Technical and Bibliographic Notes / Notes techniques et bibliographiques

THE

CANADIAN MECHANICS' MAGAZINE

AND

FAMILY FRIEND.

INDEX TO VOL. IV.

Those marked with an Asterisk are accompanied with Illustrations.

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CANADIAN MECHANICS MAGAZINE AND PATENT OFFICE RECORD

Vol. 4. JANUARY, 1876. No. 1.

HOME INDUSTRY.

A Source of Income in "HARD TIMES."

IN the last number which closed the volume of this magazine for the past year, we endeavoured to point out to Employers and Employed the mutual advantages to be gained by Manufacturers and Employers working in an unity of spirit; their interests are so intimately connected, that any action on the part of the Employed which causes a stop in the machinery of the workshop is productive of injury to themselves, their employers and the world; and even if they gain their point it leads only to temporary benefit, and by no means compensating for the loss of wages and the misery brought to their families by a prolonged stand-out. Employers aggravated by these strikes, in their turn, retaliate when times like the present happen, and those most prominent as leaders are the first whose services are dispensed with. We trust that the time is not far distant when these matters will be more thoroughly understood, when the whispers of prudence and common sense will have greater sway over the minds of men, then the insidious and loud words of the discontented and disaffected; when a feeling of good will towards each other will animate the minds of both Employers and Employed, and that they will feel their interests are mutual, and that which brings a loss to one side must result also in a loss to the other.

It is one of the many well intended objects of this Magazine to be an adviser and friend to the mechanic, and convey to him in its columns not only scientific information of value to him in every line of mechanical business, but to point out to him the ways and means of benefitting his position in life, to raise his social standing, to educate its younger members, by inculcating on their minds fine feelings of honor and morality, and to afford pleasing and instructive reading to his family circle.

The Mechanics of Canada are a numerous body, and, next to the Agriculturists, the most important body of our people, and might under the influence of Education —Education the lever of power—become the strongest motive force in the Country, and even rule its future destinies. The manufacturing interests of Canada are but yet in their incipient growth, she possesses in her crude materials enormous resourses of wealth, awaiting only time for development, and which judging from the rapid progress of her past prosperity and with a vision of the future before us, cannot be far off. This, however, is a subject far beyond our limits to dilate upon at present.

A new year has just dawned upon us, but there is still a depressing cloud hovering over every kind of mechanical labour, and thousands of mechanics in every trade are this month out of employment, and anxiously awaiting some movement in the wave of the commercial world to stir the stagnant waters of trade and set the tide of prosperity again a flowing. And here let us ask these questions, have the mechanics of the Dominion made any provision for a time like this?—have they in the days of high wages and plenty of employment saved out of their wages sufficient to carry them over the present hard times? have they a Savings Bank account? We fear not. We fear that many—very many—of those who for some years past have enjoyed a high rate of pay, are this day almost entirely destitute of money; and why is this so? Simply because from the want of prudence themselves and proper economy in their families, they have spent their earnings without judgment, in extravagances and wastefulness. This is a fault we regret to say peculiar to those who follow a mechanical trade. We know many a clerk, on the contrary side, receiving not half the pay of a first-class mechanic, employed, perhaps, in a wholesale-house or fashionable dry good store which necessitating that he should always keep up a certain position, rent a good house, clothe well both himself and his family, who has not only kept up his position in the world, but has enjoyed much of its real comforts and pleasures, and even been enabled to put by small savings to fall back upon in case of sickness, or loss of a situation, and this, as before said, when earning not much more than one-half the pay that a good mechanic has, until lately, received in this country. We have travelled over every part of the New England States and particularly noted how far better off in every way, is the native American to the Canadian mechanic. Every member of the family of the former, over a certain age, contributes by some Home Industry, with his or her earnings in whatever shape of industry it was been obtained, to add to the comfort of their home. There are few American mechanics who do not possess a comfortable *home-stead*, and in country villages, handsome cottages and gardens,—perfect models of neatness and comfort. We have frequently visited these homes, and therefore do not speak from hearsay, and have received therein that description of sensible and frugal hospitality which it would be well for many of us to imitate, where the wine bottle is never seen upon the table, the refreshments offered to their guests made by the hands of the hostess or her daughters, or gathered from a well cultivated garden. In almost every house of a well-to-do mechanic will be found a piano, a family well educated, and often some of them accomplished musicians. Have the means that have brought these comforts, these social enjoyments of a high order been gained by the head of the family alone? by no means—every member has been taught some useful trade or art, some Home Manufacture, the sale of which has afforded the additional means that have increased the comforts and pleasure of home. The American Mechanic is hardly ever at a loss to earn a livelihood during a time of depression, his ingenuity is for ever at work, and instead of being borne down by a falling off in business, he turns his attention to manufacturing many useful articles, which if not saleable at the time would realize money sooner or later. His whole industrial efforts are devoted to maintain himself until trade revived.

We by no means wish to draw any disparaging comparison between the Canadian and American mechanic, for we know full well that the States are indebted to the talent and experience of our own people,—which they have sought for and obtained at any price,—for the high position she at present holds in Arts and Manufactures. We simply wish to point out, in all kindness, that our mechanics are generally two deficient in those resources upon which they might fall back upon for a temporary support in a time like this, and to instil into their minds the great necessity of husbanding their means in times of prosperity. In a future number, therefore, it shall be our object to point out and illustrate the ways and means by which mechanic's family may, by Home Industry, always obtain sufficient employment to support themselves during times of depression, instead of passing their time in wearying idleness and despondency which too frequently leads to a greater misfortune still, namely INTEMPERANCE.

THE WINDSOR HOTEL.—The following is a list of the contractors for this hotel:—Masonry, etc., Daniel Wilson; brickwork, T. W. Peel; ironwork, H. R. Ives & Co., plastering, W. J. Cook; painting, John Murphy; carpentering, John Allan; roofing, Joseph James & Co.; steam-heating. etc., C. Garth & Co.; ranges and kitchen utensils, Bramball, Dean & Co., Chicago; plumbing and gasfitting, Robert Mitchell & Co.; annunciators, speaking tubes, etc., the Western Electric Manufacturing Company, Chicago; air ducts, drains, etc., Daniel Wilson.

DRIVING BELTS.—A new style of machinery belt suggested by J. F. Reigart, of Washington, consists of a flexible wire or rope covered with balls of vulcanized rubber.

THE BRITISH NORTH AMERICAN BOUNDARY COMMISSION.

THE expedition organised by the British and United States Governments with the object of the determining and marking out of the course of the boundary between the territories of the two Powers, has long since concluded all the field operations, and the official reports are in a fair way towards completion, and we are in a position to lay the general results of the work before our readers. The staff of the British Commission consisted of Major Cameron, R.A., commissioner; Captain Anderson, R.E., chief; and Captain Featherstonhaugh, R.E., and Lieutenant Galway, R.E., assistant astronomers, as well as Captain Ward, R.E., secretary; Mr. G. Mercer Dawson, geologist; besides the surgeon and assistant surveyors, &c. The western portion of the boundary, extending from the Pacific to the Rocky Mountains, had been marked out by the previous Boundary Commission during the years 1858 to 1862. This constituted about one-third of the length of the entire boundary to be surveyed, but as we pointed out in THE ENGINEER of August 22, 1872, it might be estimated as furnishing about half the amount of work to be performed, for the labour entailed by clearing tracks 20ft. wide through the dense forest which covered the ground to the west to the Rocky Mountains was very great. The second expedition has accomplished its task, and has not disappointed any expectations as to time, having performed its active operations in one winter and two summer campaigns. To accomplish this, the officers have had to work under circumstances as difficult, and at times as harassing, as may well be conceived, so that the greatest credit is due to them, and especially to Captain Anderson, the chief astronomer, for the character and accuracy of the work he has done.

The work may be briefly summed up as follows: The boundary to be surveyed was divided into three sections, each of which furnished the work of one campaign. (1) Commencing at a position—A on the map—called north-west point, at the western extremity of the natural frontier line formed by the chain of lakes, the boundary runs due south till it arrives at 49 deg. N. latitude, at a point B which falls in the Lake of the Woods, when it turns due west along the forty-ninth parallel—which it never again leaves—passing over much open swamp and bad ground till it arrives at Pembina station, C, on the Red River, about ninety miles west of the Lake of the Woods. (2) The parallel forming the boundary was to be traced over wild prairie land till it arrived due south of the Wood Mountain—D on the map—about 440 miles west of Pembina, (3) The forty-ninth parallel, extending from the Wood Mountain to the eastern point E, determined by Major Haig and Captain Darrah at Akimani, west of Lake Waterton, which concluded the boundary to be traced, was about 400 miles in length, running over a good deal of prairie land, finally traversing the wooded country bordering the Rocky Mountains.

The plan of operations was to complete the hundred miles, crossing over the swamps in the winter 1872-73, when the frost admitted of the work being performed. A centre or base for further operations was then formed at Pembina. After the necessary preparations, the parties pushed over the second section, arriving at the Wood Mountain in the autumn of 1873, and then tracing their steps to Pembina, to winter and to obtain the necessary supplies for the third section of their work, which was accomplished in the autumn of 1874.

Many details connected with the first portion of the work will be found in extracts from Captain Anderson's report in the *Geographical Magazine*, October, 1874. We do not propose to go into such details, but rather to pass on to the final results. We give our readers to geographical features of the map brought out in the geographical report already in print. The English and American parties travelled together, establishing joint camps, and observing at the same stations, and there was no sensible discordance in their results. It may possibly be remembered by some readers that on the previous expedition, when the English and Americans took separate stations, a considerable disagreement was found in their results. This was found to be due to the effect produced on the level by the irregular formations of the ground of each position, which varied greatly at the part of the boundary. The same effect was very distinctly observable on this occasion, but it was less in amount, and it no longer constituted a disagreement between English and American astronomers, but rather it caused both to agree on the tracing of a slightly crooked parallel of latitude. This is not a serious matter, for even if the ground were a consideration, it may be presumed that each side would in turn get the benefit of the irregularity. The latitude observations were chiefly made with a zenith telescope, and the results, as far as we have seen, are excellent. The variation of a single observation from the mean in no case exceeded about 1 min. 5 sec. are, showing how perfect an instrument is the zenith telescope for this class of work. Time observations were generally made with a portable transit. The longitude of Pembina was established by an exchange of telegraph signals with Chicago. The boundary has been marked by cairns at points about three miles apart all along the line, these being visible from each other. The total number of astronomical stations on which these depend is forty, each one being determined by observation of about eighty pairs of stars, having a theoretical probable error of from 7ft. to 10ft.

The engraving shows the form of cairn employed for marking the boundary. The cairn is commonly about 7ft. high and 10ft. in diameter, surrounded by a ditch, which would protect it from being trodden down by buffalo. It also gives a sample of the barren character of much of the ground, being slightly reduced from an official photograph taken by the Royal Engineers of the party. The difficulties to be overcome were considerable. During the first winter—the only season, as we have said, when the swamps could be traversed—the thermometer fell at times very low, on one occasion, on Dec. 24th, 51 deg. below zero, and an instrument occasionally froze to the skin round the observer's eye, in the same way as reported by Russian officers in Siberia. During the summer campaigns, on the other hand, the attacks of the mosquitoes were very distressing. From May till August appears to be their special season, when even the horses suffer so much from them that in spite of all the protection that could be given to them by the smoke of turf fires along the picket lines, they stand snorting and stamping nearly all night, and can obtain little rest except in the heat of the day. Appalling thunder storms were of frequent occurrence, lightning playing so continually as to make the camp appear almost constantly illuminated. In the autumn the prairie grass is dry and parched, and frequently catches fire, so that the entire country is swept by fire except where special means are resorted to protect it. The camps had to be guarded by clearing away all the grass in the vicinity. The buffalo occasionally threatened the party—not wilfully, but in the buffalo district, where vast numbers herd, a few individuals, alarmed by some of the party, may be the means of commencing a panic and stampede, when great numbers of buffaloes in undefined terror may come bearing down on a party with their eyes partly closed, and it is necessary to make a considerable effort to turn them aside.

The boundary being indisputably determined, the next question is the character of the country and its probable value for cultivation. On this, Mr. Dawson, the geologist of the party, informs us that the district between the Lake of the Woods and the Red River prairie is extensively wooded and very generally swampy. If the wood were cleared it is not likely that the land—which is sandy and poor—would be good for agricultural purposes, but a valuable supply of timber and peat for fuel might be obtained from it for surrounding districts. Poplar, oak and elm, and willow and much tall and slight pine abound.' The fertility of the soil in the alluvial prairie of the Red River is so great that it is difficult to exaggerate in speaking of it. The surface from 2ft. to 4ft. in depth consists of dark mould, whose colour is partly due to charred vegetable matter left by prairie fires. Beneath this there is marly alluvium of the best quality; in fact, Mr. Dawson thinks the powers of the land inexhaustible, and considers a great part to be suited for immediate agriculture. Half of it—3400 square miles, or 2,176,000 acres—might produce about 40,992,000 bushels of acre, which is the average Minnesota yield. "Hay swamps" will long continue to be a necessity to the settler. With regard to the States west of 99 deg. or 100 deg. W. longitude, the rainfall is not generally sufficient for agricultural purposes, and the question of irrigation would have to be considered. By this and arboriculture the establishment of settlements might gradually improve matters, and so gain ground to the west.

Oak and poplar abound in the vicinity of the Pembina Mountain, but the trees generally have suffered severely from prairie fires. In most parts of the Red River region water may be found by digging even moderate wells. West of the Pembina River begins the eastern part of the great treeless North American plain. About the Turtle Mountain, however, are woods, and probably a sufficient annual rainfall for purposes of cultivation. Poplar, oak, birch, and ash-leaved maple are the principal trees. Fires occur here frequently. The thickness of the oak-bark enables it to resist the destructive effect of fire better than other trees. Passing west to the "third prairie steppe," it is found that there is a want of good timber, and the ground is stony. The White Mud River, or Frenchman's Creek, is the eastern limit of the buffalo. The ground now becomes arid and bad, but improves again at the Sweet Grass Hills, and is subject to greater rainfall; and about twenty-five miles east of the Rocky Mountains commences the fertile belt of country, and wood abounds. The buffalo herds here are very numerous. For this part of the country the mountains supply an inexhaustible source of wood for purposes of construction and for fuel; extensive coal fields, however, exist. Pine forms the principal timber. Looking at the entire tract of country along the boundary, the Red River valley is undoubtedly the best, except perhaps the land in the vicinity of the Rocky Mountains. At the same time, far from deserving the character of being almost entirely desert, a considerable portion may be of future agricultural importance, and a great area in well suited for stock farming.

