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.
- [ ] 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.

- [x] Additional comments / Commentaires supplémentaires: Continuous pagination.

SCIENTIFIC CANADIAN
MECHANICS' MAGAZINE
AND
PATENT OFFICE RECORD

Vol. 8. APRIL, 1880. No. 4.

THE TAY BRIDGE.

A short history of this remarkable structure, which was partially destroyed on the last Sunday night of 1879, may form an interesting sequel to Major-General Kilner's letter, in our March number, on the subject of its destruction.

The bridge was constructed by the North British Railway Company with the object of shortening the route between London, Edinburgh, and Aberdeen. The following description is taken from articles by Mr. Grothè, C.E., who superintended the works as representative of the contractors:

Mr. Thomas Bouch, years ago, proposed the bold plan of bridging them both—the Forth at Queensferry—and the Tay about a mile above Dundee. While the desirability of such a scheme was generally recognised, the most sanguine hardly believed that it would ever be realised; but they overlooked the fact that while our wants increased, engineering science had not remained stationary, and that by modern improvements in machinery and appliances, facts could now be accomplished which, even twenty years ago, would have been classed amongst impossibilities. Mr. Bouch's earnestness, and great reputation as an engineer, at last gained the victory over the doubt of those who had to support him, and, in 1869, the company applied for and obtained the Act of Parliament which authorised them to build the Tay Bridge, and raise the necessary capital on shares—the North British Railway Company guaranteeing an interest of 5½ per cent. from the time the bridge was expected to be finished, viz., three years after it should be commenced. On May 8, 1871, the next important step was taken, viz., that of entering into an agreement with an experienced contractor for the execution of the work. Mr. Charles de Bergue, from London and Manchester, the accepted contractor, had acquired great fame in the erection of large bridges in nearly all parts of the world, but almost immediately after the signing of the agreement he became seriously ill, so that he could not take an active part in the execution. At his death, in 1873, complications arose which had a retarding influence on the progress of the work, and the contract was annulled by mutual consent of the parties, and transferred to Messrs. Hopkins, Gilkes & Co., Limited, of Middlesborough.

At the site of the bridge, the Firth of Tay is about two miles broad. On the south side trap rocks rise abruptly to a height of about 50 feet out of the water; on the Dundee side they have a more gentle slope. In both cases they very soon disappear towards the centre of the river, and are only found at depths which put it out of the question to use them as a foundation for the various piers. Their place on the river bottom is partly taken by clay and boulders, partly by sand; and under the latter, in depths of about 18 feet, a stratum of gravel is found, which is quite capable of sustaining the weight which is to be put upon it. There are in all eighty-five piers, supporting spans of varying lengths, and differing according to the weight of the latter. Those piers which stand on the solid rock are entirely constructed of brickwork set in Portland cement. Portland cement plays a most conspicuous part in the construction of the piers, the first fourteen from the south side being entirely built with it up to the very top, and all the others up to 5 feet above high water where the ironwork begins. The piers which are not founded upon rock require, of course, an extended base to carry the great weight with safety. The former consist of two cylinders of 9 feet 6 inches diameter, while those standing on gravel, and supporting spans of the same length, have the diameter of these two cylinders enlarged to 15 feet, and their top weight is greatly reduced by substituting for the heavy brickwork above high water, cast-iron columns, fixed together by horizontal and diagonal transverse bracing. Thirteen of the spans over that part of the river which is generally used for navigation are 245 feet long, and the piers are so high that at the highest water there are 88 feet of clear waterway left—more than sufficient for the class of vessels plying from Dundee to places above the bridge. The girders composing these spans are placed so wide apart that the trains can pass between them, the roadway being fixed at the bottom of the girders. In the other parts of the river this great height is not required, and the piers have, therefore, been kept much lower, the *top* of the spans in this part being level with the *bottom* of the large ones, and the rails being laid on cross sleepers resting on top of the girders. In this manner the roadway forms an unbroken line, while there seems to be a step in the girders.

On the Dundee side the line has to pass the town underground. To reach it the line must come down in time from its lofty position, and an incline of one foot, in every seventy-three of length, is, therefore, introduced in the part north of the large spans. The length of the spans on this part varies from 162 feet to 69 feet, and quite near the shore a large span of 170 feet is constructed, with a view of offering facilities for a future extension of the esplanade, which would necessitate the construction of a roadway under this span. For the same purpose it is built on the "bow-and-string" principle, and the rails kept at the bottom. Parallel girders, like those of the large spans, might, of course, have been used; but what is no disfigurement when carried out over a great length would look very bad indeed if applied to a single span. Now the curved top-boom makes the transition an easy one. The last six spans on the Dundee side, so far as they belong to the Tay Bridge contract, are short ones, being only 27 feet long. Three more of these, and a "bowstring" of 100 feet, complete the iron part of the bridge, bringing the total length to 10,612 feet, or two miles and fifty feet. On the south side the same reasons for constructing a strong incline did not exist. As the land at the south shore is about 70 feet above high water, an easy slope of one foot in three hundred and sixty-five was sufficient to bring the line to the required level. The spans on that side are mostly 145 feet and 130 feet in length. There are only two of 88 ft. and three of 67 ft. near the shore. To complete the general description of the bridge, it will only be necessary to mention that, in order to join the land portions of the line, a long curve had to be introduced on the north side extending over nearly a quarter of a circle, and one of less length on the south side; giving the bridge in plan the appearance of a gigantic **S.** From the shore the curves, especially the one on the Dundee side, appear to be very sharp, but in reality they are not, both having a radius of twenty chains, while on other lines curves of eight chains are frequently met with. Let us look at the means which were employed to construct this, the longest bridge in the world. Quite in the beginning Mr. Austin, another of Mr. de Bergue's managers, laid down a principle which was of the greatest bearing on the success of the work. It was to dispense with the staging and scaffolding which are generally used in bridge building. The piers and girders were to be erected on shore, and floated out to their destination. The consistency with which this principle was carried out would distinguish this bridge from all other structures of the same kind, even if its size and importance were less remarkable. No matter of what material the parts were constructed, whether they were iron receptacles for concrete, huge lumps of brickwork, weighing above 200 tons, or iron girders of 190 tons, they were all finished on shore and floated to their destination. During the execution the details had frequently to be modified to suit the altered circumstances, but the principle was adhered to as the only one which could produce good results in a tidal river subject to such vicissitudes, and with a continually shifting sandy bottom.

The pieces of iron forming the girders or spans were erected and riveted together on a staging near the shore, and connected with it by a gangway. Some of these pieces as they arrived from the contractors' works, at Middlesborough, were 35 feet long, and weighed three tons. Each span had four horizontal pieces or booms, two at the top and two at the bottom, and four vertical posts at the ends. Nine crosses, consisting of struts and tie bars, keep the booms at the proper distance and transmit the strains to the ends where the span is supported by the piers. The two girders of each of the 245 feet spans are 15 feet apart, their depth is 27 feet, and their weight 190 tons. To erect and rivet them on the staging required four weeks, no fewer than 18,000 rivets having to be put in each. According to one of the contractors, the materials used in the construction of the bridge comprised 3,500 tons of wrought iron, 3,700 tons of cast iron, 8,700 cubic feet of timber, 15,000 casks of cement, and 10,000,000 bricks.

Many theories have been advanced as to the cause of the fall of this bridge, which was regarded with pride and admiration as one of the great works raised by British engineers—whose works have, heretofore, been alike remarkable for the boldness of their conception and the stability of their construction. Among the theories advanced is one, in which the writer concludes that the bridge was well nigh conquered by the wind, when the advancing train offered to the wind an additional resistance, which turned the scale.

The central portion of the bridge consisted of thirteen spans—these spans consisted of what are spoken of as the *great* girders. The total number of spans were eighty-four. Thirteen of these spans went down. These thirteen central girders were raised above the level of the others, so that the rails, which ran level with the lower booms of the lower girders, were laid on a level with the lower booms of the great girders, therefore, a train, when travelling across the bridge, it appears, ran literally on the top of the structure for the first and last portions of its journey; but in crossing the thirteen central spans, it ran through a sort of *cage or tunnel of lattice work.* This the writer considers important to be borne in mind, because a theory has been started to the effect that the force of the wind blew the train off the rails, and so caused the destruction of the bridge, which he considers untenable, first, because there is, or rather was, a double guard rail right across the bridge, and secondly, because the train traversed in safety the portion of the bridge where, being on the top of the lower girders, it was exposed to the full fury of the gale.

Furthermore, the writer considers that the inquiry will, if fully carried in that direction, show that the stability of the train was greater than that of the bridge; or, in other words, that it would have required a greater force of wind to overturn the train than to upset the bridge. Taking the first of the great girders from the south end, we find that it was 227 feet in span. Next came eleven spans of 245 feet each, and then one of 227 feet. This gives a total length of 3,149 feet for the elevated portion of the bridge. The whole of this has gone into the river beneath. From the accounts of eye-witnesses, and also from the researches of the divers, it is known beyond all doubt that the train had passed completely within the cage of the greater girders before the bridge fell. In fact the wreck of the train lies almost entirely between the fourth and fifth piers. The train, therefore, passed over the 227-feet girders, and also over two of the 245-feet girders. It seems most probable that, at the time the train entered the high girders, the bridge was struggling with, and well-nigh conquered by the wind, and that the extra resistance offered to the wind by the train turned the scale. As throwing some light on this view, we will give the best approximation of figures available. In November, 1876, Mr. EDGAR GILKES, the contractor, who finished the bridge, laid the following figures before the Cleveland Institution of Engineers:—"The exposed surface of one large pier is about 800 square feet, and of the superstructure—the girder—about 800 more." In this calculation, Mr. GILKES only takes the windward girder into consideration. This is evidently fallacious, as no one can for a moment maintain that the leeward girder would be completely sheltered by the windward one. It also assumes that the effect of the wind on a lattice girder is only equal to its calculated pressure on the net surface of the ironwork, if concentrated into a plate of equal area; but it is well-known that the wind would exercise a considerable effect by mere drag in passing through the lattice work. We believe we are within the mark in reckoning the pressure on the lee girder and the drag, as equal to one half the net pressure on the windward girder. We should then have 800 + 800 + 400=2,000 square feet. Assuming that the pressure of the wind in the squalls rose to 50 lbs. per square foot, we should have a lateral force of 100,000 lbs., on each of the great girder spans, tending to overthrow the bridge sideways. And when the train came on to the bridge we should have an addition of about 1,600 square feet, which would give an addition of 80,000 lbs. pressure. There would thus be a total pressure of 180,000 lbs. acting sideways against one span of the bridge.* To counteract this pressure, there would be the weight of the train, and that of the girders, with a part of the weight of the piers. This brings us to the point where the weakness appears to have been. The upper portion of the piers, from about five feet above high-water line, consisted of very slender cast-iron cylinders, braced with diagonal ties. These were so slender as to almost merit the name of tubes, and the bolts fastening their flanges together appear to have been only $1\frac{1}{8}$ inch in diameter. In the downfall of the bridge, these slender cast-iron piers have been almost completely destroyed. There is no doubt, whatever, that the girders were of ample strength for any possible load; and these piers would also have withstood the downward pressure of such a load; but we believe that their excessive slenderness as compared with their great height, the brittle material, and the absence of any fastenings to counteract lateral swaying of the bridge under great wind pressure, only too easily account for the catastrophe.† It is well-known that tall chimney shafts sway visibly in high winds. In the case of this bridge we have something analogous to a line of tall shafts at intervals of 245 feet, with girders 27 feet deep reaching from top to top, and opposing immense resistance to the wind. Then we have the added resistance of the train, and the overstrained piers give way, tumbling girders and train into the torrent beneath.

* The total lateral pressure of the wind against the thirteen spans of girders constituting the elevated portion of the bridge—making the deduction for two of those spans being only 227 feet—would be 1,103,300 lbs., without the resistance of the train.

† We will publish in our next number the statement of some of the workmen who were employed in the construction of the bridge. Their evidence, if uncontradicted, would show that the cast iron was extremely imperfect.

We are indebted to *Martineau & Smith's Hardware Circular*, published in Birmingham, England, for much of the valuable information contained in this article.

INCOMBUSTIBLE WOOD.

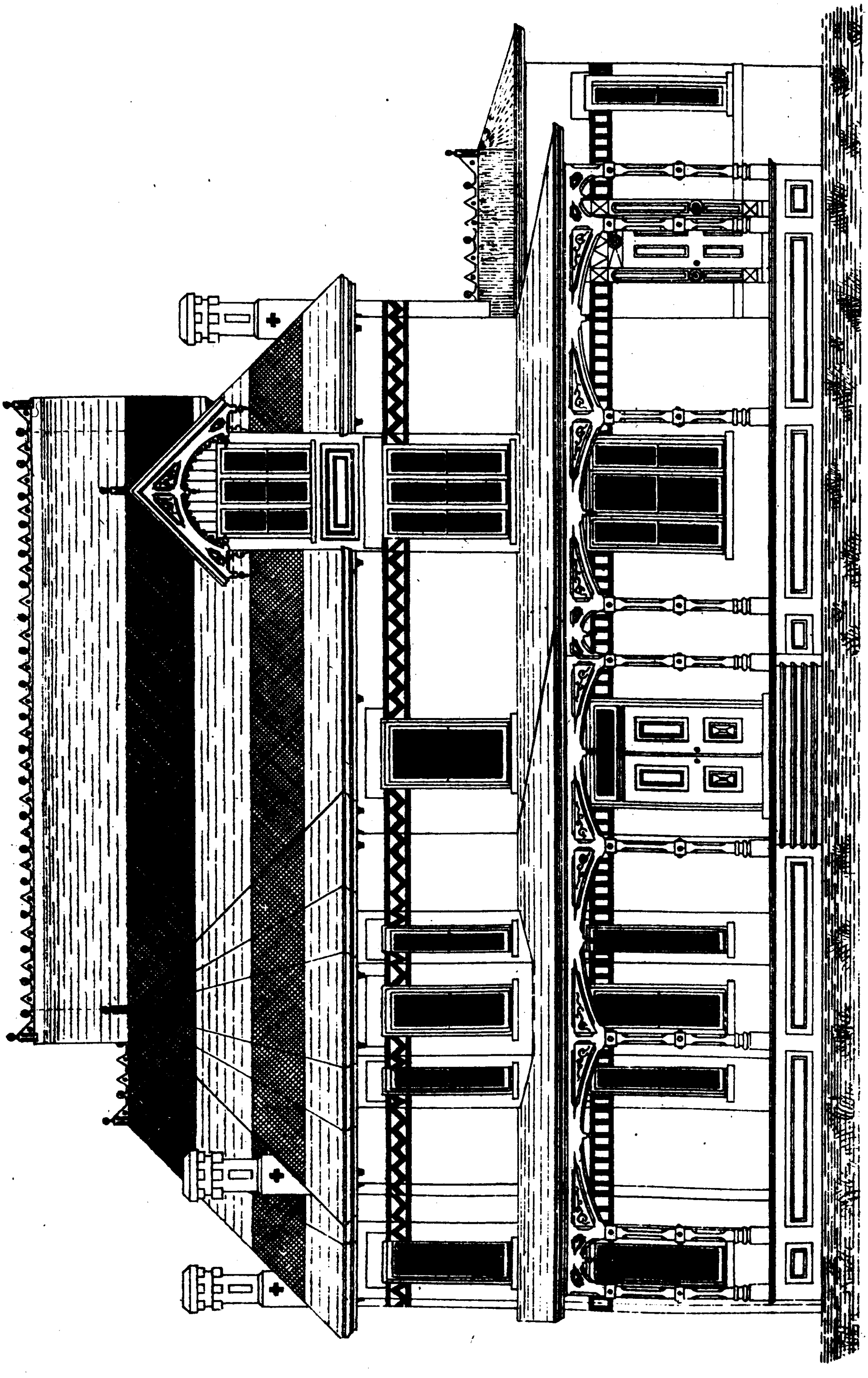
M. M. P. Folbarri claims that he has discovered a method by which wood of any kind can be rendered incombustible. It becomes, as it were, petrified, without any alteration in appearance. When intense heat is applied to wood so prepared it chars the surface slowly and without flame, but does not penetrate to any extent, and leaves the fibre intact, whereby in case of fire, the firemen would have no occasion to fear that the materials on which they tread would give way beneath them, if this operation had been undergone by the wood composing the staircases, floors, etc. The following chemical compound is said to produce the result: Sulphate of zinc 55 lbs.; potash, 22 lbs.; alum, 44 lbs.; oxide of manganese, 22 lbs.; sulphuric acid of 60°, 22 lbs.; water, 54 lbs. All the solids are to be poured into an iron boiler containing the water at a temperature of 45 degrees C., or 113 F. As soon as the substances are dissolved, the sulphuric acid is to be poured in little by little, until all the substances are completely saturated. For the preparation of the wood it should be placed in a suitable apparatus, and arranged in various sizes' (according to the purposes for which it is intended) on iron gratings, care being taken that there is a space of about half an inch between every two pieces of wood. The chemical compound is then pumped into the apparatus, and as soon as the vacant spaces are filled up, it is boiled for three hours. The wood is then taken out and laid on a wooden grating in the open air, to be rendered solid, after which it is fit for uses of all kinds, as ship-building, house-building, railway carriages and trucks, fence-posts, wood-paving—in short for any kind of work where there is any liability to destruction.

BARE BRICK WALLS—THEIR INFLUENCE ON HEALTH.

The New York *Times* of January 14th has the following: "At the meeting of the Board of Health, yesterday, a report was received from Dr. E. H. Janes, Assistant Sanitary Superintendent, in relation to an inspection of the recent additions to the new Court House. Dr. Janes says: 'I found that the interior walls consist of brick uncovered by plaster or paint, and thereby present an absorbing and evaporating surface, which in my opinion, is detrimental to the health of those who daily occupy these apartments. From its porous quality, brick readily absorbs not only air and moisture from the ground and atmosphere, but animal vapors and impurities constantly escaping from the lungs and skin of those confined between brick walls are also absorbed and exhaled in turn with the regular changes and purifications of the in-door atmosphere.

"I am aware that the experiments of Pettenkofer are cited as an argument in favour of bare brick walls, on the ground that air readily passes through them; but persons holding these views forget that animal impurities do not possess the diffusible power of gaseous bodies, but on the other hand, adhere to porous structures; and while it may be claimed that foul air will, to some extent, escape through the brick walls from an unventilated apartment, the fact remains that air in finding its way through the wall leaves most of it foulness behind. Bricks so exposed become in time exceedingly filthy, and cannot be thoroughly cleaned by any amount of scrubbing. I would, therefore, recommend that the interior walls of these rooms be covered with some material that will prevent the absorption and subsequent exhalation of moisture and atmospheric impurities.' The report of Dr. Janes was transmitted to the Surrogate, whose clerks occupy the rooms referred to in the document."

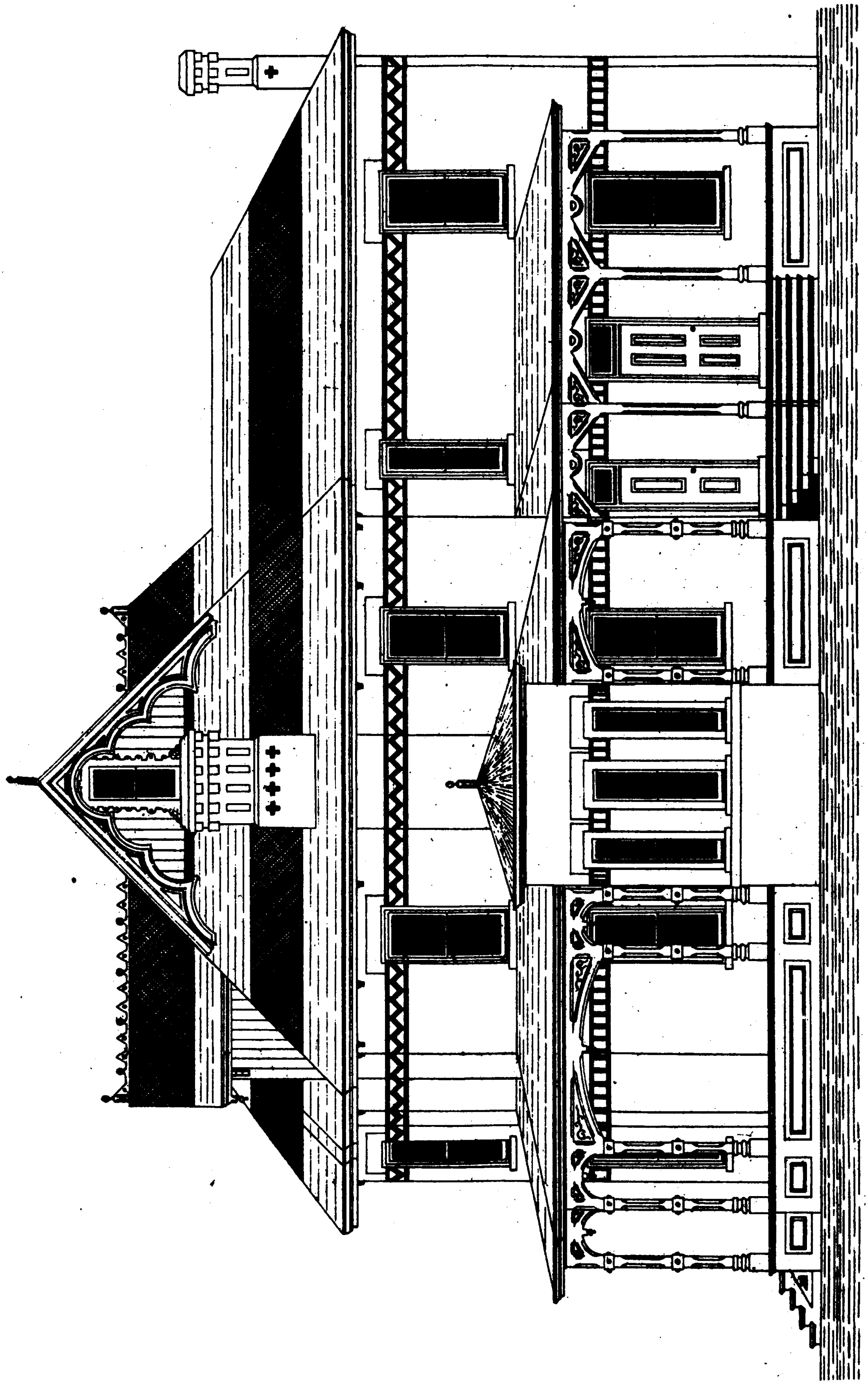
IMMENSE WAGONS.—Three immense wagons, to be used in the mines of Colorado, are being made in Chicago. The back wheels are six feet three inches in diameter, and the tire is five inches wide. The wagons, including box, are nine feet high. They are each to be drawn by twenty yoke of oxen, and are capable of carrying ten tons each.



DESIGN FOR A SUBURBAN RESIDENCE AT BROCKVILLE.—FRONT ELEVATION.

MESSRS. WARDROP & JOHNSTON, ARCHITECTS.

The Walls of this Building are to be of red brick, relieved with courses of black brick and sand stone trimmings.



DESIGN FOR A SUBURBAN RESIDENCE AT BROCKVILLE.—SIDE ELEVATION.

MESSRS. WARDROP & JOHNSTON, ARCHITECTS.

Scientific.

PROF. TYNDALL'S LATEST WORD.

If asked whether science has solved, or is likely in our day to solve, the problem of the universe, I must shake my head in doubt. Behind and above and around us the real mystery of the universe lies unsolved, and as far as we are concerned, is incapable of solution. The problem of the connection of body and soul is as insoluble in its modern form as it was in the pre-scientific ages.

There ought to be a clear distinction made between science in the state of hypothesis and science in the state of fact.

And, inasmuch, as it is still in its hypothetical stage, the ban of exclusion ought to fall upon the theory of evolution.

After speaking of the theory of evolution applied to the primitive condition of matter, as belonging to the dim twilight of conjecture, the certainty of experimental inquiry is here shut out.

Those who hold the doctrine of evolution are by no means ignorant of the uncertainty of their data, and they only yield to it a provisional assent.

In reply to your question, they will frankly admit their inability to point to any satisfactory experimental proof that life can be developed, save from demonstrable antecedent life.

I share Virchow's opinion that the theory of evolution in its complete form involves the assumption that, at some period or other of the earth's history, there occurred what would be now called spontaneous generation. I agree with him that the proofs are still wanting. I hold with Virchow that the failures have been lamentable, that the doctrine is utterly discredited.

Science and the Bible.

The *Christian Advocate* says, in reference to the first of the above paragraphs ("That there ought to be a clear distinction between science in the state of hypothesis and science in the state of fact"), that 'no doubt there is that distinction, and no doubt, either, that forgetfulness of this truth is the reason why so many premature assaults have been made on the teachings of revelation, in the name of science.' 'Science, *in the state of fact*,' is no more antagonistic to the truths of the Bible than one ray of the solar spectrum is inconsistent with the other."

The Theory of Evolution.

The *Advocate* further says: "Prof. Max Muller makes the following strong point against Mr. Darwin's 'Theory of Evolution.' He insists that philology points out the real specific difference between man and the lower animals. It erects a barrier which has never been passed. He says: 'I cannot follow Mr. Darwin, because I hold that this question is not to be decided in an anatomical theatre only. There is, to my mind, one difficulty which Mr. Darwin has not sufficiently appreciated, and which I certainly do not feel able to remove. There is, between the whole animal kingdom on the one side, and man, even in his lowest state, on the other, a barrier which no animal has ever crossed, and that barrier is language. By no effort of the understanding, by no stretch of imagination, can I explain to myself how language could have grown out of anything which animals possess, even if we granted them millions of years for that purpose.'"

ANTIQUITY OF OUR EARTH.

