young men to teach them something of practical farming. Having had more than half a century of farm life—most of the time as manager, as well as owner of several hundred acres of grain-producing land, it may not be assuming too much for me to give my view to the public at large, in regard to some of the inducements and hindrances that should be considered by a young man who may perhaps think he would like to be a farmer, and who lacks personal knowledge of just what farming really is. I rush into print, somewhat moved thereto by the notion that no one better qualified for the work is likely to undertake it.

Natural bias or inclination, is first of all to be considered in deciding on the business of life. I knew two brothers, born and raised on a farm—one of them took no interest in any of the work going on, unless some machinery was connected with it. He was made for a mechanic, and after he had finished a school course, and had made a trip to Europe, he informed his friends, that his desire to build steam engines was overpowering, and that he would consider it to be doing him no favor to give him the farm. So he went into a machine shop and, in the old way, learned a trade. The other brother, from early youth, took the greatest interest in all the operations of the farm, and during vacations from school, was with the men in the fields. He knew the places for all the tools, and the names of all the animals. In his case the inclination to be a farmer was as decided as was that of his brother to be a worker in iron. Each was allowed to adopt the desired business, though it is not often that views of boys in their teens are thus decided—it is generally easy to find out something of the biases and adaptations—and generally, when a boy thinks he knows what he wants to do, it is well to let him try to do it. If he has no experience of actual farm work, except such as has been derived from summer vacations from city life—and thinks he would like to be a farmer—I would advise following the example of a well known New York merchant, who had one among his somewhat numerous flock, who felt that he must be a farmer. This did not meet the views of the father, and much was said to induce the boy to follow his brothers into the store, but it availed nothing. It so happened that there was in the family an ancestral farm of many acres—and fine buildings that made the summer home—and on which lived a "farmer," who conducted matters, so as to have the balance of disbursements and receipts too heavy on the wrong side.

The father proposed to the son that he should go to the house of the "farmer" and spend the winter, in all respects living and sharing the food and work of the hired men, eating his five o'clock breakfast, and doing his part of pig feeding, stable-cleaning, and all other unpleasant chores—and report how he liked it the next spring. This plan was strictly carried out, and in due time the youngster was clear in his mind, that he was made for a farmer, and farmer he became, and in a few years his name was known throughout the whole land. If I should give any more of his history, I would tell everybody who he is, if indeed I have not already.

Boys raised in cities and surfeited with schools, often imagine that they would like to be farmers. Let them follow the example I have given, only extending it through a whole year, taking the same relative positions that they would be forced to take in learning any other business. Begin at the bottom, stepping on the lowest rounds of the ladder, and touching every one, until the top is reached. This is the way to qualify a man for managing a farm. Young men who have taken this way of learning farming, though their early years have been passed along paved streets, and in schools, have made some of our most successful farmers.

There is another road that is often taken, but not often with lasting satisfaction. Buy, or otherwise acquire a farm, subscribe for several agricultural papers, purchase books on farming, hire a farmer, purchase a full set of tools and machinery. —Learn by experiment, and if your money and zeal last long enough, and you work hard, you will finally make a good farmer, but your education will be a costly one. I knew a case quite like this: A farmer's son was "educated," as people say. He had his four years of classical study allowed him by a rule of the Court, and spent nearly his three years in a lawyer's office, when circumstances made it necessary for him to go to his father's house, and assume the management of nearly one thousand acres of land—perhaps one-third of it called "improved"; that is, it had been partly cultivated. Log heaps, piles of stones, clumps of bushes, and swampy places adorned the fields. The owner was just twenty-one years old—without other knowledge of practical farming than such as he had acquired in observing the rude processes of that long ago time, during vacations, and one summer with the hired men when a lad of sixteen years. He found his lands in the occupancy of tenants, who must remain for one season. He went into the fields with these tenants and worked without other compensation, than instruction in the use of tools, and devoted the season to trying to learn enough to justify his attempting the management of the farm. The next year he assumed direction. Foremen were not yet invented to help incompetent farmers. He had a team, plow, etc., for his own use, and for a while worked with his men, but soon learned that seventy-five cents a day would pay a better man than he was for holding a plow, and that his eyes to overlook the whole work, were worth more than his hands driving a team.

But the perplexities he suffered, that came of the ignorance of this "educated" man, cannot be recounted. No one as well as himself realized how little he knew of farming, and he looked among his neighbors for advisers. It so happened that there were three very successful farmers, living in different directions, but all within a few minutes' ride of his home. They were very unlike in their ways and tastes, but all able men. Each of these men was freely consulted; not all at once, but separately. They would not have enjoyed a common talk, but each alone liked to help this beginner—and many a ride he took to their houses for advice, and the habits he then formed of inquiry into farm management never left him. At school he had studied Chemistry as then taught, and could understandingly read Liebig's works, which about that time, startled the world by attempting to reduce agriculture to a science. Agricultural newspapers were diligently read, and much hard work of mind and body was done by this man; farming paid, and he became an enthusiastic lover of the business.

Although the hopes held out by Liebig, that farming might itself be reduced to a science have not been realized, yet much good did he do, by promoting investigation; and the great improvements that have been made within the lives of many of us, may be said to have commenced about the time he began writing, and this young farmer had the good fortune to commence his career just at this interesting period.

I need hardly say, that my purpose in giving these instances, has been to show that farming is a business which demands a special education, as much as any other, and that whoever is thinking of going into this business, or of putting a son into it, must know that without this education, failure is quite likely to follow.

BURNS AND SCALDS—IMPORTANT REMEDY.

Four years since (Sept. '77) the *American Agriculturist* recommended the use of Bicarbonate of Soda, that is the common cooking soda, for most kinds of burns. Since then frequent experiments and observations, the opinions of physicians, and the best Medical Journals, have more than confirmed all we then said. As burns and scalds are always liable to occur, and as this remedy, though simple has proved to be extraordinarily useful, it should be fixed in the minds of every one. The soda, and the carbonic acid so readily set at liberty from it, have anæsthetic, antiseptic, and disinfecting properties—all highly beneficial for burns.

For slight burns cover all the injured parts with a layer of powdered soda. For deeper burns, but where the skin is not broken, dip linen rags in a solution made by dissolving about one-third of an ounce of the soda in a pint of water; lay the rags on and keep them moist with the solution. For very severe burns, followed by suppuration (formation of pus), apply the rags in the same way, keeping them moist; but frequently exchange them when dry for fresh ones, and carefully wash off, with the soda solution, any matter that has accumulated underneath, so that it may not be absorbed into and poison the blood. Leading European medical journals give numerous instances in which, by the above treatment, extensive burns of very severe character have healed speedily, leaving little scar.

Health and Home.

WHAT FOODS ARE MOST ECONOMICAL?

With an advance of 20 to 100 per cent, and more, in the price of staple foods, the above is now a most important question to over forty millions of our people, and one of much interest to seven or eight millions more. Probably there are not two millions who take no thought or care as to the cost of their daily diet. Meal, flour, potatoes, corn-meal, and milk, are the main articles of sustenance for the great masses. Fish, rice, beans, and oat-meal (recently), with lesser amounts of some other articles, are consumed; but these altogether do not, we judge, constitute one-tenth of the food of the entire people, perhaps not more than five or six per cent.

Dried or smoked beef, ham, and cheese, rank high, but dried fish outranks all others. The nutritive value of dried codfish is remarkable, and it deserves special attention, 100 lbs. of it supplying as much nutriment as 341 lbs. of beef! It is cheap and abundant everywhere, because very portable, and easily kept. It yields labor-sustaining aliment at from one-third down to one-ninth of the cost of beef in different sections of the country. It is easily digestible, and if properly freshened and cooked, it can be made palatable and acceptable to a very large class needing to practice economy.

FLESH-FORMERS—HEAT-PRODUCERS.

The occupation of any class of persons has much to do with deciding the most economical foods. It is estimated that, in a temperate climate, an average man needs, each 24 hours, simply to sustain life without increasing his weight, about 11½ ounces of heat-producing, and 4½ ounces of flesh-forming foods. Laborers, and those putting forth much exertion, need most of the flesh-forming foods, such as lean meats of all kinds, eggs, cheese, fish, beans, peas, oat-meal, bread, cabbage, roots, etc.

Those exposed to cold, need more of the heat-producing foods, as fat meats, corn-meal, and generally those articles containing large amounts of oil or starch or both, of sugar, etc.

Those working hard, in cold weather, need much of both kinds combined, as in pork and beans.

Wheat contains about 69 per cent. of heat-producing, and 11 per cent. of flesh-forming elements. Indian corn about 70 per cent. of heat-producing starch and oil, and 9 per cent. of flesh-formers. Beans and peas, about 52 per cent. of heat-producing oil and starch, and 25 per cent. of flesh-formers.

Milk admirably combines flesh-forming curd or cheese, and the heat-producing oil (butter) and sugar. All kinds of cheese, including the cottage or sour-milk cheese, are excellent strength-giving food. All skimmed milk may be very economically used in supplying cottage or soft cheese as a strength-giving human food. This soft cheese is, in utility and value, very like lean meats.

SUNDRY FOOD ITEMS.

Maccaroni makes an excellent variety in the scarcity of vegetables, and should be much better known, and more used by the masses here. It is the staple food of the common people in Italy, indeed of most classes. It is made of strongly glutinous wheat flour; hence is flesh-forming, while its starch supplies heat. It may be cooked tender in boiling water, seasoned with salt, and eaten with or without cream sauce, or milk or butter. —After boiling it can be put in a pudding dish, with about a quarter of its weight of grated cheese sprinkled over it, and lightly baked. The addition of cheese makes this diet about equal to lean meat as a flesh-former.

Ripe Peas should be more commonly used. A bowl of good pea soup is as satisfying as a hearty dinner on a cold day. To make a gallon of it, wash a pint of peas and soak them over night; then boil in five pints of water, gently simmering three hours or so, until thoroughly soft. With a potato masher rub the soup through a colander or wire sieve. A pound of beef or ham bone may be boiled with the peas. The soup may be seasoned in various ways—with onions, cloves, pepper, sugar, or any or all of them, to make them most palatable.—Bean soup may be made similarly.

Stewed Carrots are a far more nourishing and economical human food than is generally known, and they should not be mainly left for animals. Scrape the roots, chop into small pieces, and stew in water until very tender. They may be seasoned with flour-and-butter sauce—all the better with cream added—and in various other ways. Some like them made piquant with a dash of Cayenne.—*American Agriculturist.*

PAPER BED CLOTHES.

It has long been well known that a covering of newspapers was an admirable heat retaining agent for a cold winter's night. Many attempts have been made to utilize this general idea and provide paper comforts and blanket, but the material would crackle, and it was next to impossible to secure the proper ventilation under this sort of bed clothes. Therefore but little beyond experimenting had been done till the "Chartaline" blanket was recently invented in England. The paper for this is made from strong fiber, which, being prepared by a special process, is freed from the stiffness or brittleness that produces the crackling or rustling sounds. When new there is a slightly crisp feeling, but this presently wears off and the blanket becomes very soft and quite noiseless.

The new bed covering is made of two sheets of paper, between which a layer of wadding, chemically prepared, is inserted in such a way that it can not gather together in lumps. The edges are strongly whipped, so that there is no possibility of the separation of the two pieces taking place.

In respect to the ventilation, it seems to be as perfect as the ordinary blanket. In respect to strength, while there is yet something to be desired, the blanket is found to be quite durable. In looks there is scope for very considerable improvement, but the materiel can easily be made ornamental in shape as well as by figures printed or painted upon it. In respect to warmth it far surpasses the old cotton or woolen article—particularly when the size and weight of the two are contrasted. But the largest gain is in cost. The paper article can be afforded at a rate which seems almost ridiculous.

ABOUT POTATOES.—EXPENSIVE FOOD.

It is estimated that New York city alone daily consumes 20,000 bushels of potatoes; or one bushel to each 75 or 80 of the resident and transcient population; or 4½ bushels each per annum. The wholesale price now (Dec.) by the car or boat load is $2.50 to $3.00 per barrel, or fully $1 per bushel, and the retail price considerably higher. Shrewd dealers and speculators have for some time past been buying up all available supplies in many localities. Ordinarily, the greater weight of potatoes for the same money value, and the frost embargo for at least three winter months, prevent the transfer of potatoes from regions of plenty to those of scarcity, as is done with grain; but active transportation over long distances is now going on.

POTATOES ARE ALWAYS AN EXPENSIVE FOOD.—That is to say, comparatively. A bushel of potatoes (60 lbs.) contains nearly 50 lbs. of water and only about 10 lbs of solid nutriment, which is mainly starch. At present wholesale prices here, this is nearly 10 cts a pound for the food they yield. Fair wheat flour, at $8 a barrel, is only 4 cents a pound. Corn at 80 cents a bushel (56 lbs.) has nearly 50 lbs. of nutriment, costing less than 2 cents per lb. Taking the country altogether, and the prices of potatoes, corn, wheat, etc., high and low, from year to year, the average nutritious food obtained in the form of potatoes costs 4 to 5 times as much as it does in the consumption of corn or beans, and 2½ to 4 times as much as in the form of wheat flour, or oatmeal, beans, rice, etc.—*American Agriculturist.*

LET THE FROST HELP YOU.

Few fully appreciate how much a freezing of the ground does to set at liberty the plant-food locked up in almost all soils. Water in freezing, expands about one-eight of its bulk, and with tremendous force. Water, if confined in the strongest rock and frozen, will burst it asunder. The smallest particles of soil, which are in fact only minute bits of rock, as the microscope will show, if frozen while moist are broken still finer. This will go on all winter in every part of the field or garden reached by the frost; and as most soils contain more or less elements that all growing plants or crops need, a good freezing is equivalent to adding manures or fertilizers. Hence it is desirable to expose as much of the soil as possible to frost action, and the deeper the better, for the lower soil has been less drawn upon, and is richer in plant-food. Turn up the soil this month wherever practicable. If thrown into ridges and hollows, in field and garden, the frost will penetrate so much deeper. Further, plowing or spading the soil now, exposes insects and weed roots to killing by freezing. Still further, soils thrown up loosely will dry out earlier in spring, and admit earlier working, which is often a gain when a day or two may decide in favor of a successful crop. *American Agriculturist.*

NEW CLOTH-CUTTING MACHINE.