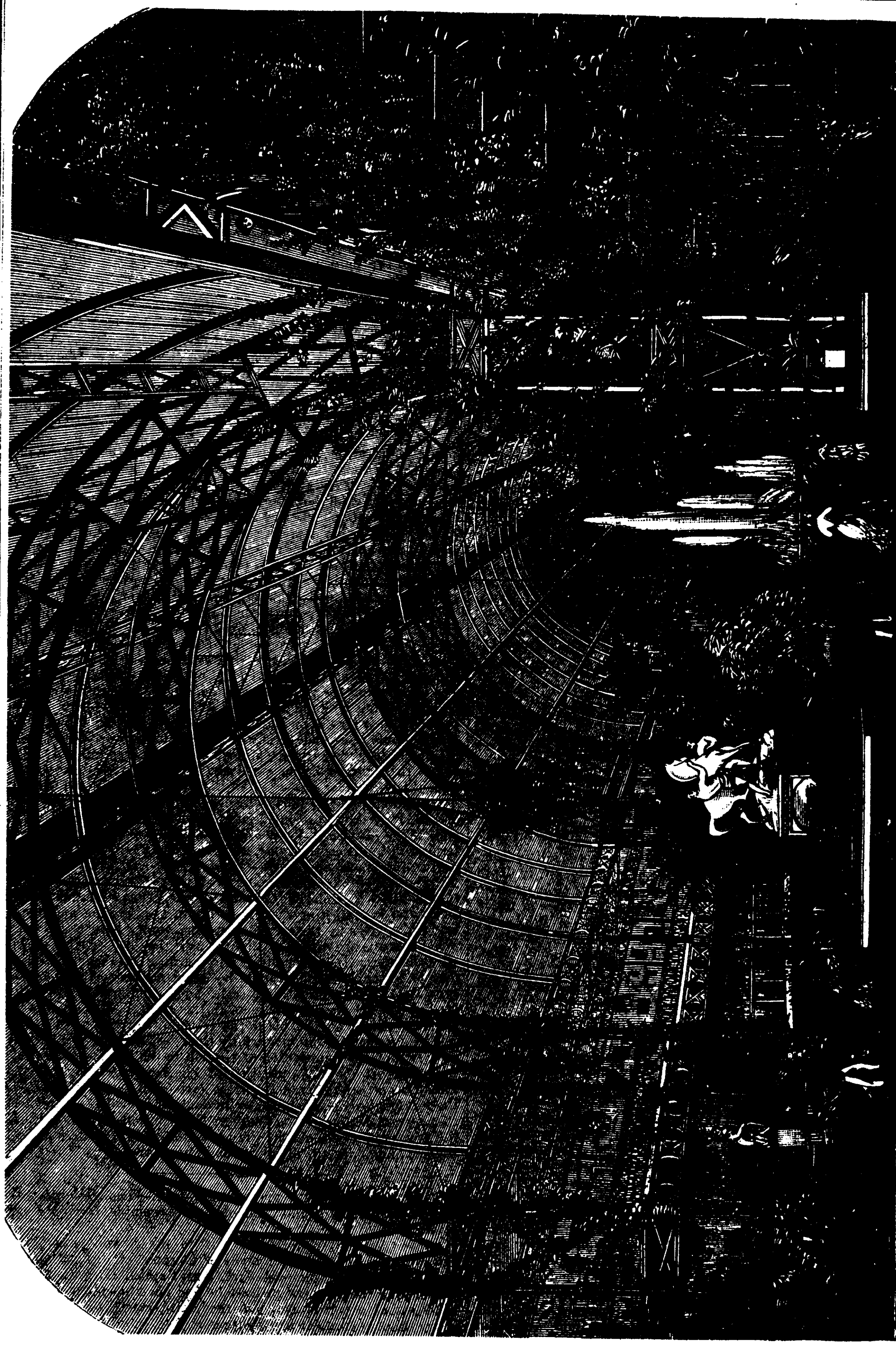
Mr. Dawson discusses at considerable length the three most important deterrents to the settlement of the north-west, namely distance from markets, grasshopper visitation, and scarcity of timber in the open plains. The first must be met by growing those whose bulk bears a small proportion to the value. Flax and hops are suggested, but wool appears likely to be more profitable than any crops in many districts.

The inroads of the grasshopper or locust are most serious, and are specially formidable from the fact that this evil has greatly increased in late years. It appears that they breed on the slopes near the base of the Rocky Mountains. For some days after hatching in the spring, the insects move but little, but when somewhat increased in size the travel forward with an organisation and determinate direction resembling that of a vast army. Their rate of progress is not more than half a mile a day until they obtain their wings, generally about the middle of July, when they take to flight. This is perhaps the most remarkable phase in their life. They wait, ready for flight, and encouraged to it by a breath of wind, but ever descending again immediately, until the wind sets in the desired direction, generally the south-east. As long as the wind is favourable the flight is continued daily till about 4 p.m. A black cloud or a storm brings them to the ground immediately, and no notice is taken of any wind except that in the desired direction Thus, some time during the autumn the army arrives at its destination, when it falls on nearly all the crops existing, and reduces the land to the state of a desert. Happily, this occurs commonly too late for the destruction of a great part, and the greatest evil is not directly due to the old locusts, but to their progeny. After depositing their eggs the insects fly here and there in a feeble, aimless way, and shortly die. The next spring the young insects are hatched, and devour everything, causing a famine in the district. The insect does not, happily, thrive as a race in the eastern cultivated lands, but becomes enfeebled and perishes. The following years are those in which great incursions of locusts have taken place—1818, 1819—the crops suffering chiefly in 1819 and 1820. In 1857, after thirty-six years' absence, all the young grain in 1858 being devoured. Again, in 1864, with less evil than usual in the year, and 1865; in 1867, causing a famine in 1868; and again in 1869 and 1870. In 1872 locusts arrived, and consequently many farmers did not sow that year, and lastly in 1874.

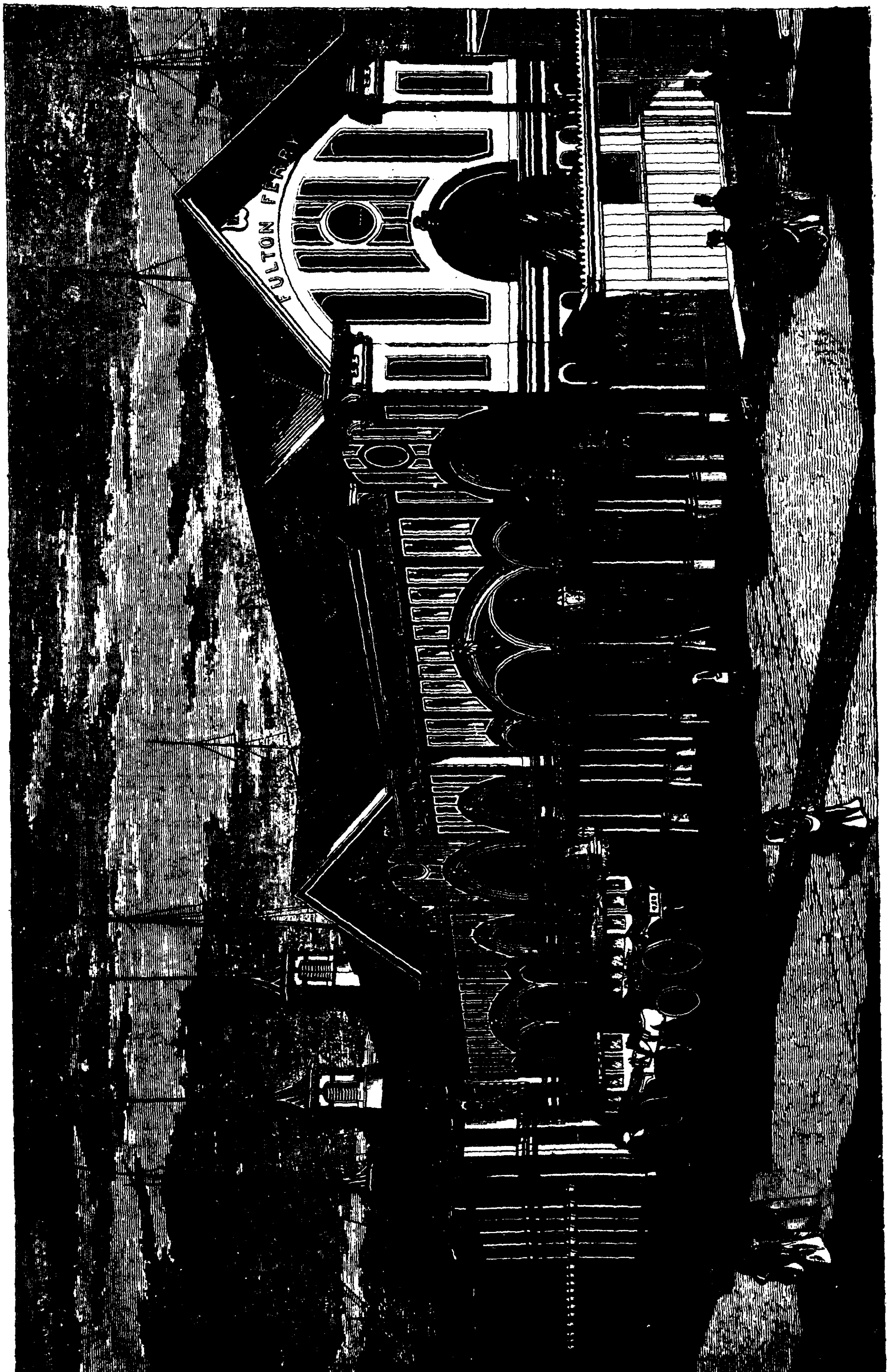
How to remedy this most serious evil is a difficult question. Mr. Dawson thinks much might be effected by systematic inspection of districts, isolating the prairies where eggs are found deposited, and so protecting them from fire in the autumn, and then firing the grass in the spring when the young insects are out. When swarms arrive in the numbers, as they do, bearing down all resistance, deep ploughing and burning the eggs has been found effectual; to this should be supplemented collecting the eggs by sweeping on a large scale, and using rollers over the ground covered by young insects in the spring. The absence of timber is chiefly attributable to the vast prairie fires, on which we can hardly speak more powerfully than by referring to what we have said of the composition of the soil in the Red River district containing so large a quantity of charred vegetable matter. Hundreds of acres of valuable trees have often been destroyed by the reckless use of signal fires by Indians. It is evident, therefore, that a great deal might be done gradually to remedy this evil by the growth of wood, and by the prevention of wholesale waste of timber, and above all, of prairie and forest fires.

To Prevent marks from Small-Pox.—The following is simple preventive against indentations becoming formed from suppuration of the pustules:

Lance the pustules on the face with a needle and thus allow the poisonous matter (which alone is the cause of disfigurement) to escape, and keep the room dark. An English Surgeon stated that during twelve years' practice he had not known one case out of twenty of a person being marked with small-pox when the above simple expedient had been resorted to.



INTERIOR OF THE ROYAL AQUARIUM, WESTMINSTER. (See page 10.)



FULTON-STREET FERRY HOUSE, NEW YORK. (See page 6.)

CORRUGATED IRON AS A BUILDING MATERIAL.

(See page 8.)

The use of corrugated iron as a building material in this country is extremely limited. It may be said to be confined to the construction of sheds, and of certain more or less hideous and ungainly churches and chapels usually, and happily, of small dimensions. In the United States the case is very different, and corrugated iron and zinc are there used to an extent of which engineers and architects in England have really no adequate conception. A new order of architecture may be said to have sprung up in the States, and churches may be found in New York built solely of corrugated iron from first to last — permanent structures, be it understood, of very pleasing appearance, and capable of affording accommodation for congregations numbering 2000 to 3000 souls. The external elevations of these edifices are not unfrequently very satisfactory, even to an artistic eye, the material lending itself easily to very complex decorative effects. It is stated, moreover, that the accoustic effects are infinitely better than any that can be attained with stone or brick walls.

As an example of the use of corrugated iron in what may in a sense be termed an engineering structure, we have illustrated at page 8, the ferry house at the foot of Fulton-street, New York. No fewer than four important lines of ferry steamers unite New York with Brooklyn- These are worked by some 20 steamers, making about 520 trips, and conveying as many as 70,000 passengers and 2750 vehicles per day. The building which we illustrate is in a sense analogous to a railway station, including under its roof booking offices, waiting-rooms, and the gangways leading to the ferry boats, which are of large dimensions and double ended. Every portion of this building is of corrugated iron, the cornices, ornaments, &c., all being stamped out or otherwise worked up. An examination of the engraving will, however, give a better idea of the capabilities of corrugated iron than pages of description. It may be worth while to mention that the use of sheet iron cornices in New York is enormous. The effect is the same as though the cornice were of heavy stone, while the risk of accident and the cost are much reduced.

With us corrugated iron is almost universally made by stamping. In this respect the people of the United States are ahead of us. The stamping process will not produce complex patterns, and a machine, which we also illustrate, is largely used instead. It is the invention of a Mr. Johnson, an American, and is now being introduced into this country by Messrs. A Austen and Co., of St. Swithin's-lane, London. Its principle and mode of action will be readily understood. Fig. 1 is a perspective view of the machine; Figs. 2, 3, and 4 are transverse vertical sections of the rollers, showing the manner in which they are constructed to form different styles of corrugations, cornices, &c., Fig. 5 is a similar view of a pair of gear wheels, showing three different shapes or kinds of teeth. In Figs. 2, 3, 4 and 5, A, is the inside rim of the rollers ; B, the outside rim, or sections composing the rim ; and C, shown in Fig. 3, represents the dovetail joints, showing the manner in which the sections are secured to the inside rim of the rollers. The machine, as shown in Fig. 1, is composed of two rollers, placed one above the other, in a suitable frame, in front of which a feed table is attached, for the purpose of receiving the sheets of metal and carrying them forward to the rollers at the proper instant. The rollers are geared together by means of gear wheels, so that motion being communicated to either one of said rollers, both of them will revolve in the proper direction. The rollers may be made either hollow or solid, with one or more different kinds of teeth or projections, or may be made in sections and grooved, as shown in Figs. 2, 3, and 4. These teeth or projections are made as follows : — One roller is made with projections to correspond with the same projections forming the mouldings which are to be formed on the metal, and are matched with corresponding depressions in the other roller, while all the other portions of the rollers that form the straight lines and smooth surfaces, as well as the projections on the gear wheels, &c., are formed on the same curve as the pitch line of the wheels or rollers on which they are formed. By using the sectional rollers grooved, as above described, by taking off one section and putting on another, it is possible, it is claimed, to do all kinds of work with two rollers that ever has been or can be done with dies, and do it better and a great deal faster.

As regards its advantages, the inventor claims (1) that this machine will corrugate twelve times as much metal in the same time as any stamping machine ; (2) that three sheets of metal of different patterns can be corrugated at each revolution of the cylinders ; (3) the external part of the cylinders being movable, the designs may be indefinitely varied ; (4) buildings constructed by means of this machine "cost about one-half of what they can be made for by any other process ; while the variety and beauty of ornamentation, as supplied to architectural purposes, easily and cheaply, obtainable by the use of this machine, can be produced by no other."

Before iron can be corrugated it must be made into a sheet. Mr. Johnson has invented a somewhat novel process for producing sheets, which deserves notice. Under the ordinary system a pile is first made of puddled bar or scrap ; this is rolled into a flat plate, and then passed through chilled rolls over and over again till "singles" are produced. To make thinner sheets these singles are placed in a species of oven, heated to a dull red, and then two being placed together, they are passed three or four times through the chilled rolls, "doubles" being the result. It is obvious that sheets so made must have a "grain" —that is to say, the fibre runs all one way. The Johnson process consists n using in the earlier stages of manufacture rolls of the kind shown in the engraving. Each is made with a surface studded with little buttons, and it is claimed that instead of the grain or fibre being drawn longitudinally from one end of the sheet to the other, "the metal is well kneaded and hammered, the scale broken up, and the fibre thoroughly intermixed and mechanically interlaced, thus producing by one operation a homogeneous plate of uniform fibre in every direction, and rendering the metal much tougher and more solid. In the manufacture of plates by this process, an equal expansion is obtained by the introduction of water into the hollow cylindrical rollers, the water passing in and out at will direct from the boiler. By this means the temperature of the rollers is preserved at such a degree that they never expand to any perceptible extent and retain at all times their original shape, thus securing plates of uniform thickness."

We have not had any opportunity of testing plates made by this process, and we cannot speak as to its merits. The idea, however, appears to be good.

It is to be regretted that no information is at present obtainable in this country as to the actual cost of corrugated iron structures in the United States. Possibly some of our American readers may feel disposed to furnish particulars. It is certain that the use of corrugated iron as a building material is extending enormously in the States. and we have placed before our readers enough to enable them to judge of the feasibility of adopting a similar system of construction in this country. It would help a large branch of our own iron trade, much in need of help.—*Engineer.*

THE ST. GOTHARD TUNNEL.

The compressed air locomotive illustrated on page 364 in the last December number, is employed in the St. Gothard Tunnel works for the removal of excavated material. It was constructed by Messrs. Schneider & Co., of Creusot, and the arrangement of the reducing apparatus, in which the air or gas may expand to any desired pressure, constitutes the original feature in the machine. This important detail was designed by Mr. Ribourt, the engineer of the St. Gothard Tunnel. Before giving a detailed description of the apparatus, it will be useful to consider the problem that there had to be solved, and the conditions that had to be fulfilled.

The great rapidity with which the tunnel works were being carried on rendered it necessary to consider how to carry on a considerable and constant traffic upon a railway laid in a gallery open only at one end, and in which the ventilation must be imperfect and artificial, while the length to be traversed was constantly increasing until a maximum of about 4½ miles was reached. The amount of excavation to be removed from each of the two extremities of the tunnel at Gœschenen and Airolo is about 530 yards per day of 24 hours, so that some 400 spoil wagons would be required to circulate constantly through the tunnel, from the face of the working to the tipping bank outside the tunnel mouth. In addition to these, 50 wagons and trucks are necessary for transporting materials, drills, &c. Altogether the total may be estimated at about 2300 tons a day.