In orthodox France, where the English theories of Darwin, Huxley, Spencer, and other savants of that class scarcely find any support, and where the opening address of the President of the Association for the advancement of science was in such strong contrast with the rationalistic ideas of the President of its English prototype, the British association, is at last awakening to the light of scientific deductions, and fairly on the road of progressive thinking. This lately became evident at the meeting of the Geological Society of Paris. Here M. Blaudet read a paper on the antiquity of our planetary system, giving it an age quite different from the theological doctrine prevailing especially in France. The French papers, while publishing it, remark that the ideas of M. Blaudet have the advantage over the theological notions, and of being at the same time more explicit, more rational, and more calming to the mind.

M. Blaudet holds, with Kant and La Place, that when the planetary system condensed from a nebular condition, it left masses behind which did not gravitate to the centre. These are the planets; Venus, Mercury, and the earth have no other origin, and this fact he considers beyond dispute. He says further:

"Our earth went, during its course in space, through six periods: 1st. The chaotic period—absence of all vegetable and animal life. 2nd. Carboniferous period—the era of the immense vegetable growth, which absorbed the carbonic acid from the air, and the products buried during successive convulsions of the earth, extended through various zones, as well under the equator as near the poles. 3rd. The cretaceous period. 4th. The eocene period. 5th. The miocene period—the primitive vegetation leaves the poles, which cool down to below the temperature necessary for life; at the same time nature, more choice in its products, gives birth to animals more and more perfect. 6th. The last or quaternary period, is that in which we now live.

"The continuous condensation of the sun is alone sufficient to explain how it has been able to furnish the prodigious quantity of heat which it has radiated into space. The calculations have been made: If it condense only enough to diminish its apparent diameter one second of an arc, it generates an amount of heat equivalent to that which it emits in 18,000 years.

"In the beginning of our earth's existence, it rolled through a space of fire, the sun's heated gases were extending beyond her orbit. The sun had then, as seen from the earth, a diameter of 180°; this slowly became reduced to 47°, next to 22°, next to 8°, and finally to 2° apparent diameter.

"Then the quaternary period began; the poles commenced to cool, and only the tropics received heat enough to sustain the luxurious vegetation of the former periods.

"The radius of the sun, says M. Minot, director of *Le Journal du Ciel*, (Journal of the Heavens,) from which I borrow these astonishing calculations, is at present to us 16 minutes or 960 seconds of an arc; its density is 0,955, (less than water, which is 1,000,) 5½ times less than the density of the planet Mercury. Supposing that the sun obtains a crust as soon as by continued contraction it has obtained the same density as this planet, and when it, therefore, has become 5½ times smaller its radius will be 1¾ times less, or 9 1-7 minutes, or 548 seconds. Its radius will then be able to lose 412 seconds on the diameter, 824 seconds before we will cease to receive the same heat as today, at the rate of 18,000 years per second of radius or about 15,000,000 years. From 16 minutes to 1 degree there are 44 minutes or 2,640 seconds; there are, therefore, 2,650 times 18,000, or nearly 50,000,000 years that the earth is in a condition to be inhabitable.

"The miocene period, or the time when the tropical flora prevailed on the tops of the Pyrenees and Alps, and at the poles, when the sun was 3°, or 180 minutes, or 10,000 seconds larger, we go back 194,000,000 years before 244,000,000 years. Paris had, even later still, a tropical temperature, and the eocene period existed 250,000,000 years before that time, or about 500,000,000 years previous to the present day.

"But the carbonaceous era consists of 777,000,000 years more, making together about 1,500,000,000 years.

"The earth separated from the contracting planetary nebula some 4,300,000,000 years before, making, as a total for the time of its independent existence, about 6,000,000,000, years."

This calculation appears to bring the existence of our earth only one milllon times longer than the Biblical theologians are trying to make it.

MARVELS OF MAN.

While the gastric juice has a mild, bland, sweetish taste, it possesses the power of dissolving the hardest food that can be swallowed; it has no influence whatever on the soft and delicate fibres of the living stomach, nor upon the living hand, but, at the moment of death it begins to eat them away with the power of the strongest acids.

There is dust on sea, on land; in the valley and on the mountain-top; there is dust always and everywhere; the atmosphere is full of it; it penetrates the noisome dungeon, and visits the deepest, darkest caves of the earth; no palace door can shut it out, no drawer so "secret" as to escape its presence; every breath of wind dashes it upon the open eye, and yet that eye is not blinded, because there is a fountain of the blandest fluid in nature incessantly emptying itself under the eyelid, which spreads it over the surface of the ball at every winking and washes every atom of dust away; but this liquid, so mild, and so well adapted to the eye itself, has some acridity, which under certain circumstances, becomes so decided as to be scalding to the skin, and would rot away the eyelids were it not that along the edges of them there are little oil manufactories, which spread over their surface a coating as impervious to the liquids necessary for keeping the eye-ball washed clean, as the best varnish is impervious to water.

The breath which leaves the lungs has been so perfectly divested of its life-giving properties, that to re-breathe it, unmixed with other air, the moment it escapes from the mouth, would cause immediate death by suffocation, while if it hovered about us, a more or less destructive influence over health and life would be occasioned; but it is made of a nature so much lighter than the common air, that the instant it escapes the lips and nostrils, it ascends to the higher regions above the breathing-point, there to be rectified, renovated and sent back again, replete with purity and life. How rapidly it ascends is beautifully exhibited any frosty morning.

But foul and deadly as the expired air is, Nature, wisely economical in all her works and ways, turns it to good account in its outward passage through the organs of the voice, and makes of it the whisper of love, the soft words of affection, the tender tones of human sympathy, the sweetest strains of ravishing music, the persuasive eloquence of the finished orator.

If a well-made man be extended on the ground, his arms at right angles with the body, a circle, making the navel its centre, will just take in the head, the finger-ends and feet.

The distance from "top to toe" is precisely the same as that between the tips of the fingers when the arms are extended.

The length of the body is just six times that of the foot; while the distance from the edge of the hair on the forehead to the end of the chin, is one tenth the length of the whole stature.

Of the sixty-two primary elements known in nature, only eighteen are found in the human body, and of these, seven are metallic. Iron is found in the blood; phosphorus in the brain; limestone in the bile; lime in the bones, dust and ashes in all. —*Journal of Health.*

RECENT RESEARCHES IN THE POLARIZATION OF LIGHT.

Faraday, in 1845, made the important discovery that bodies which (like glass or water) have ordinarily no particular action on polarized light, rotate the plane of polarization when influenced by strong electric or magnetic forces. Many experimenters have since worked in this field, and it has been proved that not only in solids and liquids, but in gases also, an electro-magnetic rotation of the plane or polarization may be effected. MM. Kundt and Rontgen have recently described to the Munich Academy experiments by which they prove such rotation, even in the less easily condensed gases, hydrogen, oxygen, atmospheric air, carbonic acid, and marsh gas, and measure its amount. Their method consisted essentially in compressing the gas strongly in a copper tube with glass ends, through which a beam of polarized lime light was passed, the tube being surrounded by a coil of wire for passage of the current. For certain reasons the polarizer and analyzer were placed within or between the glass ends of the tube, and consisted of tourmaline plates. The polarizer end of the tube was fixed, while the rest of the tube, with the analyzer, could be rotated about its axis. The amount of rotation of the plane of polarization was found to differ considerably in the different gases, and to be greater, the greater the index of refraction. In one and the same gas with varied density the amount of the rotation is proportional to the density.

An interesting question connected with such researches is that as to the possible influence of the earth's magnetism on polarization of light of the atmosphere. Some time ago, M. Henri Becquerel made a striking experiment, in which, a beam of light having been polarized by successive reflections through a tube containing sulphide of carbon, it was found that if the tube was in the plane of the magnetic meridian, the plane of polarization had not the same position when one looked northwards as when one looked southwards; but if the tube was at right angles to the magnetic meridian, the plane had the same position whether one looked east or west, and its position was midway between those in the two other cases. This seemed to indicate a magnetic rotation of the plane under the earth's influence. Recently M. Becquerel has made numerous observations on atmospheric polarization in regard to the earth's magnetism. The plane of this polarization should coincide with the plane of the sun (a plane, *i. e.*, passing through the sun, the point looked at, and at the observer's eye), when the sun's plane is vertical, if there were no disturbing influence. Now, looking at a point near the horizon north or south, or better, near the magnetic meridian, when the sun's plane is vertical, the plane of polarization is found by M. Becquerel to be deflected by a small angle, and the coincidence of the two planes never occurs till after the passage of the sun. It is exactly as if the plane of polarization underwent a rotation, always in the same direction (which with reference to the axis of rotation of the earth is direct), and this rotation M. Becquerel attributes to the earth's magnetism. In the region at right angles to the magnetic needle, the rotation was found to be *nil.*

LUBRICATING BEARINGS.

It is impossible for a bearing to run cool until the high places are reduced so that there will be a uniform film of unguent between the two surfaces. It is a custom for purchasing agents, and in some cases for practical men, when ordering oil, to mention simply "lubricating oil," without specifying the kind of bearings for which it is to be used. The latter is a very essential point. Frequently, when the oil is received, it is found to give very poor satisfaction, and some of the bearings are found to run hot. Under these circumstances, the oil is generally charged with the fault, when, in reality, the fault has been in giving the order. A good lubricant for small, close-fitting, fast-running bearings must be of a very fine quality, and have a light body, in order to distribute itself between the close-fitting surfaces. Such a lubricant is entirely unfit for large bearings, where more body is required to carry the heavy weight which is placed upon them. It is the practice in most shops to use the same kind of lubricating oil for all the machinery, which, when properly considered, is both unreasonable and extravagant, for the reason that a bearing, when improperly lubricated, is worn away much faster than it would otherwise be, and on fine machinery the lost motion in the bearings requires frequent attention.

CONCERNING THE MEMORY.—The *Medical Press and Circular* gives some entertaining statistics of memory from M. Delaunay. The inferior races of mankind, such as negroes, the Chinese, etc., have more memory than those of a higher type of civilization. Primitive races which were unacquainted with the art of writing had a wonderful memory, and were for ages in the habit of handing down from one generation to another hymns as voluminous as the Bible. Prompters and professors of declamation know that women have more memory than men. French women will learn a foreign language quicker than their husbands. Youths have more memory than adults. It is well developed in children, attains its maximum about the fourteenth or fifteenth year, and then decreases. Feeble individuals of a lymphatic temperament have more memory than the strong. Students who obtain the prize for memory and recitation chiefly belong to the former class. Parisian students have also less memory than those who come from the provinces. At the *Ecole Normale,* and other schools, the pupils who have the best memory are not the most intelligent. The memory is more developed among the peasantry than among the laity. The memory remains intact in diseases of the left side of the brain, and is much affected in those of the right, from which it may be inferred that the right side is more the seat of this faculty than the left. From a physiological point of view memory is diminished by over-feeding, by physical exercise, and by education, in this sense, that the illiterate have potentially more memory than those who know how to read and write. We remember, moreover, better in the morning than in the evening, in the summer than in the winter, and better in warm than in cold climates.

CHLORATE OF POTASH FROM THE DEAD SEA.—Chemical analysis having long ago shown that the waters of the Dead Sea in Palestine are rich in chlorate of potash, a company has been formed, and already commenced operations, to extract this salt from its waters. It is stated that in this way chlorate of potash can be obtained 30% cheaper than by the cheapest process thus far known; and as there is an increasing demand for this salt, it is a safe and profitable investment. In order to save fuel, which is scarce in those regions, the works are kept in the most active operation during the dry season, when the water is low and the River Jordan does not dilute them much, the water level varying considerably, and consequently the concentration. This body of water, of course, contains the soluble ingredients from the heights surrounding the whole water-shed, of which the rains have made a lye, and solar evaporation has concentrated in that sea.

EMAIL INK.—The drug house of Louis Muller, in Leipsic, has put on the market colored inks which may be used for writing labels on glass, porcelain, ivory, marble, mother-of-pearl, and metal. The writing is done with a goose quill, and, when dry, adheres so firmly that it cannot be removed by any liquid. Four different colors are made—black, white, red and blue.—*Drog. Zeit.*

Scientific.

DISEASE-GERMS.

An address delivered at the Anniversary Meeting of the San Francisco Medical Society, November, 1879, by J. H. WYTHE, M.D., Professor of Histology and Microscopy in the Medical College of the Pacific.

In addressing this medical association, so largely representative of the scientific learning and culture of the most cosmopolitan city in the world, I am not vain enough to imagine that I can present any new theme, nor that I can better elaborate an old one than many of those who listen to me. I deem it an honor and a token of your confidence, to have been appointed your orator at this annual meeting, and can trust to your generosity to overlook whatever may seem immature or imperfect in my remarks.

In selecting a topic of general interest to the profession, rather than one which would tempt me to indulge in vague generalizations or eulogies respecting medical progress, I am following a custom of some of the leading scientific associations of Europe and America, and not unusual here—a custom both useful and appropriate.

The theme I propose is that of Disease-Germs, a subject so influential in etiology as to have quickened many fertile imaginations, from the days of Varro and Columella to the present, although it has also led to valuable practical results. If, in the light furnished by the recent advances of biology, I can dissever the romantic and imaginative from the true, so as to indicate the real importance of disease-germs among the *materies morbi*, I shall have accomplished much.

Every agency of nature outside of the bodily organism, and every activity of body and of mind within the living structure, is capable of becoming a cause of disease, as soon as it disturbs the normal current of life, so that the number of causes is practically unlimited. Of all the causes of disease, the most difficult to isolate and investigate are those which produce what are known as miasmatic and contagious, or infectious, diseases—diseases which may be diffused through the air or water, and those which spread from one person to another.

Formerly infectious diseases were regarded as products of gaseous chemical action—so-called fermentation—or zymotic diseases; but more recently they have been considered to be each the result of a virus, in all probability specific; or a special poisonous substance has been imagined for each disease. The discoveries of the last few years have tended still further to isolate the causes of this class of diseases, and the theory of *contagium vivum* has found very general acceptance. In other words, the belief is now very general that the causes of contagious affections, and, perhaps, also of miasmatic diseases, are living, or organic, causes, so that these derangements are not merely the physical or chemical result of the action of inorganic matter. From this view it is but a step to the germ theory of disaase.

Under the general title of disease-germ, two distinct theories claim consideration: 1. The theory of vegetable parasites in the blood, generally fungi, and of this class most commonly the various species of *Bacteria*. This has been very elaborately worked out by the German pathologists, and has been favorably regarded in other countries since the publication of the observations of Pasteur, Salisbury and others. 2. The germ theory of Dr. Lionel S. Beale, who considers that "the particles concerned in the propagation of contagious diseases are allied in constitution to the living matter, or bioplasm, of the organism," and "derived by uninterrupted descent from the bioplasm, or living matter, of an organism, which at an antecedent period may have been perfectly healthy."

The definition of a germ given by Dr. Beale is identical with what modern biology terms a cell, or the elementary unit of living beings. It is simply a piece of bioplasm, "a particle of living matter, which has been detached from already existing living matter." "The living particle which sprouts from a cell of the adult plant or organism, and is then detached, may be called a germ, as well as the living particle formed in the ovum, or the living matter in the ovary, from which the new being is evolved." It is evident that this meaning to which the term "germ" is restricted is a special meaning, and, so far as it implies reproduction, is limited to the multiplication of similar cells, and not of individuals, as in the case of the ovum. The various masses of bioplasm into which the ovum of man or of the higher animals subdivides, are exact counterparts of each other, so far as external appearance and chemical composition are concerned, but they differ greatly in power. Some produce glands; some, muscle; others, nerve, bone, vessels, etc. The powers of these bioplasts, once lost, can never be regained, although they may continue to live and be nourished, and multiply even more actively than before. Indeed, observation shows that degradation in power is generally associated with increased rate of growth and remarkable vitality, as in the rapid growth of embryonic cells in new formations, etc.

"Abnormal cells cannot be regarded as parasites upon healthy cells, although many forms of abnormal bioplasm, like pus, cancer, etc., may be transferred from animals to man, or vice versa, and grow and multiply."

"If such bodies as mucous corpuscles, pus corpuscles, cancer cells, tubercle corpuscles and disease germs generally, be termed parasites, the nails, or hairs, or glands or limbs might with equal propriety be regarded as of this nature."

The following *resume* of Dr. Beale's theory is from his work entitled, "Disease-Germs; Their Nature and Origin," a work which will well repay careful perusal. The most recent biological researches have almost uniformly tended to confirm the statements made in it.

"The minute contagious bioplast is less than the 100,000th of an inch in diameter, and often so very clear and structureless as to be scarcely distinguishable from the fluid in which it is suspended. Such a minute particle may readily be transferred from the affected organism to an apparently sound organism. It may be carried a considerable distance from its source without losing its marvelous power of causing in the organism invaded a series of changes resembling, and often in very minute particulars, the phenomena which have occurred in the organism from which it was derived.

"And it is established that there exist different kinds of contagious living bioplasm, each capable of occasioning specific phenomena which distinguish it. The poison of small-pox will produce small-pox, not typhus fever, or measles, etc., nor will any of these produce small-pox. Without, therefore, pretending to identify the actual particles of the living bioplasm of every contagious disease, or to be able to distinguish it positively from other forms of bioplasm, healthy and morbid, present in the fluids, on the different free surfaces, and the tissues, in such vast numbers. I think the facts and arguments I have advanced prove: first, that the contagious virus is living and growing matter; secondly, that the particles are not directly descended from any form of germinal matter or bioplasm of the organism of the infected animal, but they have resulted from the multiplication of particles introduced from without; thirdly, that it is capable of growing and multiplying in the blood; fourthly, that the particles are so minute that they readily pass through the walls of the capillaries, and multiply freely in the intestines, between the tissue elements, or epithelial cells; and lastly, that these particles are capable of living under many different conditions—that they live and grow at the expense of various tissue elements, and retain their vitality, although the germinal matter of the normal textures, after growing and multiplying to a great extent, has ceased to exist."

These views Dr. Beale elaborates with great force and plausibility. He admits that myriads of vegetable organisms, microscopic fungi and algæ of different kinds, and their germs, may enter the human body, and are actually seen in the fluids and tissues of the higher animals during life, but he claims that all attempts to demonstrate constant species of bacteria, representing different contagious diseases, have completely failed; that the beneficial action of Mr. Lister's antiseptic treatment of wounds is traceable to the influence of carbolic acid upon the growth of bioplasm, and that the virulence of the poison in cases of dissection-wounds is greatest before putrefaction and the development of bacteria—the real virus losing its power soon after bacteria appear. He states that those diseases which are known to depend upon the growth and development of vegetable organisms are local affections, not involving the blood, and that very few morbid conditions depend upon fungi, whose germs multiply in textures already deteriorated, rather than in tissues previously healthy.

On the other hand, recent biology has shown that the animal and vegetable bioplasm have similar endowments as to nutrition, growth and reproduction. In the vegetable, or fungus cell, the bioplasm is imprisoned in a cell-wall of cellulose, while in the animal it may be either free or encased in formed material of different kinds. As to the fungi, it has been quite satisfactorily shown that they are the exciting and essential cause of both fermentation and putrefaction. They form a very extensive class of primitive organisms, which have so many peculiarities that some have been led to regard them as different from both animals and vegetables. They look like vegetables, but feed as animals. They have no chlorophyll, as the green vegetables have, and which enables them to break up carbonic acid. Light is not essential to their activity, as it is to that of green vegetables, and they are incapable of assimilating inorganic food, but require organic substances for their support. The bioplasm of some kinds of fungi has amœboid movements, like other primitive forms of life, yet their principal office seems to be to break down and restore effete organic material to the inorganic world. The excessively minute and almost vapor-like sporules of fungi float about in the atmosphere in countless numbers, only waiting for a fitting soil in which to grow. As long as there is no refuse matter to be removed these scavengers are unemployed, but the smallest quantity of decaying animal or vegetable matter left exposed, becomes covered with spores, which develop with astonishing rapidity. A scanty number of spores, only to be detected by careful research, will in a few days, and sometimes in a single night, give birth to myriads, to repress or remove the nuisances referred to. When the offal diminishes, fewer of the spores find soil on which to germinate, and when all is consumed the active legions return to their latent or undeveloped state. Like Milton's spirits

> " So thick the aery crowd
> Swarmed and were straitened, till the signal given,
> Behold a wonder; they but now who seemed
> In bigness to surpass earth's giant sons,
> Now less than smallest dwarfs."

Many of the most simple forms of fungi have been shown by recent investigations to be imperfectly developed states of other species. The *Torula cerevisiæ*, or yeast plant, whose growth is the cause of fermentation in solutions of sugar, and various forms of *Bacteria* which cause putrefaction in animal substances, appear to be but varieties, or stages in the development of some of the molds. On account of this polymorphism, or assumption of different forms, in the life history of these organisms, their study is very difficult. Those genera and species which are of most interest in pathology and etiology, may be however provisionally classified as follows, after Wagner: (*Manual of Gen. Path.*)

I. Dust, or Germ-Fungi (*Coniomycetes*). These consist of single, or loosely connected spores, which sometimes develop a mycelium, or filament, from which other spores are formed by constriction.

Here belong the "rust" of grain (*Uredo*), and the yeast-fungi (*Torula*).

II. Filamentous Fungi (*Hyphomycetes*). In these the mycelium consists of lengthened tubes, often branching in elegant figures, and bearing spores.

The "molds" belonging to this order, as the *Penicillium*, or common fruit mold; *Aspergillus*, club-mold; and *Mucor*, with bladder-like fruit on the mycelium. Here also are placed the fungi found in various diseased states, as that of the muscardine in silk-worms (*Botrytis bassiana*), the potato-disease (*Fasisporium solani*), the grape-disease (*Oidium Tuckeri*), and the fungi of diseases of the skin and mucous membranes, as the *Tricophyton tonsurans*, found in ringworm, mentagra, etc. *Achorion Schonleineii*, or favus-fungus, *Microsporon Audonii*, *Microsporon furfur* and *Oidium albicans*, or thrush-fungus.

III. Cleft-fungi (*Schizomycetes*). Here are placed the various forms of bacteria:

1st group, Globular bacteria.

1st genus, *Micrococcus*. These are globules or oval cells, sometimes united into bead-like filaments, or rounded masses. They are sometimes seen in ammoniacal urine, and are regarded by many as "ferments of contagion," and the cause of diphtheria, pyemia, etc.

2nd group, Rod-like bacteria.

2nd genus, *Bacterium*.

They are of short cylindric form, and have spontaneous motion. *B. termo* is the ferment or cause of putrefaction.

3rd group, Filamentous bacteria. Elongated cylinders, increasing by transverse division.

3. Genus, *Bacillus*. Straight filaments. *B. anthracis* is found in gangrene of the spleen.

4. Genus, *Vibrio*. Wavy filaments, seen generally in putrifying solutions.

4th group, Screw-bacteria.

5. Genus, *Spirochæta*. *S. plicatilis* is found in tartar from the teeth.

6. Genus, *Spirillum*. Spiral shorter than the last. In this group also may be placed the *Leptothrix buccalis*; long, slender filaments from the mouth, etc.

The principal argument in favor of considering fungi as the disease-germs of contagious and miasmatic disorders, are thus given by Prof. Liebermeister in Ziemssen's Cyclopedia. "In this connection there are facts of considerable importance, which have been furnished by recent investigations into the nature of many contagious diseases in animals and plants. The contagious diseases of the silk-worm, which have been a source of so much danger to the silk-worm culture, have been proved to be parasitic, and the history of the parasite has been followed thoroughly. In flies and many other insects, we have known similar epidemics of a parasitic nature to have taken place.

"The epidemic and contagious diseases of the higher classes of cultivated plants, such as the potato disease, the grapevine disease, the ergot of grain, and others, all are derived from fungus-growth. The question, too, on which for a long time opinions were divided, as to whether the fungus were the cause, or only the consequence of the disease, has been answered by the botanists with unanimity. Where the development of the fungus had been thoroughly examined, they reported that it was the sole and sufficient cause of the disease. It is clearly evident, too, that the further the progress of investigation advances in human pathology, and the more frequently low organisms are shown in diseases, the more prominently will this question urge an answer."

Prof. Wagner, of Leipzig (*Gen. Pathology*, p. 108), while acknowledging his belief that many important affections are caused by fungi, confesses that the subject is yet involved in much obscurity and doubt. He says: "No two observers have, concerning the same disease, reached the same results; the specific fungus of one is disavowed by another, etc; but in spite of all that, much is yet to be expected from the further cultivation of this field, with respect to the etiology, etc., of many diseases."

The fact that "filtration of putrid fluid through porus porcelain under pressure deprives it simultaneously of its offensive smell, poisonous action, and power of generating bacteria," proves that the infectious quality does not reside in the fluid, but in what is contained in the fluid —*Essay on Disease-Germs, by B. A. Watson, M. D.* Now in the fluid of the small-pox vesicle, in the blood and secretions of animals suffering from the cattle-plague, and in the products of other contagious diseases, Dr. Beale has found multitudes of rapidly growing bioplasts, and his statements have been fully confirmed by subsequent research. Dr. Salisbury and others find bacteria and other fungi in malarial and contagious affections. Each considers he has found the true *contagium vivum*. But may not both be true? The fungi, as well as all living things, spring from bioplasm, and may have their share in producing disease as well as the degraded bioplasm of the human tissues The latter must be a frequent cause of disease. There can be no doubt respecting the propagation of purulent opthalmia or gonorrhea by the germs, or leucocytes, which are transferred from one mucous membrane to another. "A single epithelial cell may carry multitudes of active particles of syphilitic poison, one of which introduced into the blood or lymph of a healthy person would probably grow and multiply, and give rise to pathological changes characteristic of, and quite peculiar to this particular poison." When we remember that these particles are excessively small, although alive; that they may continue to grow outside of the parent organism, and acquire by the abnormal conditions of their growth new and virulent properties; that when dried, and in a state of dormant vitality, they are sufficiently light to be carried by air currents to great distances; and that on contact with warmth and moisture, and especially with secretions similar to those whence they originate, they will at once begin to germinate and multiply; all the reasonable conditions of *contagium vivum* are fully met. On the other hand, the known properties possessed by fungi, of exciting fermentation and putrefaction, forbid us to suppose that their presence in considerable numbers in animal fluids is of no moment. Secondary infections, if not primary contagions, must be regarded as the probable result of the presence of these organisms.