The enormous quantities of ready-made clothing annually produced in this country have created a demand for some more expeditious plan of cutting out garments than the usual way of cutting them by hand. Several kinds of cutting machines have been manufactured to meet this expressed want. None of these machines, however, have met satisfactorily all of the requirements of the trade, and their introduction has been effected to a limited extent only.

The machine shown in our illustration is claimed to be practically perfect in its operation, upward of two years having been spent in perfecting every detail of the machine and bringing it to the high standard which it has attained.

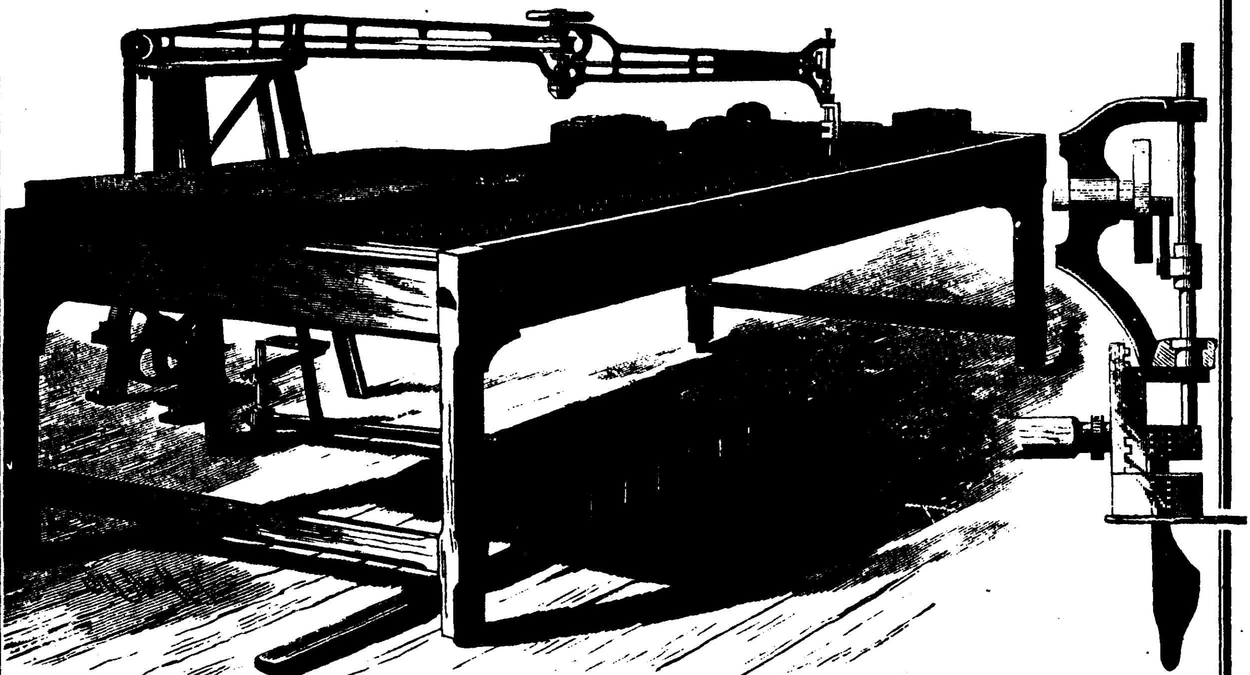
The machine is based on a principle radically different from any cutting machine that has heretofore been devised, and, as claimed by the inventor, the great success of the machine is due to this novel principle of action.

facturers from different parts of the country, who have been unanimous in their indorsement both of the machine and its work.

The machine now in use, driven by a two-horse power engine, works with wonderful rapidity and accuracy, the knife easily following the most intricate designs and cutting through thirty-four thicknesses of heavy cloth without apparent effort. As the cloth is not lifted from the table while being cut the arrangement of the layers is not disturbed and the cuts are perfectly uniform in each layer. and as the movable parts of the apparatus are above the cloth the manipulation of the machine is effected without that friction or drag which attends the operation of an ordinary cutting machine.

The machine has an estimated capacity of 2,500 coats per day, or a product equal to that of 25 skilled cutters.

With this machine is an attachment for accurately cut-



THE AMERICAN CLOTH-CUTTING MACHINE.

Instead of being laid on a solid wooden table, as usual, the layers of cloth, piled up to a height of from two to four inches, are placed upon a bed or support consisting of rows of upright wires fastened to a backing of wood, the wires being cut to a uniform length, so that their upper ends present a perfectly level surface.

The working parts of the machine are mounted on a firm base, alongside of and independent of the supporting bed, and are constructed to travel over a surface fifty or more feet in length, if desired.

The cutting instrument cuts upward instead of downward, and can be freely moved in any direction so as to follow the lines of a pattern marked on the top layer of cloth, the peculiar character of the supporting table permitting this movement without difficulty.

The machine has been in use in Philadelphia for some months past, and has been examined by numerous manu-

ting, without previous marking, from one to two hundred strips of materials of any width at a single cut, and cuts them either on the bias or at any angle across the pile of goods. They are very convenient for seam binding and other purposes. The attachment travels on the side of the table, and is connected when in use to the pressure foot of the machine, which it causes to pass in a straight line.

The machine is the invention of Mr. W. R. Fowler, the inventor of the well-known Fowler fly fan, and is manufactured by Mr. Martin J. Myers, of 819 and 821 Market street, the owner of the patents, who may be addressed for further information.

RAILWAY GARDENING.—The Boston and Maine Company now allows its station agents $10 a year each with which to buy seeds, plants, etc., and offers prizes of $50, $30, and $20 to the agent whose stations are best kept.

NEW DIVING APPARATUS.

In diving apparatus shaped to the human body it has been difficult to combine with the requisite flexibility of material a rigidity sufficient to resist at every portion of the armor the external pressure of the water without re-enforcing or aiding the material of which the apparatus is composed by pumping within it a supply of atmospheric air not only sufficient to insure life to the diver, but also sufficient to balance the external pressure of the water.

The armor, shown in the engraving, overcomes this difficulty, and is of itself of sufficient strength to resist at its every portion the external pressures without re-enforcement by an oversupply of internal air, and is at the same time sufficiently flexible to permit of the movement of the diver.

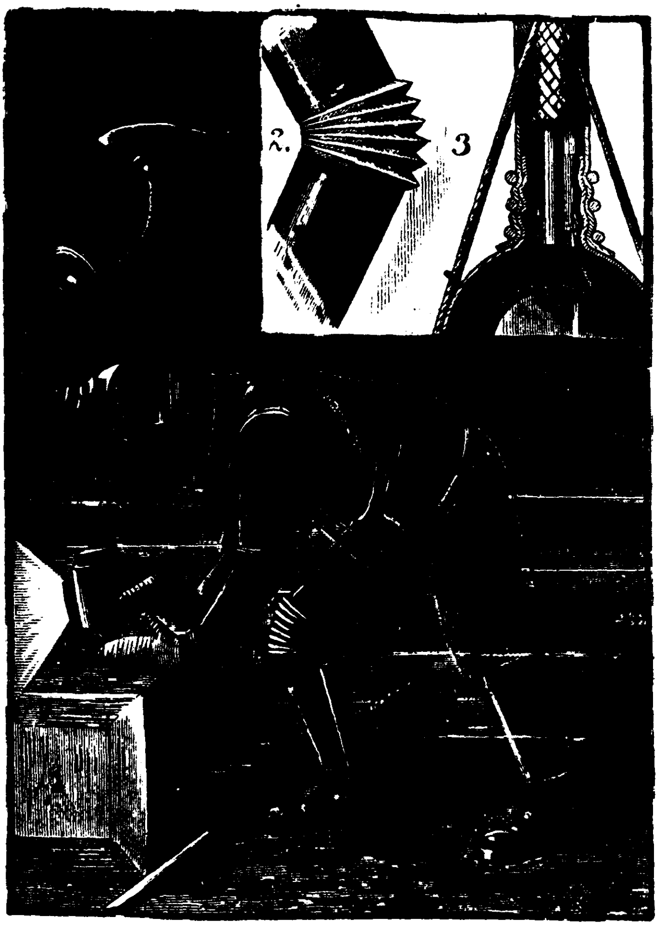
The flexible waterproof covering of the armor is made of rubber, water-proof cloth, or other fabric, which, while both strong and elastic, is impervious to water.

An interior metallic casing constitutes the inner layer, or body of the suit. The lining has rigidity sufficient to retain the contour of its various sections against the collapsing pressure of the water.

The joints corresponding to the joints of the limbs are of bellows form, permitting of the free movement of the body and limbs. The joints are stayed so as to prevent collapse from external pressure, as shown in Fig. 2.

It is obvious that this joint has the advantage of being laterally very stiff, compact, and light, a few rings cut from light sheet metal insuring, from their form and arrangement, both strong resistance to exterior pressures and large extension to the flaps. The flap portions are thoroughly protected by the rings when closed, and held with certainty in their folds, while the connection of section with section is steady and strong, whether the joint be open or shut. The apparatus, therefore, considered as a whole, is a casing at all parts, joints, and unjointed surfaces, capable of resisting external pressures.

The trunk portion of the apparatus is provided with a coupling, which starts from one shoulder, extends obliquely around the body, front and back, and terminates below the arm which is opposite to the shoulder mentioned, so that the apparatus can be easily put on and taken off.



TASKER'S IMPROVED DIVING APPARATUS.

The helmet of the apparatus, shown in section in Fig. 3, is adapted to be removed.

The air tubes consist of an inner tube for supplying air, and an outer tube for carrying off the exhaled air. These tubes are made to resist a high degree of external pressure and to have a tensile strength sufficient for raising and lowering the apparatus.

This new diving apparatus is the invention of Mr. Stephen P. M. Tasker, of Philadelphia, Pa.

Chemistry, Physics, Technology.

CHANGING THE COLOR OF THE HAIR.

Dr. D. W. Prentiss, of Washington, D. C., Professor of Materia Medica in the National Medical College, recently reported a case of remarkable change in the color of the hair from light blonde to black in a patient while under treatment by pilocarpin. The patient, a young woman, had an aggravated attack of uremia, yet it is thought this disease is of too common occurrence for such an effect to have escaped observation, if by any chance the change in the color of the hair could have been produced by the disease. The use of the pilocarpin was begun on the 16th of December, 1880, and twenty doses were administered hypodermically up to the 22nd of February, 1881, requiring the use of thirty-five to forty centigrammes of pilocarpin. The hair was first noticed to be changing color on December 28, 1880; from this last date the alteration was rapidly progressive, until a light blonde hair with a yellow tinge became first a chestnut brown, and on the 1st of May, 1881, was almost a pure black. The growth of the hair was also more vigorous and thicker than formerly. It was also much coarser, as could readily be seen by a comparison of specimens. There was a corresponding change of color of hair upon other portions of the body. Dr. Emil Bessels, of the Smithsonian Institute, has made a microscopical examination of the hair, and reports that it is in every respect normal, that the change in color is due to an increase of the normal pigment, and not to a dye. There was also a change in the color of the eyes from a light blue to a dark blue.

Changes in the color of the hair are of frequent occurrence, as a result of sudden violent emotions, such as fright, great grief, or even sudden joy; the change, however, is always from dark to white. But a rapid change from light to black is nowh re reported. In mammals and birds, however, we have numerous instances of changes of color in both directions,—from dark to light, and the opposite, this change being due not merely to new growth, but to an actual alteration of the color of existing hairs or feathers.

Dr. Weinland investigated this subject from museum specimens, and was lead to the conclusion that change of color was due to increase or diminution of oily matter. The fresh feathers were examined from the breast of a merganser, and the red color found to be due to numerous lacunæ were filled with a reddish oil-like fluid. When dried, the feathers bleached, and it was then found that the lacunæ were filled with air only. According to this theory, an increase of nutrition would have a tendency to darken the hair, and *vice versa*. This is borne out by the fact that dark or black hair is almost always thicker and coarser than light hair, and also by the change in hair to gray and white as age advances and the processes of nutrition becomes enfeebled. So also when the hair is thin, shaving the scalp will generally cause it to become thicker, firmer, and darker. This can only be through the influence of nutrition.

It gives us a clue also to the *modus operandi* of the change in the case reported, for we know by clinical experience that pilocarpin increases the nutrition of hair, as shown by its augmented growth. We have therefore in this case both positive and negative evidence in support of the view that the change in the color of this patient's hair was due to the pilocarpin, and this view is strengthened from the fact that in a case of membranous croup successfully treated with pilocarpin, June 1881, the administration of the drug for six days was sufficient to produce a distinct change in the color of the child's hair.

INFLUENCE OF ANIMAL AND VEGETABLE OILS ON MACHINERY.

Since mineral oils have come into use for lubricating purposes their manufacture has reached such perfection that their general adoption, in preference to any animal or vegetable oil, is only a question of time. The advantage derived from the use of good mineral oil is so decided that every one who possesses any technical knowledge must be convinced of the same. Mineral oils are not fats, but hydro-carbons, and are obtained from the natural crude oil after the volatile, or light oils, have been removed. Fats, however, whether animal or vegetable, whether in a fluid or solid state, contain not only hydro-carbon, but also oxygen, and represent a union of organic acids, called fat acids, with oxide of glyceryl. The greatest possible differerence exists between mineral oils and those just mentioned—viz., animal and vegetable—they having, in fact, nothing in common except that they are both greasy to the touch. It is therefore, unreasonable to ask what amount of fatty substance a mineral oil contains, because in its purest and most useful state it should not contain any fatty matter. Mineral oils, of proper specific gravity, lubricate as effectually for a lengthened period of time as vegetable or animal oils do when but freshly applied. The lubricating power of mineral oils increases in proportion to their specific gravity; therefore, on all heavy machinery, where friction has to be overcome under great pressure, the heaviest oils should be used. Mineral oils which are properly manufactured, and consequently free from gum and acid, retain their lubricating power unchanged in all temperatures so long as there is any oil on the bearings. Vegetable or animal oils, on the contrary, however pure they may be, gradually lose their lubricating power, owing to their combination with the atmospheric oxygen, which causes them to become thick, gummy, and finally, dry—thus necessitating the frequent and thorough cleaning of bearings and shafts. Mineral oils have no tendency to oxidate, and consequently do not gum or dry. Of course, we only speak here of the heavy oils, the oils of small specific gravity being unsuitable for lubricating purposes. Vegetable and animal oils chill and become solid with slight cold, while mineral oils remain liquid in the coldest weather, severe frost causing them to become somewhat thicker, but never solid. The principal reason, however, why animal and vegetable oils should be superseded by mineral is the destructive effect of the former on the iron parts of machinery. There are various causes for this. As already stated, fats consist of a combination of fat acids and oxide of glyceryl. The combination, by the action of water or steam, becomes decomposed, setting free the oxide of glyceryl. (It is in this manner, and based on this theory, that stearine is manufactured.) The same decomposition also commences, though slowly, in ordinary temperatures, through contact with the atmospheric moisture. The acids thus generated exercise a corroding influence on the iron, forming what is called metal soap. The iron gradually becomes porous, and in time is destroyed. To this injurious influence all parts of machinery are subjected, whether they come in contact with steam or not. The affinity of oxide of iron to the acids of fat is so great that, chemically speaking, the iron corrodes immediately it is brought into contact with fat.—*Dr. L. Marquardt.*

MINERAL LUBRICATING OILS.