To carry on such a traffic by means of ordinary locomotives would evidently be impossible, while horse traction is very costly, as was discovered at Mont Cenis, where more than 100 horses were employed at each end. It was therefore necessary to adopt a new method, and M. Favre proceeded to conduct experiments with locomotives supplied with compressed air. The air compressors erected for working the drills rendered these trials very easy of accomplishment ; the first of them was carried out in September, 1873, under the following conditions : From the time the works were commenced two small locomotives from Creusot were employed at both ends of the tunnel. At first the boilers of these engines were filled with air at a pressure of four atmospheres, but of course their capacity was far too small to render them of any service, and a cylindrical reservoir of about 612 cubic feet capacity, was added by way of a tender to the engine. This arrangement is shown by Fig. 1 on page 338. As will be seen the engine is an ordinary four-wheeled locomotive with a wheel base 36-37, and a weight of 4½ tons. The air tender, to which it is coupled, is carried upon eight wheels; it is furnished in the upper part with a valve, through which, by means of a flexible tube, it is filled with air from the compressor. Below is a second valve through which the air is supplied to the engine, by means of two copper pipes and a flexible length of rubber tube. The air pipe of the engine passes through the fire-box and enters the boilers, where it expands and passes on the cylinders. The working of the engine is, with the exception of filling the tender as just described, and the absence of firing, exactly the same as that of an ordinary locomotive. At the commencement of a trip the gauge shows a pressure varying between 90 lb. and 105 lb. and after the transport of a train of twelve loaded wagons from the tunnel to the spoil bank, a distance of from 1600 ft. to 2000 ft., the pressure gauge 67.5 lb. The train could then be taken back empty, with a final pressure of 30 lb. to 35 lb.

The following particulars of this engine and its average performance will be found of interest:

Weight of engine	4 tons 12 cwt.
" tender and trucks	7 " 8 "
" sixteen wagons	20 "
Load in " "	32 "
Total weight of train	62 tons.
Length of line	983 feet.
Mean pressure at starting	70 lb. per sq. ft.
" " stopping	57 " "
Capacity of air reservoir	612 cub. ft.
Length of stroke	14.17 in.
Diameter of cylinders	8.05 in.
" wheels	29.92 in.

Although a very cumbrous apparatus, the reservoir measuring 25.26 ft. long, and 63 in. in diameter, these two engines, the "Reuss" and the "Tessin," have worked at Gœschenen and Airolo from December 1873 until the present time, and they have worked very economically, the whole of the air being supplied from the existing compressors, which is not the case with the new engine we illustrate. It may be mentioned, moreover, that at these great heights, coal costs more than 4*l.* a ton.

Without entering into any detailed calculations we may note as a result of numerous experiments made with the two engines, that they have shown a high effective duty. When the engine is at work, the chief loss occurs between the slide valves and their faces; this loss of air of course increases with the pressure, and it is therefore found advantageous to work at as low pressures as possible. When this is done, moreover, the cooling of the cylinders due to the expansion of the air, is of course less considerable than at higher pressure. The cooling of the air becomes a source of great inconvenience, when working at the higher pressures, 7 atmospheres for examples, and with a high rate of expansion.

As the air pressure constantly varies in the reservoir, the driver ought—to obtain a constant work in the cylinders—to vary the point of air admission, but this cannot be done gradually, so that the air in the reservoir is wasted, and the distance that can be traversed is reduced.

These unfavourable conditions led the engineer of the tunnel, M. Ribourt, to attempt to fulfil the following conditions:

1. To introduce the air at a low pressure into the cylinder in such a way that the cut-off should be at one-half or two-thirds of the stroke.

2. To scheme an apparatus which should maintain, automatically, a constant pressure for the cylinders, no matter what may be the pressure in the boiler.

These conditions appear to have been fulfilled in the air locomotive, with the automatic reducing apparatus, which we will now proceed to describe.

The machine which is illustrated on the page 365, December number, consists: 1. Of an ordinary locomotive frame, axles, wheels, cylinders, reversing levers, &c., without any modification to be alluded to.

2. Of a main cylindrical reservoir, A, containing the supply of air at as high pressure as possible. This pressure of course gradually diminished with the working of the machine.

3. Of the automatic reducing way R, in which the air is expanded from its variable pressure in the reservoir, to the constant working pressure to the cylinders.

4. Of a small reservoir B placed between the distributor just named and the cylinders, and used as an air chamber to absorb any shocks, caused in starting or stopping the engine.

The pressure in the main reservoir is limited by the capacity of the compressor, and by the efficiency of the joints of the pipes. The maximum is reached at St. Gothard at 210 lb. By a special arrangement in cases where the compressors will give a defective duty in raising the pressure from 15lb. to 20lb., they are adapted to force in the air already compressed to 105 lb., raising it to the final pressure of 210 lb.

As above mentioned, it is advisable to admit the air into the cylinders at a low pressure, and to make the expansion as complete as possible. When this pressure is once regulated by the automatic reducing valve, it can be increased or diminished, according to the gradient of the road, the weight to be hauled, or to other requirements of the traffic, by simply adjusting the screw which regulates the spring of the valve.

This apparatus is composed of a cylinder AA, Figs. 2 and 3, same page, the interior of which is placed in connection, by means of a pipe Z, with the main reservoir, in which the pressure may be either constant or variable. For a portion of its length the cylinder AA is enclosed in a casing BB. The annular space between the cylinder and the casing is filled with the expanded air, which can escape by the pipe Y. The sides of the cylinder in the portions within the casing BB are pierced with two series of holes *a a* and *b b*. The end of the cylinder towards which the latter are placed is closed with a cover, the other end being open to the atmosphere.

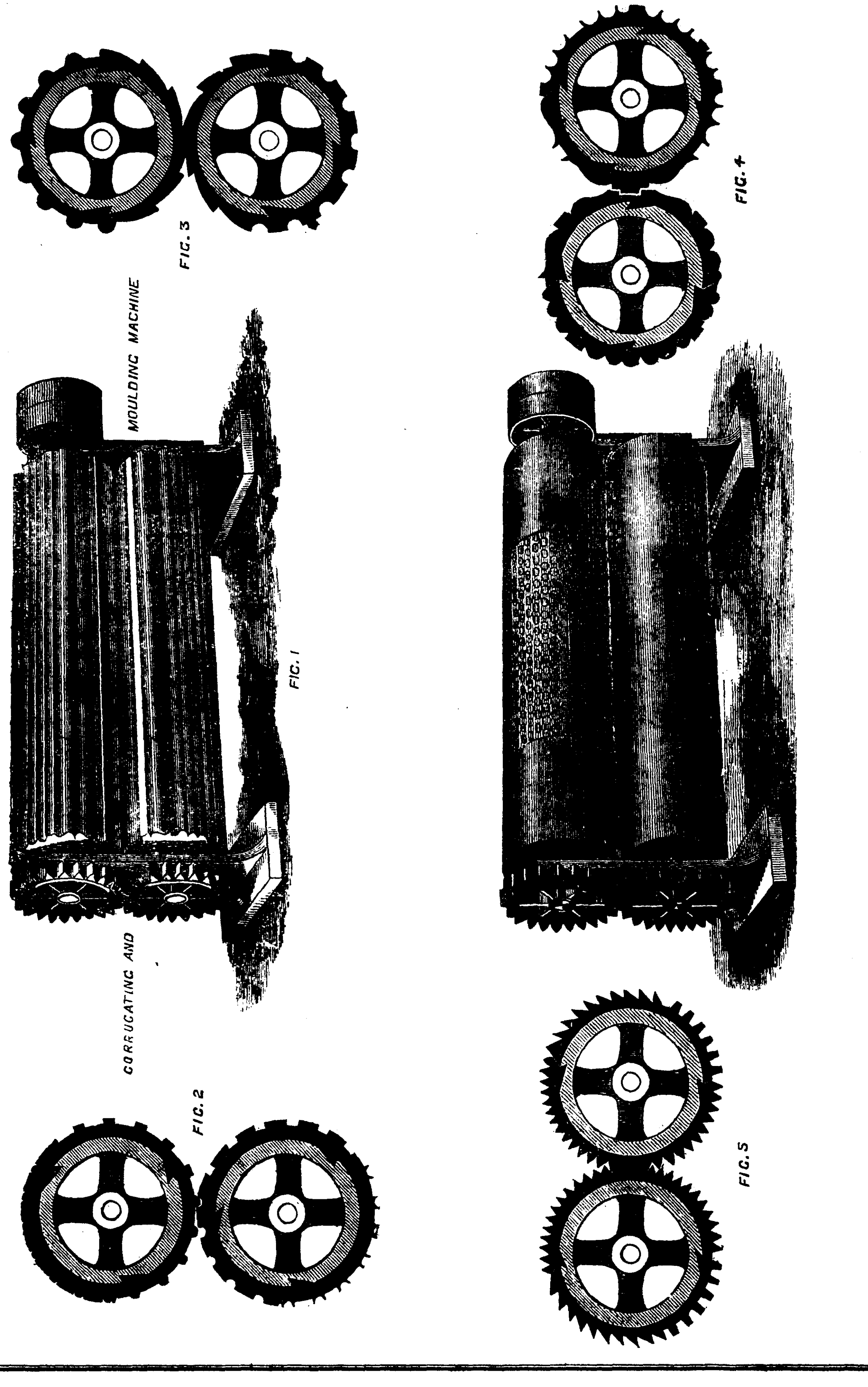
Within the cylinder A is a moveable apparatus composed of a cylinder C, fitting easily, and in one piece with a rod X, on which are fixed two pistons V and H. The cylinder C is pierced with a series of holes *c*, which according to the position of the movable system coincides either with the holes *a* a, or with the spaces left between these holes, in which case all escape of the air is prevented. During the movement of this part of the apparatus, the piston V is always between the series of holes *a* and *b*. It follows that the space between the bottom of the cylinder and the piston V is always in communication with the annular space B containing the expanded air. The two pistons V and H being of the same diameter, the moving portions remains always in a condition of equilibrium.

The end of the rod X carries a plate K, and opposite to it is another plate L, carried by a screwed spindle M, which is maintained at a constant distance from the cylinder A. A spring N is interposed between the two plates, and tends always to keep them separated. The plate L being fixed in relation to the cylinder A, the spring N tends to force the movable portion towards the bottom of the cylinder, and so to keep the holes *c* of the movable cylinder opposite the holes *a* of the fixed one. If compressed air be admitted into Z, it flows through the openings *c* and *a* and expands into the annular space B. In passing through the holes *b* it produces, by reason of its pressure, a motion of the piston V, opposed to the spring N. When this effort becomes greater than that exerted by the spring, the movable portion of the apparatus advances towards the open end of the cylinder, and the holes *a* are closed.

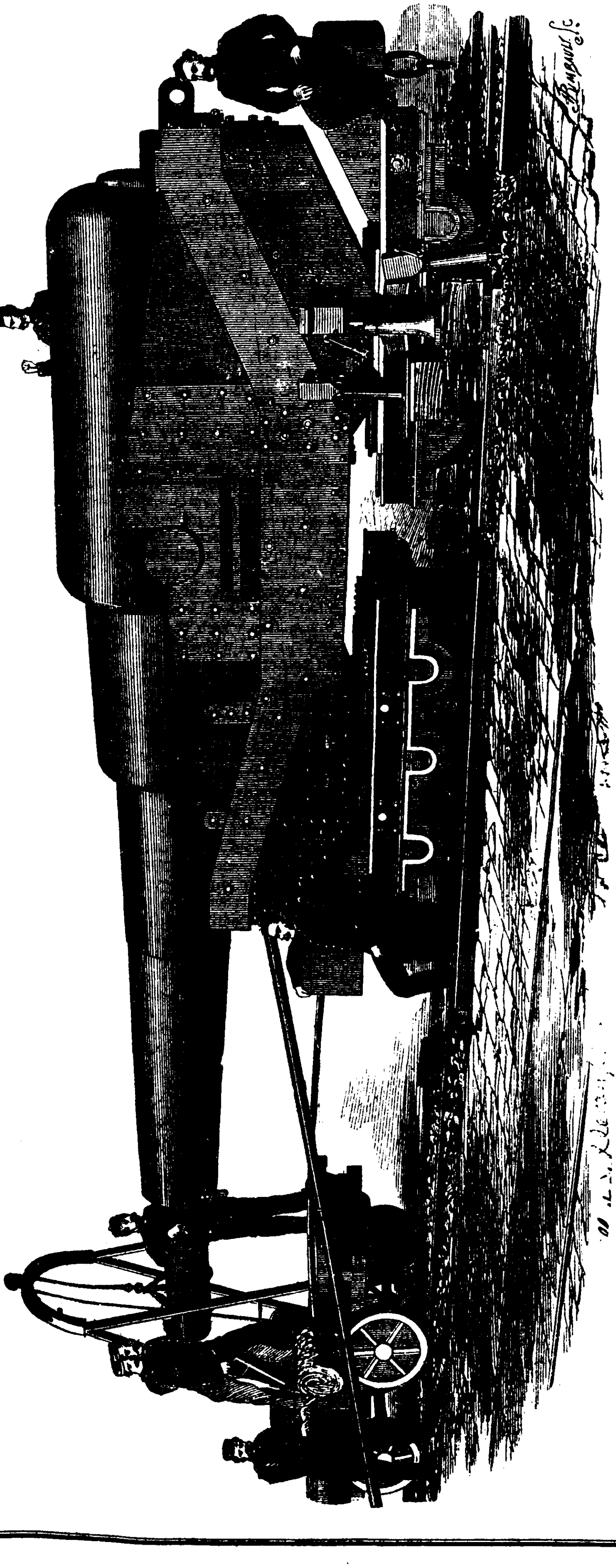
When there is a continued flow of compressed air through Y the movable cylinder C takes intermediate positions, the holes *c* partially coinciding with the holes *a*, so as to uncover more or less of their area, the dimensions of these openings depending directly upon the pressure of the air, increasing if this diminishes and *vice versa*. The pressure to which these results are due, depends only on the tension of the spring, no matter what the initial pressure of the air may be at Z. If therefore air be admitted, under either a constant or a variable pressure, it will flow from Y, at a constant pressure, always inferior of course, to the initial pressure.

When the pressure in Y is once determined by means of the spring N, it may be regulated at will within certain limit, by means of the screw M, by which the tension of the spring may be increased or diminished.

It will be seen from the above description that by means of this apparatus applied to the compressed air engine, the expansion of the air is effected by means of variable openings, the area of which is fixed by the pressure acting on the piston forming part of the apparatus, and balanced by a spring, the tension of which fixes the amount of the pressure. By adjusting the spring by means of a hand-wheel and screw, a range of pressures can be commanded with the same apparatus.



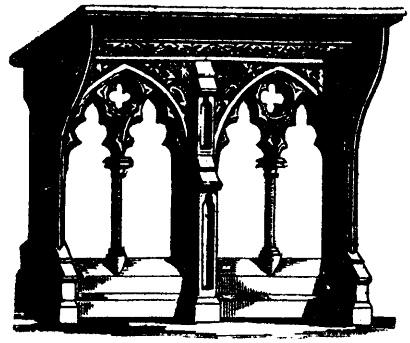
JOHNSON'S MACHINERY FOR CORRUGATING IRON. (See page 6.)



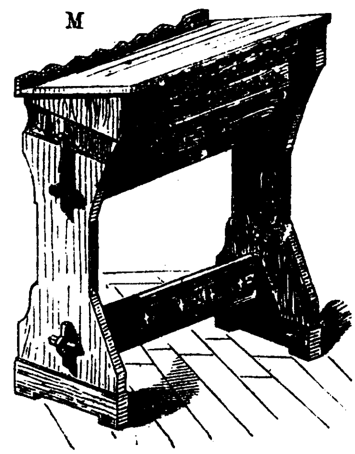
THE 81-TON GUN AND TEMPORARY CARRIAGE. (See page 10.)

DESIGNS FOR CHURCH FURNITURE.