The question of the spontaneous generation of germs is largely disposed of by either of the theories referred to. Besides, the careful experiments of Pasteur have fully shown that air filtered from its germs by cotton-wood may be admitted to fluids in which all germs have been destroyed, and no living organisms will appear in them. The experiments of Prof. Tyndall with air made so pure that a brilliant ray of light shows no suspended germs in it, and in which no infusorial organisms occur, although abundant in common air, establish the same theory. Messrs. Dallinger and Drysdale have also shown that some germs will resist a heat of 300° Fah., which accounts for infusoria in some boiled infusions. So that we may regard it as a settled axiom of modern science that every living being originates from a previously living being.

On either the bioplasmic or the fungoid theory of disease-germs, the practical utility of Lister's antiseptic treatment in surgical operations finds a rational explanation. The recent accounts published by Dr. Keith, of Edinburgh, of the application of this treatment to ovariotomy, prove how great an improvement has been made in this direction. Increased skill, and special care in operating, have doubtless much to do with the result, yet the fact remains that graver cases may be successfully treated with the use of carbolic acid spray and carbolized dressings, than a prudent surgeon would have undertaken at all otherwise.

Dr. Beale's bioplasmic theory illustrates the good effects of the sulphites, and especially of the sodium sulpho-carbolate in zymotic diseases. I have used the latter in 20 gr. doses three times a day in some cases of cancer, and have thought it had some influence in arresting the growth of embryonic abnormal bioplasm. In some cases of diphtheria and scarlatina maligna it was of undoubted benefit. It deserves a more extended and careful trial.

I need not do more than remind you, in closing this brief review of the subject, of the importance of obtaining accurate information respecting it, by careful observation; to stamp out pyemia, hospital gangrene, erysipelas, and similar affections by antiseptic treatment, and to so learn the cause of production and propagation of disease germs as to be able to adopt a course of public hygiene which shall neutralize the risk of communities being decimated by pestilent scourges, like cholera, or typhoid, and malarial fevers. Such are the results which may be expected by the attainment of positive truth upon this subject. So desirable a consummation is worth years of pains-taking study and experimentation, and the physician who succeeds in this direction will have earned the gratitude of succeeding ages.

DEEP-SEA SOUNDINGS.

Great difficulty is met with in taking deep-sea soundings by ordinary methods when there are strong undercurrents, owing to the fact that the line is carried away by the currents to such an extent that the length of line paid out affords no measure of the actual depth. Sr. Henrique de Lima has recently devised an apparatus to remedy this defect, a description of which was recently read by that scientist before the Lisbon Academy of Sciences. The apparatus appears to have some valuable features. It is based on the effects of atmospheric pressure, and consists of a cone of sheet copper, having for its base a diaphragm of the same metal, which screws into the bottom of the cone so that it may be readily removed when necessary. In this movable base there are six small holes, which allow the ingress of the sea to the interior of the cone; and to the centre of its upper surface there is soldered a small vertical wire of pure silver, which occupies the axis of the cone.

To prepare the apparatus for use the silver wire is moistened with nitric acid, which results in the production of a thin film of nitrate of silver. The base being screwed on, the cone if suspended by means of a ring at its apex, and sunk by means of two separate weights or stones suspended by cords or chains depending from three rings attached to the perimeter of the cone. To insure a vertical position to the apparatus, and to prevent it from being easily turned from its course, a small float is attached just above the suspension ring at the apex of the cone. As the apparatus sinks into the sea the water penetrates into it through the orifices in the diaphragm and gradually rises in proportion as the pressure increases during the descent. The salt water acts on the thin coating of nitrate of silver on the wire, and turns it perfectly white by the production of chloride of silver as far as immersion has taken place. By this means it is determined to what height the water has risen in the cone, and consequently what the pressure has been; and from these data the depth to which the instrument has descended is easily determined by simple formulæ. The author suggests that by suspending the lower weight by means of an apparatus which would detach it on striking bottom, the apparatus would ascend to the surface of itself, thus dispensing with the use of a line.

Another device has recently been brought before the Geographical Society of Berlin, which is not only designed for indicating the depth of water, but also its current-direction and temperature at any particular depth. This instrument consists of a brass box hermetically closed, and having attached to it an apparatus resembling a vane or rudder. Within this box a thermometer and a magnetic needle are contained, behind each of which is placed sensitive photographic paper, and in front of each of which is a small nitrogen vacuum tube. The box also contains a small induction coil. When the apparatus is lowered to the required depth, the rudder causes it to take a direction parallel to the current there existing, and hence a definite direction with reference to the needle within. The thermometer soon acquires the temperature of the water outside, and becomes stationary. At this instant an electric current is sent to the box, which, by means of the induction coil inside, lights up the little nitrogen tube, the violet light of which, photographically very intense, prints, in about three minutes, the position of the needle and the height of the mercury column upon the prepared paper. The current is then intermitted, the apparatus raised, the photographic tracing fixed, examined, and placed upon record.

NOXIOUS VAPOURS AND SMOKE.

Some highly successful experiments have been made for depriving smoke of its deleterious compounds. Sulphurous acid and carbon or soot, it is proved, can be completely scrubbed out by a mechanical process. The smoke, in its way to the chimney is intercepted by two or more wooden racks; between these are dash wheels, which, as they revolve rapidly, throw water from a tank beneath in a fine spray over the racks; the smoke from the furnace is drawn through the chamber by the action of a fan driven at high speed. In the model showing the experiment, the liquid consisted of a solution of soda, which so completely absorbed the sulphurous fumes from burning brimstone that it was possible to inhale the air from the exit flue. Equally effective was the apparatus when turpentine, about the most fuliginous of combustibles, was burned. After its smoke had been washed in the model apparatus, a sheet of white paper was not soiled by exposure to the vapor—no longer smoke—of the flue corresponding to the chimney.

At this stage of the inquiry one cannot say if the experiment shows that erection on large premises will pay, or will altogether act in certain cases, but the experiment with the model, and the subsequent demonstrations of practical use in the chimney of a furnace consuming 50 tons of coal per week, proved the test a complete success. In the latter case a striking proof that the apparatus clears the products of combustion from soot consisted in first placing a piece of wetted linen in the ordinary furnace chimney when it presented an inky aspect in about half a minute; a similar piece held in the flue from the washing apparatus was scarcely soiled.

WONDERS OF THE TELEPHONE.—Capt. John E. Greer, U. S., A., shows how the flight of projectiles can be measured by the telephone, as follows: Hitherto the accurate determination of the time of flight of small arm-projectiles has been practically impossible at long ranges, owing to our inability to see them strike, even when firing over water. The discovery of the telephone has opened up to us a simple as well as novel means of obtaining the time desired, and has also afforded us the means of verifying the formulas by which these times were formerly deduced. In these experiments two telephones provided with Blake transmitters (a form of Edison's carbon telephone) were used. One was placed within a few feet of the gun and left open to receive and transmit the sound of the discharge. The other was in the shelter-proof, which was about thirty feet in front of the right edge of the target. A stop watch, beating fourths of a second, was used in connection with it. The telephone being at the ear, the instant the sound of the discharge was received at the target the watch was started, and, on the bullet striking, was stopped. A mean of a large number of observations which rarely differed more than a quarter to half of a second from each other, gave the time of flight. The velocity of sound may be readily obtained with the telephone in the same manner.

THE AUDIPHONE, which, from recent accounts of its performances, bids fair to become a valuable instrument in assisting the deaf, is said to have been discovered by accident. The inventor, Mr. Richard S. Rhodes, of Chicago, who is very deaf, having noticed that he could hear the ticking of his watch by placing it against his teeth, though quite unable to do so by applying it to the ear, conceived the idea of the instrument now known by the name of the audiphone, which he succeeded, after a year or more spent in experimenting, in perfecting to its present condition. As now constructed, we learn from the *Manufacturer and Builder*, the audiphone closely resembles a fan. It consists, essentially, of a diaphragm of hard rubber, very thin and elastic, about a foot square, with rounded corners and a neat handle. When in use, a silken cord draws down on the inside the top of the diaphragm, presenting a convex surface to the speaker. In this position the upper edge is pressed firmly against the interior edge of the upper teeth, and the sound falling on this surface is conveyed to the auditory nerve. Many accounts of the remarkable effects of this sinple instrument are given from time to time in the daily press and there appears to be no reason to doubt its usefulness.

Miscellaneous Items.

GRINDSTONES.—What can disable a machine shop more effectually than to destroy the grindstone? Unless the loss were supplied by the modern substitute, the emery grinder, to destroy the grindstone would be to wreck the shop. A thorough study of the subject will develop more requirements than many think, and more ingenuity or skill in designing might be displayed in working out the problem. It should be strong, simple and clean; the trough expanded to catch as much as possible of the drip water and grit; a movable shield securely hinged to keep the water from splashing, and yet permit the stone to be used from either side; rests provided upon which to rest tools and the rod for turning the stone, these rests being arranged to move toward the centre as the stone wears smaller. The bearings should be generous in size, proper provisions being made for oiling without washing the grit into the bearings with the oil, and the ends of the bearings being protected by some device which effectually prevents the entrance of the grit. The stone should be secured to the shaft by nuts and washers, and the washers fixed so that they cannot turn with the nuts as they are screwed up or unscrewed. In hanging the stone, great care should be taken to hang it true sidewise, not only for convenience in using, but because a stone that is not true sidewise can never be kept true edgewise.

PROTECTION AGAINST TORNADOES.—It has been noticed, as a curious fact connected with the continental cyclones, that in ravaging a city, in many cases, the demolished buildings are not actually blown down, as if by the action of a force from without, but appear rather to have been burst, as if by an explosion from within. This circumstance can be satisfactorily explained if we bear in mind the tremendous velocity of the wind in such storms. During its rapid passage past the house, it produces a partial vacuum on the outside, when the explosive expansion of the air within causes the destruction. In many cases, houses whose open windows afford a ready escape for the suddenly expanded air, are left uninjured, while neighbouring houses, not so protected, are demolished. Indeed, it is said to be a common practice, in parts of the world where cyclones or tornadoes are common, to leave the windows and doors open on the approach of a storm, as the most effectual means of of saving the buildings.

HOW PEOPLE GET SICK.—Eating too much and too fast; swallowing imperfectly masticated food; using too much fluid at meals; drinking poisonous whisky and other intoxicating drinks; repeatedly using poison as medicines; keeping late hours at night and sleeping late in the morning; wearing clothing too tight; wearing thin shoes; neglecting to wash the body sufficiently to keep the pores open; exchanging the warm clothes worn in a warm room during the day for costumes and exposure incident to evening parties; compressing the stomach to gratify a vain and foolish passion for dress; keeping up constant excitement; fretting the mind with borrowed troubles; swallowing quack nostrums for every imaginary ill; taking meals at irregular intervals, etc.

TABLE SALT AN APERIENT.—Physicians have for a long time known that common table salt is an efficient aperient in ordinary cases of constipation. In a lecture on a case of nervous affection, Dr. Weir Mitchell, of Philadelphia, said that he had recommended the patient to take each morning on rising a tumblerful of water—cold, to prevent nauseating—in which was dissolved a teaspoonful of table salt. "This simple aperient," the doctor adds, "I frequently employ in cases of constipation, and generally find it efficient. There is great advantage in starting the bowels and in keeping them in a soluble condition, particularly in cases of nervous disorder in women, as it sometimes clears up obscure points in the case, and at all events eliminates one source of error.'

PECULIARITIES OF RAPID MOTION.—If a musket ball be fired into the water it will not only rebound, but be flattened; if fired through a pane of glass, it will make a hole the size of the ball without cracking the glass; if the glass be suspended by a thread it will make no difference, and the thread will not even vibrate. When a tallow candle is loaded in a musket and fired at a board of not too hard a wood, it will make a hole in the board. If a round disc of paper is turned very rapidly on a lathe, its edge will cut the fingers like a knife; and if such a disc of sheet iron is turned with sufficient velocity, it will even cut steel.

ONIONS AS A MEDICINE.—A correspondent of an English agricultural journal says that onions are a poison for worms, and that a dish of boiled onions given to a child suffering from worms will kill them. Another correspondent maintains that they are the best remedy for rheumatism, either cooked or raw, while a certain medical man says that boiled onions are good for a cold in the chest. We are glad to hear all this, and hope it may be true and verified by further experiments so that onions will at least be good as medicine if not for food.

NERVOUS FAILURE.—When men do not die of some direct accident of disease they die, in nine cases out of ten, from nervous failure. And this is the peculiarity of nervous failure—that it may be fatal from one point of the nervous organism, the rest being sound. A man may, therefore, wear himself out by one mental exercise too exclusively followed, while he may live through many exercises extended over far greater intervals of time and evolving more real labor if they be distributed over many seats of mental activity.

WOOD AND IRON GEARING.—When gearing is run at high speed, or in any way subjected to severe shocks, if one of the wheels of a pair has its teeth made of wood and inserted into its rim, it has been found—first, that the elasticity of the wood relieves the shock on the iron tooth and reduces the liability of breakage; second, that in case of breakage the wooden teeth are more liable to be broken, and in consequence the teeth can be readily renewed without sacrificing the entire wheel; third, the impact of iron teeth upon wooden ones makes less noise than that of iron upon iron.

ANOTHER ANTISEPTIC.—The benzoate of soda is recommended as the best antiseptic for all infectious diseases, on the authority of Prof. Klebs, of Prague. The author's experiments show that it acts very powerfully, and he affirms that a dose of from 30 to 50 grammes to a full-grown man, given daily will render the poison of diphtheria inoperative, He prepares the benzoate by dissolving crystallized benzoic acid in water, neutralizing at a gentle heat with caustic soda, and then crystallizing the solution over sulphuric acid within a bell glass.

RULE FOR FINDING THE PRESSURE PER SQUARE INCH ON SAFETY VALVES.—When the area of the valve, weight of ball, etc., are known: Multiply the weight of the ball by the length of the lever, and then multiply the weight of the lever by ½ its length; then multiply the weight of the valve and stem by their distance from the fulcrum; add these three products together; this sum, divided by the product of the area of the valve, and its distance from the fulcrum, will give the pressure in pounds, per square inch.

SANITARY ERRORS.—It is a popular error to think that the more a man eats the fatter and stronger he will become. To believe that the more hours children study the faster they learn. To conclude that if exercise is good, the more violent the more good is done. To imagine that whatever remedy causes one to feel immediately better is good for the system, without regard to the ulterior effects.

THE MOST BRILLIANT ARTIFICIAL LIGHT.—Fill a small vessel of earthenware or metal with perfectly dry salpetre or nitre press down a cavity into its surface, and in this cavity place a piece of phosphorus; ignite this, and the heat given off melts a sufficient quantity of the nitre to evolve oxygen enough to combine with the phosphorus, and the effect is to produce the most magnificent white light which chemistry can afford.

TO KEEP BELTS SOFT.—To keep belts soft and pliable, but little care is generally needed, but a little attention on this point would be well worth the while of many mill-owners. When a belt is dry and husky, but still pliable, a little blood-warm tallow, dried in by the fire or the heat of the sun, is all that is needed. When hard and dry, apply neat's-foot oil mixed with a small quantity of resin.

—A new kind of crockery, designed to fill the place of earthenware to some extent, has recently been introduced. It consists of cotton pulp, or felt, glazed with a composition into which dissolved glass largely enters. It is a durable, elastic material, possessing neither the great weight nor brittleness of earthenware; but it has yet to undergo the test of general use.

A SIMPLE CHEST-PROTECTOR.—A folded newspaper placed over the chest inside the vest, on going out during cold weather, constitutes an excellent protector for the lungs.

TO REMOVE INK STAINS.—Wash carefully with pure water, and apply oxalic acid; and, if the latter changes the dye to a red tinge, restore its color by ammonia.

THE GREAT IOWA METEORITE.

This great meteorite, which fell in Iowa the early part of last year, is thus described by Professor Thompson, of the Minnesota State University, in a recent astronomical essay: May 10, 1879, was a bright, clear, cloudless day. At 5 o'clock in the afternoon, in full sunshine, this meteorite passed through the air, exploded and fell in the town of Erterville, Emmet County, Iowa, about ten or twelve miles below the southern boundary of Jackson County, Minn., in latitude 43° 30/ north, longtitude, 94° 50/ west from Greenwich. The path it followed marked a course from northwest to southwest, and was seen for a distance of several hundred miles. Its appearance in the heavens was that of a huge globe of fire, attended by a fiery cloud. The people who saw it were greatly alarmed; not more at the flying ball of fire which seemed so near to them, than at the terrific explosions immediately above them; those who did not see it thought an earthquake had occurred, and were in great terror. The noise accompanying its flight is described as rumbling, cracking, crashing, similar to that produced by a train of cars crossing a long bridge; then came a very loud report, followed immediately by two distinct reports in quick succession, though not so explosive or loud as the first. It struck the ground in separate masses, together with smaller fragments scattered over an area of three or four miles. There were two large pieces which fell about two miles apart.

Meteorite from Chulafinne, Ala.

The largest mass, weighing 410 pounds, now at Keokuk, Iowa, penetrated a hard blue clay soil, to the depth of twelve feet. Another mass, weighing 170 pounds, now at the State University, fell on a dry grassy knoll, and was buried to the depth of 5½ feet. A few rods from the largest mass was found a fragment weighing 30 pounds, and a schoolboy picked up a specimen weighing three pounds. The form of all the pieces is like that of rudely detached masses from a quarry, or ejected from the mouth of a volcano. The mass in the museum of the university has an irregular rhomboidal outline, about 15 by 18 inches, of an average thickness of 6 inches, and when first obtained was covered, as most meteorites are, with a black shining coat or crust. The largest mass is not so regular in its formation. It is more ragged and bristles with points of nickeliferous iron. Professor Heinrich, of the Iowa State University, pronounced it the more valuable of the two large masses; but a full analysis will probably determine them to be one and the same. While the nickeliferous iron seemed more abundant in the largest, the crystalline formations are far more numerous in the smaller.

DRAINAGE FOR HEALTH.

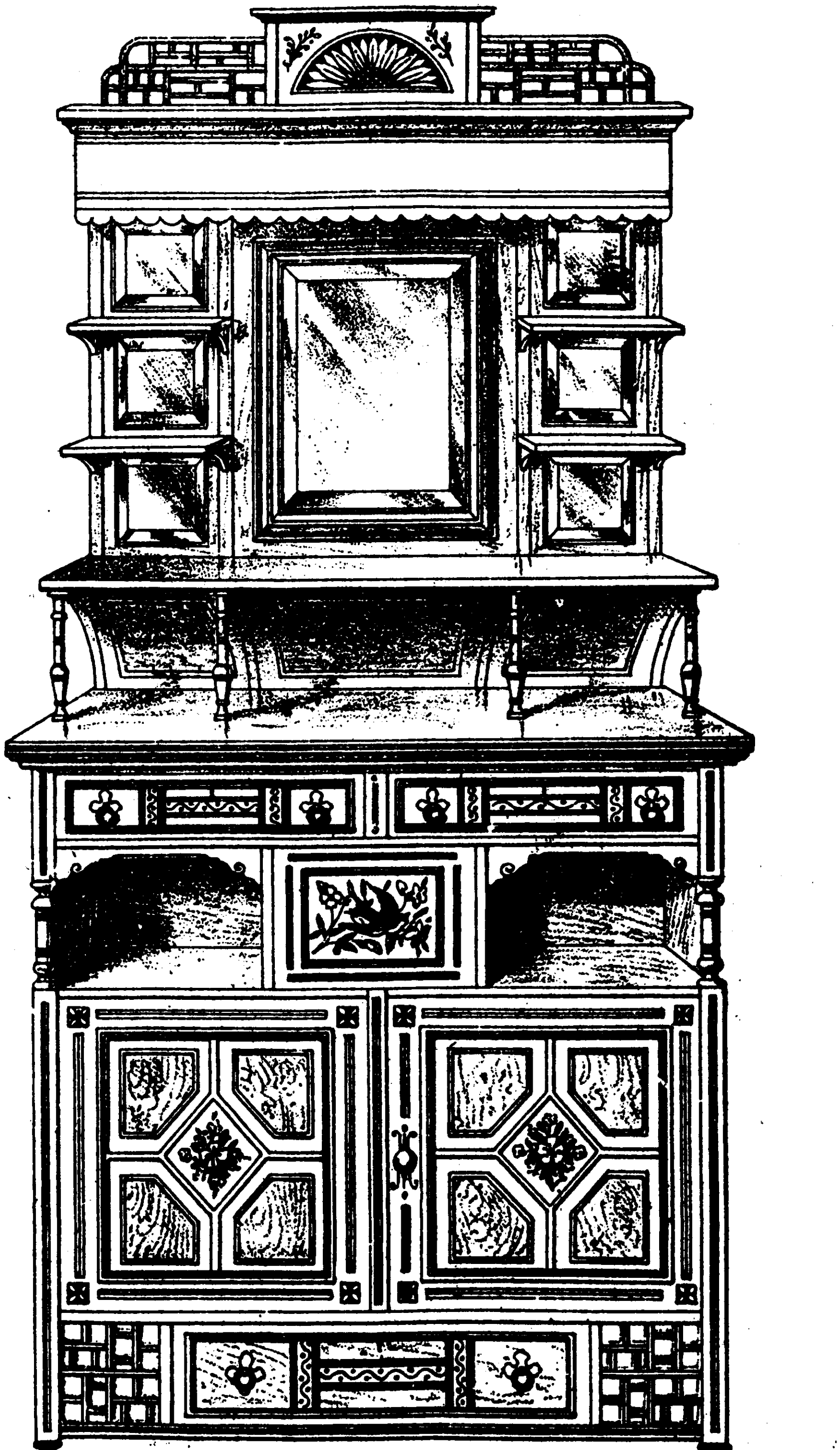
The proper drainage for buildings is a matter of importance. Cellars may be wet, stables not very dry, water may drip from the eaves, cutting holes into the earth and making puddles. The water from such puddles filters directly into the cellar, so that old houses in the country are very frequently dangerous to life on account of the water settling into the cellar. A damp cellar may sometimes be made dry by making a sink in it. Cellars are sometimes made in such wretched places that they need drain-pipes to carry off the water. In arranging any of this kind of work about a stable, it is necessary to be careful that the drainings of the stable do not filter into any water required for domestic use. Water should on no account be allowed to drip from the eaves; it is a great nuisance, undermining foundations and rapidly destroying buildings.

Air confined anywhere, even in a clean room, becomes offensive, probably unhealthy, with a disagreeable smell of closeness, and confined with filth in a drain or sewer, it must be infinitely worse. Drains built tight, with traps, etc., so that there is no ventilation of their interior, generate very poisonous gases, which are ready on the occurrence of any small leak to escape and poison everybody who happens to go near them. The best arrangements for ventilators in houses is to have a separate flue built in the chimney stack expressly to receive the ventilator pipes. Thus the air from the drain is discharged high in the atmosphere in a position to be mixed with smoke; and the noxious properties are destroyed, the smoke, whether of wood or coal, containing about the best chemical disinfectants known.

In all parts of New England hundreds of people are dying every year of typhoid fever. A large tract of the city of Boston is now building on made land, nearly as flat as the prairies about Chicago; and in a few years it will doubtless have to be regraded and rebuilt to get rid of this pestilence. From Maine to Pennsylvania there are flat undrained fields, and wet cellars nearly as bad. All over the country further South, but principally in the Mississippi Valley and the flat country bordering the ocean, the half-drained land is infested with intermittent fever and other malarial pestilences to such an extent as to destroy many thousands of people every year; so that, in spite of constant immigration, extensive tracts of country are about as sparsely settled as they were when Pocahontas saved the life of John Smith.—*Dr. Joseph Wilson.*

Colic.—The "colic is usually caused, first by costiveness, a stoppage, and then indigestion, causing fermentation and the production of carbonic gas in the stomach and the large bowels near the stomach, the expansion of which by heat produces this pain. It is almost immediately relieved by a full injection of warm water resulting in an operation from the bowels, of course removing the costiveness. This costiveness usually results either from the overfeeding or too frequent nursing of the babe—once in about three hours is sufficiently often—or from the use of too much fine food by the nursing mother. Therefore, to prevent these torturing pains, avoid or remove the costiveness as soon as known, by the injections, and great care in the time of nursing, and in the food and habits of the mother. Should the bowels seem inflamed and tender, it is safe to wet a soft flannel in tepid water and wrap around the bowels, covering with dry flannel, being careful to keep the little one comfortably warm. This tenderness of the bowels may be observed by noticing appearances when an operation occurs.

Importance of Sleep.—A medical man, discoursing upon sleep, makes this remark: "One man may do with a little less sleep than another; but as a general rule, if you want a clerk, a lieutenant, a lawyer, a physician, a legislator, a judge, a president or a pastor, do not trust your interests to any man who does not take, on the average, eight good, solid hours of sleep out of every twenty-four. Whatever may be his reasons for it, if he does not give himself that, he will snap some time just when you want him to be strong.



DESIGN FOR A SIDEBOARD.—From *The Woodworker*.

Cabinet Work.

VENEERS.

By Richard Britmead.

The ground-work forms a very important part in veneered work and if not properly selected and treated, it will go hollow and all sorts of shapes, and will spoil work that may be done excellently in all other parts. Whenever possible, the ground to be veneered should be the heart side. If veneered upon the reverse side it is certain to go hollow, as the fibres are more easily bent on that side of the wood. All knots and imperfections should be cut out, and pieces of the same kind let in, in their places; but in common work, where economy of time is a consideration, mix plaster of Paris and glue together, and fill up the hole; it will soon set, and when hard, the surface should be made perfectly level with the toothing plane. For soft, porous wood, it is as well to make a thin size with glue and water, and put over it before veneering, letting it dry. On hard, close-grained wood this is not required. If endway wood is to be veneered, well glue it, rubbing in with the fingers, so that the wood may absorb as much glue as possible, and veneer when dry.

LAYING VENEERS.