Dr. Oscar Bremken determines:

1. The specific gravity.
2. The temperature at which inflammable and continuously combustible gases are evolved. For this purpose he heats the oil on the sand bath in a crucible, 6, 4 c.m. wide and 4.7 in depth, filled to 1.2 c.m. from its edge, and after the experimental temperature has been attained he removes it from the sand bath and passes a small gas flame over it, as in Hannemann's petroleum test, trying it first from 5 to 5 degrees and afterward from 2 to 2. Oils which foam strongly when heated are unfit for many purposes. He observes, further:
3. The point of congelation.
4. The undissolved constituents on dissolving 10 c.c. in an equal volume of ether, filtering and weighing the washed residue.
5. The reaction with soda lye of sp. gr. 1.40; 10 c.c. of the oil are well shaken up with 5 c.c. of the soda lye and heated in the boiling water bath. After repeated shaking the lye must remain clear, and its volumes must not be altered. The test tube used in this experiment must be absolutely free from grease.
6. The reaction with nitric acid acid of sp. gr. 1.45; on agitating equal volumes no rise of temperature, or but a very slight one, should be perceptible. This test shows the absence of tar oils.
7. Reaction with sulphuric acid, sp. gr. 1.53; equal volumes are shaken up and heated in the water bath, when the acid should take merely a pale yellow color. A brown or black coloration shows imperfect refining, or, along with No. 6, the presence of tarry oil.
8. Behavior on shaking with water; the water must remain clear, free from a whitish turbidity, and should not have an acid reaction.—*Zeitschrift Anal. Chimie.*

To keep machinery from rusting, take ½oz. of camphor, dissolve 1lb. of melted lard; take off the scum and mix in as much fine blacklead as will give it an iron colour. Clean the machinery and smear with this mixture.

Scientific.

ELECTRIC LIGHTING—ITS FIRE RISKS AND THEIR REMEDIES.

By Henry Morton, ph.d.,

President of the Stevens Institute of Technology.

Some very lamentable accidents have strongly directed public attention to the question of danger possibly accruing to life and property through the rapidly increasing employment of electricity as a source of light, and as the actual conditions of this danger, like the true properties of the agency from which it may arise, are but little known, a brief explanation of some simple facts related to this subject will be at this time seasonable and perhaps useful.

I would propose, then, to treat this subject under two general heads, namely: 1st. The sources of danger; 2nd. The conditions of their prevention, or of security.

The sources of danger in the use of the electric light are essentially two; from the conducting wires and from the electric lamps.

As long as the electric fluid or electric energy is conveyed by a sufficiently good conductor it is perfectly harmless, resembling a river flowing in its natural channel, and powerless to rise above its banks; it is only when some easier channel into surrounding objects is offered or some partial obstruction of a certain character impedes its regular flow that trouble may arise.

The conditions of these difficulties are, moreover, very peculiar. Thus, for example, if two electric conducting wires, forming the outgoing and returning paths of a powerful current are placed near each other, but are separated by a bad conductor, as, for example, when both are tacked on to a board partition wall, the current will follow the wire from end to end, with no development of heat in the same, or tendency to leave the conductor or pass into any adjacent object. If, however, between the two conducting wires we introduce some imperfect conductor, such as a small wire, some metallic dust, or a film of water containing mineral matter in solution; then a portion of the current will be diverted into this "short-cut" from wire to wire and may heat the fine wire or the metallic dust or the wood wetted with the aqueous solution, so as to cause the ignition of inflammable matter.

Accidents of this nature have already occurred. Thus a telegraph or telephone wire having fallen across one or more of the conductors used for street lighting purposes has been fused, or, itself escaping has caused the fusion of finer wires connected with it.

Again, two wires being the outgoing and return circuits of a powerful current, have been nailed side by side, without other insulation, on the same board of a floor, partition or ceiling; and though used safely for a long time, while the woodwork was in its normal state, have developed a very dangerous activity when the wood between them was wet with dirty or impure water. In that case the water offers a circuit through which a cross current is established which first heats the damp wood, then chars it, and finally establishes a series of minute arcs or electric sparks along this charred surface, which would soon develop a conflagration if left uncorrected.

Again, two such wires as above, insecurely attached near each other, may be brought into momentary contact and then separated, in which case an electric arc, with its intense light and heat, will be established between them. In like manner a conducting wire itself may be insecurely connected at some point, and if the abutting ends are separated slightly during use, a similar "arc" with its intense heat may be developed.

These examples will give a fair idea of the dangers arising from the conducting wires, and they are manifestly to be guarded against by a proper separation and insulation of the wires themselves. Of this, however, more anon. At present, I would only further point out that there is no risk whatever of any heating or other injurious action arising in or from the conductor itself when an adequate one is used, as must be the case from motives of economy; since an inadequate conductor would involve ruinous expense in the use of the electric current.

Electricity is not to be regarded as a sort of fluid passing along the conductor; and some popular notions on this head are as absurd as were similar ones which prevailed in reference to illuminating gas, at the time of its first introduction, and which caused rules to be made in some places that no gas should be allowed to come in contact with any wood-work.

Turning next to the dangers which might be expected from the electric lamp, it is to be remarked in the first place, that these in the case of the arc lights depend much upon the number of lamps operated on the same circuit. Thus if thirty or forty lamps are operated in series, the electro motive force of the current must be sufficient to maintain a corresponding number of arcs; and, therefore, if by any means many of these arcs are closed out, the electro-motive force of the current available for the remaining ones would be so excessive that their arcs might become excessively long, and even the metallic carbon holders and other parts of the lamps constitute poles between which the arc would spring, melting the metal work and establishing a very dangerous centre of combustion.

To avoid this class of dangers two provisions should be made. In the first place some arrangement in the lamp itself by which, whenever the arc exceeds certain safe limits, the current will be automatically diverted from it and carried through a good and sufficient conductor; and, in the second place, some apparatus in connection with the electric generating machine by which the electro-motive force of its current should be varied automatically in correspondence with the resistance of the circuit, so that any diminution of such resistance, as by the closing out of several arcs, should cause a corresponding diminution in the force of the current generated.

Numerous contrivances for both of these purposes have been already carried to greater or less perfection and efficiency, and it is manifestly possible by such means to secure immunity from risks of this sort.

The securing of adequate insulation for the conducting wires in view of the endless ramifications of telegraphic and telephonic systems, to say nothing of the other conductors found in all buildings is a problem of no small difficulty. One important general principle would seem to be the equal insulation of the return as well as of the outgoing wires, as well as of the machines, and the avoidance of all ground connection for any part of the circuit. Another general rule would be the separation of outgoing and return wires as far as possible from each other; and yet another, the continuous insulation of conductors leaving no vulnerable places even where danger would not directly result from accidental contact.

Fully to discuss all the details of this subject would be impossible within the proper limits of such a note as the present, and I will therefore only say in conclusion that, with well matured plans and skillful and intelligent provision, all these dangers may be provided against and electric lighting may be made as safe as that obtained by gas or by candles; but without such care and judgment the use of electricity on the grand scale either for lighting or for transmission of power, would involve serious additions to the risks which accompany so many of the conveniences which constitute a large factor of our modern civilization.

What I have here written is but a fragment of the entire subject involved and at some future time I hope to fill out and complete this preliminary sketch.—*Prof. Henry Morton in the Sanitary Engineer.*

ONE MILLION LINES TO THE INCH.

Mr. G. Fasoldt says, in a letter to the *American Journal of Microscopy*:

I have ruled plates up to 1,000,000 lines to the inch, one of which was purchased by the United States Government of Washington.

These plates show lines truly and fairly ruled, as far as lenses are able to resolve, and above this point the *spectral* appearance of the bands in regular succeeding colors (when examined as an opaque object) shows, beyond doubt, that each band contains fairly ruled lines up to the 1,000,000 band.

I do not believe that I will ever attempt to rule higher than 1,000,000 lines per inch, as from my practical experience and judgement, I have concluded that that is the limit of ruling.

HORIZONTAL WELLS.

Tunneling into the hillsides, in California, for the purpose of obtaining pure water, has yielded satisfactory results. The tunnels vary in distance from 50 to 100 feet. A point is selected some distance above the place where water is desired, and with a comparatively light expense the water can be conveyed to any part of the premises in increasing abundance. Irrigation is made possible and easy by this same process. The cost is no greater than digging a well, while the water secured is invariably of the best.

NEW GALVANOMETER.

Horseshoe magnets are stronger and more permanent than bar magnets on account of the proximity of the two poles, and they are more powerfully affected by the current.

These considerations led M. Deprez to employ them in a galvanometer, but on account of their form he was obliged to modify the galvanometer bobbin.

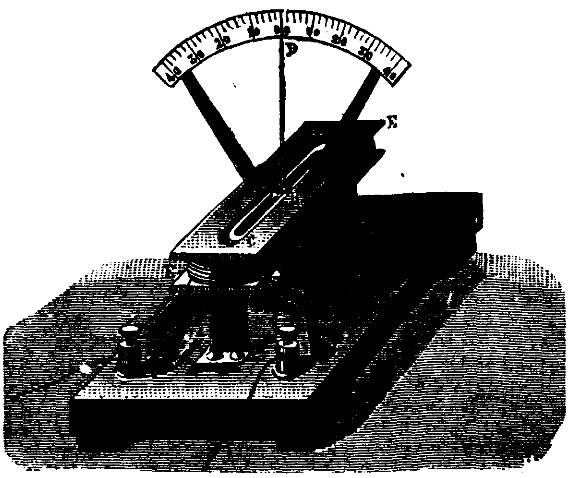
The accompanying engraving represents the arrangement adopted.

In the interior of the bobbin, E E, there are two small horseshoe magnets, A B, B C, exactly alike, and joined together at B, with similar poles opposed to each other. Each magnet may be regarded as an aggregation of an infinite number of very small bar magnets, parallel to the line upon which the horseshoe magnets are joined. When the wire of the bobbin is traversed by the current these imaginary bar magnets tend to assume a position perpendicular to the plane of the bobbin.

The advantages which result from this mode of construction are:

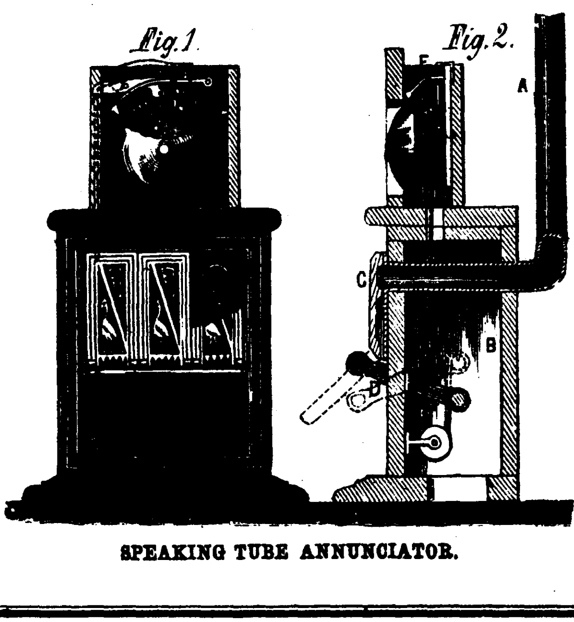
1. A more energetic action that than which would be developed by a bar magnet of the same weight and construction as the two horseshoe magnets.
2. The inertia is very much reduced, and consequently the rapidity of the indications is greater.
3. It admits of greater inclination than the bar magnet without removing it from the influence of the bobbin.

This system suspended vertically by a filament or silk constitutes an apparatus superior in sensitiveness and rapidity to the ordinary galvanometer. It is easy to render it astatic, and its magnets may be made of sewing needles.



M. DEPREZ'S NEW GALVANOMETER.

TESTS FOR WATER.—One of the readiest and simplest tests for ascertaining if water is free from organic pollution, is to cork up a small bottle nearly full of it, in which a piece of lump-sugar has been put. If by thus excluding the air, and letting it stand in the light for two or three days, there is not a milky cloud seen, but the water remains clear, it may be considered free from the phosphates with which sewage-water is impregnated. To ascertain if water contains iron, take a glass of water and add to it a few drops of the infusion of nutgalls, or suspend a nutgall in it by means of a thread for twenty-four hours. If the iron be present, the water will become of a dark brown or black color. Prussiate of potash is a still more delicate test for detecting iron. If a crystal, or a drop of it, when dissolved, be added to a glass of water containing iron, it will immediately become of a blue color. To ascertain if water contains magnesia, take a quantity of the water, and boil down to a twentieth part of its bulk, then drop a few grains of carbonate of ammonia into a small glass of water. No magnesia will yet be precipitated; but on adding a small quantity of phosphate of soda, if any magnesia be present, it will then make its appearance and fall to the bottom of the glass. In this experiment it is necessary that the carbonate of ammonia be in a neutral state.



SPEAKING TUBE ANNUNCIATOR.

SPEAKING TUBE ANNUNCIATOR.

The engraving shows a novel speaking tube annunciator, in elevation and in section. The tube, A, enters the the box, B, and terminates behind the hinged drop, C. There may be several tubes and as many drops. Below the drop or series of drops there is a rocker, D, whose arms extend into the box, and are connected by a cord, E, with the trigger of the bell at the top of the box.