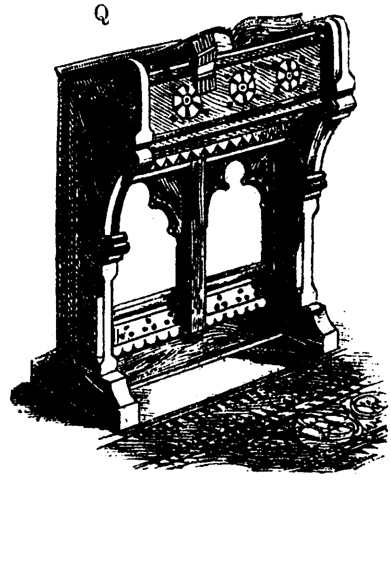
I



M



Q



The leading particulars of the engine we have described are as follows:

Capacity of the principal reservoir......	268 cub. ft.
" small "	10.6 "
Maximum pressure in large "	105 lb.
Mean " small "	60 lb.
Length of stroke......................	14.17 in.
Diameter of cylinders..................	8 in.
" wheels....................	29⅞ in.
Weight of engine..................about	6 tons. 15 cwt.
Width of gauge........................	37.39 in.

All the principal dimensions are shown upon the drawings.—From *Engineering*.

OUR NEW VOLUME.

We have much pleasure in presenting to our Readers, at the commencement of a New Year. The Canadian Mechanics Magazine much improved in *Style*, *Type* and *Illustrations*. It will now compare very favourably, in the above respects, with any scientific paper or Magazine published in either Great Britain or the United States. The Proprietors have spared no expense in their endeavours to improve this work and to make it, to all Canadians who are interested in Architecture, Civil Engineering, and Mechanical pursuits, a most suitable volume for their requirements, containing more varied information, more illustrations and articles on the most recent and important subjects connected with science and mechanics generally, than is to be found in any other Magazine of its kind.

We therefore naturally expect that every Scientist-Architect, Engineer, Manufacturer, and Mechanic in this Country, will not only become an annual subscriber, but that many of them will afford contributions of their professional knowledge so as to render its columns still more instructive and entertaining, particularly in regard to all matters of a scientific nature appertaining to the Dominion.

To sustain a work of this kind, however, we must have a liberal support; we must not be content until almost every mechanic has enrolled his name on our Subscription List; we trust therefore that our canvassers will meet, everywhere, with encouragement, and that a national spirit will pervade the mechanical community to give a preference to home over foreign literature so as to enable us to maintain the Magazine in its present improved style, and to obtain the best talent in the Country to contribute articles for its columns.

THE AMERICAN ARTIZAN.

With much regret we have read the Announcement of the Publishers of this valuable Magazine that it will be discontinued at the end of the year 1875. Most sincerely do we hope that when times improve it will be revived. We consider the suspension of this paper as a loss to the scientific world. In point of style of work, particularly in its beautiful wood-cuts, it stood foremost among all the scientific periodicals published in the United States and perhaps elsewhere.

THE ROYAL AQUARIUM, WESTMINSTER.

On page 4, we give an internal view of the fine buildings of the Royal Aquarium and Winter Gardens, shewing the main hall as it will appear when completed. The internal arrangements will be very tasteful and leave little or nothing to be desired.

THE 81-TON GUN AND TEMPORARY CARRIAGE.

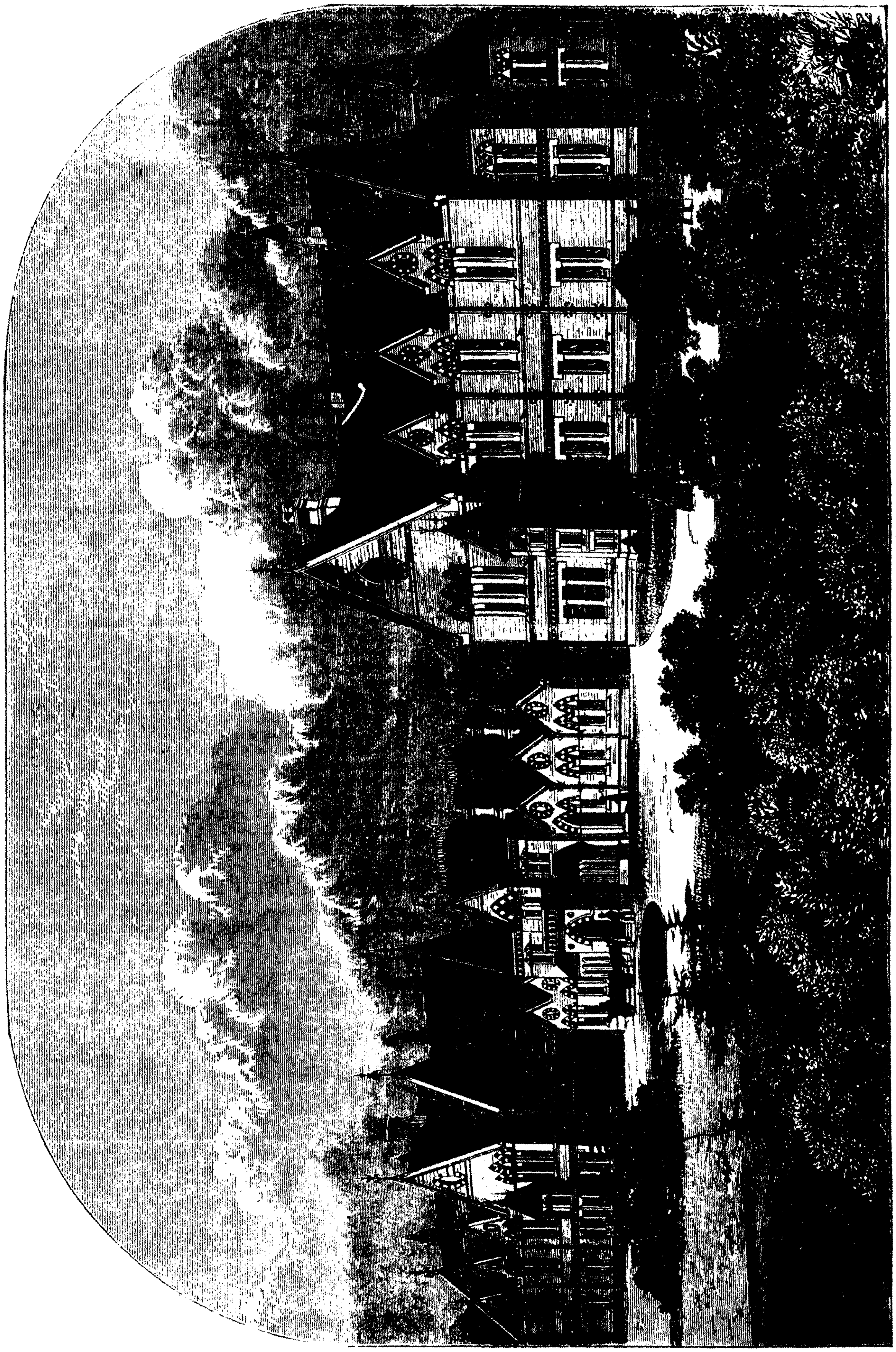
In a previous number illustration we gave an account of the 81-ton gun, and described the manner in which the gun was mounted. We now give on the present page a perspective view, prepared from a photograph, representing the gun mounted on its temporary carriage, and showing also the arrangements for lifting the projectiles. The gun and carriage together weigh about 122 tons, and our engraving gives a good idea of the size of this enormous weapon.

THE DUTIES, RESPONSIBILITIES, AND PRIVILEGES OF THE ARCHITECT.

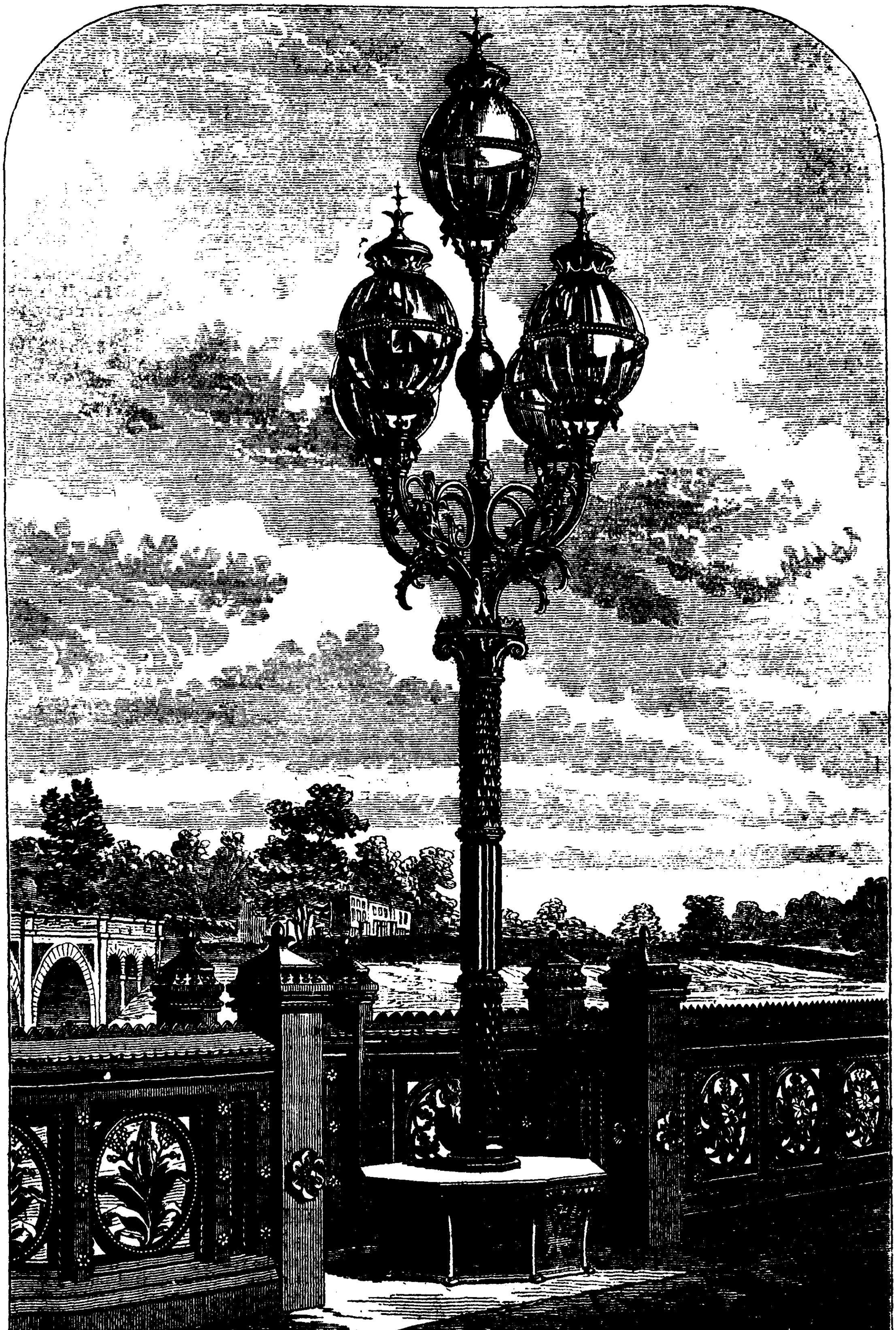
ARCHITECTURAL ASSOCIATION.

The first ordinary general meeting of this Association for session 1875-76 was held on Friday, the 5th inst., whom the president (Mr. John S. Quilter, A.R.I.B.A.,) delivered an opening address.