The introduction of machinery for the purpose of cutting veneers has been a material saving both in the cost and wear of furniture, while it has enabled the workmen to extend to a surface of thousands of feet any fine piece of timber he may meet with, which, before the invention of that machinery, he could not have extended to as many hundreds of feet. The value to which a single log of fine timber is turned by means of the improved machinery—either the knife or saw—is really incredible to those who have never witnessed the operation. When the cabinet-maker has occasion to use veneers, he has only to purchase a log of the wood which suits his purpose, send it to the mill, and he has it returned cut up to the required thickness in a very short time, and at a trifling expense. There are many persons unconnected with the trade who are of the opinion that solid wood makes the best furniture. This is a great mistake. In most cases, solid wood is used only as a matter of economy, especially in walnut furniture. The solid wood does not cost as much per foot as good veneer, leaving out of the question the cost on the ground-work wood, the glue, and the extra labor in veneering.

Veneer is used by cabinet-makers to give strength and beauty to their work. The most rare and beautiful woods are cut into veneers. The fall of a piano jointed up and veneered on both sides has double the strength of one jointed in plain solid wood without, being veneered, to say nothing of its beautiful appearance; so are panels, fretwork, etc. While the cabinet article is kept free from damp, and in such a state that the glue is not dissolved, the covering of beautiful wood does not wear out; and thus, with a vast saving in the more costly material, there is the same durability as if nothing but that material had been used for the whole. There is another advantage in the use of fancy woods on the surface, namely, that the body of the article, in numerous pieces of furniture upon which the fancy wood is laid, can be much better put together than if it had formed the external portion. When mahogany was first introduced as a cabinet timber, it was used solid for chairs, tables, etc. When, however, its great value became known—the ease with which it can be worked, the improvement polish or varnish effects in its color, the firmness with which it holds when glued, and the improvement time gives it when properly taken care of— good mahogany was considered far too valuable a timber to be used solid; and it began to be employed as the staple timber for veneering. Other woods, some lighter and some darker, were used for borders and ornaments, but mahogany for the body of the work; and when it came to be so employed, a great revolution was effected in the art of cabinet-making.

Veneering whether done in mahogany or any other wood, was at first very expensive. The veneers were cut by hand, and were as thick as what we now call bread stuff; they were also of unequal thickness, the wood being mangled by the operation of cutting and the finest pieces—those, namely, which are fine figured, cross-grained, or have the figures across their thickness—were always in danger of being broken.

A great number of inventions for cutting veneers have been tried since, and at the present time the machines are almost perfect. In France the vertical saw and knife are used. In England the sawing machinery consists of the segments of saws fixed on the edge of a large wheel some twenty or thirty feet in diameter, and driven at high speed. Logs of any size can be cut into veneers with ease. The average number of veneers cut by the saw is from twelve to fourteen to the inch, and by the knife-cutting machine the average for general use is thirty six, an immense difference. Of course the thickness of the saw at every cut accounts for the difference; but with the knife-cutting process there is no waste, the knife-cut veneers in any wood can be bought for a less price than is charged for the sawing only. For the best work sawn veneers are generally used in preference to those that are knife-cut, except the burr-walnut, which is always knife-cut. Knife-cut veneers can be had in any thickness to order; the machine can be adjusted so as to cut veneers as thin as required.

In consequence of the veneers being cut so much better than they were formerly, different ways of laying them have been adopted. The fancy-work table and ladies' workbox makers produce some neat work, lining inside with bird's eye maple veneer as thin as writing paper which is cut with scissors and pasted in with shoemakers' paste, it being too thin for glue. It is cut so perfectly that but little cleaning up is required, a piece of fine sand-paper rubbed over the veneer before cutting out being all that is necessary. Knife-cut veneers are generally more easy to lay than those cut with the saw, as there is less substance to resist and the glue penetrates more. We will now describe the different methods of laying veneers, beginning with work laid with the veneering hammer. It can be made of any kind of wood. There is a piece of hoop-iron, an eighth of an inch thick and the edge rounded so that it will slide easy, fitted in the bottom. Large work, such as a sideboard top, if veneered with the hammer, should have the ground-work made rounding on the faced side by well sizing it with thin size, and as the veneer shrinks, it will pull it quite level again in drying.

Before commencing to glue, have a couple of warm flat-irons ready in case they are wanted, as very much depends on the temperature where the veneering is to be done. When all is ready, wet a piece of sponge in some size, which is better than water, and wipe over the outside of the veneer (if a large surface, it is better done in twice); then glue the groundwork with moderately thin glue. When the surface is glued, put the veneer on in its place quickly, and rub the hammer up and down straight, to press all the air out from between; then commence crossway, placing one hand on the end of the hammer and the other at the extreme end of the handle, with a wriggling motion towards the edge, which follow up quickly till the surface is gone over. If the glue flows freely, the veneer is generally down; but if not, it must be wiped over with the sponge again, and the irons used, which will make the glue warm; then use the hammer again, as the glue must be got out. It can be easily ascertained whether the veneer is down by tapping it over with the end of the veneering hammer handle; and if a faulty place be found, it must be made all right. Knife-cut veneers in wainscoat oak, bird's-eye maple, and all similar light woods, are best laid with the hammer, as they lay very easy, and the glue does not penetrate right through them as it does with a caul; but if a caul be used, the glue should be mixed with flake-white to the consistency of white paint.

An illustration of a want of knowledge in the laying of white-wood veneers was shown in the Musical Instrument department of the International Exhibition of London, in 1872. A pianoforte in bird's-eye maple wood was exhibited, the wood of which was as good as it was possible to obtain; but it was spoiled by using the ordinary glue, no doubt boiled in an iron kettle. The work of the fall-maker and the part-maker were alike after cleaning off, showing large patches of dark green color through the grain of the wood where the caul was the hottest and the most pressure applied. Of course, the glue will penetrate into the grain of any wood when laid with hot cauls; but it does not show in dark woods such as rosewood, walnut, mahogany, etc. Now, if the workmen had mixed a little flake-white with the glue, as previously described, the beautiful, delicate colour of the wood would have been preserved, and the instrument, by its better appearance, would have been considerably more valuable. The beauty of the case is a point of great importance to the manufacturer; for though, of course, it adds nothing to the value of the musical parts of the instrument, in a commercial sense it enhances the quality of the entire piano.

The next method of laying veneers is with a caul, which is a much cleaner way than using the hammer. The caul is usually made of wood about an inch thick; it must be larger than the work to be veneered, and must be planed up true on both sides. Zinc cauls are sometimes used, of about a quarter of an inch substance; they last longer than wood, and the glue, if any should come through the veneer, does not adhere so firmly to zinc as it does to wood. When all is prepared, see that there is a good fire to heat the cauls, and while the caul is getting hot, soak the under side of the groundwork with warm water, and rub it well in with the hand, letting it stand a few minutes; then glue the surface, care being taken to leave no place uncovered with glue, which should not be thick, and let it stand for a time, that the steam may evaporate; then lay the veneer on, and fasten in a couple or so of places with a veneer-pin (a piece of wire like half an inch cut off a common pin,) or if veneer-pins are not to be obtained, use fine tacks; then place the caul on and screw down quickly, either in a press or with hand-screws.

In large manufactories, where steam-power is used, there is very little difficulty in veneering flat surfaces. The workman is only required to glue his work and fasten the veneer on in its place with a few veneer-pins; it is then taken to the press, which is a large iron box with screws and clamps on the top for pressing the work down. The veneer is laid face down on the box, and the screws just brought to a gentle pressure; the steam is turned on inside the box, the heat of which soon causes the glue to flow; the screws are then tightened and the steam allowed to escape. The metal top will soon cool, and the work can then be removed. This plan is particularly useful for large surfaces such as loo-table tops or wardrobe ends, which by this process can be done with as much ease as a drawer-front. Shops which do not possess steam-power frequently use a kind of press answering the same purpose, consisting of a frame-work with the screws, etc., and a thick iron plate heated by a number of gas jets underneath; when sufficiently heated, the gas is turned off and the plate allowed to cool, when the work can be removed.

The next method is to lay veneers without a caul, as practised by the cheap furniture makers. To do this, soak the under side of the ground-work with water, as before described; then rub a piece of common soap on the outside surface of the veneer; then glue and fix the veneer in its place with a veneer-pin at each corner (the pins are doubled over when driven in sufficient to hold; the holes do not show when taken out, as a tack would); then take two veneers and heat well before the fire; place both together, and put in the press, or handscrew down. A dozen pieces may be done in the same way with a little help in making them hot; but the pieces should be all of the same size, and placed exactly even when screwed down. Chiffonier ends, small cabinets panels, etc., are usually done in this way. The glue for this purpose should be thin.

FRENCH TABLES, CABINETS, ETC., WITH SHAPED FRAMING.

As the surface is of every shape, but flat, it is impossible to have recourse to the caul or hammer. The way to proceed is as follows: Get a piece of very close canvas, the best that can be procured, and make a sort of bag or pillow about an inch and a half or two inches thick, and fill it with dry sand; then put it upon a hot plate, constantly turning it until thoroughly hot through; then glue and fix the veneer with a veneer pin or two, and cover it with paper; then place the sand-bag on, and screw down. The best screws for the purpose are the common hand-screws which are used in both France and Germany; they are made with a single screw like a small cramp and can be had in different sizes. A piece of wood should be fitted very near to the hollows, which should be screwed down first.

ROUND OR CIRCULAR WORK.

Make a kind of windlass to turn with a handle; fix the work on the spindle, and have some one to turn. If a straight shaft like a circular washstand or circular pedestal is to be veneered, first glue the ground work, then place on the veneer, and fix with veneer pins, letting the veneers overlap each other; put a straight-edge across, and cut down for the joint with a veneer-knife; then remove the pieces and press the joint up. Care should be taken to have a piece of webbing ready (ordinary chair-web will do), one end of which tack on, and pull moderately tight while the handle is being turned. Keep the edge of the web up close until the veneer is covered; then tack the end down, and damp the webbing over slightly with a wet sponge, which will cause it to pull very tight. Place the work before a good shaving fire, and keep it turned until warm all round; then let it stand to dry, and the veneer will be found to be down. If a faulty place is discovered after removing the webbing, apply a warm iron to the part, and rub it a little with the veneering hammer, and it will be all right. No water should be used, and the irons should be only moderately warm. In veneering small columns, etc., the veneer should have thin canvas or calico glued over the face side before laying, otherwise there is a danger of the veneer splitting in the laying.—*American Cabinet-Maker.*

TO PREPARE VENEERS BEFORE LAYING.

Mahogany veneer is the easiest to manage, as it requires neither drying nor flattening, but is put on just as it is received. If badly sawn, it must be toothed, until the saw-marks are nearly out before laying.

Satin wood, king wood, manilla wood, zebra wood, ebony and snake wood should all be treated in the same manner as mahogany.

Bird's eye maple veneer, if sawn veneers, should be well shrunk between hot cauls previous to laying.

Tulip wood, purple wood, coromandel wood and yacca wood should be treated the same as bird's eye maple.

Rosewood veneer, if new wood, should be held over a shaving fire, and kept moving quickly until the gum begins to boil out of the pores of the wood; then place between two cauls and, hand-screw down till dry; then tooth and veneer. Knife-cut veneers do not require this treatment.

Wainscot oak veneer, the same as mahogany.

Thuya wood, the same as maple.

Pollard oak veneers. Well shrink between hot cauls, and tooth all to a thickness as nearly as possible, and joint up with a buhl-saw. Place two pieces of veneer together, and follow the figure of the wood with the saw. When the veneer is made to the size required, place all the pieces as fitted, and fasten them down on a board with a few veneer-pins; glue some strips of paper over the joints, and let them remain till dry. If a large top is to be made, it is best done in two or three parts, and jointed together at the last. Where much work of this kind is done, a marqueterie-cuttter's "donkey" should be made; this is like a harness maker's clamp, fixed on the end of a sawing-stool, with a string through the top, and secured to a piece of wood at the bottom of the stool, so that the pressure of the foot is sufficient to grip the veneer for sawing, and is instantly released by raising the foot. After jointing up as described, take out the veneer pins, and fill up any little imperfections in the under side with glue and yellow ochre; then lay with a caul.

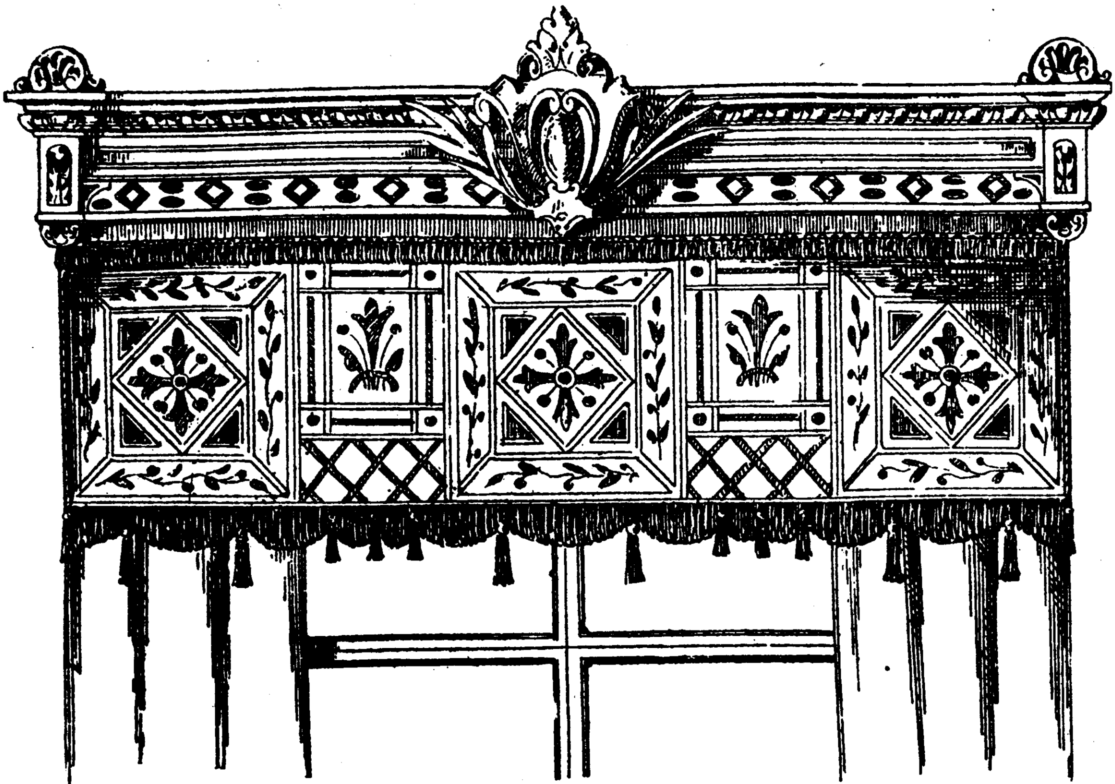
Plain walnut veneers should be treated like mahogany.

Burr walnut veneers. First damp all over with a wet sponge, then cut out the required size for the work; it will cut very easy when damp, and not split. A shoemaker's common cutting-knife is very useful for a veneer knife, and can be bought for about four pence. After cutting out, place between hot cauls, and when cold it will be well flattened and shrunk. Then fill up all holes and joint together. If the holes should be made round or square the joint will show; they should be cut an irrigular shape, like the figure of the wood. After the pieces are fitted in, glue paper on the back; and when dry, if the joint should not quite close in any part, just damp the place with the finger before veneering. It is best to lay this sort of wood with a caul where possible, in which case a sheet of paper should be placed all over the veneer before the caul is put on, as the glue will come through every part. Some size the veneers before laying; but this is a waste of time, as, when the caul is removed, the glue will be found to have penetrated the veneer like a sponge. In cleaning off flat work, time is saved by the use of an iron smoothing or panel plane. For shaped work, just damp with a wet rag well rubbed with soap, and it will be found to crape up as easy as possible.

Amboyna veneers. Treat similar to mahogany but joint up like pollard oak veneers.—*American Cabinet-Maker.*

New Use for Sawdust.—Sawdust can be converted into a liquid wood, and afterwards into a solid, flexible, and almost indestructible mass, which, when incorporated with animal matter, rolled, and dried, can be used for the most delicate impressions, as well as for the formation of solid and durable articles, in the following manner: Immerse the dust of any kind of wood in diluted sulphuric acid, sufficiently strong to affect the fibres, for some days; the finer parts are then passed through a sieve, well stirred, and allowed to settle. Drain the liquid from the sediment, and mix the latter with a proportionate quantity of animal offal, similar to that used for glue. Roll the mass, pack it in molds, and allow it to dry.

A New Boot Sole.—A Chicago boot manufacturer, Mr. Goodrich, has introduced what he is pleased to call an indestructible sole, in which nickel-plated steel rivets are embedded in the leather. These rivets are forced through perforations from the inside of the sole to its outer surface, and being less in length than the thickness of the leather, the head is securely embedded, and does not drop out as the sole becomes worn. Owing to the nickel-plating, it is claimed there is an entire absence of rust.



The above Illustration, from a design by a celebrated London firm, embodies many valuable features, which will no doubt prove available to the practical upholsterer. The good taste and judgment of the workman will readily suggest the proper material for its construction.

DESIGN FOR A WINDOW CORNICE.

WALL DECORATIONS.

Efforts have for some time past been made, writes the London correspodent of the *Art Interchange*, to improve the designs of wall paperings, in accordance with the rule that wall decorations should be in low or tertiary tones of color, and that the design should be flat, and not shaded in relief. An experiment has lately been made of producing wall paperings in sheets measuring about three feet by two feet. It is stated that this plan produces a better effect when the whole wall is finished, than when the paper is laid on in long sheets, as formerly. There is, certainly an amount of variety, in the tone of the different blocks of paper, which gives rather the effect of a hand-painted wall than the mechanical accuracy of ordinary paper-hanging ; but it would seem doubtful if the increased labor required to piece the blocks carefully will not seriously interfere with the general adoption of this plan, even if the advantages which it is supposed to secure are actual ones. It is affirmed that the printing of the designs can be made more artistic by this means, and that greater freedom of treatment is possible as to coloring. Painted walls, however, with the designs stencilled on and afterwards worked up by hand, seem more in favor than paper, at the present time, and are certainly, much more durable and cleanly, since they can be washed without injury. The same may be said of the new linoleum muralis, which has the further advantage of keeping out damp.

Very beautiful designs have been brought out in this material, both for the coverings of the wall itself and for the dados or wainscoating, and excellent effects are produced by coloring the background in with flat tints, and leaving the design in relief, or, the designs may be worked up to a very high state of finish by hand coloring.

Somewhat the same effect may be produced by papering the walls with a good flock paper, and afterwards painting over the whole with a broad flat color. We have seen several rooms decorated in this way, the effect of which was admirable. The raised design coming out in darker tints than the background.

Another very satisfactory form of wall decoration is the "gerso" work, a revival of an old Italian industry. It is chiefly suitable, however, for panels of cabinets or sideboards, for narrow borderings for dados, pilasters, or, in any place, where any large space has not to be covered. It is a kind of paste which is modelled on wood panelling in relief, and the design is then painted in any way that is desired, and the whole finished off with a coating of thin varnish. A very beautiful effect is produced by working a design in "gerso" on stained green wood and coloring it in bronze gold. We have seen some beautiful little panels, of a dull red ground, with a design of the leaves of the Virginia creeper with its richest autumn coloring. If the design and coloring be good, it is difficult to imagine any better or more artistic mode of decorating panels than this.

For more expensive kinds of decoration, embossed leather is still high in favor. Many of the old Spanish designs have been copied and reproduced in their original colouring in this way. There is an imitation of leather, made of a coarse kind of papier maché, which is very accurate, and cannot be distinguished from the real embossed leather except by close inspection. It is claimed as an advantage for this manufacture, that it has not the close, stuffy smell which seems to cling about the leather panels, and which sometimes makes a room disagreeable. If, however, any imitation is used at all, the linoleum muralis is certainly the best.

Japanese papers still continue to be largely used for all sorts of purposes, and are very satisfactory both as to wear and to general effect.

Silk damasks, and various forms of woven tapestry, are used for wall hangings, and are undoubtedly much the most beautiful where expense is not an object. The Duke of Westminster has one room entirely hung with embroidered panels of thick fawn-colored silk. The cost of such a wall hanging would preclude most people from indulging in such luxury ; but there is no doubt that, like most good things, these panels will be cheap in the long-run, for they will simply last forever, and will always be beautiful. Beautiful hangings for the walls of a room were lately made of Etruscan red silk, with a small pattern in damask on it. Portions of the design were picked out with fine Japanese gold by hand, and the effect was excellent.

INLAYING.

The wood used should be walnut or satin-wood for the ground, and the dye wood for the inlay, such as fustic for yellow, camwood for red, etc., or holly and chestnut, stained the required color. Back piece, or leaf is produced separately—one at once and in one plan. An engraving of the design is carefully pasted on the ground or counter, and cut out entirely, after which the several leaves are sawn out from different colored veneers from another copy of the design, and then inserted in their respective places. This way requires extreme exactness, but admits of complete success. In the second method the design is also pasted on the corner, which is then left entire. The leaves are cut out from wood of appropriate colors, and are then glued on the respective parts of the paper pattern on the counter.

The projecting leaves are then cut in, either singly or in groups, with the fret-saw, which is just allowed to graze their external margins. The leaves are then all parted from the ground, and inserted in their respective apertures in the counters; by this, or the counterpart method, the fitting becomes more easy, and the cuts may be slightly sloped, or bevelled, to increase the closeness of the joint. In the third method the leaves or other ornaments are cut from their appropriate colored veneers, and glued down in their proper position on a sheet of paper. A sheet of white paper is also glued or pasted down on the sheet of veneer that is to be the ground of the design, and a sheet of blackened copying paper is also necessary. The three are assembled together—the ground, with its white paper upwards, lowest, then the copying paper, and at the top the leaves, etc. These are then struck with a mallet gently, so as to print their own shapes on the ground; or rolling in a rolling dress, not a screw press, will answer.

The printed shapes are then cut out in the counter, one at a time; so that the outer edge of the saw-kerf falls exactly on the margin of the black mark. By this method the fitting can be made unexceptionally good, as there is no trouble experienced from the unequal stretching of the paper, which will sometimes occur when two copies of the design are employed, as by the first method. The ribs of the leaves are made by scratches of a graver which are filled up with fine wood-dust and glue. Occasionally great effect may be given by choice, judiciously made, of an inlay, the marks in the grain of which can be arranged to suit the subject, and the shading of leaves, etc., to give them roundness, by scorching the edges with a heated iron before placing them. In this way white flowers, etc., with many petals, can be made in holly, each petal being cut separate and scorched before grouping, to form the flower; or the indelible brown ink might be made use of to vein and shade white wood after the marquetrie has been completed ready for polishing by scraping and smoothing.

IMITATION MARBLE PAPER, OIL-CLOTH, ETC.

Hitherto the imitations of marble or other natural materials, says an English exchange, have been executed by the artist's hand, guided by his taste and his knowledge of the mineral or other substances he desired to imitate, therefore these imitations have been frequently more or less inaccurate.

Now in order to reproduce the true resemblance of the mineral substance to be copied, and to have the power of reproducing these exact copies, the inventor of a recently-patented improvement proceeds as follows:—A block or slab of the substance to be copied is smoothed, and, if necessary, polished; the natural veins or other markings are then incised or sunk in the surface of the block or slab.

This portion of the process of this invention may be carried out in two ways; the block or other surface to be copied may be etched or incised by the action of acids or other chemical means, or it may be engraved so as to produce a fac-simile of the natural specimens selected for reproduction; thus, if white-veined marble is to be reproduced, either in the ordinary manner of printing or as in the cylinder process of the paper-hanging manufacture, the block, slab, or cylinder is incised, etched, or engraved so as to imitate exactly the original or natural specimen; and where several colors are required to reproduce a fac-simile of the original marble or other surface, then a corresponding number of blocks or cylinders must be so etched or otherwise incised, and these blocks or cylinders may be employed as a means of transfer to stone, metal, wood, or other material suitable for printing purposes. In this way an accurate reproduction of selected natural samples may be obtained and multiplied to any extent.

The inventor does not, however, confine himself to the precise details of the process or processes before referred to, as the same may be varied without departing from the essential features of the invention, but what he considers to be novel and therefore claims as his patent, is—1st. The method or system of producing from the natural material or substance a fac-simile applicable to the ordinary processes of printing or otherwise transferring such designs; and 2nd. The particular method of obtaining exact representations of marbles or other natural ornamental surfaces by means of etching, engraving, or otherwise incising such natural surfaces, and afterwards applying these blocks, slabs, or cylinders to the purposes of printing or other method of reproduction.

PAINTING ON SILK.—Painting on silk so as to allow of the grain of the material showing, should be proceeded with as follows: The silk material selected should be of a medium quality, and not too highly "dressed." It should be tightly stretched upon a frame or board, the frame being the best. When stretched in a frame, the whole of the silk should be sized with a coating of colourless gelatine well diluted with water and strained through clear muslin before using, in order that there may remain no lumps of gelatine in the liquid. Should the silk give or slacken after this preparation has been applied to it, it must be taken out from the frame or from the board and re-stretched. Trace the pattern to be painted upon tracing cloth, and put white or red carbonized paper (according to the color of the material) between the cloth and the silk, and mark through the outlines with a knitting needle. Take away the cloth and paper with a fine camel's hair brush, go over every outline, painting it in the color that is to be finally used about it. Paint your design in, as in ordinary water-colour flower painting, using the best water colors in cakes, and being careful to obtain the carmine, ultramarine, and other bright colors of the best. Never use gamboge, as it is a bad dryer. Mix gelatine or some white of egg with all the colors before using, but only in small proportions; add Chinese white to any color that requires brightening or being made lighter, and when the painting is finished, put clear gum arabic upon the shadows to strengthen them. Water color painting on silk is not so effective by candlelight as the before-mentioned body color painting; but it can be worked up to a higher degree of finish.