When a person in a distant portion of the building wishes to communicate with another who is within hearing distance of the bell he blows in the speaking tube, and the air current thus created being directed against the drop, C, at the other end of such tube, causes it to fall upon the outer bar of the rocker, D. The drop being constructed of a thick metal plate, and therefore heavy, tilts the rocker, as shown in dotted lines, so that it pulls on the cord, E, which, in turn, tilts the lever that raises the hammer, which is instantly released and allowed to fall upon the bell, which gives the required notice. The person thus called will, after responding to the message, close or replace the weighted drop in its upright position, and thus relieve the rocker, which, being released, returns automatically to its former position, and is ready for the next alarm.

This invention was recently patented by Mr. W. R. Ostrander, of New York city.

THE BROOKLYN BRIDGE.

The bridge which unites the cities of New York and Brooklyn is the longest suspension bridge in the world. The length of its arch over the East River is 1,594 feet 6 inches; and its total length from the western extremity of its foundation in Chatham street, New York, to its eastern extremity on Sands street, Brooklyn, is 5,987 feet. Its width is 85 feet, and the height of its floor above the water is 119 feet, while its height in the centre of the river is 135 feet. The height of each of the granite pillars is 276 feet 6 inches.

Its construction was begun in January, 1870, and the first wire was placed in May, 1877. The length of each wire of the four cables is 3,578 feet 6 inches. Each cable contains 286 wires, nearly 3-16ths of an inch in diameter. The weight of each cable is 42½ tons, and there are 19 girdles on each of the four cables. The resistance of each cable is 11,200 tons. The bridge will be ready for use in 1882. Its total cost will probably be about ten million dollars.

Fig. 2.—Jacket on Boiler at the Grand Opera House, New York.

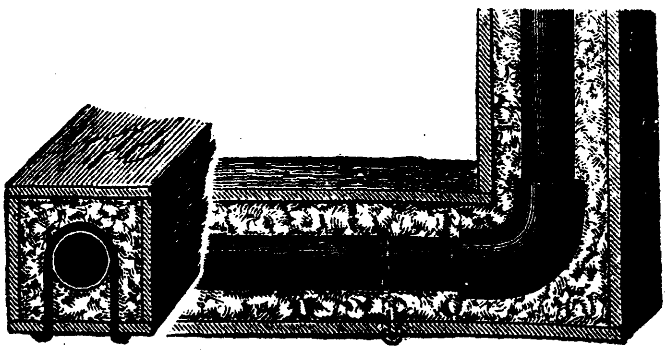


Fig. 5.—Method of Using Mineral Wool by Means of Wooden Boxes. Plan Well Adapted for Use of Pipes Exposed to the Weather.

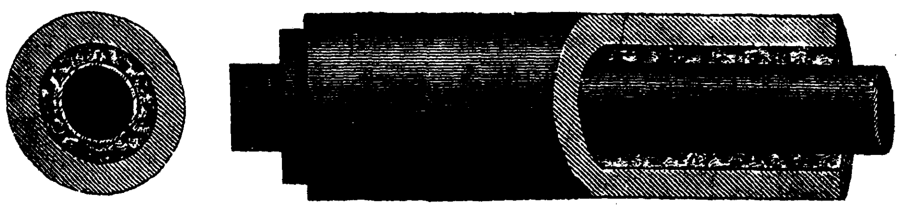


Fig. 1.—Use of Mineral Wool Inside of Wooden Collars. Plan Pursued by the New York Steam Company with its Underground Pipes.

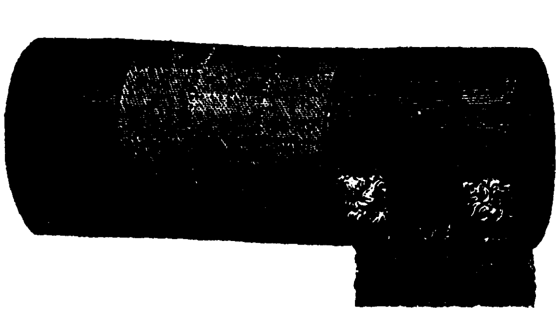


Fig. 3.—Canvas and Sheet Iron Cover Used on Boilers of the Pennsylvania Railroad Company.

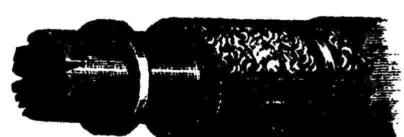


Fig. 4.—Mineral Wool within Wooden Collars, made in Sections and Protected next to the Pipes by Tin or Sheet Iron.

NON-CONDUCTION.—DIFFERENT METHODS OF APPLYING MINERAL WOOL.

NON-CONDUCTION.

The retention of heat after it is once generated would seem to be as important, from an economic point of view, as the lessening of the consumption of fuel, yet this practical aspect of the case seldom receives attention. Many devices are brought forward which are calculated to reduce the quantity of fuel in given instances and to effect a saving amounting to a large percentage, while the heat wasted by radiation and convection is allowed no consideration.

In the case of cooking stoves, for instance, we have for an object to heat small ovens to a fixed temperature, which must be maintained, and although this result is successfully attained, it is done at the expense of fuel, for, as a general thing, no part of our stoves is protected by any poor conductor, and the heat is not confined where it is needed. It would seem that at least two-thirds of the surface of a cooking stove might have double walls which could be filled with an incombustible material, and thus not only keep a more constant temperature in the ovens, but prevent a needless amount of radiation and consequent waste of fuel. The question of the loss of heat receives attention in the handling of steam, because it is compulsory to do something to prevent condensation, and not especially for the reason that fuel can be saved.

We are naturally very extravagant, and at the same time parsimonious, in this matter of heat-saving, for, on the one hand, we allow, day after day, the freest use of coal to obtain a desired effect, and, on the other hand, if recommended to make a temporary outlay which would permanently bring about the same result, we say it would not pay. The efficiency of fuel should not be determined by the amount of heat, which might be called surplus heat, that we may lose with impunity.

Then, again, we mistake the power of a medium to prevent the passage of heat. It is generally expected that an inch of insulating material must totally eclipse the radiation from a surface heated to 212 degrees. There is nothing capable of doing it, and physicists have not ventured to suggest how attenuated the fibers or how microscopic the air spaces would have to be to accomplish this result. Everything bearing upon successful insulation is quite the contrary of the prevalent expectation, that a little thickness is going to keep in a high degree of heat, or that an inch of material will prevent the extraction of warmth from water pipes so effectually that they cannot freeze. Furthermore, bodies radiate heat in greater proportion as the temperature increases (nearly as the square of the temperature), and, therefore, the thickness of the jacket should vary accordingly. There is also a great difference between air-confining materials as to the time in which they may be raised to a maximum temperature, and this is probably due to the nature and position of the fibers ; if there is much parallelism between the threads, the highest temperature is sooner reached than if there is no common direction to them.

There is a material now growing into general use which the principles of non-conduction would certainly have brought forth, if the theoretical part of a science could ever take a substantial form. The conversion of scoriaceous substances, chiefly blast-furnace slag, into fine threads called mineral wool, had directed considerable attention to the marked difference between bodies which readily transmit heat and those which retard its passage ; and it really seems as if the density of one and the porosity of the other would soon be recognized as essential characteristics, and then we will no longer be offered a production which will accomplish two opposite results.

The use of dense materials for the transmission and radiation of heat, or for the conduction of sound, makes it appear rational to think that extremely porous material must have the complementary effect. The adaptation of mineral wool to all purposes where the circulation of the air would either allow the passage of heat or the transmission of the vibrations necessary to sound, has gone beyond experiment, and real merit is conceded to the material. The method of the New York Steam Company is to place an 11 inch steam pipe in a hollow log 3 inches thick, but leaving a space all around, 2½ inches wide, which is filled with mineral wool.

This plan it illustrated in Fig. 1 of the engravings. Fig. 4 shows a somewhat different method of reaching the same result. Wooden collars made in sections are employed, protected next to the pipes by tin or sheet iron sufficiently high to carry over joints. The lagging or strips of wood which are nailed to the collars are shown in the central part of the cut. After these strips are in place, the pipe is covered with cotton cloth or burlaps, and painted white or in some color. Fig. 5 shows pipes incased in mineral wool, which is held in place by wooden boxes. The boxes for this purpose are made of ⅜-inch boards, and the method shown is one well adapted for use in the case of pipes exposed to the weather. Figs. 2 and 3 show two methods of protecting boilers against radiation, one being the plan employed at the Grand Opera House, New York, and the other the method adopted by the Pennsylvania Railroad Company.—*Metal Worker.*

AERIAL NAVIGATION.

There has long been a theory among balloonists than an easterly current of air prevails at a certain height from the West to the Atlantic coast in this country, and several attempts have been made to test it. Recently such an attempt was made by Prof. King with all possible precautions for success, but it ended in failure because it was discovered that after ascending some 3,000 feet the wind did not blow in an easterly direction, and the balloon became unmanageable. After drifting for a short distance, Prof. King's balloon descended in a field, and the attempt was abandoned. Regarding this theory of navigating the air by the help of eastern currents, Mr. Donaldson, one of the most experienced balloonists we have, says : "There is no science in air navigation. A balloon is nothing more than a feather in the air. There is nothing in the eastern air current. The air is full of currents running in every direction and different every day. The science of ballooning is nothing more than the skill necessary in knowing how to go up, how to regulate with ballast, how to descend, and how to make a safe landing. Twenty men's power cannot alter the course of the balloon in a strong current. I alone, however, when above the clouds in a calm, have raised my balloon by fanning the air, but I could not change its course. I don't think that human invention can devise any apparatus that will steer a balloon in the air. There is not a sufficient body of resistance in the air at any height over two hundred feet."

Inventors are still, however, engaged in endeavors to solve the problem as to how to navigate the air, and now, if some one will find out how to confine gas so that it will not escape from the balloon, it will be a discovery worth considerable to aeronauts, because then they can stay up until they want to come down. They can stay up to be blown wherever the wind takes them. That is the one discovery or invention necessary. Then the other invention must be made an apparatus to steer a balloon while in the air, so that it can be operated like sailing a ship at sea. There are the two things necessary for positive aerial navigation ; First, to box up and preserve the lifting power of gas for an indefinite time—until done with it for the trip ; second to invent a steering apparatus. Until these things are done successfully, ballooning will be all an experiment haphazard, and forever groping helpless in the air, without a single purpose in full control.

A method of propelling an elongated balloon by a screw worked by an electric motor, has recently been patented in France. An experimental balloon has been made and fitted up, the motive power for which will be derived from a small dynamo-electric machine, the frame and all metal parts being made hollow to ensure lightness. The force generated by this machine will be stored in very light electric accumulators made of ebonite or parchment lined with sheet lead. It is claimed that the electric motor is superior to a steam engine for the purposes on these points. 1. It has a constant weight, while that of a steam apparatus is alway changeable. 2. It is free from the danger of fire in the presence of a combustible gas. 3. It is most simple and easily managed.

M. Jules Godard, a well-known aeronaut, exhibits at the Electrical Exposition in Paris an electrical warner in which, when the balloon is descending, an electrical vibrator is set in operation, when it is ascending a bell rings. This effect is obtained very simply by a valve, which is in equilibrium when the balloon keeps it level and is moved by a slight current of air.

Among the practical uses for balloons in their present form may be noted that of obtaining astronomical observations. M. W. de Fonvielle, of Paris, recently ascended at midnight, in a balloon, for the purpose of noting the appearance of comet B, 1881, as seen by him from the car. It was proposed to examine the curvature of the comet's tail above the dense and moist lower atmosphere, and to test the efficiency of M. Trouve's electric lamp. At an altitude of 1,000 metres the curvature was almost insensible, instead of acquiring fantastic proportions. The tail was a little longer than seen from the earth, but was cut off straight, as if a line were drawn over it horizontally with a ruler. The appearance of the tail was as if produced by legions of large stones traveling in the planetory space independently of the comet, and having no other connection with it than that of being temporarily lighted by the rays which its atmosphere had caused to deviate from their natural route. These myriads of remnants of worlds would, therefore, produce the same effect as dust lighted by a ray of sun admitted into a dark room through a crevice. M. Fonvielle insists that it is to this cause that the zodiacal light is in all reasonable probability to be attributed. The brilliancy of the light which the comet showed when the balloon arrived at the height mentioned, increased in a very large proportion, notwithstanding the transparency of the atmosphere. It seemed that the brilliancy had increased about half beyond its normal brilliancy as seen from the earth. By the aid of the electric lamp the records of the instruments could easily be read. M. Fonvielle very properly insists that hereafter astronomical investigations should include ballooning.

Architecture, etc.

THE "EASTLAKE" STYLE OF ARCHTECTURE.

This modern idea of architecture is of comparatively recent origin, being the outgrowth of conceptions originating with Mr. Charles E. Eastlake of England—not as a style of house architecture, but in connection with house furniture and internal decorations, as contained in a published work by Mr. Eastlake, entitled "Hints on Household Tastes." Its peculiar features, however, soon became popular, not only in the sphere of the mechanical arts to which it was first applied, but in the external embellishment of buildings. This popularity, to a greater or less extent, has spread throughout all sections of the United States, and is now being greatly sought after upon the Pacific coast.

Unfortunately, it is simply a "style"—not a classified "order" of architecture, with defined principles of treatment, and rules of application and delineation. It is so unrestrained in its requirements, that the wildest conceits of the uneducated pretender may be imposed, and the most absurd and distorted features defended as "in keeping with the style." Delineated with accurate taste and good judgment, its application in the construction of a certain class of buildings may be made pleasing to the eye; but the excessive *gaucherie* indulged in by a class of reckless adventurers, who abuse the integrity of this new idea by extravagant, unsightly and ill-conceived creations of their own, is calculated to render it offensive and repulsive to those enjoying a fair degree of refinement in the æsthetics of architecture; this may cause its rejection even as a "style," except by a limited number who prefer oddities and peculiar things because they are such.

Could Charles E. Eastlake behold some of the extravagant delineations covered by his name, he would doubtless cry to the gods to blot out the monstrosities as hideous deformities. Judicious liberties and combinations are excusable in all orders and styles of architecture; but when they run rampant, with no regard to consistency, beauty or harmony, the doctrine and rules of propriety cease, and disorder and distraction ensue. The tendency of the "new style" runs in this direction, as it provides the basis upon which unqualified men may operate, and find a defense for their stupid creations.

"All can't invent and imitate,
No more than those who clothe us can create."