In his preliminary remarks, Mr. Quilter said he entered upon his duties as President of the Association with the determination of fulfilling them the utmost of his power. He was thankful, however, that the success of the Association did not depend upon his management, for he was supported by so many earnest and able fellow-workers that he felt every assurance in accepting the responsibilities of his office. He continued as follows:—The duties of the committee and officers of the Architectural Association have become increasingly onerous year by year, owing to its extent, growth, and prospective influence upon the profession. It now numbers nearly 700 members, although only claiming to be the junior society, having for its sole object the education and advancement of the students of the profession. This increasing influence is the natural consequence of the rapid development of the architectural profession. The Association has hitherto supplied the means of instruction which the colleges and schools have done for other professions; and when we consider that the whole of this work has been voluntary, it must be admitted that the success has been very great, especially as the requirements which it has been called upon to meet are of quite modern invention. A century ago scarcely five-and-twenty architects could be found in the United Kingdom; now, London alone contains nearly a thousand, and more than twice that number are spread over the numerous provincial towns. One of the consequences of this enormous increase has been a demand for increased skill, with the consequent division and subdivision ot the duties of the architect In former times the employment of an architect was exceptional; his place was ordinarily supplied by the builder, unless in the case of a building of great importance and considerable expense. The architect was then compelled to embrace within his practice the varied work of an engineer, surveyor, constructor, and decorator; but now the whole of the engineering work is undertaken by several separate professions. Surveying is not only a distinct division but is also subdivided into quantity and measuring surveyors, land surveyors, and valuers, and further divisions of the profession are now rapidly taking place. Constructive, decorative, ecclesiastical domestic, and municipal works have their special architects, who are prepared to meet the demand for special skill in each of the numerous branches. Nor is this result a matter to be wondered at. So great is the competition in every branch of our profession that nothing short of the most persistent application can ensure success in any one of them, and the practice of study, which has hitherto only been submitted to as a necessity, must before long be accepted as a rational and desirable object to be attained. "Know what you have to do, and do it," was the advice given to the talented author of the "Seven Lamps," and it well expresses the great principle of success in the practice of architecture as well as of every other art. We are all students, either entering, or about to enter, upon the practice of our profession; and nothing can be more important than that we should have a definite understanding as to what we have to do in order that we may be able to do it. With this view I purpose devoting a short time to the consideration of "the duties, reponsibilities, and privileges of the architect." Before, however, entering upon this three divisions of the subject, it may not be out of place to offer a few remarks upon what is meant by an "architect." The name, which signifies the "chief workman," more clearly expresses what he was in former times than what he now is; for the various trades connected with building have become so divided, and have consequently caused a want of general interest on the part of those employed in carrying out the works, that it has taken from the architect his position of chief workman, and he has now become the general director of the whole; he is the mind controlling and giving intention to the movement of the body, his knowledge must include every work necessary to complete his idea, and he calls them into action in the same manner as an artist selects the various colours on his palette to form an harmonious picture. The architect is no longer a leader of a band of independent artistic workmen, each having his individual skill and taste upon which he can rely without any particular instruction or direction from the architect, who has now to prepare every detail, to work out every problem of construction, and to take into consideration every accessory, before giving his instruction ; and even then he has to keep a sharp oversight of the whole, in order to see that his instructions are accurately followed. Many and fallacious are the opinions of the public as to what an architect is. Some imagine him to be an ideal personation of artistic ability, whose word or sketch is sufficient to create "a thing of beauty" which shall be a "joy for ever" ; whilst others look upon him simply as a mechanical individual who is required to provide so much brains in consideration of so much per-centage. These errors are not to be wondered at, seeing that so undecided an opinion is held on this subject by the profession itself. It cannot be expected that the public will ever place the architect in that position which he has a right to claim until his duties, responsibilities, and privileges are more clearly defined ; and if architects themselves cannot agree, the public will suit its varying fancied, and architects will be tossed from pillar to post, the abused of all, and trusted of none. A sober unprejudiced consideration of the duties of an architect will readily supply sufficient material to form a fair opinion upon the subject. In general terms, the architect may be described as the artistic and constructive adviser of his client, and the less he has to do with the business transactions (as a party to them) between his client and those employed to execute the work, the better for his position, for the only way in which he should be associated with any contract or agreement is in the position of an independent adviser. This will free him from any supposed bias in favour of the employear, and remove any possibility of a doubt as to his acting with perfect impartiality between both parties. A general impression prevails that the architect is the agent of his client, bound to stand by his interests whether just or not ; but nothing can be more prejudicial, as by accepting such a principle he lays himself open to suspicion, and unless he is a very keen man of business, he becomes fair game for every unprincipled workman to dupe, on the ground that it is business to look after his client's interest, and the workman's to do all he can to over-reach it. Such is the result of this vicious principle, and nothing but a rigid stand on the honour of the profession could remove the impression. The employor or the originator of any work in which an architect's skill is required does not seek the aid of an architect in the same way in which an aggrieved person seeks that of an attorney, but, having explained to him the general character of the work he wishes carried out, he then asks his advice as to the best means of obtaining the execution of his wishes. From this it is evident that the first duty of the architect is to ascertain with great care and definiteness the views of his client ; many of them may be mistaken, but the mistake will generally be found to arise from a want of technical knowledge, and this may be set right. But every attention must be paid to the object which the promoter has in view, and it will be necessary that the architect should divest himself of every preconceived idea, and ascertain by patient investigation and tentative suggestions upon what his client's views are based. Much labour may be saved, and many misunderstandings prevented, by a careful attention to these points. In short, the architect must not forget that it is his duty to give the best effect he can to his client's views. Possibly they may not at first commend themselves to his taste, but no architect has any right to insist upon his client adopting his own theories in matters of taste, and if it is found impossible for both to agree, it would be far more discreet, and show a nobler spirit, for the architect to suggest that his client should seek the assistance of some one more likely to comply with his wishes, than to force upon the client a work which will always be a source of vexation and annoyance. This is a hard doctrine, especially to a young architect anxious to do his best, and make his mark while he wishes to retain his client, but I command the practice to all who wish to maintain the standard of the profession. It is also the duty of the architect to keep in mind that he is a member of an honourable profession, and he is bound to do everything in his power to raise a high standard of honour in all his transactions, by refusing to take any part in actions, whether suggested by clients or others, that would be derogatory to the dignity of the profession. The temptation is often very strong, and the worldly advantage, or fear of offending one whose interests you are anxious to secure, are great inducements to yield ; but, apart from higher motives, the sense of honour towards our fellow-members should be sufficient to prevent our engaging in any undertaking which we should not like others to know. I regret very much that it should be necessary to urge such warnings as these, but it is to be feared that the race for wealth which has caused so much moral dishonesty among many classes of society, has also given rise to actions on the part of members of our profession which are not likely to bring credit upon those who have engaged in them. The next duty of the architect, after clearly ascertaining the wishes of his client, is to bring his own knowledge and experience to bear upon the subject in order that he may advise as to the best means of carrying out the work. And here his ability and character find their greatest development. It will be necessary for him to bring every faculty which he possesses to bear upon his work, and at no point is any weakness or ignorance of his duties more likely to be evident, for not only will he be compelled to show that he has grasped the wishes and intentions of his client, but he must also be able to suggest the best means to be adopted in executing every part of the work ; and lastly, he must have a sound judgment as to the probable cost of the whole, in order that his client may decide before he has too far as to the advisability of proceeding or modifying his ideas. The latter requirement is the great bugbear of the young architect, who is always, sanguine that he can get the work done much cheaper than any one else, and is fearful of naming too high an amount lest his client should abandon his intention ; but a diligent study of this duty will well repay the labour and save many a dispute afterwards, for it is undoubtedly one of the duties of an architect to give his client a reliable estimate of the cost of works that he is asked to design, and any attempt to delegate this duty to the surveyor is an injury to the position of the architect. This does not, however, imply that he should be either a quantity surveyor or a valuer ; their duties are quite distinct, and are in no way interfered with by this duty of the architect. Having completed these preliminary duties, his next duty is to prepare such instructions and details as will enable those employed to execute the works. The particulars of this part of the work of an architect are too well known to require any description ; nor need I stay to refer to the duties of the surveyor in preparing the quantities ; but we next come to the duties of the architect is superintending the execution of the works, and I would refer to these particularly, because great laxity and want of carefulness is often shown here ; and it is to be feared that it generally arises from a want of practical knowledge on the part of the architect, and this arises from the imperfect education on practical subjects which the present system of pupilage gives rise to ; and it does not relieve the architect from his duty because he has a clerk of the works who attends to such manners. But it is not only the architect's duty to prepare his design, but also to know how the design is to be executed in every particular. It is, I believe, a general impression among clerks of works that it is their business to make any alterations that may be necessary to enable the architect's design to be executed ; but no more mischievous theory could exist, as it implies that the design and the construction are quite distinct matters, and that it is not necessary for the design of any work to be dependent on its construction. I cannot but refer here to the great advantages which are afforded to the young architect by the classes of the Association, and especially the class of construction, in which the detailed work of every trade is described, and I have been astonished, in looking through the papers of last session, at the amount of really useful information that has been collected ; in fact, it has struck me that, notwithstanding our already over-crowded literature, we are sadly in want of an architect's technical handbook. This completes the duties of the architect, for since the introduction of the separate profession of measuring and quantity surveyors, the measuring-up and adjustment of the accounts, as well as the preparation of quantities, falls into their hands, and we may hope that the rapid rate at which the profession is increasing will result in a more uniform and satisfactory method of measuring builders' work ; for it is a great drawback to the system, which is otherwise so desirable, that the various ways in which works are measured up will often make a difference of 10 or 15 per cent. in the builder's account. Much more might be said upon this, but it is not within our province. Before I leave this portion of our subject I take the opportunity of directing attention to the other branches of the Association, and of pointing out the manner in which they are intended to assist the student in obtaining that knowledge which is necessary to prepare him for the practice of his profession. I have already referred to the Class of Construction, which has for its object the study of the science of building, with especial reference to a knowledge of the details of the various trades ; and in addition to this a class has recently been formed



PROPOSED SURGICAL HOSPITAL STOCKTON-ON-TEES, ENGLAND.. (See page 22.)



BEAUTIFUL DESIGN FOR LAMPS, GIRARD AVENUE BRIDGE, PHILADELPHIA.

IN OUR NEXT ISSUE WE WILL GIVE THE WHOLE DESIGN AND CONSTRUCTION OF THIS FINE BRIDGE.

to study the theories of construction, in order to afford the student an opportunity of learning the higher branches of the science. The artistic part of an architect's duties are well provided for by the two Classes of Design and the Class of Colour Decoration. The elementary Class of Design gives the younger student instruction in the general principles of design, and a definition of the various styles that have been employed during the different periods of English history. The senior class prepares the members for carrying this knowledge into practice, and by designs for special subjects under certain restrictions, affords opportunities for overcoming obstacles which are sure to present themselves in the ordinary practice of an architect. The Class for Colour Decoration provides the means of studying one of the special branches which are taken up by some architects, and other classes could readily be formed in a similar manner for the practice of design in furniture, stained glass, and many similar subjects, if a sufficient number of members were willing to unite for that purpose. There is, however, a want of unity of purpose in all these classes, and I can only suggest one means by which they can all be brought to work together, and that would be by making it the object of each to prepare the students for the various divisions of the Architectural Examination. There are also classes for the study of land surveying on the one part, and water-colour drawing on the other,—subjects associated, although not intimately connected, with architecture ; but we must now pass on to consider some of the responsibilities of architects. This is a difficult matter to deal with, and requires extremely careful consideration, for unfortunately there are many points of great importance to the profession that have not been legally decided, or as to which the decisions given have as often been upon the one side as upon the other. But I cannot believe that this is a good and sufficient reason for avoiding the question, as was suggested at the Conference a short time ago. Surely it is one of the chief duties of any society that claims to have the interest of the profession at stake, to devote its energy to the removal of these doubtful points, and, if necessary, to get the sanction of the legislature to a general code of laws affecting the profession. It has frequently been supposed that an architect is responsible for every matter that goes wrong in a building erected according to his designs, whether the error arise from careless workmanship or unforseen contingencies ; in fact, some two or three years ago the *British Medical Journal* and the *Pall Mall Gazette* seriously discussed the liability of architects for murder, owing to the faulty construction of some drains ; and many cases have occurred in which architects have been held responsible for the faults and delinquencies of the workmen employed in carrying out works from their designs. The chief cause of the error arises from a mistaken view of the duties of the architect ; for if he is supposed to be the agent of the employer, and his duty to consist in seeing that the interests of the employed are protected, such may naturally be the consequence ; but if the architect takes the position I have advocated, as the professional adviser of his client, and as an impartial umpire between all parties in the matter, he will be free from any such liability, and the only ground upon which he can be held responsible would be the most reasonable one of want of knowledge or ability in the practice of his profession,—a responsibility which no architect having any claim to the title would for a moment hesitate to assume ; and it should be the duty of the profession to give to all qualified architects such evidence of their qualification as would enable the public to know that they were incurring a risk in employing any one in the capacity of an architect who did not possess the necessary evidence of his fitness. This has been attempted partially by means of the Architectural Examination ; but until the matter is taken up by the whole profession, and no one allowed to practise without first giving proof of his ability to perform the duties of an architect, it is vain to expect the public to take the trouble to ascertain an architect's qualifications, and any tyro who has a sufficient number of friends can commence to practise as an architect, and, trusting to his good luck, with the assistance of a few clever draughtsmen, may delude his clients into a belief that he is a duly-qualified architect, until some irreparable blunder dispels the vain delusion. This brings us to consider, lastly, the privileges which belong to the architect, and I fear their enumeration will not occupy much time, for so long as we are content to scramble among the common herd for the chance of picking up a few guineas, it would be well to say little about privileges ; these can only be claimed by those who are willing to uphold the dignity of the profession, both by a careful study and preparation for its duties, as well as by a strong determination to withstand any attempt at lowering its standard. The architect's privileges are ; confidence and reliance on the part of those for whom he acts ; a submission to his opinion on all subjects connected with his art ; and a ready acknowledgment of his services. The attainment of all these may appear Utopian, but if so it is the result of the unstable condition of the profession ; and the architect who is the best qualified for his duties is compelled to submit to treatment which is ungenerous and disgraceful, because there are others in the profession who find such submission the only way of covering their failings. It must not be supposed that I am crying down the profession, or attempting to make out the evils to be worse than they really are ; a careful perusal of our periodical publications will reveal a state of affairs quite as bad as I have described, and my only object in drawing attention to them is to urge the adoption of some remedy for the evil, which is not likely to be removed if it is passed over as a matter not calling for attention. I have a very strong objection to anything like a radical reform, as it often cures one evil by substituting three others for it ; but I hold that the cure is to be gained by an increase of conservative principles, and the avoidance of any cliques or party-spirit. To conclude, I would ask your attention whilst I endeavour to apply this matter to the object of our gathering this evening. It may be said, and justly, that I have said a great many things which everybody knows, and it may possibly be thought that the subject is of very little practical use ; but if I can succeed in impressing upon the younger members of the Association the necessity of a high standard of attainments for an architect who wishes to stand well in the profession, I shall feel I have done something towards raising the profession of architecture to that position which it should occupy ; and, judging from the many evidences I have seen of ability among the numerous members of the Association, I am convinced that we have within our ranks sufficient power, if rightly developed, to accomplish for the profession all the objects which I have endeavoured to recommend. I have, therefore, thought it desirable in my remarks to aim rather at the result than the means, and to lay before you some reason for an earnest, persistent, unanimous effort to do our utmost as members of an honourable profession to raise and maintain the highest possible standard.

BARLOW'S ROCK DRILL.

(See page 16.)

We annex an illustration of a new form of rock-boring machine constructed and patented by Messrs. H. B. Barlow, Jun. and Co., of Ellesmere-street, Chester-road, Manchester, who have also shown it at the Cheetham Hill Exhibition, where it has been awarded a prize medal. The machine is hand worked, it being intended for use where neither steam nor compressed air is available. As will be seen from our engravings the machine consists of a light stand supporting guides which can be adjusted to various inclinations, the particular machine shown being adapted for drilling holes vertically or at angles down to 45 deg. The boring tool is not connected to the hammer but rests on the rock, being merely guided by the collars through which it passes and which insure its being kept parallel with the hole which is being formed. One of the guide collars has an intermittent rotary motion given to it by a ratchet, this causing the tool to be partially rotated after each blow.

The tool is struck rapidly by a steel-faced hammer worked by a crank through the medium of a spring as in Shaw and Justice's well-known arrangement. The throw of the crank is 1¼ in., but when in full work the hammer under the action of the spring moves about double the stroke due to this throw, a speed of 40 revolutions per minute of the handle causing 212 blows per minute of about 5 in. fall to be struck by the hammer. The machine is simple and readily set to work, and we hope on a future occasion to be able to give some particulars of its performance on different classes of materials.

THE HERCULES SCREW PROPELLER.

The illustration on page 16, represents a new form of screw propeller so attached to the vessel as to serve the double purpose of a means of propulsion and a rudder. It is claimed that the peculiar curve and shape of the blades causes the water to leave them in a spiral column at the hub. The spread of the water is thus prevented, and the force of propulsion, according to the inventor, is concentrated directly behind and within the diameter of the wheel. The combined wheel and rudder attachment are intended to obviate the resistance offered by the usual form of rudder to the free passage of the water from the screw, causing a loss, it is estimated, of from eight to ten per cent. of the motive power. The axis of the propeller is hung in bearings in a stout metal frame, which is pivoted to the sternpost of the vessel or to outriggers on the same, and is so connected with the tiller as to be readily swung to the right or the left thereby. The propeller shaft projects out through the sternpost, and is attached to the propeller axis by a flexible coupling joint A, which consists of two jaws upon the shaft, circular on their face. Similar jaws are affixed to the propeller, and all are united by joint pins to hold them in place. The joint is made of cast steel and is very strong in construction. For canal and harbour navigation, this invention furnishes a quick and powerful steering apparatus by which boats are enabled to round the sharpest curves with ease, and to avoid the frequent danger of collision incident to crowded localities. The wheel is the invention of Messrs. Stevens and Miller, Howard Ironworks, Buffalo, N. Y. We are indebted to the *Scientific American* for the engraving. We illustrate a somewhat similar scheme by the small cut.—*The Engineer.*

A NOVEL TREATMENT FOR WOUNDS.

Having noticed an account of the somewhat novel treatment recently applied in the case of a wound, we addressed a note of inquiry to the gentleman named, Mr. A. K. Smoot, a commission merchant of Baltimore, and received a reply, a portion of which, with permission, we copy. Mr. Smoot says, under date of September 22d: "On the 7th of the present month I accidently jumped from an elevation of three or four feet on to a large nail or spike, driving it about two and a half inches through my foot. This happened in the morning, and towards evening the foot commenced swelling and the pain increasing, so much so that it was with difficulty my physicians., Drs. Atkinson and Warner, could relieve me by the use of the strongest narcotics. I slept but little during the night. The next day the same treatment was continued, with the application of a hot poultice to the wound. On that day I received a card signed 'Sympathizer,' stating that the smoke from burning wool or woolen rags would immediately relieve the pain and stop the inflammation. The directions were to smoke the wound twenty minutes at a time, repeating the operation two or three times. I accordingly took a piece of woolen blanket, and after making a fire in an iron pot I smothered it with pieces of the cloth and held my foot in the smoke. This soon relieved the pain, the swelling went down, and up to the present time there has been scarcely any inflammation; a little bloody water has escaped from the sore, but that is all. My physicians approved of the treatment, and I well know it relieved me of pain and has proved of great advantage in the healing of the wound. I am now able to walk and the wound is doing well. I applied the smoke once every day, and also by the advice of my physicians continued the hot poultice. The treatment with the smoke is said to be applicable to all wounds arising from bruises, cuts, nails and the like, and I hope it may prove beneficial to others."—*Herald of Health.*

Preliminary Labors for the Channel Tunnel.—The soundings for the submarine tunnel between England and France are being carried on actively. They are at this moment directed to the parts of the straits near the English coast, a few miles from the shore. Each evening the vessel which carries the commission returns to Dover, Calais, or Boulogne, and work is recommenced the next day. The engineers, MM. Larouss and Lavallée, are perfectly satisfied with the results obtained, and so far nothing has occurred to destroy their previous views relative to the depths of the various layers which constitute the bottom of the channel, and the anticipated possibility of a successful construction of the most gigantic tunnel in the world, which our fathers would have considered an impossibility and a foolhardy undertaking. But considering the engineering triumphs of the present day, based on the accumulated experience of the last few decennials, and the power of capital, the enterprise must appear to all well informed persons to be perfectly feasible.

TAPE-WORMS.

The origin of tape-worms is the eating of measly pork, which has not been sufficiently cooked to destroy the germ. It may also be communicated to beef by the knife of the butcher should he cut pork and beef with the same knife. The germ adheres to the interior of the human intestines, soon becomes the head of the tape-worm, and then the links grow, each of which eats and digests independently of the head.