MOUNTING PLANS, ETC.—Lay the tracings face down on a stretching board, damp them well, and with a sponge gently work them out until perfectly flat. Then run off the superfluous water and with a soft paint-brush spread an even coating of good flour-paste over the entire surface, working this evenly over all, until the paper is properly saturated. Take hold of two corners of the cloth, get an assistant to take hold of the other two, stretch them out and cautiously lay the cloth over the paper. Then, beginning at the centre work towards the side, until the cloth is perfectly flat, and in close adherence with the paper. The cloth should extend a few inches beyond the paper, and be well pasted down to the board. After this is done raise each corner of the cloth until the paper underneath is seen and put a pin through to mark the exact position of the corner of the paper, then return the cloth. After all has properly dried put a straight edge from pin to pin, and with a sharp knife cut through the cloth to the margin of the paper. The whole would then be complete, and if properly done, even and neat.

HARDENING PAPER.—The French papers speak of a method of rendering paper extremely hard and tenacious by subjecting the pulp to the action of chloride of zinc. After it has been treated with the chloride it is submitted to a strong pressure, thereafter becoming as strong as wood and as tough as leather. The hardness varies according to the strength of the metallic solution. The material thus produced can be easily colored. It may be employed in covering floors with advantage, and may be made to replace leather in the manufacture of coarse shoes, and is a good material for whip-handles, the mountings of saws, for buttons, combs, and other articles, of various descriptions. An excellent use of it is in large sheets for roofing. Paper already manufactured acquires the same consistency when plunged, unsized, into a solution of the chloride.

FURNITURE POLISH.—1 oz. beeswax, ¼oz. white wax, 1oz. Castile soap. The whole to be shred very fine, and a pint of boiling water poured upon it; when cold, add ½ pint of turpentine and ½ pint of spirits of wine; mix well together. To be rubbed well into the furniture with one cloth and polished with another.

ON ROTTING WOOD.

We condense the following from an interesting lecture recently given by Prof. Wm. H. Brewer, of Yale College, before the New Haven Board of Health:

It is well known that all woods contain certain nitrogenous, organic compounds, known chemically under the general name of *albuminoids*, and that these substances are active in inducing and favoring rot. All chemical methods for the preservation of timber from decay look towards getting this nitrogenous portion into some less soluble condition, or into some combination less liable to chemical change. When green wood is well soaked in cold water, a considerable quantity of such albuminoid matter is dissolved out, remaining in solution in the water. This solution, even when very dilute, is extremely putrescible—more so, indeed, than any person would deem possible, until he had tried the experiment. The fact is as true of the hardest woods, as maple and locust, as it is of soft wood.

To illustrate: If a few pieces of such green wood, be carefully freed from bark and all foreign dirt, and put into the purest cold water and let stand at the ordinary temperature of 60° or 70° Fah., the water soon begins to become turbid or opalescent; this opalescence increases, in two to four days a thin pellicle forms on the surface, active putrefaction sets in, along with an abundant growth of ferments and the liquid soon becomes peculiarly and pungently stinking. The odour naturally varies with the kind of wood used, but in all cases it is very rank, fully as much so as the same amount of *animal* matter in solution. The intensity and rapidity of putrescence vary, of course, with the temperature, the kind of wood, and the degree of concentration of the solution.

As in the case of other putrefaction, what the gases are which produce the exhalations, we are entirely ignorant. It is probable that they are organic compounds of simpler molecular constitution than the albuminoids which furnished the necessary elements.

If kept long enough, and of sufficient concentration, there is an abundant fungoid growth in the solution, and if kept in the light it grows darker in color, gradually becomes sour to the taste and smell, but continues offensive in odour for a long time; in bottles partly filled, it continues to smell bad for two years. Where the solution is kept in the dark, the odour seems more offensive than if the decay goes on in the light.

In the free air, and full sunlight (the condition to which piles and various other wooden structures and vegetable matter in swamps are subjected) along with the putrescence, a white fungus growth begins on the surface of the wood, which rapidly becomes slimy. This forms much more abundantly on the ends of the grain of the wood than on either the radial or tangential sides. If the solution is poured from the wood and kept in a separate vessel, and in the light it grows dark, as already described, but the fungus growth goes on, modified, of course, by the temperature and the degree of concentration, or until the decay has become complete.

If the wood continues to be placed in successive portions of clean water, the soluble matter continues to be extracted for several months, even if the blocks be very small, and the tendency towards putrefaction grows less and less. Finally, however, the soluble matter appears to be removed, the water then remains clear, and the wood ceases to be covered with fungus growth, at least to any visible extent.

Timber, when thoroughly water-seasoned, is known to be very durable, and it is probable that it is so merely because of the removal of the soluble and putrescible albuminoids.

Experiments tried with the same woods in sea water, and in brackish water (made by mixing two measures of fresh water with one of sea water), show similar sanitary results; they are even actually intensified. The turbidity begins sooner in sea water than in fresh; the film on the surface is more abundant, and the smell is more disgusting. Heart-wood and sap-wood act essentially alike in this matter, the difference is one of degree rather than of character.

The suggestiveness of these facts is almost too obvious to need comment, and yet I will add a word. Vast quantities of wood and vegetable matter, decaying in water or in swamps are too common.

If piles about our warves and similar structures do not smell so badly, it is merely because the solution is more dilute. The decay goes on, however, and so with vegetable matter decaying in swamps, sawdust in ponds, and so on to the end of a long chapter. The trouble has sometimes been attributed to the obvious gases evolved, notably to light carbureted hydrogen, which one may see bubbling up, with nitrogen and carbonic acid through the water of ponds, where sawdust, or vegetable matter, is decaying on the bottom. As I have maintained in a paper read at a previous meeting of this association, I cannot believe that either of these latter gases of decay seriously affect health. These latter experiments on wood only confirm the views then expressed.

The exhalations of swamps, or of vegetable matter decaying in still water is universally regarded as unwholesome in climates where for a part of the year, at least, the weather is as warm as we have it. So far as I know, there is no exception to this on the whole earth, and hence the general sanitary bearing of the observations here recorded need not be further argued.

Mechanics.

BLACKSMITHS' HAMMER SIGNALS.

When the blacksmith gives the anvil quick light blows it is a signal to the helper to use the sledge, or to strike quicker.

The force of the blows given by the blacksmith's hammer indicates the force of the blow it is required to give the sledge.

The blacksmith's helper is supposed to strike the work in the middle of the width of the anvil, and when this requires to be varied the blacksmith indicates where the sledge blows are to fall by touching the required spot with his hand-hammer.

If the sledge is required to have a lateral motion while descending, the blacksmith indicates the same to the helper by delivering hand-hammer blows in which the hand-hammer moves in the direction required for the sledge to move.

If the blacksmith delivers a heavy blow upon the work and an intermediate light blow upon the anvil, it denotes that heavy sledge blows are required.

If there are two or more helpers the blacksmith strikes a blow between each helper's sledge hammer blow, the object being to merely denote where the sledge blows are to fall.

When the blacksmith desires the sledge blows to cease, he lets the hand-hammer head fall upon the anvil and continues its rebound upon the same until it ceases.

Thus the movements of the hand-hammer constitutes signals to the helper, and what appears desultory blows to the common observer, constitutes the method of communication between the blacksmith and his helper.

WHY THE THUNDERER'S GUN BURST.

Our readers will remember that about a year ago, a 38-ton gun on board the British ironclad Thunderer burst, killing a number of men and wounding many more. A committee appointed to investigate the disaster, came to the conclusion that the explosion was caused by a double charge. The gun, having missed fire when loaded with a battering charge (a 700 pound projectile and 110 pounds of powder), was again loaded with a full charge, and fired with both of the charges and the projectiles in the gun at the same time. This decision having been seriously questioned, the government ordered an experimental test by loading and firing the sister gun in the manner alleged. The test was made at the proof butts adjoining the Royal Arsenal at Woolwich, February 3. The second 38-ton gun was loaded and fired with a double charge of 80 and 110 pounds of powder, one 600 pound shell and one 700 pound Palliser projectile. The gun burst as its fellow did on board the Thunderer, thus justifying the opinion of the committee of investigation as to the cause of that disaster. The muzzle of the gun and the projectiles were buried in the sand at the proof butts. The remainder of the gun, with the exception of its base, was blown to atoms.

CUTTING COLD STEEL WITH SOFT IRON.

BY B. S. HEDRICK, OF WASHINGTON, D. C.

The development of heat by friction has been long known. For some time it has also been known that the operation of rolling and rubbing had the effect of changing the molecular structure of iron and steel. These operations will toughen and compact cold iron, and will harden and condense steel. Some time since Mr. Jacob Reese, of Pittsburg, Pa., had occasion to construct a machine for cutting bars of cold hardened steel. For this purpose he mounted a disc made of soft wrought-iron upon a horizontal axis, so as to be rotated with great velocity. With any moderate speed no cutting was produced. But, on giving the disc such a speed of rotation as to cause the periphery of the disc to move with a velocity of about 25,000 feet per minute (nearly five miles), the steel was rapidly cut, especially when the bar to be cut was slowly rotated against the disc. Sparks in a steady stream were thrown off. At first it was supposed that the steel was simply rubbed or ground off; but on examining the pile of accumulated particles beneath the machine, they were found to be welded together in the shape of a large cone, similar to the stalagmites in the limestone caves; they were nearly like the spikes of frost as formed in winter on Mount Washington, and illustrated at the Troy meeting. Real fusion takes place. The steel is melted by the swiftly-moving smooth edge of the soft iron disc, but the disc itself is but little heated. The bar of steel on each side of the cut receives but slight heat, and the ends are left with a fine smooth blue finish. By this process a rolled, polished, and hardened steel bar of two or three inches in diameter, may be cut in two in a few minutes. The soft metal disc of iron used was about forty-two inches in diameter, and three-sixteenths of an inch thick. The particles fly off in a thick jet or steam apparently while hot, through which the naked hand may be passed without injury, and a sheet of white writing-paper held in the steam for a minute is not burned nor colored in the least. They glance off without burning the hand, having assumed the condition which causes the spheroidal state of liquids.

REMARKS OF THE EDITOR.

The explanation of this curious phenomenon lies in the fact that the very rapidly rotating iron disc causes great numbers of particles of iron to come into contact with comparatively very few particles of steel, every particle of which has to withstand the impact of thousands of iron particles; it thus gives way to superior numbers, this impact at the same time developing heat enough, not only to melt the detached particles of steel, but to bring in the spheroidal state.—*Manufacturer and Builder.*

Mending Belts.—It is not always economy to replace a partially worn belt by a new one. So long as there are portions of a worn belt that retain a part of their original soundness, it is useful as a portion of another belt. In no case put a piece of new unused belting into an old or partially worn one; more than eighteen hundred years ago this fact was recognized and recorded, although the word "bottle" was used instead of belt. The uniform tensions of a belt is impaired by uniting new and unused leather with that which has grown supple by use. No belt should have more than one butt joint. The pieces should be put together in scarf joints by means of rivets or lace leather; old belts have usually absorbed so much lubricating oil that belt cement—fish glue—will not "take." In riveting, the heads should be on the wearing or pulling side and the burrs or washers on the other. In sewing a lap the awl should be passed through in a slanting direction and the stitches should present the smallest amount of surface on the pulling side. In making a butt joint the lacing should not be crossed on the pulley side. The ends of the belts should always be cut by a try square to insure perfect straightness. In taking up belts, even narrow belts, it is much better to cut and sew the belt *in situ* than to run it off the pulleys. The proper degree of tension can always be thus secured and the belt not be kept too loose nor shortened too much; besides, there is always an uneven strain, liable to work injury to the belt in running it on. If you cut your own lace leather, the handiest way to make laces is, after straightening one edge of the skin, to guide the knife with the thumb instead of a straight edge, under which the leather will stretch and pull. By holding the thumb rigid any width of lace may be assured and the work is very rapidly performed.

To Saponify Petroleum Oils—According to the London *Journal of Applied Science*, the following is the practical mode of operation in the particular case of a refined petroleum: Stearic acid is the fattty matter employed, and, upon being melted, is poured into the petroleum—in the proportion of about 15 parts of fatty acid to 100 of petroleum. After thorough intermixture has been effected by stirring, the mixture may be saponified in the usual way. It is recommended, however, that animal or vegetable fatty matter be added to it before saponification, the result being an improved product, the proportions reccommended being two of acidified petroleum to the three of fat. Either soda or potash may be used in saponifying, and the soap produced will be hard or soft according to the alkali employed and the proportions taken. The product is represented to be actively detergent, and to be free from tendency to putrify. We give the foregoing for what it is worth: From the neutral chemical character of the mineral oils, it would appear that the result of the operation just described would be simply a case of mechanical suspension, and not one of chemical union as in the case of the soaps proper. The process is affirmed to be applicable not only to the native mineral oils, but likewise to such as may be obtained from schist, asphaltum and other sources. The novelty of the process seems to consist in first saturating the mineral oils with a fatty acid, and then saponifying in the usual manner, the capacity for saponification having been imparted by the addition in question.

Plumbago as a Lubricator.—The *Engineer* gives this example of the value of black lead as a lubricator: "A fly-wheel shaft bearing, eight inches in diameter and 10 inches long carried a load of nearly ten tons. The bearing was supported on a box girder, and was lined with good brass. The engine could not be run, as this bearing invariably got nearly red-hot after a few revolutions; various oils, tallow, sulphur and gunpowder were tried with most indifferent success. By using a mixture of tallow and sulphur the engine could be run half an hour at a time, and once or twice has run a whole day, the shaft making 60 revolutions per minute. It was determined to have a new crank shaft with a longer bearing, but as at the last moment the use of black lead and tallow was suggested, a package of the ordinary black lead used for stoves was worked up with some tallow, the bearing carefully wiped, and the grease box on the cap filled with the mixture. The bearing never heated again unless oil was allowed to get access to it. The success of the plumbago as as a lubricator was perfect. It should be added to the foregoing that while the principle of lubricating by graphite, or plumbago, is scientifically correct, and has in thousands of instances been practically illustrated, it has been damaged seriously by the use of impure graphite. For perfect success the graphite should be absolutely clean.

Effect of Plants on the Health.—The popular belief that plants kept in the house are injurious to the inmates, is purely fanciful. Under the influence of sunlight the leaves of plants absorb carbonic acid from the atmosphere and decompose it, yielding back the life-supporting oxygen, from which the inference might be justified that they were rather wholesome than otherwise. On the other hand, it has been shown that when the influence of light is withdrawn, this action of the plant is temporarily suspended—the plant sleeps, and the excess of carbonic acid gas taken up during the day is given off at night; and because of this action, the presence of plants in sleeping apartments has been thought to be unwholesome or injurious. The bad effects to be attributed to plants from this cause are too trifling to be worth serious consideration. The inhabiting of sitting and sleeping apartments warmed by baked air drawn from foul cellars, the neglect of means to secure proper ventilation, especially in sleeping apartments, and the poisoning of the atmosphere of dwelling-houses by the entrance of sewer gases through leaky traps, are very real and common dangers, compared to which the one alluded to sinks into utter insignificance, if indeed it be worthy to be considered at all.—*Manufacturer and Builder.*

To Remove Rust from Steel.—Steel which has rusted can be cleaned by brushing with a paste composed of ½ ounce cyanide potassium, ½ ounce Castile soap, 1 ounce whiting, and water sufficient to form a paste. The steel should first be washed with a solution of ½ ounce cyanide potassium in 2 ounces water. To preserve steel rails from rusting, a good method is to paint them with melted caoutchouc, to which some oil has been added. The caoutchouc must be melted in a close vessel to prevent its burning, and should be frequently stirred. It is also said that dipping the steel in a solution of common soda (about 1 in 4) will preserve it from rusting.

A Hard Composition.—Melt together over a gentle fire in an iron pot: Pitch, one part; gutta-percha, two parts; orange shellac, five parts; add to this six parts of white lead (lead carbonate) in impalpable powder, and stir until a perfectly homogeneous mixture is obtained, and you will have a composition hard enough to make pool balls, which may be cast and coloured with analine dyes mixed with dilute alcholic solution of bleached shellac.

To Remove Old Paint.—Slake three pounds of stone quicklime in water, and add one pound pearlash, making the whole into the consistence of paint. Lay over the old work with a brush, and let it remain for from 12 to 14 hours, when the paint is easily scraped off.

THE STEEL SQUARE.

From *The Metal Worker*.

In all that has been written for *The Metal Worker* upon the subject of pattern cutting, and in all that has been published of letters from our readers about shop rules, little or no attention has been given to the steel square, the usefulness of which in a general way must be unquestioned. Just why every one has omitted a statement of the uses to which this tool may be put it is difficult to determine. It may be that tinners generally are disposed to consider it a wood-worker's tool, and fail to see any fitness in their use of it. But if it is only a wood-worker's tool, there is still good reason why tinners and mechanics of other trades among our readers should know something about it. A saw is certainly a wood-worker's tool, and the hatchet was not devised as an instrument for a metal worker's use, but both saw and hatchet are found very useful things to have and to be able to use about every shop. There is enough rough wood-work to be done and enough repairing required in the regular course of business to make a certain degree of familiarity with the use of these wood-working tools quite convenient. The same is true, although in a little different sense, of the steel square, considering it for the moment as exclusively a wood-working tool. There is many an odd job—a shelf to put up, a bench to build, a partition to construct or a framework to make—which it is very well to do without the expense and bother of sending for a carpenter. Familiarity with hatchet, saw, plane and square in such cases is very desirable.

But the steel square is not exclusively a wood-worker's tool. Accurately described, it is a mathematical instrument of very extensive application, and is available for use in the problems of pattern cutting, as well as in those of framing and construction. The tinner and metal worker have as clear a title to its employment as the carpenter, and because some one saw a carpenter employing a square before he noticed a tinner using it, affords no just cause of accusing the tinner of appropriating a wood-worker's tool. Mathematical principles and the tools founded upon them do not belong to any sect or guild, but, rather, are for any and all who can make use of them, without any restrictions whatever.

There is probably no other tool in use among mechanics which has half the capacity for usefulness, or, to put it in another form, of which half as many applications can be made, as the square. A mere list of the operations which may be performed with it, and of the purposes for which it may be advantageously employed, would occupy more space than we shall devote to this article, while to explain in detail the manner of using it to accomplish the many results of which it is capable, might occupy space equal to the whole of our paper for several numbers. We believe the square, with which by long association every one thinks himself familiar, is a much underrated tool, and that it is entitled to very much more attention and study than is usually bestowed upon it. In the hands of the intelligent mechanic the square becomes a simple calculating machine of most wonderful capacity, and by it he solves problems of the kinds continually arising in mechanical work, which by the ordinary methods are more difficult to perform.

While asserting that the square is no more a wood-workers' tool than a carpenters' tool, or that of a mechanic in any other trade in which use can be advantageously made of it, we do not forget that the wood-workers use it much more than the tinners, nor that the squares made and sold are almost exclusively of the kind known as carpenters' squares. There are so few requirements in the tool specially pertaining to the tinners' use of it, that a square calculated exclusively for him is hardly demanded. Or we may state it in other words, thus: There being no objection to the marks upon the square, put there especially for the carpenter, the tinner finds all his requirements met when he obtains a carpenter's square. Tinners, then, are using carpenters' squares because there are no special marks and scales required to be put upon the tool for their use, and because the scales and marks employed by the carpenters do not incommode them, not because they have learned to employ a tool in one line of mechanical employment which really belongs to another.

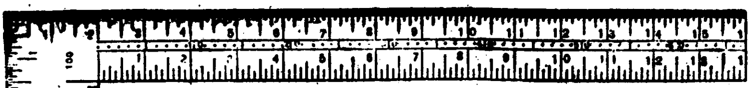
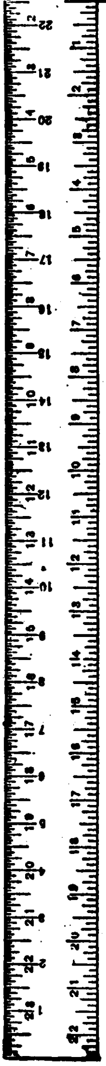
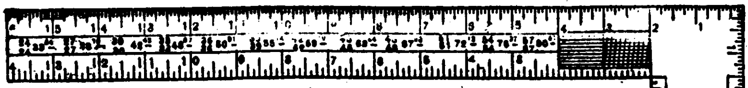
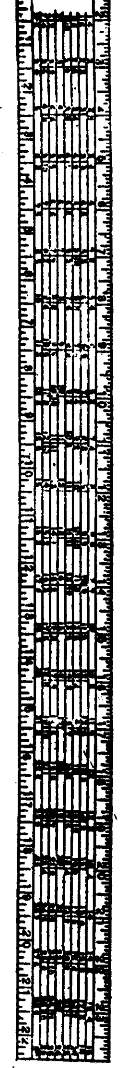
Since the squares which tinners are using are of the kind usually employed by carpenters, an explanation of the marks and scales to be found upon them cannot fail to be of interest. Accordingly at this time we will present a general description of the tool, from a carpenter's standpoint, reserving for another opportunity a consideration of some of the problems in the solution of which it may be advantageously employed.

One of the first things to consider in the study of the square is the marks and scales upon it. The only matter demanding prior attention is the names of the parts of the square itself. The long arm of the square is called the blade. The short arm is called the tongue. The junction between the blade and tongue is called the heel. The blade of the square is 24 inches long, and the tongue from 14 to 18 inches. The blade in good squares is 2 inches, while the tongue is 1½ inches wide. With inferior tools the tongue is sometimes narrower.

In the accompanying engravings Figs. 1 and 2 show a steel square of the best grade, being known in the hardware trade as No. 100. The cuts show the tool and all its divisions at one-fourth full size. The first marks which attract our attention, and which are also the best known, are the divisions into inches and fractions of inches. The heel of the square is the point from which it is most convenient to measure, both along the blade and also on the tongue, and hence in numbering the inches the figures commence at the heel, running toward the end of the blade and tongue respectively. The inch marks along the inside edges of the square commence numbering likewise with the interior angle. Since the width of the blade is in even inches, the inch marks upon the two edges of the tongue correspond, but because the width of the tongue is in other than even inches, the inch marks along the two edges of the blade no not correspond. Commencing at the end of the blade upon the face (Fig. 1) and corresponding to the inch divisions marked along the outer edge, is a set of figures by which the distance from the end of the blade may be read, which adapts this part of the tool for use in measuring the depth of mortices, &c. The different edges of the square are variously divided into fractions of inches. The outside edges of the face, as shown in Fig. 1, are divided into sixteenths, while the inside edges are divided into eighths. The outside edges of the reverse, as shown in Fig. 2, are divided into twelfths, while the inside edges are divided into eighths.

The fine lines upon the tongue ruled longitudinally between the inch marks 2 and 4, divide an inch into tenths. The diagonal lines which cross them between 2 and 3 are also one-tenth of an inch apart, thus enabling the operator to obtain divisions of hundredths of an inch. The use of this scale is precisely similar to that of the diagonal scales frequently found with sets of drawing instruments. The numbers occupying the middle of the tongue in Fig. 2 from the diagonal scale to the end, constitute what is known as the "brace rule." The numbers on the left, placed one over the other, represent the run, or, in other words, the two sides of a right-angled triangle, while the numbers to the left represent, in inches and (decimal) fractions of an inch, the length of the third side or hypothenuse. Or, to explain it in another way, the equal numbers placed one above the other may be considered as representing the sides of a square, and the third number to the right the length of the diagonal of that square. Thus the exact length of a brace between shoulders having a run of 57 inches on a post, and a run of the same on a beam, is 80.61 inches. The brace rule varies somewhat in the matter of the runs expressed in different squares. Some squares give a few brace lengths of which the runs upon the post and beam are not equal. For example, $\begin{matrix}18\\20\end{matrix}$ **30**, will be found among others.

The parallel rows of figures along the blade in Fig. 2 constitute what is called board measure. The manner of using it is as follows: Under 12 of the inch marks along the outer edge of the blade will be found the figures 8, 9, 10, 11, 12, 13, 14 and 15, which represent the length of the board or plank to be measured. The contents in feet and inches will be found under the several inch marks along the outer edge of the blade, corresponding to the width of the piece being measured. We can make this plainer by a simple illustration. Suppose we desire to ascertain the contents of a board 14 feet long and 10 inches wide. Find 14 under 12 of the inch marks along the edge. Follow the space in which it is placed back to the figures under 10 of the inch marks, where will be seen 11.8, which is read 11 feet and 8 inches. In like manner if the board is 16 inches wide, the result (under 16 of the inch marks) is found to be 18.8, or 18 feet and 8 inches. In the same way the measure of boards of any width from 2 inches up to 24 inches, and of either of the lengths above enumerated, may be quickly and accurately determined. By combining figures, lengths may be calculated which are in excess of those above given. For example, if we have a board 20 feet long we double the answer in the 10 feet row, and for a piece of timber 25 feet long we add the figures in the 12 and 13 feet rows together. This rule is calculated, as its name indicates, for board measure or for surfaces 1 inch in thickness. It may be advantageously used, however, upon timber by multiplying the result of the face measure

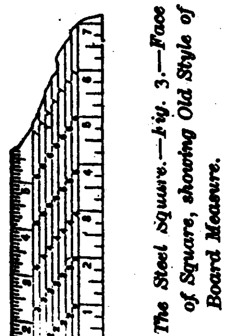





of one side of a piece by its depth in inches. To illustrate: Suppose it be required to measure a piece of timber 25 feet long, 10 x 14 inches in size. For the length we will take 12 and 13 feet. For the width we will take 10 inches, and multiply the result by 14. By the rule a board 12 feet long and 10 inches wide contains 10 feet, and one 13 feet long and 10 inches wide, 10 feet 10 inches; therefore, a board 25 feet long and 10 inches wide must contain 20 feet and 10 inches. In the timber above described, however, we have what is equivalent to 14 such boards, and, therefore, we multiply this result by 14, which gives 291 feet and 8 inches, the board measure.