And so it runs with the Eastlake style. Those who can invent nothing meritorious in architecture can imitate the new idea; that is to say they can scribble up something that looks peculiar, and give it the name of Eastlake.—*California Architect.*

THE MAGNETIC PHOTOMETER.

The magnetic photometer recently invented by M. Coulou consists essentially of a radiometer bulb, with aluminum needle, hung by a silk fibre, and having two vanes and two pieces of iron acted on by an exterior arching magnet which can be slid up and down on the upper tube. When the instrument is not in use, the needle is let down to rest on the mouth of a tube a little below it; this being done by moving a spring runner, from which the fibre is hung, by means of a magnet outside. The instrument is sensitive at once to heat, light, and electricity, and so may serve as a thermometer, or electrometer, as well as a photometer. To measure one form of energy the others are rendered constant. The graduation will be guided by direct experiment.

Fine Arts.

ART IN WALL PAPERS.

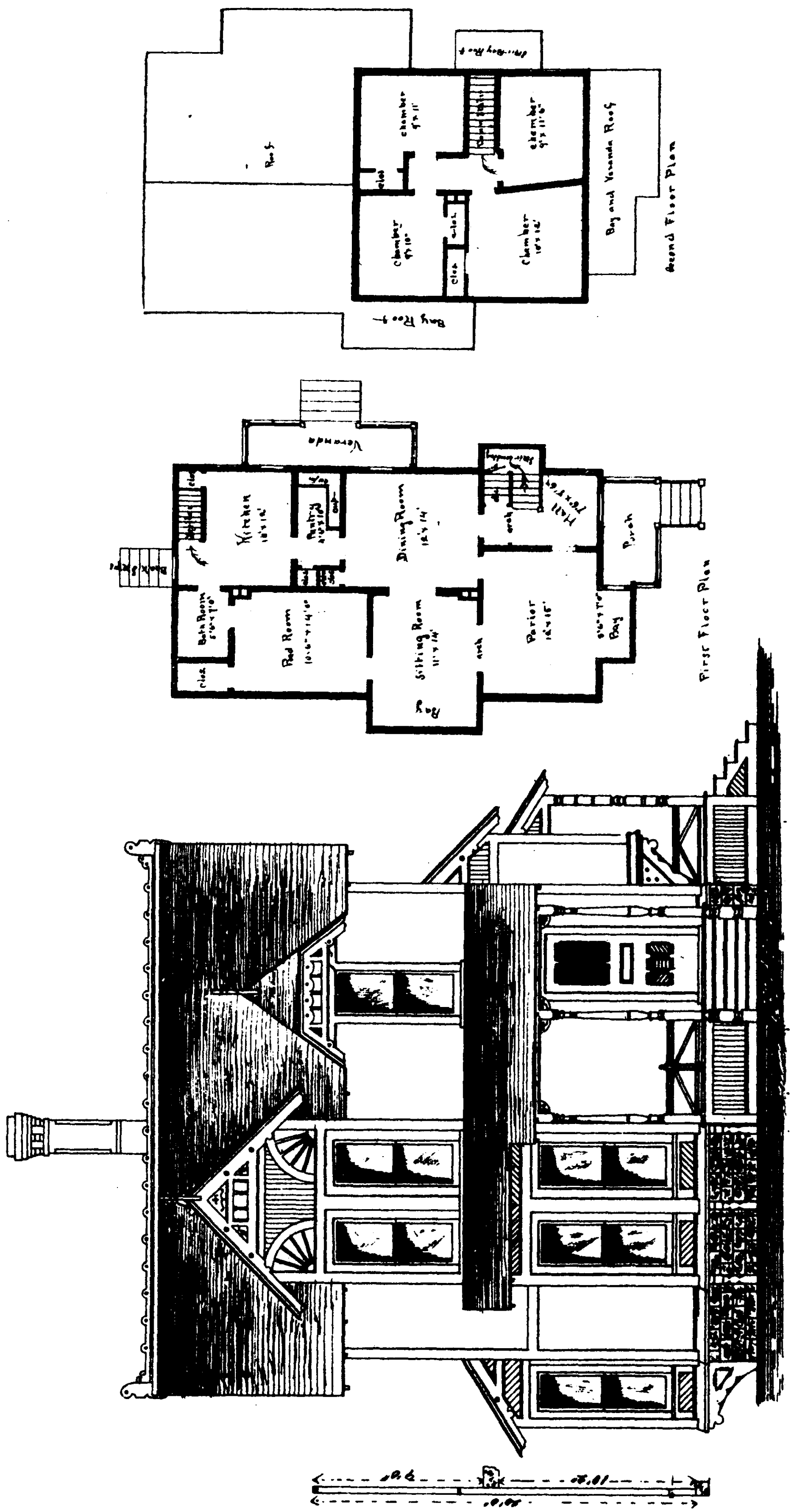
At an exhibition of designs for wall paper, which was opened in New York on the 17th of October, some sixty original designs were displayed. About one-third of these came from England, Germany and France. Taken as a whole, the display was good, including many tasteful and well-wrought designs, betraying the hand of the professional. Those from abroad rather surpassed in execution the American designs, as might be expected, since this branch of art has long been taught in the technical schools of Europe, while in this country it is new. American artists have found it heretofore more profitable to paint landscapes, and commercial art has been neglected. The combined artistic and technical requirements of the industry are yet to be learned by many who would be glad to contribute to such an exhibition. The foreign designs, while carefully worked out as regards technical details, harmonious combination of color, etc., lacked originality; they seemed to be repetitions in another form of patterns with which the public is already familiar. The American designs were often original in conception although poorer in execution. One design had for its theme the poem of Poe's raven, and was wrought in gray, silver, gold, black, white, red and purple. A unique geometrical pattern therein contained conventionalized representations of such flowers as the apricot, convolvulus minor, purple hyacinthe, heath, rosemary, adonis flos, locust, blue bell, white poppy and many others. This use of flowers was intended to express the sentiments of the poem. The frieze had a bust of Pallas, with the well-known raven perched on top. Altogether this original idea was well carried out. Two other striking designs had respectively the sea, and the honeycomb for themes. In the first a pretty result was obtained with broad bands of deep green, and bluish green sea water, shells, fishes and sea plants. The field of this design represented a broad expanse of water, in two colors, seen through a silver net. The honeycomb pattern had a field of silver honeycomb cells, outlined with gold, some of which were filled with gold to represent honey. This served as back ground, against which clover blossoms and bees were thrown in an artistic distribution.

The four successful contestants for the prizes offered proved to be women. The first prize of $1,000 was awarded Mrs. T. C. Wheeler, for the "honeycomb" design; the second prize of $500 went to Miss Ida T. Clark, for the marine motive; the third prize of $300 was taken by Miss Caroline Townsend for a design in roses and lilies; and the fourth prize of $200 went to Miss Dora Wheeler, for a very pretty study of pink peonies. The prizes were evidently awarded for their originality, and the happy medium shown between artistic and conventional designs, as well as for a new departure in wall paper art.

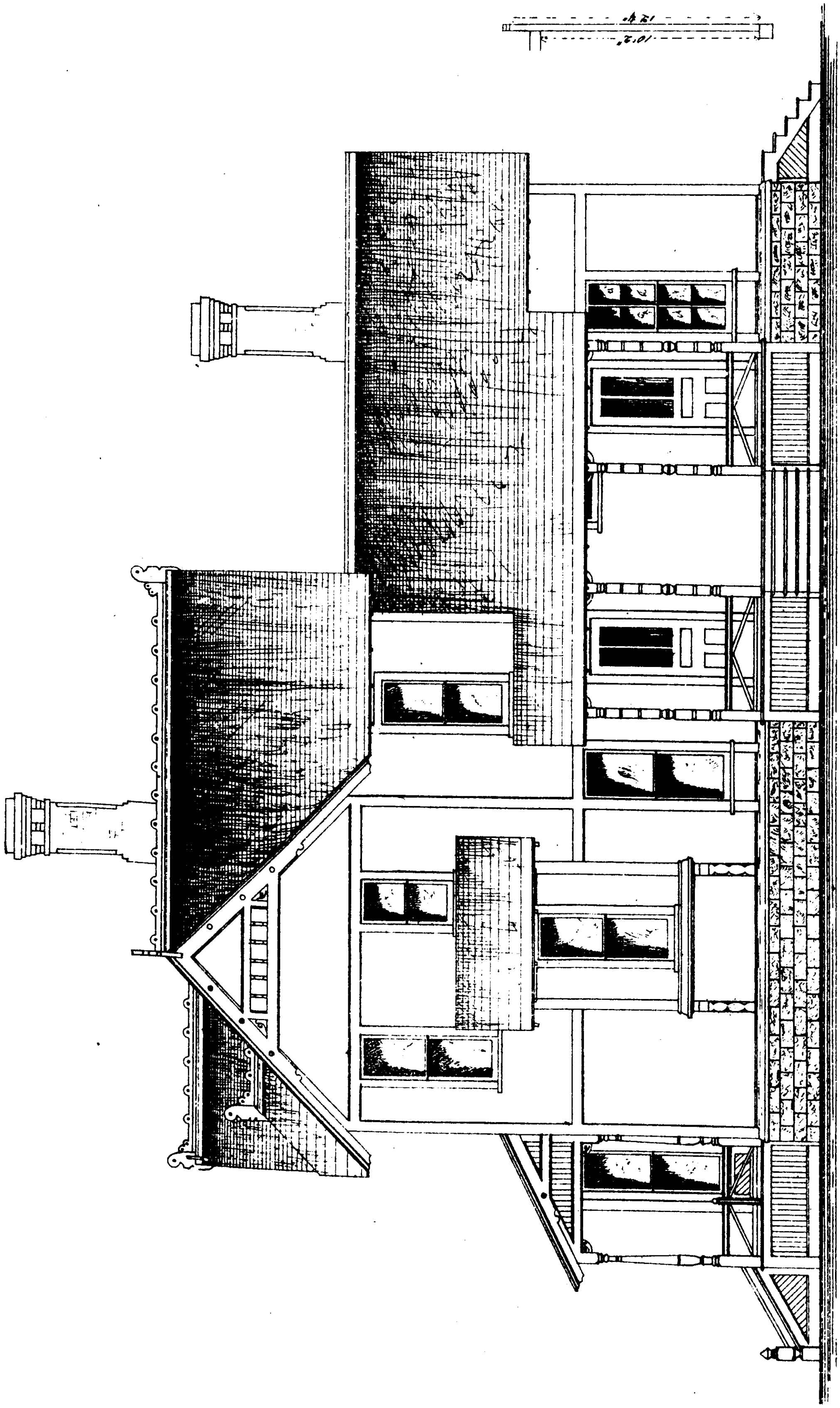
This being the first exhibition of the kind held in New York, too much should not be expected of it. If others follow, this will serve as an educator, and in a short time good, and desirable work may be expected, quite equal to that which now comes from Europe. Any attempt to encourage home production and liberate American manufacture from foreign dependence is to be commended as a step in the right direction.

A FRENCH PHOTOGRAPHIC SALON.

A handsome salon on the first floor is a fitting reception room to a studio, which of late years has attained such a high reputation, both in Paris and in Milan, as that of MM. Benque et Cie. Fluted columns, draped with rich maroon curtains, are at the entrance to this apartment, into which not a ray of direct sunlight enters All is soft and sombre within. There are extensive windows, but these are hidden by loosely festooned drab silk, so that while there is plenty of illumination, it is subdued and yet refulgent. The walls are of chocolate brown, the damask, chairs, and furniture gold and black, the fittings rich and handsome. This fine carbon portrait in frame complete, standing a meter high (39 inches), is a speciality of the firm Benque et Cie., and sells for a thousand francs. These pictures on the table are what is termed "Paris portrait," similar in height to the panel or promenade, but half an inch broader, a very attractive size, but still, to our thinking, not so elegant in its proportions as the promenade. Of cabinets, there is also a collection, not large, for we believe that there are not more than a score of photographs in the whole salon. Two or three cartes are here also, but during the past three months, our host tells



FRONT ELEVATION



RIGHT SIDE ELEVATION.

us, not a single carte picture has been taken in the establishment. Here too, we find Madame Nilsson, not in a frame, but in the flesh ; she is looking at some portraits of sister artistes, after undergoing a lengthened sitting. "We have just taken one hundred clichés," our friend whispers, "and within the space of an hour and a half."

Before we walk up stairs, we are presented with a card of terms. Here it is:

12 Cartes-de-visite, 30 francs ; the dozen following, 20 francs ; 12 cabinet portraits, 80 francs ; 6 cabinet portraits, 50 francs ; the dozen following, 60 francs ; 12 Paris portraits, 120 francs ; 6 Paris portraits, 80 francs ; the dozen following, 100 francs.

In the Benque establishment, gelatine reigns supreme. "Do you develop at once, or in the evening?" we ask. "Always in the evening—we are now so confident of our results ; of those hundred clichés just taken of Madame Nilsson, not one will be developed till to-night." The development is done by artificial light, by means of a gas-burner behind ruby-glass, a convenient tap permitting the photographer to heighten and lower the jet at will. The developing, too, for the most part is done mechanically. As soon as some idea has been obtained of the exposure of the plate, and the time and strength of development, half a dozen clichés are put together in a rocking tray. The developer is poured over the films, and then the tray rocks to and fro by itself, kept in motion by a heavy pendulum that swings underneath. It saves a world of trouble, our host tells us, and produces very uniform results. We always like to take the sense of photographers on the development of dry plates, and we put the question whether pyrogallic or oxalate treatment is preferred. "*Oxalate toujours—Oxalate toujours*" is the energetic reply.

The studio is large and roomy—the largest in Paris, our friend says ; at any rate, it measures fifteen meters (nearly fifty feet in length). There is nothing particular to be noted about the lighting ; top-light is the dominant light. The walls are of very dark brown, and we remark upon this. They are dark, admits our host ; but when they are again painted, we shall color them darker still. Large plates are in general use at the Benque establishment, and large cameras. As a rule, six poses are taken on one plate. We mentioned the other day the circumstances of Madame Judic being portrayed 132 times in this studio at one sitting. She was at the atelier for two hours only, and, during that time, changed her dress four times. Twenty-two poses were taken, of each six clichés, with an exposure of about three seconds. The negatives were developed at night, and there were only two technical failures. "Elle ne voyait plus," when she went away after the ordeal, our host remarked of the fair comedienne. Certainly, such rapid work could not have been undertaken before the days of gelatine. There is no dark room adjacent to the studio ; the plates in their slides are sent up a shaft from the laboratory below, and delivered close to the assistant's hand in the studio, after the manner of Messrs. Window & Grove's studio, which we described the other day. The exposures are made by means of the ordinary pneumatic-Cadett shutter.