To remove it, a large dose of Rochelle salts is given at night; at 10 o'clock in the morning a dose is given made of ½ ounce of bark of pomegranate root, ½ drachm pumkin-seed, 1 drachm ethereal extract of male fern, ½ drachm powdered ergot, 2 drachms powdered gum arabic, and 2 drops of croton oil. The pomegranate bark and pumpkin-seed are to be thoroughly bruised, and, with the ergot, boiled in 8 ounces of water for 15 minutes, then strained through a coarse cloth. The croton oil is first well rubbed up with the acacia and extract of male fern, and then formed into an emulsion with the decoction. In each case the worm will be expelled alive and entire within two hours.

The above perscription is from the *Druggist's Circular*, and is similar to the old established method; but a recent publication informs us that where this failed, the tape-worm was effectively driven out by means of diluted carbolic acid, which is a poison for all small animals and inferior forms of life.

This may be a very effective remedy but we consider the prescription should not be used without having first consulted a physician.—Ed. C. M. M.

LOW'S COMBINED HAND AND SLIDE LATHE.

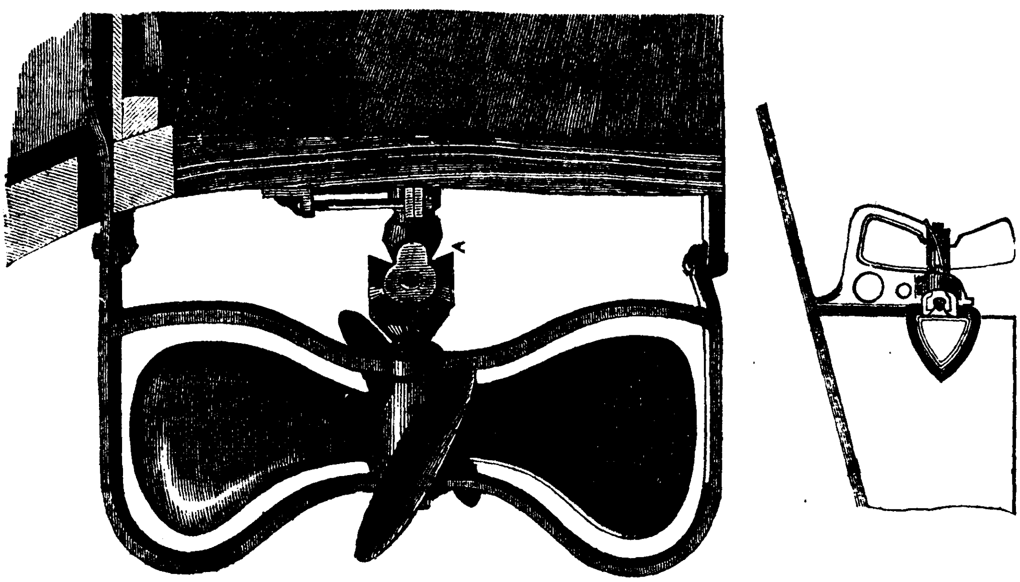
(See page 17.)

Competition in manufacture is now so keen that a very small apparent modification or improvement in method is sufficient to decide the balance between profit and loss, or permit of underselling a rival in the market. One of the greatest aids to the cheap production of manufactured goods of any class, is the use of special tools, and this is being more and more appreciated amongst our manufacturing engineers. It is now quite a matter of course that when an engineering firm prepares to produce any article in large quantities, the whole of the work has to be systematised, and usually special tools are designed to effect the largest number of operations with the least expenditure of time and fewest alterations in setting. This policy of putting down special machinery is undoubtedly an economical one in the end, although it may appear somewhat formidable in first cost, and it cannot be too strongly recommended to those who may wish to manufacture successfully.

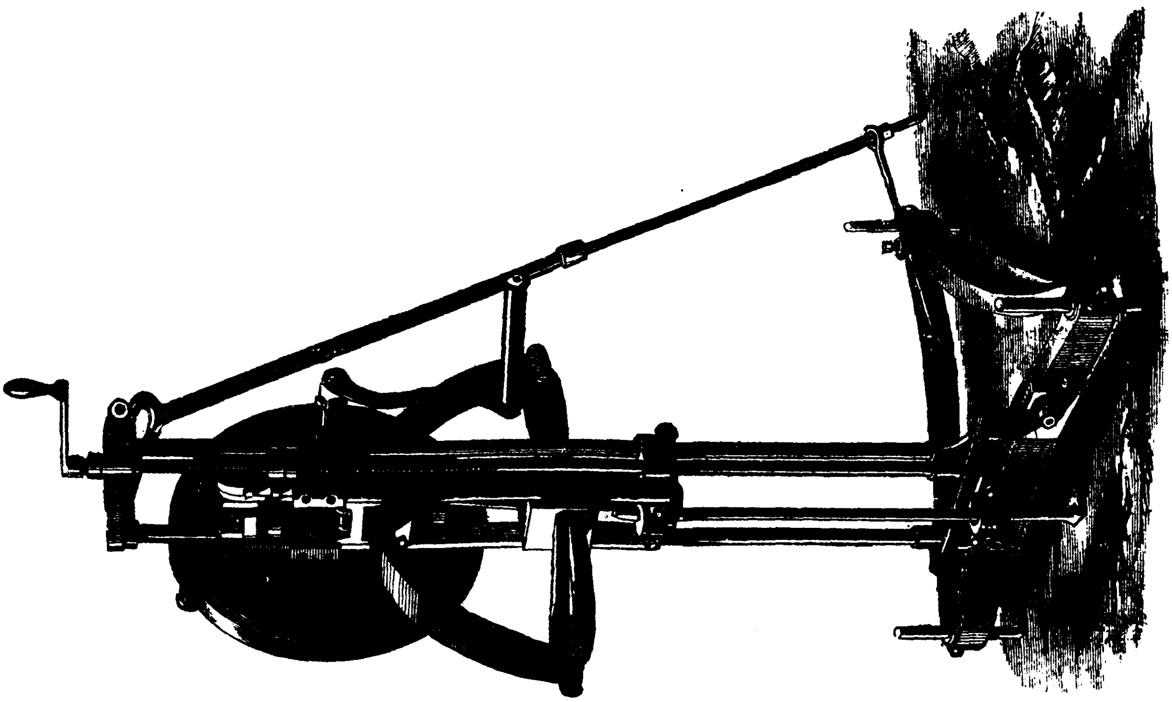
We illustrate, this week, a most useful special tool made by Messrs. Low and Duff, of Dundee. It is a light lathe made specially handy and useful for turning out very light brass fittings, such as those for gas brackets, though it would be equally serviceable for small jet cocks, or any kind of work whatever that can be run in the lathe. Small as work of this class is, the article will probably have at one time to be held between centres for the shank turning, and at another to be chucked for boring. In such articles, also, the length between centres is usually very small, and the poppet-head must be brought close up to the head stock. If now it is desired to use the hand tool upon the face of the chucked work, the poppet-head must be pushed back, and the workman even then cannot stand opposite his work in the case of the ordinary lathe owing to the length of the bed.

On referring to our illustrations, it will be seen that the poppet-head is made part of a casting, which does not slide on the bed as usual, but is able to revolve on a pin in a plane transverse to the length of the bed. In this way the work can first be centred between the ordinary centres and any all-round turning done on the shanks. The poppet-head is then released by slackening a nut, and it may be made to revolve so that it falls below the bed-plate (Fig. 1). The hand-tool slide-rest can be also swivelled into place in front of the work, which may now be chucked; and all face-turning can be thus readily accomplished.

We had much pleasure in personally inspecting the lathe at work on the finishing of gas-fittings, and the celerity with which they could be turned out completely finished was sufficient evidence as to the usefulness of the tool for increased rapidity of production. The economy of room which is also obtained by the use of such a lathe, with a short bed-frame, is worthy of consideration in the case of town workshops, where area is so much curtailed. On the whole, this is one of the neatest specialties in lathes that we have seen for some time, and as the diminution in weight will enable such lathes to be supplied at cheaper rates than the old long-bed ones they are evidently very cheap and useful tools to put down. The castings are strong and of good construction, and the work that is put on the lathe is of first-rate character. This is as it should be, for in no case is it good policy to spare a fair outlay for good workmanship in the tools, since they will always impress their own defects on the work done in them. A bronze medal was awarded to this machine at the late Exhibition at Cheetham Hill, Manchester. — *Iron.*

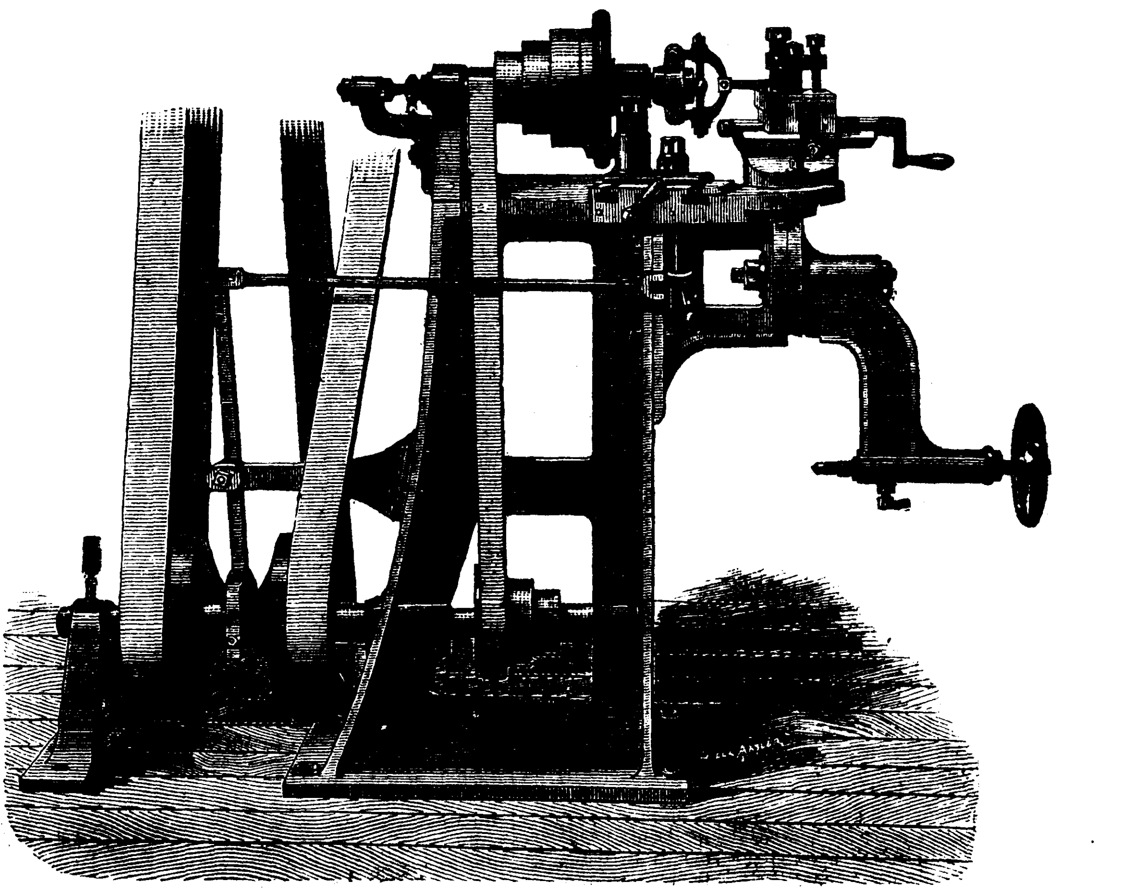


THE HERCULES SCREW PROPELLER. (See page 16.)



BARLOW'S ROCK DRILL. (See page 16.)

LOW'S COMBINED HAND AND SLIDE LATHE. (See page 17.)

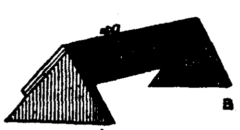


SHARPENING EDGE TOOLS.

Very few general amateurs have sufficiently practice to acquire, or to retain when acquired, the knack of producing perfectly flat facets on their plane-irons, chisels, &c.

By the aid of the following simple contrivance, put together very easily, the end may be attained with despatch and certainty, the shavings leaving the plane with the real professional "whistle."

A simple saddle of wood, with a thumb screw and clamp, or dog, for fixing the tool firmly to the cross bar. The oil-stone is placed between the cheeks and the tool so adjusted that the saddle bears with its heels or hinder angles, A and B, on the bench, the tool, of course, bearing on the oil-stone. The saddle, and with it of course the tool, is then worked backwards over the stone.



Hints on Public Speaking.—To become an effective speaker requires various essentials, most of which may be acquired by perseverance. First—let your mind be well stored with facts relating to the subject upon which you have to speak. Secondly—let your convictions be fully impressed with a sense of the truth of what you propose to advocate. Thirdly—Aim at natural, rather than artificial eloquence ; talk slowly, clearly, respectfully, but firmly ; and always attach more importance to what you say, than to how you utter it, or the reception your views may meet with. Never begin to speak until you feel urged to say something ; and finish the very moment you find your ideas begin to flag.

A TRAP TO CATCH LIONS.

In Algeria, there is annually a great loss of life and property, by the depredations of lions. The loss of property is estimated at $50,000 a year. The inhabitants cut away the forests as a means of protection against the wild beasts. M. Cheret devotes himself wholly to their extermination. As an assisting means in this his life-work, he has invented a lion-trap made as follows :

The frame and bars are of iron. It is 10 feet long, 6 feet 6 inches wide, and the same in height. Mounted on three cast-iron wheels of small diameter, it can be moved on difficult ground. The upper part opens with folding-doors, like a wardrobe, which close of themselves at the slightest shock given to springs of steel. Catches retain the lids as they fall, and imprison the animal as soon as he touches the bottom of the trap. The plan is to place this trap, properly baited, on the ground frequented by the wild animals, and then, when the game is caught, to wheel the machine away to some menagerie prepared for the purpose.

CORRECTION OF ECHO IN PUBLIC HALLS.

The plan of correcting echo in public halls by stretching wires across them from wall to wall, has had a practical trial in the cathedral at Cork, and given satisfactory results. From a letter published in *Nature*, giving an account of the experiments made in order to ascertain the best method of straining the wires, we take the following particulars : At first the wires were strained at a considerable height, but they produced comparatively little effect. Then a double course of wire was strained at a height of twelve or fifteen feet round the large pillars of the central tower, and other wires completely across the church. The effect of this was a greater distinctness of sound throughout the building. Further experiments were made, but none with more satisfactory results this. When these wires were strained across the church over the heads of the choir, every sound seemed to stop at once ; all resonance was gone. The matter is to be investigated thoroughly, with a view to discover the most efficient mode of correcting echo by means of stretched wires.

CIRCULAR IRONCLADS.