On some squares the board rule is arranged in the shape indicated by Fig. 3 of the accompanying engravings that is, the numbers representing contents instead of being feet and inches are even feet, and instead of being placed in regular rows under the several inch marks, are arranged diagonally, as in the cut. The use of this form of the rule is the same as that of the one above described, save that all the answers give the nearest approximate even number of feet, instead of expressing the actual contents in feet and inches. However, by the position of the numbers either a little to the left or right of the line under the inch mark indicating the width, the operator is supposed to determine in his mind the fractional part of a foot contained. From all the information we have been able to obtain concerning the origin and use of this rule, which at present is almost entirely superseded by the later and better form above described, it seems that it came into existence at a time when fractional parts of a foot in measuring lumber were disregarded, and when things generally were conducted upon a broader and more liberal basis than at present. It does not answer at the present day to calculate a board at 18 feet when in reality it contains 18 feet 8 inches.

Along the centre of the tongue upon the face, as shown in Fig. 1, will be noticed a number of dots, and a row of figures numbering them by tens. This is known as the "octagonal scale," the use of which is as follows: Suppose it is required to reduce a square timber, say, for example, 12 x 12 inches, to octagon shape. First draw a centre line along each face, which, of course, will be 6 inches from the several edges. With the compasses, take twelve of the divisions in the octagon scale, and set off this space on the faces of the timber, measuring each way from the centre lines. The points thus obtained will be correct for the gauge lines. The rule always to be observed is as follows: Set off from each side of the centre line upon each face as many spaces by the octagon scale as the timber is inches square. For timbers larger in size than the number of divisions in the scale, the measurements by it may be doubled or trebled, as the case may be.

Now, it will not surprise us at all if our readers (the tinners and metal workers) find themselves, after perusing the above description of the square, better informed concerning the marks and scales upon it than the carpenters among their acquaintances. On the other hand, the carpenters are able to teach them many a trick in the use of the square applicable to the tinners' requirements, which upon demonstration will be apt to open somebody's eyes in astonishment. So, perhaps, after all, things are about even on the first count. It is a good subject for study, and much will be gained by a comparison of notes, both among mechanics of the same trade and between mechanics working at different trades.



The Steel Square.—Fig. 3.—Face of Square, showing Old Style of Board Measure.

THE STEEL SQUARE.—*(See page 116)*

Mechanics.

MECHANICS' APPRENTICES.

There was an apprentice case in one of the courts recently which brought up a very important subject which deserves particular consideration apart from the merits or demerits of the controversy between this one master and this one apprentice. The apprentice sued his master for not having taught him some of the most important features of the trade which he was apprenticed to learn. The jury rendered a verdict in favor of the master, which indicated that they did not think the case of the apprentice a good one; but how many masters in these days do really teach their apprentices all that they nominally agree to teach them? The trade-unionists theoretically base their peculiar attitude toward the apprentice system on the ground that apprentices are, in the majority of instances, not taught as they should be; but that they are, instead of being instructed in all the mysteries of a trade, merely instructed in certain specialities. How much the present peculiar relations between master and apprentices are due to trade-unionism, need not now be discussed. We have simply to recognize the fact that the old-fashioned apprentice system has completely broken down, and that there is an urgent necessity that there shall be a substitute provided for it, in the interests not only of individuals but of the whole community, which will be beyond the reach of malign and selfish influences, exerted on the one hand by masters who are anxious to get men's work out of boys at less than men's wages; and on the other hand, by workmen who, in their dread of competition, seek to prevent boys from learning trades at all.—*Philadelphia Telegraph.*

HOW TO JUDGE OF LEATHER IN BELTS.

Without entering into the question of the merits or demerits of rubber or other kinds of belting, one cannot but notice the want of unanimity of opinion, even among belt manufacturers, as to what really constitutes the best leather for making belts to convey power in running machinery, and, if we include makers of belts on the other side of the Atlantic, the differences in theory and the divergence in practice are much wider than they are here. As a rule, too, this is a matter about which machinists generally have but little information, and are, with here and there only a rare exception, but indifferent judges.

The best belt, theoretically, is that which combines the highest tensile strength with the greatest power to resist wear by attrition, being at the same time subject to little change by dryness, moisture, heat, or cold. These qualities supposing the manufacture to be ordinarily good, are mainly dependent upon the tanning. In Europe there is very little difference known or acknowledged between good sole and good belting leather. The heaviest or "plumpest" leather is usually considered there the best for belts, as well as for the soles of boots and shoes. Our belt makers, however, recognize an essential difference. The sole of a boot or shoe, particularly in all heavy work, needs to have but little flexibility, but must have the greatest possible capacity to resist wear by attrition, and be as far as practicable, impervious to water, while it is never subjected to any test of its tensile strength.

Sole leather, therefore, in all the toughest wearing grades, is made as thick and solid as the tanner can make it; great care is taken to open wide the pores of the hide, in the earlier part of the tanning process, see that all the gelatine is saved to combine with tannin, and that the hide is left in the tan liquors long enough to take up all the tannin it will absorb. This makes the finished leather oftentimes a great deal thicker than the original hide; but such leather, it need hardly be said, would not be the best for making belts, for it has little flexibility, and its tensile strength has been greatly impaired by the straining of the fibres of the hide to take in the large amount of tannin it has received.

The tanner who would make the best belt-leather, however, although he cannot swell the fibres of the hide with tannin to the extent above noted, must produce a firm, solid belt with not a little of the elasticity and strength of steel; it must be sufficiently flexible, and yet of great power to resist wear by attrition, and to stand, with little stretching, the heaviest direct strain. These qualities are best obtained by an amount of tanning which will make the finished leather but little thicker than the raw hide of which it is made. On cutting a piece of sole or belting leather, one will notice the network of hide fibres interlacing each other, and which, before tanning, were surrounded with gelatine. These fibres give the hide its great tensile strength, and any considerable displacement of them by the transformation of the hide into leather impairs this quality. A piece of good belt leather, therefore, when freshly cut, should look bright, with the intervening spaces between the fibres fine, even and regular. The texture should be uniform throughout, and with the utmost solidity there should be great elasticity.

SHEARING STRENGTH OF AMERICAN WOODS.

(See page 121.)

Mr. John C Trautwine, a well-known authority in matters pertaining to engineering, communicates to the *Journal of the Franklin Institute* an account of some valuable practical experiments on the shearing strength of a number of kinds of native woods, to determine the reliability of this material for pins or tree-nails, for which it is very commonly employed.

For the purpose of these experiments, Mr. Trautwine employed the iron holder shown in the accompanying cut, (for which we are indebted to the *Journal*), through the cylindrical pole in which the wooden pin *p p* to be tested was placed. Two specimens of each kind of wood named in the annexed table were tested, all the specimens being of fairly seasoned wood, and free from defects. Where the differences in result did not exceed 10 per cent. the mean value is given.

The specimens tested were in the shape of cylindrical pins ·64 of an inch (or full ⅝ inch) in diameter. The central pieces sheared off were ⅝ inch long. The single circular area of each pin was ·322 of a square inch; and that of the two areas simultaneously sheared, ·644 of a square inch.

The test specimens fitted closely into the cylindrical hole of the holder, and as the two parts A and B of the holder were pulled in opposite directions, the test pieces could only yield by direct shearing at O and C. The trials were made upon one of Riehle Brothers' testing machines. To obtain the results in pounds per square inch of total sheared area, Mr. Trautwine has multiplied his experimental values by 1.55 (that is ·644 x 1.55 =1 square inch).

SHEARING STRENGTH OF AMERICAN WOODS.

	Pounds per square inch.
Ash	6,280
Beech	5,223
Birch	5,595
Cedar, white	1,372 to 1,519
Cedar, Central American	3,410
Cherry	2,945
Chestnut	1,535
Dogwood	6,510
Ebony	7,750
Gum	5.890
Hemlock	2,750
Hickory	6,045 to 7,285
Locust	7,176
Maple	6,355
Oak, white	4,425
Oak, live	8,480
Pine, white	2,480
Pine, yellow, Northern	4,340
Pine, yellow, Southern	5,735
Pine, yellow, very resinous	5,053
Poplar	4,418
Spruce	3,255
Walnut, black	4,728
Walnut, common	2,830

CHOPS AND STEAKS FOR THE SICK.—In cooking steaks for the sick, they should always be cut about one inch in thickness. Beat it well with a rolling pin. This renders it tender and preserves the juice. Place upon a broiler and cook for seven or ten minutes, turning frequently. When done lay it upon a hot plate and season with salt and pepper, and a little butter. Never chop meat with a sharp instrument. It severs the fibres, thus allowing the juice to escape while cooking.

TREATMENT OF SIMPLE HICCOUGH.—Dr Grellety once saw a mother, tender and full of affection for her children, give them a morsel of sugar dipped in table vinegar whenever immoderate or too rapid repletion of the stomach or any other cause had induced hiccough. The latter ceased as if by magic. Since then the Vichy physician has very frequently employed this means on his own account, and has never found it without avail.—*The Pharmacist and Chemist.*

IMPROVED TREATMENT OF COTTON FIBRE.

The great world of industry knows but very little of what it owes to the quiet, retired men of science, who spend their time, night and day, in inquiring into the hidden mysteries of nature, and in bringing them out, one by one, to subserve the constantly increasing wants of man. We have frequently called attention in these columns, to facts of this kind, and we now again refer to other matters of similar import. In our issue of the 7th instant, reference was made to a recent interesting chemical discovery, whereby most of the qualities and appearance of silk was given to ordinary flax fibre.

It is now announced that M. L. D. Kœcalin, of Basle, has devised a method, and that machinery has also been invented and constructed whereby cotton fibre mixed with a very small proportion of animal fibres—wool or silk—may have their entire body uniformly treated by one and the same process, so as to enable them to be dyed or printed with desirable colouring matters, such as have hitherto been applicable to animal fibres only.

For this purpose vegetable oils, from which their glycerine has been eliminated, are, by preference, employed. The cotton fibre is steeped repeatedly in a bath of this mordant, either in the state of loose filaments, or of woven fabric, and either alone or mixed with silk. Between the several steepings, the fibres are subjected to pressure, in order to cause the mordant to penetrate intimately into the pores; and the fibre is then exposed to sufficient heat for fixing the mordant in it. After this treatment the fibre will be found to have become so far assimilated in its nature to silk or wool fibre, as to be susceptible of treatment with the same colouring matters with which these are treated. Olive oil has been found to give the best results in the above-described process. In operating with this oil, a quantity contained in a suitable vessel is treated with sulphuric acid, whereupon a dissociation of the fatty bodies, and a separation of the glycerine is effected, the latter, together with the excess of sulphuric acid, being removed by washings based on the different densities of the fatty bodies.

The product obtained is mixed with from three to four times its weight of water, producing a liquor which constitutes the mordant. If the cotton be in the form of a woven fabric, the steeping is effected by means of a machine, in which the fabric, on issuing from the bath, passes between two pressing-cylinders, from which it again enters the bath, and then again passes between pressing-cylinders, and so on repeatedly, in order to insure the fibre being thoroughly impregnated with the mordant.

If the cotton be in the state of filaments, or in hanks, a machine is employed such as is used in dyeing, in which the hanks are hung upon pegs or rollers, and cylinders, situated over the top rollers, are caused to act upon the hanks, so as to subject them to pressure, at the same time that they impart to them the requisite movement for circulating through the bath.

IRON IN BRIDGE BUILDING.

The use of iron in bridge construction has produced a boldness of conception in the present generation of engineers which casts the performances of their predecessors entirely in the shade. A half century ago such spans as the fallen ones of the St. Charles and Tay bridges, for the loads that they were calculated to support, were impossible. Now they are far from being of the first magnitude. There are 10 truss bridges across the Mississippi above St. Louis, which are not regarded as very wonderful structures, and yet seven of them have spans as long as those of the Tay bridge.

The bridges at Winona, LaCrosse, Dubuque, Keokuk and Hannibal, have spans of 240, that at Rock Island of 250, and that at Louisiana of 256 feet. The span which gave way at St. Charles was 320 feet in length, yet the same bridge has two pans 406 feet long. Over the same river is a truss bridge at Leavenworth, with three spans of 340 feet, and another at Glasgow with five of 315 feeet. Across the Ohio there is a truss bridge at Steubenville with a span of 320 feet, one at Parkersburg of 350, one at Cincinnati with a span of 515 feet, the longest truss yet built, and one at Louisville with a span of 400 feet. The truss bridge over the Kentucky river, on the Cincinnati and Southern railroad, has three spans 375 feet in length, resting on iron piers 175 feet high. The proposed bridge over the Hudson at Poughkeepsie has five spans of 500 feet with piers 135 feet above high water.

In Europe there is a truss bridge over the Vistula at Graudenz with 12 spans of 300 feet. The truss bridge of Lessart, in France, has a span of 314 feet, and was pushed across from one abutment to the other after being put together. The bridge over the Rhine at Wesel, has four spans of 313 feet. The Kulenburg bridge in Holland, which was the monarch truss before the construction of the Cincinnati bridge, has a span of 492 feet.

From these examples it would seem that the St. Charles and Tay bridges, instead of being risky engineering ventures, are entirely within the domain of experience; but, nevertheless, the fact remains that, notwithstanding the boldness with which the engineers of the present day meet the exactions of the locomotive, they are comparatively novices in the use of iron. The first iron bridges were of cast-iron, and soon proved to be too lightly proportioned. The first suspension bridges were similarly defective. Does it remain to be proved that the wrought-iron work of the past 20 years betrays too great a confidence in the material? Were the St. Charles and Tay disasters unaccountable accidents, or were they fair tests of current engineering theories? These are questions which engineers would do well to discuss.—*St. Louis Globe.*

TECHNICAL BREVITIES.—Reference is made in the foreign technical journals to the production by a French inventor of a species of *artificial nacre*, or mother-of-pearl, made of the pulverized shell of the haliotis, solidified with gelatine, and compressed. The product can be stamped, moulded, and, in fact, fashioned as may be required; and may be dyed in any color, polished, and varnished. It is designed to substitute tortoise shell, mother-of-pearl, etc., for inlaying or mounting in cabinet work, in the production of fans, buttons, etc.—The German Telegraphic Engineers, who have experimented with it, have reported favorably on the *alloy of aluminium and iron* for telegraphic wires. They affirm that it produces a wire both finer and stronger than iron, less susceptible to atmospheric changes, and of superior conducting qualities.—A contract for laying a *submarine cable* across the Gulf of Mexico, connecting the United States with the Mexican republic, has received the approval of the latter government.—The "German Society for the Promotion of Industry" offers a prize of $750 and its gold medal for a *substitute* for either *gutta-percha* or *caoutchouc*.—The best results are being obtained in the use of *bichloride* of *ethidene* for anæsthetic purposes. This agent, it may be remembered, was recommended by a commission of English physicians appointed to find some anæsthetic more prompt and efficient than either, and free from the dangers of chloroform. The bichloride seems to fill the bill perfectly, but at present is too costly. This objectien will doubtless be overcome.—For *bleaching animal tissues*, Tessié du Motay places the substances for a few minutes in moderataly concentrated solution of sodium bisulphite, when they almost instantly become white.—Two German chemists, Clonet and Ritter, independently of each other, assert the *presence of arsenic* in all commercial grape-sugar. It is doubtless derived from the sulphuric acid used in the manufacture. The quantity found varied from ·0022 to ·1094 grams per kilo. This fact is of interest, in view of the immense quantities of this substance manufactured in this country, and used by confectioners, brewers, and others.—The *topophone* is a new instrument, designed to be used on shipboard, by which the exact direction of sounds emitted by fog-horns or fog-bells may be promptly determined. It was found, in actual experiments made for the Light-house Board, that the pointer of the instrument could be easily brought to within 10 degrees, or less than one point, of the true direction of the sound, which is sufficiently accurate in the practical use of the apparatus.

POLISH FOR MARBLE MANTELPIECE.—Wash the marble thoroughly with diluted muriatic acid, or warm soap and vinegar; should this not restore the polish, then apply the following preparation of wax, which is harmless even for painting, and is most excellent for furniture. Boil a quart of water and dissolve ½ oz of potash in it, when dissolved, add a ¼lb. of virgin wax, boil it well together for nearly an hour; put it away to cool, when the wax will be on the top; then put the wax in a mortar, rub it well with the pestle, adding sufficient rain water to make it into a soft paste; rub some of this on the marble with a rag; polish with a soft duster.

VARNISH FOR WHITE WOODS.—Dissolve 3 pounds of bleached shellac in 1 gallon of spirits of wine; strain, and add 1½ more gallons of spirits. If the shellac is pure and white, this will make a beautifully clear covering for white wooden articles.

—ENGLAND during the five years just ended, imported silver to the value of $331,553,000, and exported it to the value of $349,671,000—being an excess of $18,118,000 of exports of silver over imports.

THE FRAMING SQUARE.

BY WM. E. HILL.

The "framing square" is a steel tool having two arms at right angles to each other; the longer and wider arm is called the "blade," the shorter arm the "tongue." The blade in good squares is 2 inches wide and 24 inches long, while the tongues on the same squares are $1\frac{1}{2}$ inches wide and from 14 to 18 inches in length. A lucid description of the tool, with many of its capabilities, was published in the *American Builder* during the year 1876, and subsequently; some things, however, which were not described in the papers referred to I propose to discuss in this, and following papers.

Fig. 1, Plate 83, shows a portion of a first-class square; the diagonal scale on the tongue is designed to aid the workman in minute measurements. The lines between *a* and *b* are one tenth of an inch apart, so also are the lines betweeen *b* and *c*. It will also be seen that diagonal lines are drawn across the spaces from point to point. The primary divisions are tenths, and the junction of the diagonal lines with the longitudinal parallel lines enables the operator to obtain divisions of one hundredth part of an inch; as, for example, if we wish to obtain twenty-four hundredths of an inch, we place the compasses on the "dots" on the fourth parallel line, which covers two primary divisions, and a fraction, or four tenths, of the third primary division, which added together makes twenty-four hundredths of an inch. Again, if we wish to obtain five tenths and seven hundredths, we operate on the seventh line, taking five primaries and the fraction of the sixth where the diagonal intersects the parallel line, as shown by the "dots," on the compasses, and this gives us the distance required.

The use of this scale is obvious, and needs no further explanation.

The "board measure," as shown on this square, gives the feet and inches contained in each board according to its length and width. Under Fig. 12 on the outer edge of the blade, the length of the boards, plank, or scantling to be measured is given, and the answer in feet and inches is found under the inches in width that the board, etc., measures. For example, take a board nine feet long and five inches wide; then under the Fig. 12 on the second line will be found the figure 9, which is the length of the board; then run along this line to the figure directly under the five inches (the width of the board), and we find three feet nine inches, which is the correct answer in "board measure." If the stuff is two inches thick, the sum is doubled; if three inches thick, it is trebled, etc., etc. If the stuff is longer than any figures shown on the square, it can be measured by dividing and doubling the result.

The "brace rule" is on the tongue of the square. This rule is easily understood; the figures on the left of the line represent the "run" or the length of two sides of a right angle, while the figures on the right represent the exact length of the third side of a right-angled triangle, in inches, tenths, and hundredths.

The "octagonal scale" (Fig 2) is on the opposite side of the square to the "brace rule," and runs along the centre of the tongue. Its use is as follows: Suppose a stick of timber ten inches square. Make a centre line, which will be five inches from each edge; set a pair of compasses, putting one leg on any of the main divisions shown on the square in this scale, and the other leg on the tenth subdivision. This division, pricked off from the centre line on the timber on each side, will give the points for the gauge-lines. Gauge from the corners both ways, and the lines for making the timber octagonal in its section are obtained. Always take the same number of spaces on your compasses as the timber is inches square from the centre line. Thus, if a stick is twelve inches square, take twelve spaces on the compasses; if only six inches square, take six spaces on the compasses, etc., etc.

Fig. 3 shows how a common rafter can be laid out, and the proper angles or levels obtained, by a practical application of the square. Avoid lining for a "lookout;" give ample length for projection. Take pitch of roof on tongue, and half the width of building on blade: the angle along edge of blade then, is the bevel of foot of rafter; the "lookout" or projection must be provided for independent of the actual length of the rafter. Run the square along the rafter as many times as there are feet in half the width of building.

To find the hypothenuse when the base and altitude are given: let *a* equal altitude, *b* the base, then, $a_2 \times b^2 = y$ the hypothenuse, etc. This is the rule on which the foregoing is based. Braces of different runs may also be found by the use of the square as above, under the principles contained in the rule. A full explanation of the use of the square for getting rafters and braces under the above rule, can be found in the *American Builder* for 1876.

Fig. 4 shows how an octagon can be produced by the aid of a steel square. Prick off the distance *a o* equal to half the distance of the square; mark this distance on the blade of the square from *b* to *o*, place the square on the diagonal, as shown, and square over each way. Do the same at every angle, and the octagon is complete.

To obtain the same figure with the compasses, proceed as follows: Take half the diagonal on the compasses, make a little over a quarter sweep from *c*, and at the intersection at *d* and *c*, then *d* and *c* form one side of an octagonal figure.

Again: take a piece of timber twelve inches square, as Fig. 5; take twelve inches on the blade from *a* to *b*, mark at the point *a*, operate similarly on the opposite edge, and the marked points will be guides for guage-lines for the angles forming an octagon. The remaining three sides of the timber can be treated in the same manner.

These points can be found with a carpenter's rule as follows: Lay the rule on the timber, partly opened, as shown in the cut, "prick off" at the figures 7 and 17 as at *a* and *b*, and these points, will be the guides for the gauge-lines. The same points can be found by laying the square diagonally across the timber and "pricking" off 7 and 17.

To make a moulder's flask octagonal proceed as follows: The flask to be four feet across. Multiply 4×5 (as an octagon is always as 5 to 12 nearly), which gives 20; divide by 12, which gives $1\frac{2}{3}$ feet, cut mitre to suit this measurement, nail into corners of square box, and you have an octagon flask at once.

Another method of constructing an octagon is shown at Fig. 6. Take the side as *a b* for a radius, describe an arc cutting the diagonal at *d*; square over from *d* to *e*, and the point *e* will then be the gauge-guide for all the sides.

Another method (Fig. 7) is to draw a straight line, *c b*, any length; then let *a b* and *a c* be corresponding figures on the blade and tongue of the square, mark along either and measure the distance of required octagon; move the square and mark also. Now use the square the same as before, and the marks *c b* and *b d* are the points required.—*Wood-Worker.*

Queries.

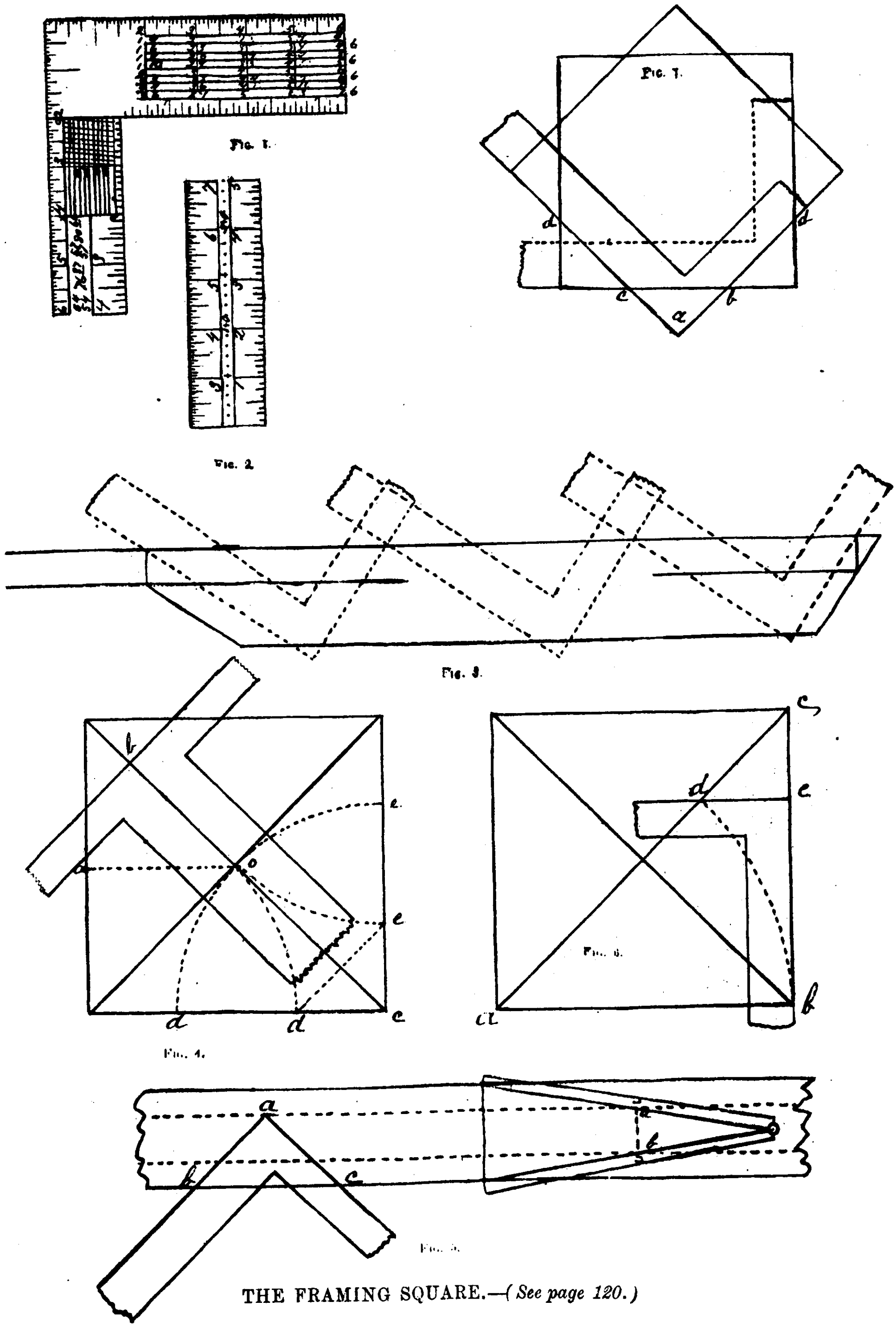
[1008.]—What is the best way to remove rust from Russia sheet iron or a mechanic's tools?—I have tried dry lime on the Russia iron and failed to clean it.—R. M. J. B.