In the enlarging-room there is one point worth mentioning. The camera is disposed pretty well as usual ; but just in front of the transparency is placed a swing looking-glass or mirror, perhaps twenty inches high. This permits, in a most convenient manner, the concentration upon the transparency of light that comes through a small opening in the wall, and if the mirror is turned to its proper angle by hand, the hand being never quite steady, no partial lighting is likely to ensue.

There are two printing rooms, and MM. Benque send the negatives to one or the other, according to their density. Thus in the top printing room, which is on the roof, the denser clichés are to be found, and those which will bear strong light ; while in the more subdued light of the lower printing room are located such clichés as require more delicate treatment. From 1,200 to 2,000 prints are produced here every day, for the firm has now a large publishing connection, and their portraits go to every capital in Europe. Printing to this extent would be impossible in a London atmosphere, and for this reason our big metropolitan firms have usually an establishment in the suburbs for the purpose. But in Paris they burn charcoal more than they do coal, and, moreover, when this is used, it is of a much less sooty character than that employed in England.

Starch, prepared fresh every day, is invariably employed for mounting at the Benque establishment ; where so much publishing is done it is a matter of imperative necessity that the mounting should be depended upon, especially as black mounts are used just now. We are glad to hear, by the way, that of late these black mounts are more satisfactory than was the case a short time ago. Numerous cases of fading were then rife, and the cause, as our reader knows, Mr. Spiller was able to trace to the presence in the mount of a considerable quantity of sodium chloride, or common salt. The test to discover this—namely, the adding of a few drops of nitrate of silver solution to water in which one of these has been steeped for some hours, and observing whether any turpidity results—is so simple that any photographer can make use of it for himself.

Besides making itself known through its publication, the firm also adopts the practice of exhibiting its work largely in Paris. The Boissy d'Anglais, although a turning out of the Faubourg St. Honoré, is not a very frequented thoroughfare, and hence visitors to Paris might well escape seeing the studio. MM. Benque et Cie. have therefore opened an exhibition in the Rue Royale, that familiar street leading from the Madeleine to the Place de la Concorde, and here a display of the firm's finest work is exhibited. A *piece de resistance* is always present in the form of a scene from one of the Paris plays. Whatever happens to be popular on the boards for the moment is here illustrated. The boat-scene from Michael Strogoff is the present attraction, a fine enlargement from nature, measuring perhaps three feet across, and including the portraits of half a dozen favorites. Any scene is chosen in which many characters are grouped, and the photograph being well executed, it naturally draws considerable attention. A magnificent portrait of Gounod, another of Judic, and a forcible picture of that Swedish professor with the hard name who discovered the North East passage, are attractions at the little exhibition in the Rue Royale.—*Photographic News.*

SATIN PAINTING IN OILS.

It is beyond our province to teach oil painting in itself, and therefore, if any of our readers wish to undertake it on satin, and have not already mastered its technicalities, our first direction to them will be that they should take one or two lessons in the technicalities of the art, especially as oil painting on satin does not admit of alteration or effacement, and all that has to be done must be resolved on beforehand, and carried steadily through without change.

We will suppose, therefore, that a knowledge of oil painting has been acquired, and that the amateur only wishes to know how to apply it to decorating satin. The requisite materials are oil colors in tubes, small bristle and red sable brushes in tin ferrules, a large palette, and some turpentine, with the usual requisites of palette knife, etc. All materials must be kept scrupulously clean and free from dust, the color must be fresh and pure, and the hands must never rest on the satin, but on a sheet of tissue paper spread over the whole, excepting the part actually being worked upon ; and the greatest care should also be taken to avoid any smears or splashes of paint. It saves time to have separate brushes for each color.

Their exact sizes will depend partly on the painter's method of work, and whether its aim is breadth of effect or fineness of detail ; but, unless for folding screens or very large work, the higher numbers are useless. Nos. 3, 5, and 7 are useful sizes ; 2 may occasionally be required for fine strokes, and 9 for broad leaves, such as water lily or arum. It is best to have two jars of turpentine for rinsing the brushes—the second for the final cleansing—to ensure their being thoroughly empty of color.

The satin must have a perfectly smooth face, and be free from folds. If these are unavoidable, they should be slightly damped and ironed on the wrong side, with a handkerchief or thin paper between, but only the folds themselves must be pressed down, as, when possible, satin should not be ironed. If, when it is held horizontally to the light, the face looks woolly, the piece should be rejected ; but, on the other hand, a fine, close make of satin, without any admixture of cotton or thread, is preferable to the richest quality. When two substances are mixed in the same material, one is apt to shrink more than the other ; hence arises the wrinkled look which is called "cockling."

When the satin is cut to the required size, it must be pinned out flat on a drawing board, on which a sheet of paper has been laid. Toilet pins will make smaller holes than drawing pins. A large piece of satin, such as a fan leaf should have the pins not less than an inch apart ; very small pieces can have one pin at each corner only. Though it must lie perfectly flat, the satin must not be stretched, as the recoil would make the painting uneven. No sizing is required for oil painting, and the next step, therefore, is to sketch the design. If the artist can draw sufficiently well, the better plan is to do this directly on the satin, all danger of soiling it with the transfer paper being thereby avoided; and the pencil used must be a moderately soft, not a hard one. Mistakes, of which the fewer the better, can be taken out with bread-crumbs or india-rubber; the best and old-fashioned kind of the latter must be used, "erasers" making smears which are ineradicable. But a design may be also sketched on paper and transferred; and in either case, if much arrangement, as in wreaths, is required, this should be thoroughly worked out on paper and decided upon before it is placed on the satin. The artists' colormen now supply white, blue, red, and black tracing papers—the former is used for transferring on black. All must be well rubbed before laying on the satin, so that no more of the color will come off when it is pressed on than is necessary. When the design is laid down, design, transfer paper, and satin must be securely fastened at the four corners and the centre of each edge, to avoid all dangers of slipping.

The satin will now be ready for painting. Small quantities of each color to be used must be squeezed on the palette—of the pure colors no more than is necessary, as they will keep fresher in the tubes; but with mixed tints it is well rather to err on the side of grinding too much, as it is often troublesome to get the exact match again. It is also better to waste a little color by cleaning it off, than to spoil a great deal of work by using what is dull and dirty.

We do not advise an amateur to begin by trying a great variety of colors, as this only causes embarrassment; more can always be added as the work becomes easier. A learner should select some simple figure or flower, and thoroughly master the color it requires; then some other subject may be painted with the same, and a third upon a different colored ground.

The only medium employed is turpentine. It quickly dries, but it must be sparingly used. Too much of it will run into the satin, and a difficulty will be found in getting the color sufficiently thin to "take" on the satin, and at the same time not to run. If it runs, the brush is too full. Instead of loading the color, it must lie quite smoothly; no brush marks are to be seen, and the requisite texture is best attained by grinding the color with the turpentine until it is thin enough to flow freely from the brush, but at the same time not to charge the brush with too much of it. If when dry the ground appears through the paint, it must have a second coat. Only practice can teach the exact quantity of turpentine to be used, or of color to be taken up with the brush. When the work is finished, rather dry color in little bright touches here and there may be used with good effect.

We have now to add a few general remarks on the subject of the color of the satin to be chosen, and on suitable designs for the work.

The choice of the color of the satin will of course depend on the choice of the subject to be painted on it. Black is a good ground for flowers, but for landscapes it looks like a black sky; therefore blue, blue-grey, or pale saffron for evening effects, are preferable. Figures look well on black, but blue or pale pink are better for amoretti or child subjects. For flowers, cream or ivory satin looks well, with red, crimson, blue or purple; crimson, but not terra-cotta red, with cream-colored, such as Gloire de Dijon roses; while terra-cotta color is a suitable background for buff or black. Pale blue or turquoise blue make lovely grounds for almost every sort of flower. They are especially suited for peach or almond blossom, with sulphur-colored butterflies, or for a design of corn, pink bind-weed, and blue cornflowers, the blue of the last being shaded from the lighter blue of the ground. Greens require good management with green leaves, but when the eye for color is naturally good, and the skill acquired by training and practice is good also, the effect obtained by the relief from the ground of its own color shaded in the design cannot be surpassed; and a pale green ground, with its suggestion of the "green lap of the flowery May," is most appropriate for peach, almond, pear or apple blossom, with their brown stems and budding green leaves, or, the most graceful of all, white cherry blossom pendent on its long slender stems, and its unfolding bronzed leaves.

In regard to designs, figure subjects are sometimes chosen; but unless they are children, elves or cupids—in short, very airy and fanciful—we do not think them particularly suited for this style of painting, which is not so much elaborate or elevated as graceful.

It must be remembered that painting on satin, whether in oils or water-colors, is not pictorial, but decorative. For this reason, we do not care for landscape, unless it is a mere suggestion as a background for flowers and plants. Large-foliaged plants—such as tree or dwarf palms, yuccas, flags, maize, cannas—are all effective; so are ferns when the fronds are simple, pinnatifid forms being most difficult to render. All serrated edges to leaves are difficult also, but of course they cannot always be avoided. Butterflies, dragon flies, and birds are easy, and are effective and suitable. A peacock, with his tail spread, makes a splendid panel for a fire-screen.

The round gipsy tables now in vogue can be covered with black satin painted with a wreath, and edged with deep fringe or with a corresponding border. Honeysuckle with its ivory flowers and crimson buds, and here and there a cluster of its scarlet berries, makes a beautiful wreath for painting on black satin; so does jessamine, either the white alone, or the white and yellow mixed. Pelargoniums—the "nosegay varieties," with their velvety spots—are well suited for the work. Scarlet geranium requires careful management, lest it look staring. A most brilliant wreath is formed by the little Tropæolum speciosum, and there is none more graceful than one of our common pink bindweed. A good design for a table is a bouquet of flowers loosely tied and apparently carelessly thrown down (but *not* in the center), while some of the flowers are scattered. Again, flowers may spring from one edge of the table, and birds and butterflies hover above them. For designs of this kind the position of each object may be studied from any Japanese drawing at hand, as even in the commonest they are instinctively put in their right places. We may add that, while it is a matter of taste whether a wreath or bouquet is of one kind of flower or of several kinds, it is a matter of practical utility to know that it is infinitely easier to arrange the former well than the latter.

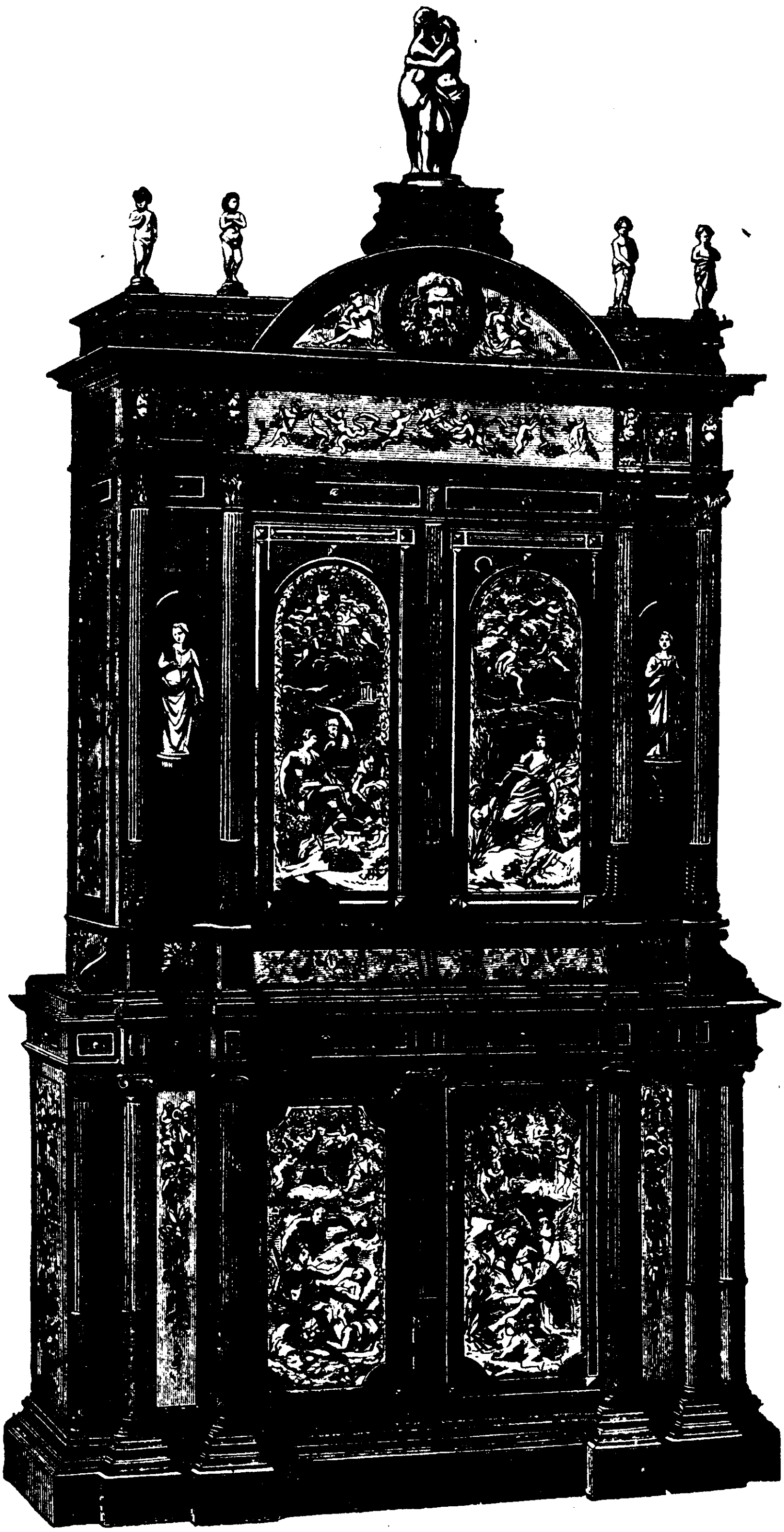
Panels or screens look best with tall plants or flowers standing up from the ground, or sprays hanging down from above, but these may alternate. A four-leaved screen may represent the seasons—apple-blossom for Spring; roses for the Summer; a bough of apples for Autumn; and for Winter that "fruit that counterfeits a flower," branches of the lovely spindle tree, with its rose-colored fruit split here and there to show the orange kernel, and a dark trail of ivy to relieve it, with a suggestive feathery spray of the wild clematis seed, called by country people "old man."