In our last impression we noticed, at some length, Mr. E. J. Reed's able letters to the *Times* on circular ironclads. At the moment those letters were written Mr. Reed had had no experience of the sea-going qualities of the Novgorod of the Admiral Popoff, and he was, therefore, judiciously reticent on the subject. The *Times* of Wednesday, however, contains three letters from him, dated respectively October 13th, 14th and 15th, which supply the deficiency. He has had and enjoyed a cruise in the Black Sea on board the Novgorod, and the result of his experience is apparently quite satisfactory. The Novgorod is, it will be remembered, the smallest of the two circular ironclads which Russia possessess; but Mr. Reed tells us that her behaviour surpassed his expectations. He embarked at Yalta at 8 p. m. on the 13th of October. The glass was falling, wild clouds gathering, and a heavy sea uning. It was proposed that the ship should start the same night, but apparently in deference to Mr. Reed's desire to see the ship in a gale, her sailing was postponed till 6 a. m. on the following morning. It blew hard during the night, but the wind went down about daybreak, and the sea, though rough, was not nearly rough enough to test the sea-going qualities of the Novgorod as Mr. Reed wished. However, he had a rough cruise. The ship "presented an unexampled sight in many respects, dealing with the sea as I never saw it dealt with before; she rose and fell to an almost imperceptible extent, and her pitching and rolling were so very small and easy that there was no period, whether the sea was broad on the bow, right ahead, or almost abeam, when one could not stand, walk and even write with perfect comfort." Such testimony as this coming from the late Chief Constructor of the British Navy, may be taken as conclusive evidence that circular ironclads constitute admirable gun platforms; and strengthens the favourable opinion which we have already expressed concerning them. The important question—the almost all-important question—of speed, however, does not receive so favourable a reply. The Novgorod attained a rate of but 6½ knots an hour, and Mr. Reed tells us that this miserable tardiness was not the result of the bad weather, inasmuch as one of the peculiarities of this class of vessel is that their speed is practically little affected by wind and sea. It is true that he adds that she has run at a higher speed; but he does not particularise the conditions which contributed to bring about the better result. Mr. Reed has taken great pains to attribute the slow speed of the ship to deficient engine power; but he has totally failed to produce in this way a valid excuse for a serious defect. Indeed, he has manifested a direct inconsistency. Speaking of the good qualities of the Popoffka as a gun platform and floating citadel, he has explained that she is really in one sense very tiny ironclad. He points out that the weight of our own Sultan is 9000 tons, that of the Devastation the same, while the Glatton coast defence ship weighs 5000 tons. On the other hand the weight of the Novgorod is only 2500 tons. If we use her armoured surface as a measure of capacity, she is equivalent to a ship of 140 ft. long and 30 ft. broad—dimensions less than those of the small gun-boats Viper and Vixen, built in 1865, and which no skill could render fit to go to sea. It is, no doubt, high testimony to the excellence of the circular system that a ship so small should carry 18 in. of armour and two 28-ton guns. Her armour and guns, indeed, alone exceed in weight that of an entire gun-boat of the Viper class, hull, engines, boilers, masts, guns, and all. But Mr. Reed forgets that the very fact that the ship is so small is conclusive evidence that her lack of speed is not due to want of engine power. The nominal power of the Novgorod's engines is 480 horses. Allowing that they work up to less than four times their nominal power, we should still have a force of 1800 indicated horses to propel 2500 tons, or rather more than one-horse power for each 1·4 tons of displacement. Now the Bellerophon has steamed at 14 knots, and her ordinary speed may be taken as 13 knots with an indicated horse-power not greater in proportion than this. In fact, there are very few, if any, ironclads in existence which have a greater proportion of power—off the measured mile—than one indicated horse to a ton and a-half of displacement. In dealing with this question of speed it must not be forgotten that the power required varies as the cube of the speed, or, in some cases, as the fifth power. Although it is not strictly accurate, it will be near enough for our purpose to assume that the cube ratio holds good for the Novgorod. If, then, 1800-horse power give her a speed of, say, 7 knots, not less than about 7000-horse power would be required to impart to her the very moderate velocity of 11 knots—that of the Bellerophon at half-boiler power. What the coal stowage of the Novgorod is we do not know. Assuming it to be 300 tons, she could keep the sea at 11 knots for not more than thirty hours. Her engines, boilers, and machinery generally would weigh at the very least 1000 tons, or probably 600 tons in excess of the weight of the machinery by which she is at present propelled, for it must be remembered that the subdivision of power among a number of small engines does not conduce to lightness. But it is obvious that the Novgorod could not possibly carry 600 tons additional weight on her present draught of water; and so we are brought back to the old difficulty, that of combining speed, armour, and gun power in a small ship. Everything has been sacrificed to enable the Novgorod to carry very powerful guns and very thick armour; but it remains to be seen whether it would not be possible by a similar sacrifice of speed in an ordinary ironclad to obtain qualifications somewhat similar to those of the Popoffka. If it is asserted that a velocity of 7 knots is enough, then we are all wrong in building ironclads to steam at 14 knots. But no one ventures to assert this. Even Mr. Reed is not satisfied with the speed of the Novgorod, and he enters into a somewhat wild dissertation to prove that circular ironclads can be made to steam much faster than 7 knots. He urges indeed, that their form is admirably adapted for the reception of machinery of great power. We do not dispute his premises, but we must point out that which Mr. Reed has forgotten, namely, that great power means great weight; and the very same laws will hold good for a popoffka as for an ordinary vessel. To be fast she must be big. But any large ship which is content with a velocity of 11 knots, can carry armour as heavy, and guns as powerful, as a circular ironclad. The paramount advantage of the Novgorod is, that on a given draught and displacement, she goes to sea with heavier guns and armour than ony other ship of her size; but this is not all clear gain. It is obtained partly, we willingly admit, because of her form; and partly, because she is as slow as a river barge.

If it can be shown that a circular ironclad, with a displacement of, say 10,000 tons, can be made to carry heavier armour and more guns than ironclads of the same weight, steaming at the same velocity, than it must be conceded at once that the circular ironclad is probably the ship of the future. A Popoffka of this weight would be about 173 ft. in diameter, and her draught of water would be 15 ft. The area to be covered by armour, allowing the belt to be 8 ft. deep, would be about 4343 square feet, or say as much as would be required to protect an ordinary ship 238 ft. long and 40 ft. beam; but a ship of these dimensions would not have much more than one-fourth the displacement of the circular ironclad. On the other hand, it is not improbable that the actual structure of the Popoffka, independent of armour, would weigh much more in proportion to that of the ship. It is no joke to carry 70-ton guns about the centre of a deck 170 ft. in diameter. Still, all things considered, it is evident than an enormous advantage would rest with the circular ship. But it is doubtful to the last degree whether any considerable advantage would be goined by mounting more than two guns of 80 tons, or even 40 tons, in one vessel. It appears to us that two ships of 5000 tons each would be preferable in every way to one of 10,000 tons. If, however, it is impossible to get a speed of ten or eleven knots—and it appears to us to be impossible—out of a circular ship of much less than 10,000 tons displacement, it is evident that the sacrifices which must be made to attain velocity are relatively enormous; and this fact will militate powerfully against the use of circular ironclads—so powerfully, indeed, that they can never be regarded as efficient representatives of a great naval power at sea. On the other hand, they appear to possess localised powers of attack and defence which are simply unrivalled. Not only would they defend our own coasts, and operate efficiently in proximity with our principal harbours and dockyards, but they might proceed quietly, and at their leisure, to attack the ports of a foe. Half a dozen 5000-ton Popoffkas moving in concert could undoubtedly set at defiance any ships which could be brought against them, except such vessels as Thunderer and Devastation; and once lodged under the walls of a fort, there can be little doubt as to the result. But the great fact remains that they cannot go in search of a fleet. Our admirals have, ere now, hunted foes through almost every sea and ocean on the face of the earth. This duty could not be performed by slow ships. They would be continually eluded.

In conclusion we may express once more the opinion that very short and broad ships, of something like the ordinary type, would probably, on the whole, be more suitable for a British fleet than circular ironclads. These last, however, must, with the limitations we have indicated, be regarded as most important innovations in the practice of modern naval architecture. It is, perhaps, easy to overrate their merits; but we shall, as a nation commit an error if we do not attach its true value to the lesson which Russia has just taught us.—*The Engineer.*

GUMPEL'S PATENT RUDDER.

(See page 21.)

"It is above all things necessary that the rudder have ample power—great power seldom used, ready when wanted. The rudder must be able to do anything; and to turn the ship short and sharp on her heel may save her." Thus very truly remarks Mr. Scott Russell in his work on naval architecture; but although since that time steam steering-gear has given us the power to employ large rudders, and to put them over rapidly so the maximum angle of efficiency, still, it is only in vessel provided with steam power that this method of working the helm is possible, and even in such vessels it is not universally adopted. The ordinary rudder, worked either by wheel or tiller, which is the means of steering most frequently used, is put over to large angles with so much difficulty, especially if there be a heavy sea running, that we heartily welcome any steering apparatus which will require less power and can be put in operation in a shorter period of time than the ordinary rudder takes. Such a one was the balanced rudder introduced into the navy some years since; but the inconvenience attending its employment, owing not only to the difficulty and uncertainty of steering with it under sail, but also to the resistance it offers to a vessel's onward motion in consequence of one-third of its total area being on the wrong side of the fore-and-aft line, has prevented its being adopted in the merchant service. The rudder invented by Mr. Gumpel, however, seems to possess all the advantages with none of the disadvantages of the balanced rudder. In this, as shown by the illustrations, the rudder shaft is cranked, the crank pointing forward when the rudder is amidships. On this crank the rudder blade can rotate, but its fore edge is kept from leaving the fore-and-aft line of the vessel by means of a pintle moving in a slot under the counter. Thus, when the rudder shaft is turned, the blade is carried over to port or starbeard, but the fore edge being kept by the pintle in the fore-and-aft line, the rudder assumes in relation to the ship the same position that the common rudder does, and is thus free from the evils of the balanced rudder, which, when deflected, extends to both sides of the stern-post. Now in the ordinary rudder, the pressure increasing as the angle increases, and the arm at which it acts always remaining the same, the power required to turn it through the last few angles becomes very great indeed; but with Gumpel's rudder, the resultant pressure on the rudder being represented by a straight line through the centre of pressure perpendicular to the surface of the rudder, a line let fall on this perpendicular from the crank head will represent the arm at which the resultant pressure acts, which has to be counteracted by the force applied to the tiller, and from the construction of the mechanism this arm decreases as the angle of inclination increases. If, then, the length of the crank is made equal to four-fifths of the distance of the point where it is attached to the rudder from the fore edge of the latter, when the crank is put over at right angles to the rudder, the angle of maximum efficiency—namely, 38 deg. 40 m. —is reached, and the pressure on the rudder acting along the line of the crank shaft, there is absolutely no strain required to retain the rudder in this position. It appears, therefore, that for any given angle the advantage of Gumpel's rudder over the ordinary rudders is inversely as the length of the arms at which they act, and this beginning at four-fifths, or ·8, when it is first set in motion, afterwards diminishes rapidly until it becomes zero, and the actual work done to bring over Gumbel's rudder to its angle of maximum angle of efficiency is only four-tenths of that required for the ordinary rudder.

These facts are the result of an investigation made by Dr. Woolley, and in order to prove them and test the general efficiency of the rudder, the inventor has built a small steam yacht of about 20 tons measurement; her dimensions being:—Length, 52 ft. over all, and 45 ft. on the water line; breadth, 8 ft.; draft, 3 ft. 6 in. foward, and 4 ft. 6 in. aft; area of midship longitudinal plane, 180 square feet; and area of rudder surface, 4½ square feet. Several trials have been made, the results of all of which fully corroborate the theory expounded by Dr. Woolley. A very careful series of tests have been lately carried out with a dynamometer to ascertain the exact pressures on the tiller at various angles of inclination of the rudder, while the yatch was kept constantly running at a uniform rate of 7½ miles an hour. The angles were determined by means of a carefully marked quadrant fixed at the after end of the vessel, the zero point being adjusted accurately under a pointer attached to the tiller when the rudder was perfectly free and the vessel going straight ahead. The tiller was pulled over by means of a tackle fastened to the dynamometer, and when the pointer denoted the angle at which it was desired to determine the pressure, the rudder was held fast and the reading of the dynamometer taken. The readings were taken at every 5 deg. up to an angle or 25 deg., after which they were taken for every degree up to 35 deg. Commencing with a pressure of 9 lb., at 5 deg. the power increased steadily up to 21 deg., when 30 lb. was registered. This was found to be the maximum angle of pressure; at 22 deg. only 28 lb. being registered, and diminishing to 7 lb. at 35 deg. and nothing at 38 deg. 40 min. Theory shows that if the resistance varies as the sine of inclination, the maximum would be attained at 21 deg. 26 min., whereas if the resistance varied as the square of the sine, the maximum would be attained at 28 deg. Now, these results corroborate the law of variation of resistance as the sine, which has already upon other grounds been adopted by Mr. Froude and other scientific authorities.

The accompanying table shows a comparison of the theoretical pressures for Gumpel's rudder and the common rudder, and those actually observed with the former, the law of resistance varying as the sine being adopted. This table shows most graphically and conclusively the value of Gumpel's rudder, the benefit of which is so great that we have no doubt it will be generally adopted in the mercantile marine.

Pressures on Tiller of Gumpel's and Ordinary Rudders.

Angles of inclination of rudder.	Pressures in lbs. Ordinary rudder (theoretical.)	Gumpel's rudder (theoretical.)	Gumpel's rudder (observed.)
5°	14·297	11·406	9
10°	29·707	21·397	21
15°	44·371	29·144	28
20°	57·049	31·342	29
25°	70·493	30·797	25
30°	83·475	24·272	19
35°	95·670	12·215	7
38° 40'	104·137	—	—

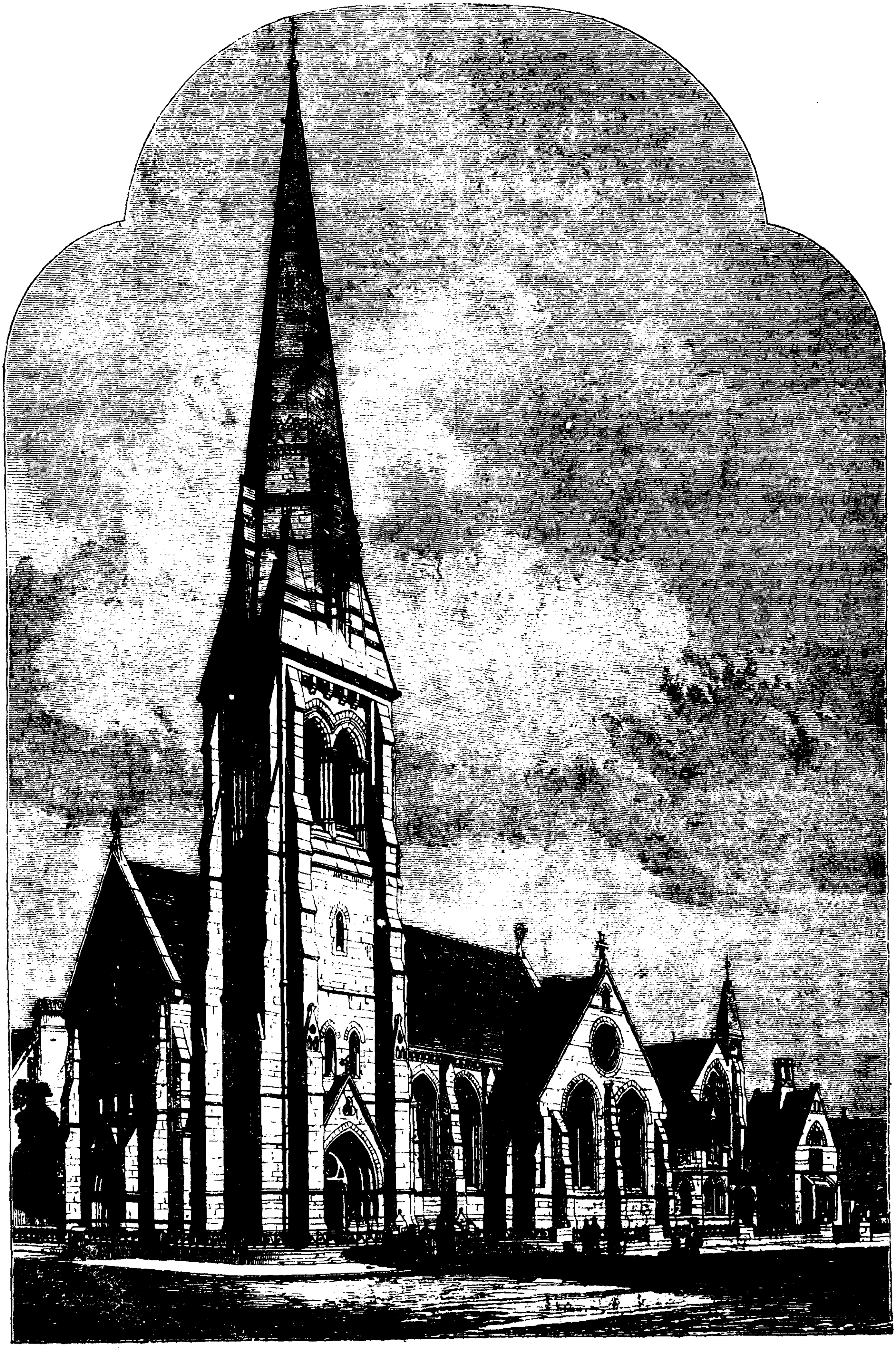
A NOVELTY IN WATER PROPULSION.— A New-Haven, Conn., mechanic, has invented, and is said tc have recently successfully tried, a new thing in water propulsion, not for speed, but for economy and for progress without "wash," adapting it especially to canals. He has a boat with two keels— these are parallel—an air-tight box being fixed between them. Air, compressed to the degress of three or four atmospheres, by a small steam engine, is introduced through this box to the surface of the water. The emission of the compressed air resisted by the water, and confined between the parallel keels, operates to propel the boat about five miles an hour without commotion of the water.