Replies to Queries.

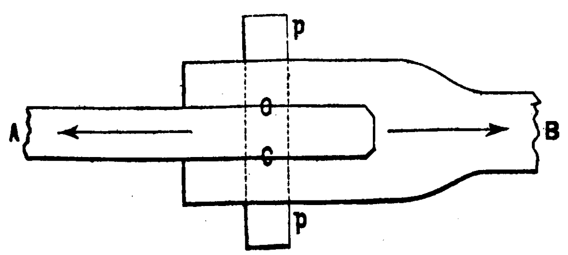
[No. 1,001.]—In answer to question No. 1,001 I would say I have taken the buckle out of saws frequently by placing them on a smooth piece of hardwood plank and by taking a short piece of hardwood scantling about 2″ x 3″, or somewhere thereabouts, and 4 or 5 inches long, and cutting the end perfectly true. I have placed it over the buckled places and struck it smartly, shifting it about and also changing the saw from one side to the other.

[No. 1,007.]—In answer to question No. 1,007 I would say that I made a very good job of a flute, the first joint of which was split so that the cork would not fit tight in it. I wiped it clean of all grease and filled the crack with Wilcox's Indian Rubber Cement; the wood must be thoroughly warm, as also the cement. The ferrules were ivory; I took them off as they were loose; when the cement began to set I anointed the ferrules with some fresh from the bottle and put them on. After the cement was well dried I smoothed it off with a very sharp knife. The only fault to be found was that the cement was white and I could not color it. The flute, however, sounded well and that was what the owner wanted. A cement that has caoutchouc and shellac as its constituents will answer well for this purpose.—R. M. J. B.

CHEAP WATERPROOF VARNISH.—Use the very same material mentioned in the former question, glue and bi-chromate of potash. It is well to mix no more than you are going to use. After putting it on, expose to sunlight; if you cover your woodwork first with a solution of logwood extract, the size will make it deep black; in fact, if well done on a good ground, it will imitate ebony.



THE FRAMING SQUARE.—*(See page 120.)*



STRENGTH OF AMERICAN WOODS.

CEMENTS.

Quite as much depends upon the manner in which a cement is used as upon the cement itself. The best cement that ever was compounded would prove entirely worthless if improperly applied. The following rules, says the *Druggists' Circular*, must be rigorously adhered to if success would be secured. :

1. Bring the cement into intimate contact with the surfaces to be united. This is best done by heating the pieces to be joined in those cases where the cement is melted by heat, as in using resin, shellac, marine glue, etc. Where solutions are used, the cement must be well rubbed into the surfaces, either with a soft brush (as in the case of porcelain or glass), or by rubbing the two surfaces together (as in making a glue joint between two pieces of wood).

2 As little cement as possible should be allowed to remain between the united surfaces. To secure this the cement should be as liquid as possible (thoroughly melted if used with heat), and the surfaces should be pressed closely into contact (by screws, weights, wedges, or cords) until the cement has hardened.

3 Plenty of time should be allowed for the cement to dry or harden, and this is particularly the case in oil cements, such as copal varnish, boiled oil, white lead, etc. When two surfaces, each half an inch across, are joined by means of a layer of white lead placed between them, six months may elapse before the cement in the middle of the joint has become hard. In such cases a few days or weeks are of no account; at the end of a month the joint will be weak and easily separated, while at the end of two or three years it may be so firm that the material will part anywhere else than at the joint. Hence when the article is to be used immediately, the only safe cements are those which are liquefied by heat and which become hard when cold. A joint made with marine glue is firm an hour after it has been made. Next to cements that are liquefied by heat are those which consist of substances dissolved in water or alcohol. A glue joint sets firmly in twenty-four hours; a joint made with shellac varnish becomes dry in two or three days. Oil cements, which do not dry by evaporation, but harden by oxidation (boiled oil, white lead, red lead, etc, etc.) are the slowest of all.

Aquarium Cement.—Litharge, fine, white, dry sand, and plaster of Paris, each one gill; finely pulverized resin, 1-3 gill. Mix thoroughly and make into a paste with boiled linseed oil to which drier has been added. Beat it well, and let it stand four or five hours before using it. After it has stood for 15 hours, however, it loses its strength. Glass cemented into its frame with this cement is good for either salt or fresh water. It has been used at the Zoological Gardens, London, with great success. It might be useful for constructing tanks for other purposes or for stopping leaks.

Casein Mucilage.—Take the curd of skim milk (carefully freed from cream or oil), wash it thoroughly, and dissolve it to saturation in a cold concentrated solution of borax. This mucilage keeps well, and as regards adhesive power far surpasses the mucilage of gum arabic.

Casein and Soluble Glass. Casein dissolved in soluble silicate of soda or potassa makes a very strong cement for glass or porcelain.

Cheese Cement for Mending China, etc.—Take skim milk cheese, cut it in slices and boil it in water. Wash it in cold water and knead it in warm water several times. Place it warm on a levigating stone and knead it with quick lime. It will join marble, stone, or earthenware so that the joining is scarcely to be discovered.

Chinese Cement (Schio-liao).—To three parts of fresh beaten blood are added four parts of slaked lime and a little alum; a thin, pasty mass is produced, which can be used immediately. Objects which are to be made specially waterproof are painted by the Chinese twice, or at the most three times. Dr. Scherzer saw in Pekin a wooden box which had travelled the tedious road via Siberia to St. Petersburg and back, which was found to be perfectly sound and waterproof. Even baskets made of straw become by the use of this cement, perfectly serviceable in the transportation of oil.

Pasteboard treated therewith receives the appearance and strength of wood. Most of the wooden public buildings of China are painted with schio-liao, which gives them an unpleasant reddish appearance, but adds to their durability. This cement was tried in the Austrian Department of Agriculture, and by the "Vienna Association of Industry," and in both cases the statements of Dr. Scherzer were found to be strictly accurate.

Faraday's Cap Cement.—Electrical Cement.—Resin, 5 oz; beeswax, 1 oz.; red ochre or Venetian red in powder, 1 oz. Dry the earth thoroughly on a stove at a temperature above 212°. Melt the wax and resin together and stir in the powder by degrees. Stir until cold, lest the earthy matter settle to the bottom. Used for fastening brass work to glass tubes, flasks, etc.

Cement for Glass, Earthenware, etc.—Dilute white of egg with its bulk of water and beat up thoroughly. Mix to the consistence of thin paste with powdered quicklime. Must be used immediately.

Glass Cement.—Take pulverized glass, 10 parts; powdered fluorspar, 20 parts; soluble silicate of soda, 60 parts. Both glass and fluorspar must be in the finest possible condition, which is best done by shaking each in fine powder, with water, allowing the coarser particles to deposit, and then to pour off the remainder, which holds the finest particles in suspension. The mixture must be made very rapidly, by quick stirring, and when thoroughly mixed must be at once applied. This is said to yield an excellent cement.

Gutta Percha Cement.—This highly recommended cement is made by melting together, in an iron pan, two parts common pitch and one part gutta percha, stirring them well together until thoroughly incorporated, and then pouring the liquid into cold water. When cold it is black, solid and elastic; but it softens with heat, and at 100° Fah. is a thin fluid. It may be used as a soft paste, or in the liquid state, and answers an excellent purpose in cementing metal, glass, porcelain, ivory, etc. It may be used instead of putty for glazing windows.

Iron Cement for Closing the Joints of Iron Pipes.—Take of coarsely powdered iron borings, 5 lbs.; powdered sal-ammoniac, 2 oz.; sulphur, 1 oz.; and water sufficient to moisten it. This composition hardens rapidly; but if time can be allowed it sets more firmly without the sulphur. It must be used as soon as mixed and rammed tightly into the joint.

2 Take sal-ammoniac, 2 oz.; sublimed sulphur, 1 oz.; cast iron filings or fine turnings, 1 lb. Mix in a mortar and keep the powder dry. When it is to be used, mix it with twenty times its weight of clean iron turnings, or filings, and grind the whole in a mortar; then wet it with water until it becomes of convenient consistence, when it is to be applied to the joint. After a time it becomes as hard and strong as any part of the metal.

Kerosene Oil Lamps.—The cement commonly used for fastening the tops on kerosene lamps is plaster of Paris, which is porous and quickly penetrated by the kerosene. Another cement which has not this defect is made with three parts of resin, one of caustic soda, and five of water. This composition is mixed with half its weight of plaster of Paris. It sets firmly in about three quarters of an hour. It is said to be of great adhesive power, not permeable to kerosene, a low conductor of heat, and but superficially attacked by hot water.

Cement for Uniting Leather and Metal.—Wash the metal with hot gelatine; steep the leather in an infusion of nutgalls (hot) and bring the two together.

Cement for Leather Belting.—One who has tried everything says that after an experience of fifteen years he has found nothing to equal the following: Common glue and isinglass, equal parts, soaked for 10 hours in just enough water to cover them. Bring gradually to a boiling heat and add pure tannin until the whole becomes ropy or appears like the white of eggs. Buff off the surfaces to be joined, apply this cement warm and clamp firmly.

Litharge and Glycerine Cement.—A cement made of very finely powdered oxide of lead (litharge) and concentrated glycerine unites wood to iron with remarkable efficiency. The composition is insoluble in most acids, is unaffected by the action of moderate heat, sets rapidly, and acquires an extraordinary hardness.

Cement for Attaching Metal to Glass.—Copal varnish 15; drying oil, 5; turpentine, 3. Melt in a water bath and add 10 parts slaked lime.

Paris Cement for Mending Shells and other Specimens.—Gum arabic, 5; sugar candy, 2; white lead, enough to color.

Porcelain Cement.—Add plaster of Paris to a strong solution of alum till the mixture is of the consistency of cream. It sets readily and is said to unite glass, metal, porcelain, etc., quite firmly. It is probably suited for cases in which large rather than small surfaces are to be united.

Soft Cement.—Melt yellow beeswax with its weight of turpentine, and color with finely powdered Venetian red. When cold it has the hardness of soap, but is easily softened and moulded with the fingers, and for sticking things together temporarily it is invaluable.

Soluble Glass Cement.—When finely pulverized chalk is stirred into a solution of soluble glass of 30° B. until the mixture is fine and plastic, a cement is obtained which will harden in between six and eight hours, possessing an extraoardinary durability, and alike applicable for domestic and industrial purposes. If any of the following substances be employed besides chalk, differently colored cements of the same general character are obtained: 1. Finely pulverized or levigated stibnite (gray antimony, or black sulphide of antimony) will produce a dark cement, which, after long burnishing with an agate, will present a metallic appearance. 2. Pulverized cast iron, a gray cement. 3. Zinc dust (so-called zinc gray), an exceedingly hard gray cement, which, after burnishing will exhibit the white and brilliant appearance of metallic zinc. This cement may be employed with advantage in mending ornaments and vessels of zinc, sticking alike well to metals, stone, and wood. 4. Carbonate of copper, a bright green cement. 5. Sesquioxide of chromium, a dark green cement. 6. Thénard's blue (cobalt blue), a blue cement. 7. Minium, an orange colored cement. 8. Vermilion, a splendid red cement. 9. Carbon red, a violet cement.

Sorel's Cement.—Mix commercial zinc white with half its bulk of fine sand, adding a solution of chloride of zinc of 1·26 specific gravity, and rub the whole thoroughly together in a mortar. The mixture must be applied at once, as it hardens very quickly.

Steam Boiler Cement.—Mix two parts of finely powdered litharge with one part of very fine sand, and one part of quicklime which has been allowed to slake spontaneously by exposure to the air. This mixture may be kept for any length of time without injuring. In using it a portion is mixed into paste with linseed oil, or, still better, boiled linseed oil. In this state it must be quickly applied, as it soon becomes hard.

Turner's Cement.—Melt 1 lb. of resin in a pan over the fire, and, when melted, add ¼ of a lb. of pitch. While these are boiling add brick dust until, by dropping a little on a cold stone, you think it hard enough. In winter it may be necessary to add a little tallow. By means of this cement a piece of wood may be fastened to the chuck, which will hold when cool; and when the work is finished it may be removed by a smart stroke with the tool. Any traces of the cement may be removed from the work by means of benzine.

Wollaston's White Cement for Large Objects.—Beeswax, 1 oz.; resin, 4 oz.; powdered plaster of Paris, 5 oz. Melt together. To use, warm the edges of the specimen and use the cement warm.

MICROSCOPIC DISCOVERY OF MALARIAL POISON.

For some years, physicians and scientists have been much occupied in efforts to ascertain the nature of the poison which produces malarial fever, and success has finally crowned these labors, as will be seen by the following, which we copy from a contemporary:

The poison is not cognizable by the senses, nor can it be detected by chemical tests. The air of mararial districts has been analyzed, the soil has been submitted to microscopical examination, but no light was thrown on the subject. But not finding a thing looked for is only negative proof, and by no means decisive in any investigation. One thing was certain, namely, that the poison was generated in salt and fresh water marshes, in wet meadows, from vegetation decaying under a hot sun, in lands alternately flooded and drained, in the moving of earth rich in vegetable matter, and in the drying up under certain atmospheric conditions of stagnant pools; but what the poison was that produced those remittent and unremittent diseases which are known by the various names of marsh fever, malarial fever, fever and ague, and popularly as "chills" and "shakes," has at length been discovered by two scientists, Signor Tomasi, of Rome, and Prof. Kleb, of Prague. After spending three weeks in that fever-stricken region, the Roman Campagna experimenting on its soil, its atmosphere, and its stagnant waters, they have succeeded in seeing the microscopic fungus, which, on being placed under the skins of healthy dogs, caused distinct and regular paroxysms of intermittent fever, and produced in the spleens of these animals that peculiar enlarged condition which is a recognized part of the pathology of this disease.

The report of their investigations and experiments, and the success that crowned them, was read a short time since in the Academy at Rome, and if further tests substantiate the truth of their discovery, the next series of experiments will have for their object the means whereby these poisonous fungi may either be destroyed or rendered innocuous. The practical agricultural remedy of draining and liming will probably remain the best remedy.

The discovery of the source of malaria in a minute fungus, discernible only under the microscope, merits the applause with which it has been received, and will strengthen very materially the belief in the germ theory of disease which has found in Tyndall one of its ablest advocates.

WORKSHOP NOTES.

The leaves of certain plants, when conventionally treated, become excellent decorative forms. Of these, ivy, maple, crowfoot, oak, and fig leaves are well adapted for the purpose.

In the sphere of what is called industrial art, use and beauty are, in theory at least, closely associated; for not only has the humblest article of manufacture, when honestly designed, a picturesque interest of its own, but no decorative feature can legitimately claim our admiration without revealing by its very nature the purpose of the object which it adorns.

Moldings were originally employed to decorate surfaces of wood or stone, which sloped either vertically or horizontally from one plane to another. Thus, the moldings of a door represent the beveled or chamfered edge of the stout framework which holds the slighter panels. It is obvious, therefore, that these moldings ought to be worked in the solid wood, and form part of the framework.

Nothing is more difficult than to estimate the value and intensity of color when spread over a large surface from the simple inspection of a pattern-book. The purchaser will frequently find that a paper which he has ordered will look either darker or lighter when hung than it appeared in the piece. For this reason it is advisable to suspend several lengths of the paper side by side in the room for which it is intended, and it is only by this means that a notion of the ultimate effect can be arrived at.

The fact is that either from shortness of purse or the *vis inertiæ*, we rest content with a great many bad things against which our secret soul revolts. In consequence of this our surroundings, regarded as a whole, present the heterogeneous effect of a bouquet made up of potato blossoms and whiteweed mingled with tea roses and gardenias. Cabinet-makers will not be disinterested enough to manufacture furniture, however good, which does not meet the public taste. For this state of things there is but one remedy, and that is to raise the standard of public taste by creating museums and schools of art. The demand for good things will then be made, and the supply will speedily meet it.

Real art can accommodate itself to the simplest and most practical shapes, as well as to the most delicate and subtle forms of refined manufacture. There is no limit to the height of dignity which it can reach; there is no level of usefulness to which it will not stoop. You may have a good school of design for the art-workmen; you may have a bad school of design for the art-workmen; but you can have no grand school, for both the blacksmith and the goldsmith are bound by æsthetic laws of equal importance, and the same spirit which guides the chisel must direct the lathe.

The most formidable obstacle which lies in the way of any attempt to reform the arts of design is, perhaps, the indifference with which people of reputed taste are accustomed to regard the products of common industry. There is many a connoisseur of pictures and of sculpture, many a *virtuoso* now haunting auctions and curiosity shops with a view to gratify his particular hobby, who would be surprised if he were asked to pass his opinion on the merits of a door-knocker or set of fire-irons. By such men—and they represent a very numerous class—art can only be valued as an end in itself, and not as the means to an end.

Unpolished mahogany acquires a good color with age. It also looks very well stained black and covered with a thin varnish. Stained deal, as a cheap substitute for oak, may answer in places where it is not liable to be rubbed or handled; but for library wear it cannot be recommended, since it shows every scratch on its surface, and soon becomes shabby with use. When for economy's sake deal is employed it is better to paint it in flatted color, because this can be renewed from time to time, whereas wood once stained and varnished must remain as it is. Indian red and slate grey are perhaps the best general tints for wood when used for ordinary domestic fittings, but these may be effectively relieved by patterns and borders of white and yellow. Sometimes a mere line introduced here and there to define the construction with an angle ornament at the corners will be sufficient. In all chromatic decoration, bright and violent hues *en masse* should be avoided.

To Case-Harden Cast Iron.—In three gallons of clean water mix one-half pint of oil of vitriol and two ounces of saltpetre. Heat the iron to a cherry red and dip as usual.

ARCHITECTURAL ADVICE.

(From Rules for Criticism in Hobbs' Architecture.)

As the whole is more important than any separate part, and equals all the parts, it demands the first and last consideration. All architecture must be practical, and should be mechanical; and errors in this department are unbearable ignorance, and put the architect below the artisan, who could do better. All work, when practical and mechanical, should be beautiful, or the architect has no genius or merit. All ugly things should be dropped as soon as possible, and all beautiful parts be made use of to the greatest extent admissable with propriety. No part should chop up the whole unless it be worthless. There should be some master line throughout the whole work, like the three colors, red, blue, and yellow, which, when balanced, produce a neutral gray or black; and so an equal balance of these three lines will produce a neutral, or as near nothing as possible.

Central ornaments, pediments, etc., must be of sufficient power to master the sides or the sides master them; if equal, the effect is neutral and the labor lost. Make the parts which have the most important offices to perform the purest and ornamentally attractive. Never attract attention by ornamenting unpleasant things, as it makes them conspicuous.

Do all things with strict regard to economy. Never use labor and material unless it pays in the design. All false things, as string courses, false windows, chimneys, and other parts not wanted, but necessary to make a design acceptable, show lack of good architecture. He that can use the least labor and material and produce the most beautiful effect, is the best architect. It is not the knowing a fact that makes men wise, but their estimation of its true value.

Learn to see the beautiful in all things, but if they have ugliness about them, never see it without condemning it. Guard the avenues to the senses by good judgment, and let nothing foul or unsightly enter without being accompanied by an idea that will reform it; then it will lie quietly in the mind and not come forward to disturb the good.

TEMPERING STEEL SPRINGS.

Tempering to impart to steel its maximum of elasticity, is a branch of the art requiring, to obtain the best results, the most expert of manipulation. This is especially the case where the springs are subject to severe strains in proportion to their dimensions, while at the same time subject to vibrations. Under these conditions, the least degree of undue hardness causes a spring to break, while undue softness causes it to bend to a permanent set, thus altering its normal form. For instance, if a spiral spring, whose coils are distended by force applied at the ends, "sets," the coils, when released from distention, will not approach each other to the distance they did before distention, the amount of difference being the amount of the "set;" or, if the coils were compressed and failed, when released, to resume their natural positions relative to each other before compression, the spring has "set." Hence the relation between the length, breadth, and thickness of a spring, and the nature, and amount of its duty are vital elements in estimating the quality of its temper.

The commonest method of spring tempering consists in first hardening the steel, and then blazing it off by heating it in connection with some fatty combustible compound, which will take fire and blaze when it has acquired a certain temperature, it being found that the temperature at which heavy oils, tallow, etc., take fire is about that necessary to reduce a well-hardened spring to the degree of temper imparting to steel its greatest elasticity.

Here we have two separate operations, hardening and tempering; and to avoid this, and temper at once, without the intervention of hardening, is an object of great importance. It has been accomplished, however, in several cases. Thus, one of our largest spring manufacturers tempers spiral springs as follows: They use Gregory's crucible steel, heating it in a furnace burning gas coke, but the furnace has a return flue and heating chambers, and ovens between the flues, the heat passing through the brickwork forming the flues into the ovens. To facilitate renewing the ovens (which, of course, also renews the flues), the floor of each oven (which forms the ceiling of the oven below), is built on iron supports, protected by the brick-work and suitable fire clay, the bricks all being made to pattern, thus involving very little labor in building. The furnace doors are at the end, and are kept closed as much as possible. In this way the steel has no contact with the products of combustion of the fuel, and the air is excluded as far as practicable (two valuable features). The furnaces are long and narrow, and not being connected with the flue there is but little disposition for the cold air to rush in when the furnace doors are opened.

The hardening and tempering of springs, whose coils are of thick cross-section, is performed at one operation as follows: The springs are heated in the furnace or oven described, and are first immersed for a certain period in a tank containing fish oil (obtained from the fish "moss bunker," and termed "straights"), and are then removed and cooled in a tank of water. The period of immersion in the oil is governed solely by the operator's judgment depending upon the thickness of the cross-section of the spring coil, or, in other words, the diameter of the round steel of which the spring is made. The following, however, are examples:

Number of coils in spring	5¾
Length of the spring	6 inches
Outside diameter of coils	4¾ "
Diameter of steel	1 inch.

The spring was immersed in the oil and slowly swung back and forth for 28 seconds, having been given 35 swings during that time. Upon removal from the oil the spring took fire, was redipped for one second, and then put in the cold-water tank to cool off.

Of the same springs the following also are examples:

Example.	Time of immersion in oil.	Number of swings in oil.
Second	36 seconds.	46
Third	27 "	36
Fourth	38 "	40

SIZE OF SPRINGS.

Number of coils in the springs	6
Length of the springs	9 inches.
Inside diameter of coils	3½
Size of steel	1 x 1⅛ square.

Example.	Time of immersion in oil.	Number of swings in oil.
First	9 seconds.	12
Second	8 "	12
Third	8 "	12
Fourth	9 "	12
Fifth	9 "	12
Sixth	9 "	12

To keep the tempering oil cool, and at an even temperature, the tank of fish-oil was in a second or outer tank containing water, a circulation of the latter being maintained by a pump. The swinging of the coils causes a circulation of the oil, while at the same time it hastens the cooling of the spring. The water tank was kept cool by a constant stream and overflow.

If a spring, upon being taken from the oil, took fire, it was again immersed as in the first example.

In this, as in all other similar processes, resin and pitch are sometimes added to the oil to increase its hardening capacity if necessary.

The test to which these springs were subjected was to compress them until the coils touched each other, measuring the height of the spring after each test, and continuing the operation until at two consecutive tests the spring came back to its height before the two respective compressions. The amount of set under these condition is found to vary from three-eighths of an inch, in comparatively weak, to seven-eighths of an inch for large, stiff ones.—*Joshua Rose. M. E., in Wheelwright and Blacksmith.*

—There is a notion very prevalent among people who have given themselves but little trouble to think at all on the matter, that to ensure grace in furniture, it must be made in a flimsy and fragile manner. Thus we constantly hear the expression of "light and elegant" applied to a set of drawing-room chairs which look as if they must sink beneath the weight of the first middle-aged gentleman who used them. Now, lightness and elegance are agreeable qualities in their way, and, under certain conditions of design, art should be aimed at. For instance, the treatment of mere surface ornament, such as painted arabesques, etc., or of details purely decorative and useless as the filagree gold of a lady's ear-ring, may well be of this character; but objects intended for real and daily service, such as a table which has to bear the weight of heavy books or dishes, or a sofa on which we may recline at full length, ought not to look light and elegant, but strong and comely; for comeliness, whether in nature or art, is by no means incompatible with strength.

PAPER-HANGING.

We would urge the necessity, from a sanitary point of view, of having the walls of a room thoroughly stripped of all old paper, and washed and dried before laying on new paper. Old papers, containing as they do a large amount of vegetable and animal matter in the form of size, are easily softened by the moisture, and become putrefied and mildewed, the odor from which is unpleasant and unhealthy. This, however, is an evil that can easily be averted by expending a few dollars in stripping and thoroughly cleaning the wall before each re-papering. Inquiry is often made by the careful wife as to whether paper-hangings will clean, and if so, which is the best method to adopt. Good hand-printed paper will clean, but machine-made paper, owing to the material used in sizing the colors, as already explained, will not. The following is the method that can be used:—Cut into four or six parts a moderately sized loaf of bread that is two days old—it must be neither newer nor staler. With one of these pieces, after blowing off all the dust from the paper to be cleaned with a good pair of bellows, begin at the top of the room, holding the crust in the hand and rubbing lightly downwards with the crumb, about half a yard at each stroke, till the upper part of the hanging is completely cleaned all around. Then go round again, with a light sweeping stroke downwards, always commencing each successive course a little higher than the upper stroke had extended, till the bottom is finished. This operation, if carefully performed, will frequently make very old paper look almost equal to new. Great caution must be used not by any means to rub the paper hard, or to attempt cleaning it in a lateral or horizontal way. The dirty part of the bread, too, must each time be cut away, and the pieces renewed as soon as it may become necessary.

MENDING BELTS.