A short time ago, the Turners' Company, of London, England, held their eleventh exhibition of specimens of turnery at the Mansion House. At previous exhibitions a large number of specimens of hand-turning were placed on view, and a considerable amount of attention was bestowed upon the affair by members of the turnery trade, and also by those who are in any way connected with building or cabinet work.

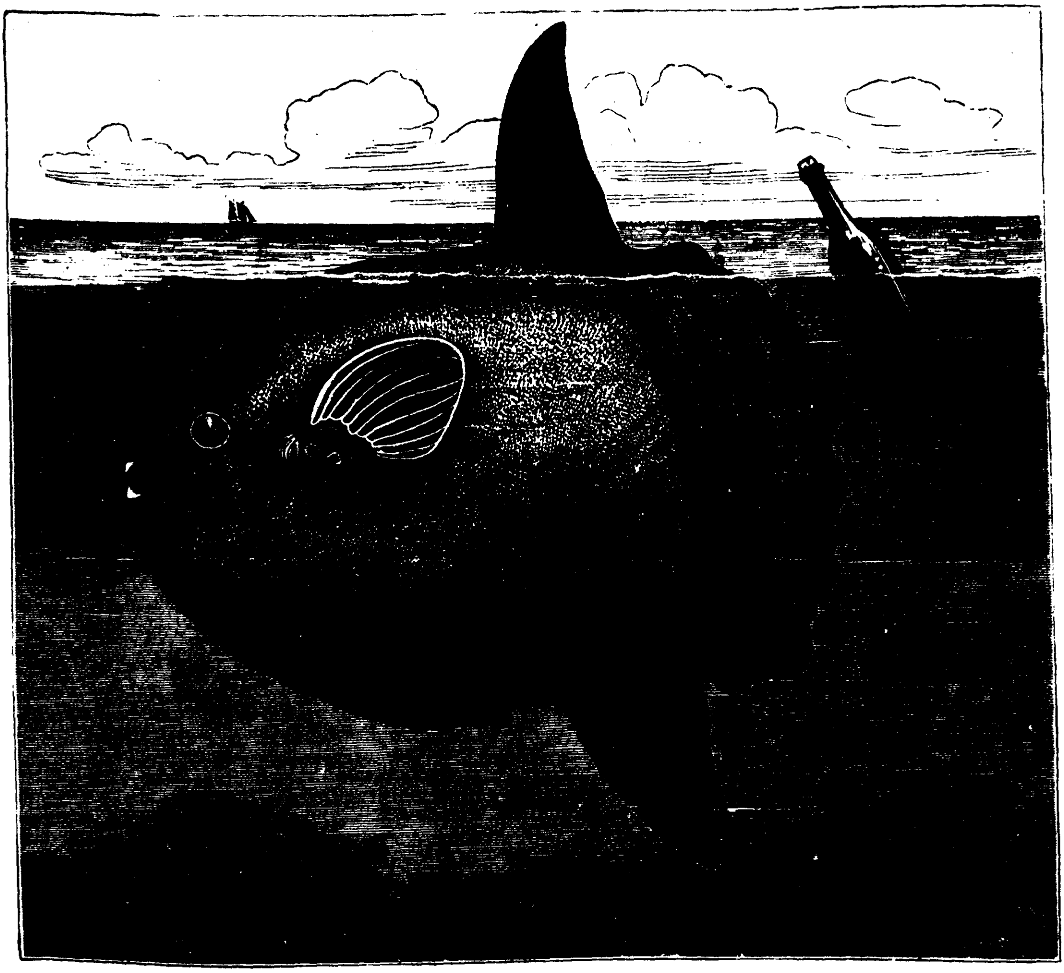
On the present occasion the numerical strength of the exhibits was not equal to that of last year, but the work shown was of very excellent quality from a technical point of view.

The competition was divided this year into three classes—namely, turning in wood, including both hard and soft materials; in pottery, comprising terra-cotta, stoneware, earthenware and porcelain; and in metal. In wood, the qualities considered in awarding the prizes were among others, beauty of design, symmetry of shape, utility and general excellence of workmanship, exact copying, fitness of the work and novelty; and the specimens were all of hand-turning without special rest or tool apparatus. In regard to pottery—form, execution and beauty were considered; and in relation to metal—truth in turning, accuracy in fitting, and general finish were dealt with. In each class the company offered as their chief prize a medal, the freedom of the company and of the city of London; and for other prizes they gave bronze or other medals, certificates and money gifts, these latter being mainly given by the Baroness Burdett-Coutts, Mr. Henry Collings and Mr. A. P. Bower, while Mr. S. Morley, M.P., gave special prizes for the best specimens of amateur work in ornamental turning in any material. In wood there were twenty-six exhibits, including vases, candle-sticks, inkstands, columns, oval frames, plates, waiters, table-legs and columns, cigar-holders, paper-racks, ring stands and other articles.

The judges for the wood turnery (Mr. A. P. Bower, Mr. S. Jacques, Mr. Jones and Mr. Winser,) in their report state: "It is the pleasing duty of the judges to certify the continued improvement shown in this over former exhibitions. The various merits shown by very many of the exhibits have rendered the decision of the judges one of more than usual difficulty. In this, which may be considered the leading department of the company's craft, the court may be congratulated on the good results which have accrued by their appeals to the trade, now extending over so many years."



EBONY CABINET MADE BY TURPE, OF DRESDEN.



THE GREAT SUNFISH.

An unusual number and variety of tropical fishes and reptiles have visited our coast this season. In the turtle family we have had the green turtle, the shell turtle, the logger-head, and the huge leather turtle.

Of free swimming fishes taken by fishermen there has been the jew fish, gray snapper, tarpon, chætodons (angel fish), and great numbers of the balloon or porcupine fish, real man-eaters of sharks, and, the most odd-looking of all, the great sunfish (*Orthogoriscus mola.*)

The specimen from which I made the accompanying illustration was captured at Oak Island Beach, about thirty miles from New York, on the Atlantic, last August, and was exhibited at Fulton Market Slip, New York. The color of the sunfish is grayish-brown, darker on the back than on the sides of the abdomen. The skin is rough, it being covered with minute patches of small spines.

One of the curious features of this fish is the structure of the eye, which is embedded in a mass of soft and flexible folds, while behind the eye is a sac filled with a gelatinous fluid.

When the sunfish is alarmed, or is basking on the surface of the water, the eye is pressed against the sac, and the fluid contained therein is forced into the folds of the membrane, which distends them so as to nearly conceal the organ of vision.

The sunfish is armed with two powerful teeth, with which it feeds on the coarser seaweeds found growing at the bottom of the shallower ocean waters, and also on the gulf-weed of the Gulf Stream. Some years ago I was sent to Greenpoint, L. I., to bring on a large living specimen of the sunfish. This specimen was confined in a pound or trap; when not disturbed it swam near the surface, with its huge dorsal fin entirely out of water. Its favorite food consisted of tubularians, sertularians, and ascidians, on which I constantly fed it.

The sunfish often attains a very great size. One that was caught in Florida, and sold to the New York Aquarium, measured six feet.

According to Yarrell, the young of the sunfish or head fish are furnished with several dull pearl-like teeth of various sizes situated in the lower jaw, some thin and flat, presenting an edge, others behind being cylindrical, short, and rather pointed. These disappear with age, for we learn from Jenyns that in the adult the lamellated substance is undivided.

Various parasitical animals, such as Pennella, Sagitta, and Tristoma coccineum, are found frequently adhering to the body.

The head of the sunfish is not distinct from the trunk, but suggests that the entire fish consists of a head only, thence the name head-fish. The form of the body is oblong, subtruncated behind, and compressed. The caudal, anal, and dorsal fins are confluent. The body is scaleless and destitute of lateral lines.

The fisherman relates that when trolling not long since for bluefish, he came across a sunfish as large as a hogshead, which was asleep on the surface of the water, with his huge dorsal fin entirely out of the water. At first he was well clubbed with an oar, but he didn't seem to mind it much. Then a couple of bights were made in the sheet rope, which were passed over his head, hoping that his fins would prevent their slipping, but it was no go. He opened his eyes as if awakening out of a sound nap, and went slowly under the water in a vertical direction, apparently only slightly disturbed. This specimen was estimated to weigh at least 800 pounds, and was much larger than the one exhibited at Fulton Market Slip.

The flesh of the sunfish is white, and as well flavored as that of the sturgeon. Its liver is large and yields considerable oil, which is greatly prized by sailors for its supposed medicinal qualities. The specimen from which the accompanying illustration was made measured four feet in length.—*Scientific American.*

Educational.

LOVE OF BOOKS AND READING.

BY A. E. WINSHIP.

A book is the home of the thought it domiciles. Thoughts met only in newspapers are merely horse-car acquaintances, besides whom we sit for a moment without knowing the name or occupation of the man; while those found in library-books are no more than incidental vacation friends, whom we enjoy for a time and never see again. We can only know thoughts and love them intelligently when we have their home within our own library to run in upon them in a friendly way, sitting in sweet converse with them for a moment or a day, as inclination dictates.

It is hardly worth while to claim acquaintance with a man whom we have met but once, however keen our enjoyment of his company: neither is it quite honest to claim acquaintance with an author, however great our appreciation, unless we have for our own the book in which he dwells. Whittier loses in a slight degree his hold on the love of his readers, because his homes change from Amesbury to Danvers and the Bear Camp River. It would certainly have heightened the pleasure of all lovers of literary men had he a permanent home, with wife and children like Longfellow, to whose home, overlooking the Brighton meadows and the winding Charles, multitudes make their pilgrimage. How much Walt Whitman, Bret Harte, and Joaquin Miller lose by leaving in the public mind the idea that they are rovers, while Curtis's hillside home, and Holland's Thousand-Island residence intensify their friendships. Every one appreciates the weakness of the musician's hold upon the community because so seldom inlinked with any home name. We listen, applaud, and admire the great artists with voice or instrument, but never think of them again until another brief concert-season arrives. And when they pass the years of best vocal powers, they live only in occasional reference. A historic incident divorced from all locality has no value; no more have thoughts and expressions that we do not know in their home, resident in some book.

We need to call a halt all along the educational line, and see if we have not gone quite far enough in cultivating a love for the hand-organ element in reading, creating a passion for type without inspiring a love for good thought elegantly expressed. We want *Helen's Babies* or *That Husband of Mine* to call at our door and give some timely jingle, and then pass on out of sight and sound. What have the schools done to remedy this?

Teachers devote fully one-fourth of all their time for the nine or ten years of a pupil's school-life to teaching reading; and what do they teach, even at the best. Of course, there are honorable exceptions, but the rule is that they simply teach the child to read aloud, a thing that nine-tenths of them will never do a dozen times in their life after leaving school. They are not taught to love reading, and least of all to love books, for the thing is impossible in a reading book, which changes its selection and style of selection every day, being a hop, skip, and jump, from ballad to oration, from dialogue to epic poem, from hymn to story.

Even our high schools and academies usually teach from English literatures that have brief selections rather than entire essays or stories, though there are a few works that remedy this evil; and when an extended poem is studied, the teacher not infrequently goes to the other extreme, teaching so minutely as to squeeze all the life and juice out of it, having it studied in a manner that they can never read in life, and in a manner that will never germinate a love for good reading or good books.

A school that turns a pupil into life without a well-established habit of reading the best things from a love of them, has failed in its mission. The public must demand that the schools teach the pupils to read profitably. Every child who goes out of the grammer shool should have read intelligently under the supervision and direction of the teachers, one or more of the best works of each of the best authors. How can pupils be expected to appreciate the value of a book when the school itself does not appreciate it. Where is the grammar school with a library of standard books of a literary or avocational nature? We put tens of thousands of dollars into a school-house to enshrine a mayor's name, and possibly a few dollars into a few reference-books, but not one cent into a library.

Many a man lives on a cheap-restaurant style of coverless literature, or at best on a round of boarding-house style of library accommodations, simply because his love of good books was not cultivated in his school-days. We have no sympathy with the unpardonable extravagance of unreasonably elaborate bindings, and even less in the purchase of a "timely" book which chances to be the rage, but the purchase of which one will regret ever after. But every child ought to be taught to love to read and re-read the works that are immortal, to love those books in a comfortable home-like binding, to love to make the sacrifice requisite to own them.

Fellow-teachers, do we love the best literature, and read it to the exclusion of all that is transient? Do we own books of permanent literary merit? Is our home-library an example to our pupils? If not, let us begin the work of library-building, the work of choice reading at once, and teach by example as well as precept.

Fellow committeemen, do we appreciate the necessity of school-room libraries of the best literature? Do we, in selecting teachers, inquire into their own reading-habits, and the character of their book purchases? Do we make a place in our curriculum for the best teaching of reading? Do we, in our school visitation, by our inquiries and advice exalt this department of education sufficiently? As critics, as parents, do we in the home, with the pen, in the Sunday-school, or in the pulpit, as circumstances may direct, enforce the necessity of driving out of existence the twelve scandalous New York city weeklies, with their three million circulation, by supplanting the love of them with a love for the best in literature?—*Journal of Education.*

THE ACME OF MISINSTRUCTION.

The public schools of Philadelphia—some of them at least—have achieved the unenviable fame of having "about the vilest plan of education that was ever devised." So at least an indignant parent says, and the proof offered is, we trust, sufficient. We cannot bring ourselves to think that any school work can be worse.

Hearing his little girl sobbing over a rule which she was trying to commit to memory, he investigated the matter and found the words to run in this wise:

"Rule for Short Division Rule dash one write the divisor at the left of the dividend, semicolon, begin at the left hand, comma, and divide the number denoted by each figure of the dividend by the divisor, comma, and write the quotient beneath, period. Paragraph."

"2. If there is a remainder after any division comma, regard it as prefixed to the next figure comma and divide as before period. If any partial dividend is less than the divisor, comma, prefix it to the next figure, comma, and write a cipher in the quotient period."

"Paragraph Proof period dash multiply the quotient by the divisor, comma, and add the remainder, comma, if any, comma, to the product, period.

The teacher's object was not to reduce this particular ten year old girl to idiocy or insanity by the quickest possible method; the aim was simply to insure the "correct" writing and pointing of the rule in the recitation room. All the children had to study rules that way; and though a Philadelphia lawyer could not easily follow the sense of a rule through such a jargon of words, it seems that Philadelphia children are compelled to; or, rather, they are compelled to memorize the jargon and the sense is disregarded. In the course of his inquiries the parent found that if a comma was left out in writing the rule, though the sense remained unchanged, the pupil suffered as much in loss of marks as though she had committed a vital blunder.

A more thoroughly foolish perversion of arithmetical instruction could not well be conceived. And the professional stupidity and formalism which could devise such an outrageous method of teaching one subject is from that achievement alone demonstrably unfit to be trusted with any branch or department of instruction.

Taking the schools as they run, good, bad, and indifferent together, it is speaking within bounds to say that two-thirds of the work done in them might be wiped out and abolished to the benefit of the children. They might then have time to learn in a reasonable way some things worth their while to know, in the learning of which in a proper way they would be educated and not stultified, as they are under the more or less mitigated Philadelphia fashion now prevalent.

The Royal Agricultural Society is about to offer prizes for the invention of a mechanical means of droining land, and one of the objects aimed at will be the introduction of an automatic excavating machine, capable of working on the land which now suffers from want of proper drainage.

Miscellaneous.

PAINTING OF CEMENT AND PLASTER.

Much difference of opinion prevails respecting the question of painting Portland cement, and we have seen work painted a few weeks after the cement has set, which has stood well. There is one point which has a great deal to do with the question of successful painting, namely the absorbency and dryness of the brickwork itself. Many new walls, saturated with moisture, are cemented, and in this condition no paint can possibly stand if laid on too soon. It is a good and safe rule to enforce that Portland cement work should not be painted within a year of its completion, to allow it to dry thoroughly; but we are safe in saying the majority of new fronts are painted before they have been finished three months. A very desirable precaution seems to be to coat the work with linseed oil first.

The painting of plaster work requires the same care, and the lime works out in small bubbles, destroying the paint. In painting plaster, white lead and linseed oil, with a little drier, is recommended by one authority. This coat should be of the consistence of thin cream, so that the oil is absorbed into the plaster in a few hours. In a day or two another thicker coat may be applied, and a third a few days after, rather thicker, followed by the finishing coat. Four coatsare not too much for good work. By the absorption of the oil into the plaster the surface becomes hardened, and may be washed. Another method to facilitate this absorption is followed by painters, which is to give the plaster two or three coats of boiling linseed oil, and then to apply the other coats of paint. We are inclined to think the application of the oil before the paint a better plan, to insure a thorough saturation of the material. The color of Portland cement, and the uneven tint it sometimes assumes, is the main reason why painting is resorted to. For this reason we think it may be worth the attention of manufacturers to turn their consideration to the subject, and those using cement as a stucco might also prevent a blotchy and uneven tint by attending to the preparation of the wall and the sand they use with the cement.—*Building News.*

AN EXHIBITION OF POSTAGE STAMPS.

An exhibition of stamps by a society in Vienna has brought out some curious information relative to its branch of postal affairs. Some of the collections exhibited were of considerable historical interest and value, notably that of Dr. Moschkan, collected during the Franco-Prussian war. It contained the stamps and the envelopes of the German and the French field post-offices, and of the field post office of the Swiss corps of observation, a postage stamp from Alsace, issued by the North German Bund, August 1, 1870, balloon letters from Paris and Metz, the photographically reduced letters for the pigeon post, stamps issued under Gambetta's dictatorship, and others by private firms who managed the postal communication during the Commune. He exhibited the first Stamps of the German Empire, and of the French Republic, and one which bears the head of the Count de Chambord, issued by the Legitimists in 1870, in anticipation of a Bourbon restoration.

Among the portraits of postal reformers which grace the walls of the exhibition were those of Sir Rowland Hill and the Duchesse de Longueville. This heroine of the Fronde introduced envelopes in 1635 for letters carried by the Paris city post. Envelopes with an impressed stamp were used first in Sardinia in 1819. The Spanish stamps reflect, in the heads of Isabella, Amadeo, Don Carlos, and Alfonso, the dynastic changes that have taken place. A collection of Spanish stamps from 1850 to 1853 is valued at $150. The Austrian stamps, including those for Holstein under the Austrian occupation, and for Bosnia, amount to 2,362 specimens. There are 120 postal cards belonging to the General Postal Union, and a good collection of forged stamps was shown expressly for the benefit of collectors. The verdict of the visitors was that our stamp with the head of Washington was the most beautiful one in the exhibition.

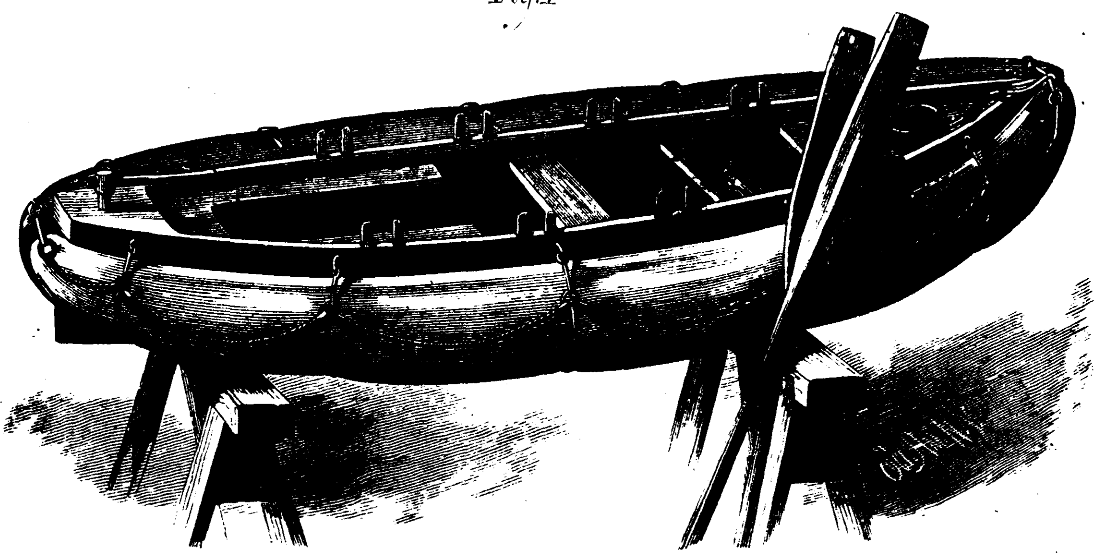
In connection with this exhibition, some figures of the operations of the General Postal Union may be interesting. It extends to twenty-five States and to the British, French, and Dutch colonies. It forwarded in the year 1879, 3,949,000,000 letters and cards. This total may be divided into 3,481,000,000 for Europe, 1,246,000,000 for America, 175,000,000 for Asia, 11,000,000 for Africa, and 36,000,000 for Australia. Including newspapers, printed matter, and samples, the Postal Union forwarded 6,776,000,000 packages, of which 5,285,000,000 belong to Europe.

Of the various European nations the English write the most letters. The figures for 1879 are 1,176,400,000 for England, and 553,000,000 for Germany. But the economical Germans sent 123,000,000 postal cards, while the English used only 114,000,000. It is reckoned that in the whole world the daily requirements are 13,000,000 letters and cards, giving every inhabitant of the globe a yearly average of 3½ written communications. The annual average of European countries for each inhabitant is: England, 36; Switzerland, 25; Germany, 18; Holland, 17; Belgium, 15; France, 14; Denmark, 13; Austria, 11. In England there is a post office for every 2,463 inhabitants; in Germany, for every 5,037; in Austria, for every 5,498; and in France, for every 6,242. Switzerland possesses the most post offices in proportion.

BALLOON PHOTOGRAPHY.

At a meeting of the Balloon Society of Great Britain held last Friday at the Westminster Aquarium, Mr. W. B. Woodbury read a paper on Balloon Photography, in which he remarked that though little had been done at present in the advancement of the science of photography for balloon purposes, yet he believed that the day was not far distant when they should be able to obtain bird's-eye views of all the principal towns and villages of the world, photographed and laid map-like before us for our minute inspection. Nothing, however, of a practical nature has yet been accomplished. The difficulties in the way were numerous; but they had been smoothed down by the introduction of photographic dry plates from 20 to 50 times more rapid than the means we have hitherto had at command. We had first to consider the fact that it was not the object we wished to photograph that was in rapid movement, but the instrument with which we were working. Let them suppose a train going at express speed; if the camera were perfectly steady the rapidity of the exposure would represent the train almost standing still, but if during the same rapid exposure the camera moved only the hundredth part of an inch in any direction, the effect on the exposed plate would be that of the train as well as the whole landscape having moved some dozens of yards, which would be fatal to all ideas of obtaining anything like a sharp or clear picture. It was evident therefore, that we required not only the most rapid plates that could be made, but also the quickest form of instantaneous shutter. The whole of the balloon photographer's picture was composed of distant objects, and therefore they wanted only such an exposure of plates as would give them the hard outlines with a slight amount of half tint. But they must not expect to get artistic pictures so much as plans. He next considered the relative advantages of photographing from a free or captive balloon, and gave the preference to the latter, as in the case of the former the exact tract of country it was wished to photograph could not be decided upon beforehand. A light rudder or sail might perhaps with advantage be attached to the balloon, to assist the cord in keeping it steadier. The principal difficulty then remaining to be overcome was the surging motion of the balloon from side to side in its captive condition; and this could be done away with by attaching two wires or cords to the camera at right angles to the line taken by the cable holding the balloon. He suggested the use of elastic indiarubber cords instead of ropes. The camera which he had constructed, with the special object of taking views from a captive balloon, was now at the Paris Exhibition. The taking of plans and villages was only one of many uses that such an apparatus as he described could be put to. In case of war its uses would be manifold. The outlines of fortifications, inaccessible otherwise to the view, could be obtained, and if an army were massed, though invisible to the opposing force, any movements would be easily detected by taking a series of views at intervals. By means of a sciopticon or other form of magic lantern, the image of the negative directly on development could be projected onto a large sheet of paper in a darkened room, and the principal outlines rapidly sketched in crayon, so that the results could be easily and quickly examined by those in command, and enlarged photographic images subsequently obtained for more careful reference. In exploring expeditions it would be of great utility, as the directions taken by rivers or streams could be observed even though hills intervened. Also to Arctic expeditions it might prove of very great service; but in these two latter instances the Montgolfier system of balloon would, he thought, have to be adopted, as few exploring parties could carry the necessary materials for the formation of hydrogen *en route*. The first attempts at balloon photography were made by the late Mr. Negretti during an ascent with Mr. Coxwell.

Fig.1



HALL'S LIFE RAFT.

IMPROVED LIFE RAFT.

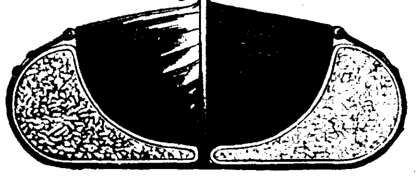
The engraving shows an improved life raft recenly patented by Mr. Thomas Hall, of Newton, Mass. It is designed to be carried on ships and steamboats, and consists of a double float or raft made of cork or other buoyant material, and of such shape that they may be fitted to the outside of the ordinary ship's boat.

These rafts or floats are made in two parts, one being placed on each side of the boat, to which they are secured by suitable fixtures and lashings, as represented in the engraving.

When the parts of the raft are united they form a cradle or holder in which the boat rests, and the curved ends of the rafts are nearly in contact with each other at the bow and stern of the boat. While it is preferable to make the raft of such materials as can most readily be made to conform to the shape of the boat, straight cylinders or caissons may be used.

On board a ship or steamboat the raft and its included boat is carried on deck or hung from the davits in the usual manner, and when launched it takes the water without danger of upsetting. The boat may be filled with people, and the life lines will support a large number of those who are in the water, both being used simply for floating: or the lashings may be cut and the floats detached from the boat, which can be rowed, with its passengers, to any desired point, and return to take off those who are clinging to the floats and life lines.

Fig.2



TRANSVERSE SECTION OF LIFE RAFT.

WHITE OR BROWN BREAD.

The earliest agitator in the matter observed two years ago, when travelling in Sicily, that the laboring classes there live healthily and work well upon a vegetable diet, the staple article of which is bread made of well-ground wheat meal. Nor are the Sicilians by any means the only people so supported. "The Hindus of the Northwestern province can walk fifty or sixty miles a day with no other food than 'chapatties,' made of the whole meal, with a little 'ghee," or Galam butter." Turkish and Arab porters, capable of carrying burdens of from 400 to 800 pounds, live on bread only, with the occasional addition of fruit and vegetables. The Spartans and Romans of old time lived their vigorous lives on bread made of wheaten meal. In northern as well as southern climates we find the same thing. In Russia, Sweden, Scotland and elsewhere the poor live chiefly on bread, always made from some whole meal—wheat, oats or rye—and the peasantry of whatever climate so fed always compare favorably with our south English poor, who, in conditions of indigence precluding them from obtaining sufficient meat food, starve, if not to death, at least into sickliness, on the white bread it is our modern English habit to prefer. White bread alone will not support animal life. Bread made of the whole grain will. The experiment has been tried in France by Magendie. Dogs were the subjects on trial, and every care was taken to equalize the quantity of food, given in each case to the weight of the animal experimented upon, and so forth. The result was sufficiently marked. At the end of 40 days the dogs fed solely on white bread died. The dogs fed on bread made of the whole grain remained vigorous, healthy, and well nourished. Whether an originally healthy human being, if fed solely on white bread for forty days, would likewise die at the end of that time remains, of course, a question. The tenacity of life exhibited by Magendie's dogs will not evidently bear comparison with that of the scarcely yet forgotten forty days' wonder, Dr. Tanner. Nor is it by any means asserted that any given man or any given child would certainly remain in vigorous health for an indefinite length of time if fed solely on wheat-meal bread. Not a single piece of strong evidence has been produced, however, to show that he would not; and in the only case in which whole bread has been tried with any persistency or on any considerable scale among us—to wit: in jails—facts go to show such bread to be an excellent and wholesome substitute for more costly forms of nutritious food.—*Nineteenth Century*.