It is not always economy to replace a partially worn belt by a new one. So long as there are portions of a worn belt that retain a part of their original soundness it is useful as a portion of another belt. In no case put a piece of new, unused belting into an old and partially worn one; more than 18 hundred years ago this fact was recognized and recorded, although the word "bottle" was used instead of belt. The uniform tension of a belt is impaired by uniting new and unused leather with that which has grown supple by use. No belt should have more than one butt joint. The pieces should be put together in scarf joints by means of rivets or lace leather; old belts have usually absorbed so much lubricating oil that belt cement—fish glue—will not "take." In riveting, the heads should be on the wearing or pulling side, and the burrs or washers on the other. In sewing a lap, the awl should be passed through in a slanting direction, and the stitches should present the smallest amount of surface on the pulling side. In making a butt joint, the lacing should not be crossed on the pulley side. The ends of the belt should always be cut by a try square to insure perfect straightness. In taking up belts, even narrow belts, it is much better to cut and sew the belt *in situ* than to run it off the pulleys. The proper degree of tension can always be thus secured and the belt not be kept too loose, nor shortened too much; besides, there is always an uneven strain, liable to work injury to the belt, in running it on. A good belt clamp should have a place in every shop and factory. If you cut your own lace leather, the handiest way to make laces is, after straightening one edge of the skin, to guide the knife with the thumb instead of a straight edge under which the leather will stretch and pull. By holding the thumb rigid, any width of lace may be assured and the work is very rapidly performed.

SEWER GAS AND DISEASE.

The authorities of one of the largest hospitals in London lately took measures to ventilate all the drains and sewers in connection with their institutions. Up to the time these alterations were made, pæmia and erysipelas had almost driven the medical staff to despair. When the whole of the ventilation was completed, and as soon as the pressure was removed from the traps of the closets and lavatories, no fresh cases were found to occur. For months the hospital wards were free from both erysipelas and pæmia. Suddenly, however, there was a fresh outbreak of these diseases, but it was noticed that the epidemic was confined to one of the surgical wards, built apart from the main building, on the pavilion plan, and having only one story. Close investigation proved that the ventilation pipe in this wing had been stopped up by a careless workman. When this was remedied, all traces of the epidemic disappeared.

NEW REGISTERED WARMING STOVE.

The growing popularity of heating and warming stoves for burning petroleum or other mineral oil, is shown in the alacrity with which manufacturers, in obedience to the public demand, produce new and special patterns as the winter season comes on. A perfect little stove of this kind—emphatically claimed as "The Stove of the Season"—is illustrated in the annexed engraving. It is a handsome stove, and when burning imparts considerable warmth and cheerfulness to the room, thus rendering it useful for warming bedrooms, landings, halls, &c. As will be seen, it is of octagon shape; the tank, handles, and body ring are made of best bright tin, and the body of ornamental bronzed iron, with a neat bronzed cast iron top. It is fitted with a movable 8-inch burner (manufactured under Rippingille's patents, of which the Albion Lamp Company have the sole right of production) which gives great heat without smoke or smell, at a small cost for oil. There are eight ruby glass panels through which radiant heat is reflected, giving the stove a most attractive appearance. Ironmongers will find this a good item to put before their customers in cold weather, as the octagon is at once a cheap and pretty stove for domestic purposes.

Improvements in Boiler Making.—We made reference a few weeks since to some improvements in boiler making, whereby leakage due to the unequal expansion arising from the difference of temperature between the top and bottom of a boiler might be avoided. The remedy consisted in welding the plates in complete rings, so as to avoid the necessity of rivet joints at the bottom of the boiler. This plan required the rolling, for some boilers, of much larger sheets than had hitherto been attempted. That difficulty, however, was soon overcome, when a second presented itself, in bending such large plates into the proper "set." This work, according to the Newcastle (Eng.) *Chronicle*, entailed the expenditure of a large amount of additional time and labor. At length, however, the managing engineer of the Jarrow Rolling Mills of Newcastle conceived the idea of using vertical "bending rolls," instead of the ordinary horizontal ones. The thought was promptly developed and a set of the new rolls erected at the Jarrow Works, which the *Chronicle* says are exceedingly simple in arrangement, and eminently successful in operation. By their use there is a large saving of the labor and time consumed in the ordinary course of plate bending; and what is of equally valuable importance, the required "set" of the plate is obtained to a nicety, and with perfect ease. By the introduction of these improvements, those works are now enabled to construct marine boilers of extra large size; and the experiment has been completely successful.

Why Does Steel Harden?—Mr. James Nasmyth opens up a very interesting question in the following letter recently published in *Engineering*: "In these days of earnest scientific investigation, it is to me a matter of surprise that no special attention has been given to one of the most vitally important subjects, namely, 'the reason why' steel becomes hard on being suddenly cooled down from a red heat by plunging it into cold water. On this one simple but wonderful property of steel depends the entire range of those mechanical arts which lie at the basis of civilization, and by whose exercise we are enabled to rise above the savage condition. It occurs to me that it is from the want of due consideration of the enormously important consequences that arise from this wonderful, yet simple, property of steel, that the causes of so remarkable a change as respects hardness which results on suddenly cooling it from a red-heat condition, has prevented the subject from receiving special attempts to investigate its nature. While in these days the most powerful and active intellects are occupied in physical investigations, in searching into the nature of those actions in matters which are ever in progress around us, so far as I am aware no one has made an attempt to enter upon this vitally important subject. It is in the hope that these remarks may chance to direct the attention of some one who may have the ability and opportunity to enter upon the investigation to do so.

Cracking in Hardening.—In tools composed partly of iron and partly of steel, steel laid as it is called, the tendency to crack in hardening may be avoided in a great degree by hammer-stretching, hammering the steel edge at a low temperature until it is expanded, so that when cooled in hardening it will merely contract to a state of rest with regard to the iron parts; the same effect can be produced by curving a piece, giving convexity to the steel side before hardening.

FERDINAND DE LESSEPS AND THE CHAGRES CANAL.

The Viscount Ferdinand de Lesseps, with his family and staff of engineers, arrived in this city, Feb. 25, from Panama, where he had been to examine the route of the proposed Chagres Canal.

Born in Versailles, France, Nov. 19, 1805, M. de Lesseps early entered the diplomatic service of his country, continuing therein some forty years. In 1854, he went to Egypt on the invitation of the Viceroy, Said Pasha, to examine the project for a ship canal across the Isthmus of Suez, and two years later he published a memorial giving full details of the enterprise. A stock company for the construction of the canal was formed, and M. de Lesseps gave himself up entirely to the prosecution of the great undertaking. The work was begun in 1859, and completed in 1869. This great achievement, conceived and carried out in spite of gigantic physical, financial, and political difficulties and discouragements, gave M. de Lesseps undisputed rank as the first engineer of the age.

Since the completion of the Suez Canal M. de Lesseps has suggested or has been consulted with regard to several great geographical and speculative enterprises—among them the conversion of a large area of the Sahara desert into an inland sea; the cutting of a ship canal through the Isthmus of Corinth, which is now being excavated; and the laying out of an elaborate scheme of Russian railways connecting the south and east of Europe with India. All these projects, however, are of comparatively small importance beside that of severing the Isthmus of Panama by means of a salt water ship canal at sea level.

With the history of this enterprise, since the Canal Congress in Paris last spring, our readers are already familiar. M. de Lesseps says that as early as 1869 he was convinced that a sea-level canal without locks was the only one practically possible for the Isthmus; and at a public meeting in Paris, in 1870, he confidently asserted that opinion. This, however, it is proper to remember, was purely a matter of theory, for at that time there had been no careful survey of a route for a canal without locks, and accurate estimates of the practicability or probable cost of such a work were out of the question.

Having gone to the Isthmus determined to demonstrate the wisdom of his choice, M. de Lesseps has naturally succeeded in finding confirmation of the justness of his *à priori* belief.

The proposed canal substantially follows the route of the Panama railroad. A tide-lock is to be constructed in the Bay of Panama to control the level of the canal. In the Bay of Limon, on the Atlantic side, it is necessary to construct a breakwater two kilometers long, on account of storms. The cost of the entire work, estimated at 843,000,000 francs, includes the following items: All excavations, dredging, and removal of earth, 570,000,000 francs; dam at Gamboa, 100,000,000 francs; changing the waters of the Chagres, Obispo, and Trinidad, 75,000,000 francs; tide-lock on the Pacific, 12,000,000 francs, and breakwater on the Atlantic coast, 10,000,000 francs. Contingencies are estimated at 76,000,000 francs. The work will take eight years to complete, and it may be commenced before next June. The estimates contemplate the removal of 75,000,000 square meters of rock and soil.

The Gamboa dam will be required to form an artificial lake to receive and regulate the flow of the waters of the three rivers, whose periodical floods furnish the most serious danger to the proposed canal. This dam will be 5,000 feet long and 40 meters high. It will be exceeded in size only by the three great dams at St. Etienne, France. La Gemappe, Belgium. and Alicante, Spain. The last has stood for three hundred years.

As a reception given to M. de Lesseps by the American Society of Civil Engineers, Feb. 26, the distinguished engineer insisted that the proposed Chagres Canal was a much less difficult task than the canal at Suez. The deepest cutting would have to be about the height of the Brooklyn bridge towers. One of the visiting engineers, M. Douzat, said there would be seven miles of deep cutting, averaging 180 feet, of which 160 was rocks. The deepest cutting in other parts of the canal would average 40 to 45 feet. The entire length of the canal is about 45 miles. In answer to the question why a sea-level canal was preferred to one with locks, M. de Lesseps said:

"If the Commission of Engineers which had gone down to Panama has reported in favor of a canal with locks, I should have put on my hat and left the whole project and would have had nothing to do with it. That plan will do for small ships, but when we have vessels now afloat 500 feet long, and others on the stocks 600 feet long, it is impossible to say for what you would have to build locks. Single locks would be slow, and double locks, though quicker, would be very expensive and require constant repairs. At Nicaragua they intended the use of locks, and with the earthquakes which prevail there the repairs would be ruinously expensive, and even at Panama, where earthquakes do not exist, they would be fatal by reason of the loss of time. I would not have anything to do with a locked canal except for little ships. It is not the proper idea for a grand interoceanic canal."

M. de Lesseps is a man of medium height, strongly built, alert in all his movements, erect and elastic in carriage, and seemingly not much over fifty years of age, though really seventy-four. His first days in New York have been devoted to the inspection of the elevated railways, the Brooklyn Bridge, the working of the fire department and the Croton water service.—*Scientific American.*

TECHNICAL NOTES.—Prof. Egleston, in a recent lecture on Gold, made the point that the idea that this metal was confined to the most ancient formations must be abandoned, since it has been found in deposits of all ages. He made the curious calculation that all the gold in the world would only suffice to make a pile 25 feet wide, 45 feet long, and 25 feet high.——A paragraph is going the rounds of the technical press that sheet iron covered with gum of the *euphorbeaceæ*, common and luxuriant in the tropics, affords an excellent protection against fouling when exposed to the action of sea-water. A test-piece of iron, covered as above stated, and immersed at the Chatham dockyard, England, where every thing becomes rapidly fouled, was taken out after lengthened immersion quite clean. This gum is described as being intensely bitter and poisonous to the lower forms of life. Further details will be found elsewhere in this department.——The experiments in electric lighting in London, inaugurated some time ago by the Metropolitan Board of Works, are said to have given such satisfaction that a further extension of the system (the Jablochkoff plan is employed) has recently been made from the Central Station at Charing Cross on the Thames embankment.——The sensation created by the last announcement from Menlo that Edison had succeeded in solving the problem of electric lighting for domestic purposes has died out sooner than we had anticipated. At present writing, the globes are affected with a disposition to crack, the carbon horseshoes disintegrate, and, saddest of all—for those upon whom it was unloaded—the stock of the company has fallen almost as rapidly as it "boomed." Moral: "Never holler till you're out of the wood."——A contract for laying a submarine cable across the Gulf of Mexico, connecting the United States with the Mexican Republic, has been approved by the Mexican Congress.

—A daily action of the bowels, says *Hall's Journal of Health*, is essential to good health under all circumstances; the want of it engenders the most painful and fatal diseases. Nature prompts this action with great regularity, most generally after breakfast. Hurry or excitement will dispel that prompting, and the result is nature is baffled. Her regular routine is interfered with, and harm is done. This is a thing which most persons do not hesitate to postpone, and in the case of riding to town, a delay of one or two hours is involved. This never can occur with impunity, in any single instance, to any person living. This very little thing—postponing nature's daily bowel actions—failing to have them with regularity—is the cause of all cases of piles and anal fistulas, to say nothing of various other forms of disease: fever, dyspepsia, headache, and the whole family of neuralgias. A man had better lose a dinner, better sacrifice the earnings of a day, than repress the call of nature; for it will inevitably lead to constipation, the attendant and aggravator of almost every disease. To arrange this thing safely, breakfast should be had at such an early time as will allow of a full half hour's leisure between the close of the meal and the time of leaving for the cars.

CELLULAR CONSTRUCTION.—A good illustration of the principle and strength of cellular construction may be given as follows: Take a piece of tin, some 12 inches long and 6 inches broad. Lay its ends on two blocks. Thus suspended a few ounces of weight bends it down to the ground, but roll it up in a tight roll and you may suspend very many pounds from it without its yielding a particle. This illustrates the strength of cellular construction. On this plan the *Great Eastern* steamship was built, she having, up to the water-mark, an inner and outer metal shell of three-quarter-inch plate, placed three feet ten inches apart, and between them, at intervals of six feet, run horizontal webs of iron plates, which convert the whole into a series of continuous cells or iron boxes.

THE FEET IN WINTER.

Sometimes in washing the feet in warm water a great deal of scurf or whitish soft substance may be scraped from the soles. This is dead skin, dried perspiration, and other accumulations, all resulting from a want of personal cleanliness. These accumulations occur most in winter, when washing the feet is neither as convenient nor agreeable as in summer time. Many persons suffer from cold feet, simply from a neglect to keep them clean. Few suffer thus in summer time, one reason for which is that the skin is moist, the pores are open, a free evaporation takes place, and the blood is invited to the surface. In winter the skin is dry, harsh and cold. To keep them constantly warm and comfortable is indispensable to good health, and to do this the surface must be brought to the condition of summer—that is, must be soft and somewhat moist, instead of being harsh and dry. This may be soon brought about by soaking the feet in warm water for half an hour at a time daily, using most freely a very stiff brush, with good soap. After the skin has become soft and smooth, a good washing with soap and warm water twice a week during cold weather will greatly contribute to a healthful condition of the feet as well as to personal comfort. If the feet are kept unexceptionally clean, and are nevertheless inclined to be dry, considerable benefit will be derived by rubbing into the soles every morning a little sweet oil, 20 or 30 drops to each sole, with the palm of the hand, patiently and well, the object being to secure by artificial means, that softness and moistness which is known to favor evaporation and invite thither the flow of blood. If in addition, the feet were placed in cold water regularly every morning (when not unwell) not over two inches deep, and remaining in not over half a minute in cold weather, then rub briskly dry with a coarse cloth, next with the hands, all followed by a brisk walk or stamping for a minute or two, or until they begin to feel comfortably warm after the cold bath, an improvement in the condition of the feet would be secured in a reasonably short time, which would largely compensate for the trouble taken.—*Hall's Journal of Health.*

HOW LONG WE ARE TO LIVE.

It is not every one who asks himself this question, because, strangely enough, it is the belief of many persons that their lives will be exceptionally lengthy. However, life assurance companies are aware of the credulous weakness of those whose lives they assure, and have therefore compiled numerous tables of expectancy of life for their own guidance, which are carefully referred to before a policy is granted. The following is one of these well-authenticated tables, in use among London assurance companies, showing the expectancy of life at various ages. In the first column we have the present ages of persons of average health; and in the second column we are enabled to peep, as it were, behind the scenes of an assurance office, and gather from its table the number of years it will give us to live. This table has been the result of careful calculation and seldom proves misleading. Of course, sudden and premature deaths, as well as lives unusually extended, occasionally occur; but this is a tale of average expectancy of life of an ordinary man or woman:

Age.	More yrs. to live.	Age.	More yrs. to live.
1	39	50	21
10	51	60	14
20	41	70	9
30	34	80	4
40	40		

Our readers will easily gather from the above tabulated statement the number of years to which their lives according to the law of averages, may reasonably be expected to extend.

STRAIGHTENING CASTINGS.—Sometimes a casting is warped in cooling and requires straightening before being used. If the piece is to be planed or otherwise finished it should be straightened by heating and placing weights upon it. If it yields to this treatment it will retain its corrected form after the scale is removed, and through all the after processes; but, if the piece is to be used without finishing, it may be straightened by "pening" with the hammer—striking with the "pene" or wedge-shaped end of the machinist's hammer. This process makes a series of indentations on the convex side of the iron, stretching the "skin" of the casting; but when these indentations are removed by after working, the casting is liable to return to its curved form. In "pening," that portion of the casting that receives the blow should be immediately over the face of the anvil or bench block; in other words, each blow should find a solid resistance, and the casting should be moved along the face of the anvil as the work progresses.

CAUSE OF DRUNKENNESS.—Dr. Jackson expresses the opinion that one of the most common inducements to the use of alcohol, is that people overwork themselves, and being so exhausted that they cannot sleep, resort to smoking, chewing and alcohol drinking. This may sometimes be the case, but we can testify to having learned by observation that men do not become drinkers because they cannot rest, but because instead of devoting their leisure hours to useful reading and proper entertainments, they spend them in drinking saloons among dissipated companions, or they drink at home to kill time. When a man is fatigued from bodily labor, all he has to do is to keep his mind occupied with reading, or have others read to him, and he will soon feel sleepy. The kind of reading has, of course, much influence, and a man must learn by experience what kind of literature will keep him awake, and the sort that will cause him to sleep.

SODA FOR BURNS.—All kinds of burns, including scalds and sunburns, are almost immediately relieved by the application of a solution of soda to the burnt surface. It must be remembered that dry soda will not do unless it is surrounded by a cloth moist enough to dissolve it. This method of sprinkling it on and covering it with a wet cloth is often the very best; but it is sufficient to wash the wound repeatedly with a strong solution. It would be well to keep a bottle of it always at hand, made so strong that more or less settled at the bottom. This is what is called a saturated solution; and really such a solution as this is formed when the dry soda is sprinkled on and covered with a moistened cloth. It is thought by some that the pain of a burn is caused by the hardening of the albumen of the flesh which presses on the nerves, and that the soda dissolves the albumen and thus relieves the pressure; others think the burn generates an acrid acid which the soda neutralizes.

WARM CLOTHING.—If you are apt to feel chilly dress warmly at home. A wadded coat will enable the chilly man to sit and work anywhere in doors, and so will an extra suit of thin flannel worn during the whole of the active day. Just let any one who doubts what we say try the very simple expedient, when the chilliness becomes unbearable, of putting on his dressing gown over his ordinary clothing, and in five minutes he will be perfectly comfortable and ready for work, while he will not suffer as he fancies he will, when he goes out of doors. The popular notion upon that subject is a mere delusion. You are not strengthened for outdoor work by shivering indoors, but rather weakened; habitual warmth, if not too great, being one of the best preservatives of constitutional strength. Always try to remain moderately and healthfully warm.

MAKING GLUE WATERPROOF.—The best substance is bi-chromate of potash. Add about one part of it, first dissolved in water, to every thirty or forty parts of glue; but you must keep the mixture in the dark, as light makes it insoluble. When you have glued your substances together, expose the joint to the light, and every part of the glue thus exposed will become insoluble and therefore waterproof. If the substances glued together are translucent like paper is, all will become waterproof; if opaque like wood, only the exposed edges will become so, but they also protect the interior—not exposed parts—against the penetration of moisture.

LIME FOR DIPHTERIA.—A child in Auburn, ill of diphtheria, and whose life was despaired of, was cured by slaking lime. Small lumps of lime were kept constantly slaking near its mouth for a day and a half, until over a barrel lime was thus slaked. The child was thought to be dying before this remedy was employed. It breathed the fumes constantly until cured.

NUTRIMENT IN BEANS.—One pound of beans will support life in action as long as four pounds of rice. Two pounds of beans will help do more muscular work than three pounds of wheat, and more brain work than three and one-half pounds. The reason why beans require stronger powers of digestion than wheat is that they contain casein instead of gluten.

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

—THE first gold mine in the United States was discovered in South Carolina, in 1790.

Agricultural Implements and Machinery.

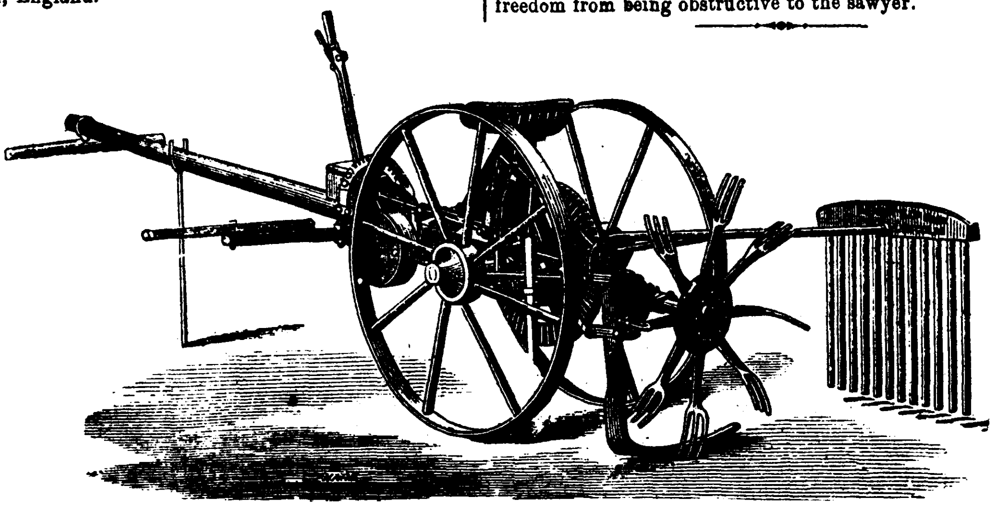
PENNEY'S IMPROVED POTATO DIGGER.

The value of this labour-saving implement has been completely tested in recent trials. This machine is shown in our engraving, and is wonderfully simple and compact. The potatoes are raised and strewed on the surface of the ground, ready to be gathered, at the rate of from three to four acres per day, and at a cost of about 50 per cent. less than when taken up in the ordinary way by manual labour. The apparatus is of light draught and one pair of horses can work it with ease. The driver has complete control of the whole by means of a single lever, which raises and lowers the machine and puts the revolving forks entirely out of gear when required. The digger is well and strongly made, and remarkably easy of management by an ordinary farm labourer without any previous experience in the use of such machinery. This machine is manufactured by Messrs. Penney & Co., Lincoln, England.

LAKEMAN'S CIRCULAR SAW GUARD.

AN ENGLISH INVENTION.

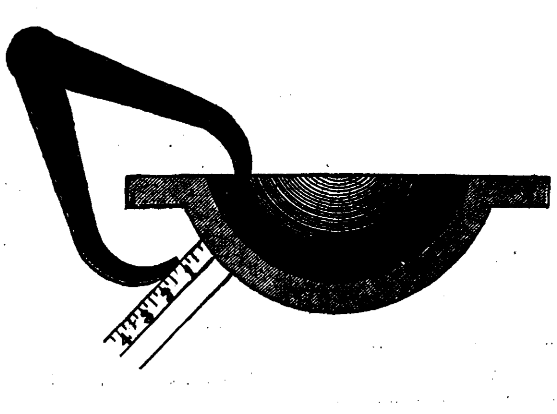
This is an appliance of simple construction, which consists of a sheet iron bent plate, which is curved over the top of the saw, and which can be adjusted as to height by the aid of the thumb-screw. Most accidents due to circular saws occur when the attendant is pushing a piece of wood up to the saw; his foot slips and he falls forward on it. This last, it will be seen, the guard effectually prevents. The guard consists of three pieces, namely:—(1) The mortise plate A, secured by three bolts to the fence. (2) The radial arm, B, which is secured and adjusted vertically into the mortise plate A, by means of the nut and collar B1 A2; and (3) the covering plate, C, which is secured and adjusted laterally in the radial arm B, in conformity with the adjustment of the saw fence, by means of the thumb-screw, C1. Where several saws of various diameters are used in the same bench, it is advisable to have two or, perhaps, three covering plates, C, graduating in size to cover the whole series of saws. Thus, it is plain that the apparatus, as described, is in its mode of fixing exceedingly simple. It is to be recommended on account of its simplicity, its cheapness, its immovability when fixed, and for its perfect freedom from being obstructive to the sawyer.

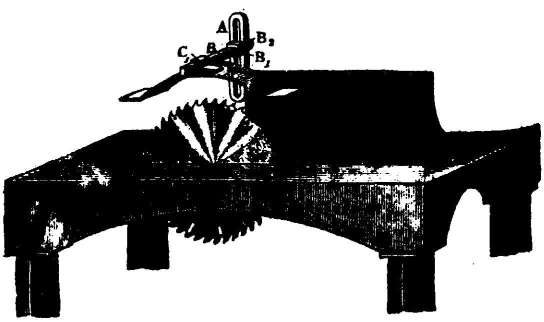


PENNEY'S IMPROVED POTATO DIGGER.

A MECHANICAL "WRINKLE."

To get at the dimensions of a piece of work of irregular shape, the following simple procedure is given by John Walker in the *Millstone*: The adjoined casting being of spherical form, with flange, it would puzzle most mechanics, without special tools, to find its thickness. The first thing usually resorted to would be to drill a hole at a designated point. The accompanying "wrinkle" provides a readier method, and does away with the application of special tools. By simply applying a common rule, as shown, and setting the calliper to some even inch on the rule, so that it may easily be removed, it will be seen that the difference between the even inch denoted and the actual opening of the calliper is the dimension required.





LAKEMAN'S CIRCULAR SAW GUARD

Rule for Finding the Weight Necessary to Put on a Safety Valve Lever.—When the area of valve, pressure, etc., are known: Multiply the area of the valve by the pressure in pounds per square inch; multiply this product by the distance of the valve from the fulcrum; multiply the weight of the lever by one half its length; then multiply the weight of the valve and stem by their distance from the fulcrum; add these last two products together, subtract their sum from the first product, and divide the remainder by the length of the lever; the quotient will be the weight required.