THE GULF STREAM. —The deep-sea soundings of Lieutenant Berryman confirm the prevailing theories concerning the cause of the Gulf stream. At the depth of 2,000 feet in the Straits of Florida, the temperature is only three degrees above freezing, while deep soundings on the telegraph route show a temperature of ten to fifteen degrees below the freezing point. Hence the warmer and lighter water is from the Mississippi crowded to the surface, and is forced toward the colder regions of the North flow south to restore equilibrium.

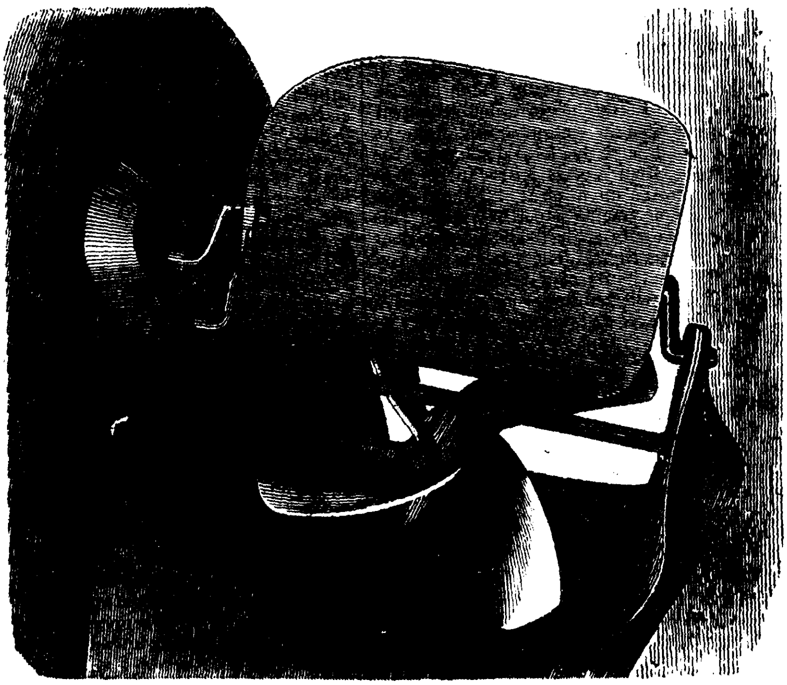
THE great American inventions, which have been adopted all over the world, are the following: 1. The cotton gin, without which the machine spinner and the power loom would be helpless; 2. The planing machine; 3. The grass mower and grain reaper; 4. The rotary printing press; 5. Navigation by steam; 6. The hot air (caloric) engine; 7. The sewing machine; 8. The india rubber industry; 9. The machine manufacture of horse shoes; 10. The sand blast (for carving); 11. The gauge lathe; 12. The grain elevator; 13. The artificial manufacture of ice on a large scale; 14. The electro-magnet, and its practical application, by Henry and Morse; 15. The only successful composing machine for printers.

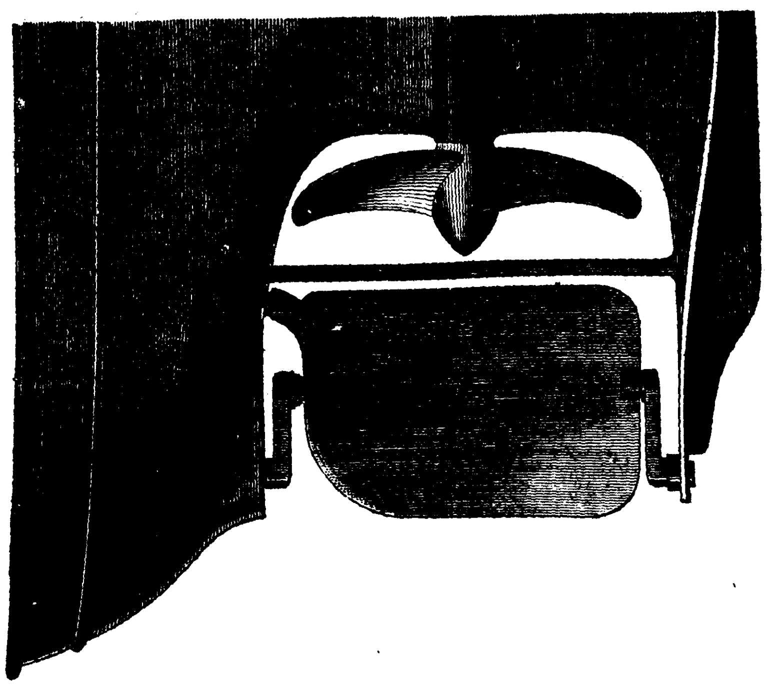
A FRENCH mechanic has discovered that by keeping his turning tools constantly wetted with petroleum he was enabled to cut metal and alloys with them, although when the tools were used without the oil their edges soon turned and dulled. The hardest steel can be turned easily if the tools be thus moistened with a mixture of two parts of petroleum and one of turpentine.

THE BREAKING-UP OF LARGE MASSES OF CAST-IRON has, as our mechanical readers are well aware, been a matter of considerable difficulty and expense. This is, however, according to the *Moniteur Scientifique*, now accomplished in the case of large guns by placing dynamite at the lower end of the gun and filling the bore with water. The explosion of the dynamite, transmitting its force through the water, fractures the gun.



CONGREGATIONAL CHURCH AT BALLIOL ROAD.





GUMPEL'S PATENT RUDDER. (See page 21.)

AIDS TO THE ART OF DRAWING.

(Continued, see page 24.)

THE CAMERA OBSCURA.

One of the best known instruments, also based on optical principles, and which may be used in drawing, is the *camera obscura*, of which we give two forms. Fig. 8 is an arrangement adapted to taking views from windows or other fixed position. It is a rectangular wooden box, formed of two parts, which slide in and out. The luminous rays pass into the box by a double convex lens secured in place as represented in section 2, and form an image on the opposite side, which is at the focal distance of the lens. But the rays are reflected from a glass mirror inclined at an angle of 45° and form an image on a piece of ground glass inserted above. When a piece of tracing-paper is laid on this screen, a drawing of the image is easily made. The wooden door shown serves to cut off extraneous light. The parts of the box slide one within the other, like the joints of a telescope, so that by elongating it more or less, the reflected image may be made to fall exactly on the screen, at whatever distance the object may be situated.

THE PORTABLE FIELD CAMERA OBSCURA.

Fig. 9 is another arrangement of the camera obscura, in portable form, so as to be carried on sketching tours. The box or lantern portion shown in detail in Fig. 10 consists in front and rear pieces of wood or tin, connected at the sides by cloth or paper, folded like the bellows of an accordeon. In the front side is the lens, placed in a little telescope of tin, which easily slides in and out and inside of the back, and at its lower edge is hinged a small mirror, which, when the box is extended, falls forward until it strikes against a stop within the front side, which maintains it at an angle of 45°. Any convenient arrangement may be added to hold the box extended. When the latter is closed, the mirror folds against the back, the lens telescope slides in, and the front and rear sides come together, making a bundle little larger than a good-sized pocketbook. At each corner is a socket to receive the ends of bent iron wires as shown, which serve as supports, and the lower extremities of which enter sockets attached to the sides of the table, as represented in Fig. 10. The table is composed of slats glued to a back of cloth. On the back of the middle slat is a socket, and also a bar pivoted in the middle, which turns at indicated by the dotted lines, and forms a solid support for the table when extended. The object of making the table thus in pieces is so that it can be rolled in a compact bundle. A tripod of legs jointed to a pivot which fits in the socket under the table supports the apparatus, and may, when detached, be folded into a single bar, serving as a walking-stick. A square of black cloth completes the device, and is thrown around the wires to form a dark-chamber beneath the lens-box, large enough to accommodate the head and hand of the artist. The drawing-paper is attached to the table after it is extended and receives the image formed by the lens and reflected downward by the mirror.

THE PROPORTIONAL DIVIDERS.

We have still to notice some ingenious devices which are more adapted as aids in mechanical drawing rather than as direct means of tracing outlines, as are the majority of the apparatus thus far described. Fig. 11 is termed a proportional compass, and consists in two slotted arms of brass, German silver or other metal, connected through the slots by a small sliding tumbscrew. Metallic points are provided at both ends of the arms. The object of the device is to reduce or enlarge drawings to a given scale, and for this purpose suitable divisions are marked on the edge of one of the slots. Suppose, for example, it be desired to reduce a given line to one third, the two long points are placed upon its extremities, a pointer on the clamping screw being previously removed to coincide with the ⅓ mark, so that the same forms the pivoting point of the two arms. The distance then included between the two short points at the opposite ends will be exactly one third the line measured, and hence may be thus laid off on the copy. In enlarging, the operation is reversed, and is too obvious to need explanation. The instrument can be made without difficulty by any one used to working in metals, and the marks on the arm can be obtained by actual experiment. It can be purchased, however, for a small sum from any mathematical-instrument maker.

It cannot be too deeply impressed on the mind, that application is the price to be paid for mental acquisitions, and that it is as absurd to expect them without it, as to hope for a harvest where we have not sown the seed.

IMPROVED EMERY GRINDING MACHINE.

(See page 32.)

In no department of the arts has more steady progress been made than in the perfection and application of emery-wheels. We have had occasion to say before that these applications were revolutionizing many branches of industry, as the application of this system of sharpening enables tools to be kept sharp and of the proper form so cheaply that milling is, to a very great extent. supplanting the use of planing-machines, lathes, etc., in many classes of metal-working. Moreover, the application of emery-grinding to the sharpening of saws and other tools for working wood has added greatly to the facilities possessed but a few years since. Tools for cutting mouldings of complicated shape can now be sharpened and their form retained with far greater accuracy than formerly. Among the most active and enterprising of those to whom the mechanical world owes these improvements is Mr. T. Duncan Paret, the President of the Tanite Company, of Stroudsbourg, Pa., whose intelligent discrimination has enabled him to add to his own improvements the valuable inventions of others, until, in capacity and efficiency, the tools represented in the catalogue of the Tanite Company stand unrivalled in this or any other country. The machines herewith illustrated are among the new additions to their previously very extensive list.

Figs. 1 and 2 respectively represent Sanford's universal grinder, so called because it facilitates operations upon a large class of work done by machinists, stove-fitters, and others which cannot be conveniently performed on horizontal machines, and because the wheel can be made to assume a very great variety of positions. We copy from the *Scientific American* the description of this machine. The principal feature of the device is the manner in which the wheel may be adjusted to work at any angle by simple mechanism, involving the use of no extra pulleys and belting. Fig. 1 shows the grinder arranged for acting upon vertical work; in Fig. 2 the wheel is represented inclined.

The wheel-shaft is mounted in bearings in the frame, A. which, by means of a set-screw passing through a slot, is secured to a shank which enters a socket on the standard, B. The shank, by loosening the set-screws which confine it in the socket, can be drawn out to tighten the belt which, acting on a pulley on the wheel mandrel, rotates the wheel, or it can be turned in the socket so as to set the latter at any angle. By means of the slot and set-screw in the frame, the wheel can be adjusted nearer to or further from the table, as desired. The mandrel has several inches traverse in the frame, so that the pulley can be pressed down or lifted from the work by means of a simple lever arrangement at C. The lever may be set and held at any position by means of the nut shown, or the former may be counter-weighted and operated by a treadle beneath the table.

In order to grind flat surfaces the wheel is lowered down to them. A conical wheel is used for grinding holes in stove-plates, etc., an aperture being made in the table or an auxiliary platform thus provided being secured on top of the latter. For edging plates, the table can be made of sufficient size to sustain the whole weight of the plate, so that the attendant can bring a more even pressure on the wheel with little labor and without danger of injuring it. The wheel can be inclined so as to grind bevel edges with readiness; and by suitably-formed grinders mouldings can easily be ground.

Fig. 3 shows the machine so arranged that it serves as an ordinary horizontal grinder: Fig. 4 shows it arranged for an emery-belt, a wooden pulley taking the place of the emery-wheel on the mandrel.

Since these designs were executed, the Tanite Company have started an entirely new pattern, the object of which is to preserve the features shown in the engravings, but to still further perfect the machine by adapting it to an iron column with adjustable table, similar to plan of a vertical drill. When completed in this way, with the addition of other novelties which we cannot now describe, this machine will be invaluable for pattern-makers and for all who have irregular work to do.

Value of Small Patents.—Many small but useful inventions are never patented because their inventors do not think them of sufficient importance to patent. A few days ago the agent of a manufacturing company who called at our office directed our attention to a patent we had taken for his company about four years ago for a little improvement in lamps, of which, at the time the invention was made, it seemed doubtful whether it was worth patenting. He informed us that the patent is now worth twenty thousand dollars a year, and, of course, the value of such a patent is likely to increase year by year.

Hard Steel *versus* Soft Iron.—Mr. Isaac Reese, of this city, has an invention for cutting bars of hardened steel, and on Saturday last Professor B. S. Hedrick read before the American Association for the Advancement of Science, in session at Detroit, an essay on "The Requisite Amount of Simple Friction of Soft Iron against Cold Steel to Melt it." He said the development of heat by friction has been long known. For some time it has also been known that the operations of rubbing and rolling has 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 Pittsburgh, Pa., had occasion to construct a machine for cutting bars of cold-hardened steel. For this purpose he mounted a disc of about forty-two inches diameter, 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 a velocity of about 25,000 ft. 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. But on examining the pile of accumulated particles beneath the machine they were found to be welded together in the shape of a long cone, similar to the stalagtites in the lime-stone caves; they were nearly like the spikes of frost as formed in winter on Mount Washington, and illustrated at 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 a slight heat, not at all drawing the temper, or oxidising it. 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. The particles fly off in thick jet or stream through which the naked hand may be passed without injury. They glance off without burning the hand, having assumed the condition which causes the spheroidal state of liquids. — *Pittsburgh Leader.*

THINGS USEFUL TO KNOW.

Varnish brushes should never be allowed to touch water, as it not only injures the elasticity of the hair, but a resinous substance is formed in the hilt of the brush, which can never be thoroughly removed, and which will work out little by little when the brush is used, destroying the glossy surface which otherwise might be obtained.

Paint intended for outside work, which cannot be protected by varnish, is mixed as follows: Crush the color if in lumps, and mix to a stiff paste with linseed oil, boiled or raw—the latter is preferable; then, if a dark color, add brown Japan or gold size, in the proportion of half a pint to a gallon of oil; in a light color, use patent dryer in similar quantities.

Horses will work much more easily, and lose less of their effective forces, by working abreast, than when they are placed in single file. If four horses are to draw a load in one wagon, it is better to have a long double whiffletree, with a span of horses on each side of the tongue, than to have one span placed before the other.

A skillful sawyer, in sawing a log into scantling, which he knows will spring, will first mark off the ends into cuts; and then, after sawing once through on one side of the log, will saw a slab off the other side, and finish in the middle. By this means the lumber will be about as true as if the timber were not inclined to spring at all.

To fasten emery to leather, boil the glue very thin, add a little milk, raise the pile of the leather, and put on glue with the brush. Then sprinkle on the emery, and let it cool.

To preserve soap-grease, fill a cask half full of good strong lye and drop all refuse grease therein. Stir up the mixture once a week.

Many persons, in preparing potatoes for cooking, pare off a thick slice from the surface instead of digging out the eyes. The skinning process is all wrong, as the strength of the vegetables lies near the surface—the starch growing less abundant as the center is approximated. The best way is to scour them well, and either bake or boil them with their skins on.

HINTS ON THINGS FAMILIAR.

Why is a ray of light composed of various colours?—If solar light were of one colour only, all the objects would appear of that one colour, or else black.

Why are some things of one colour, and some of another?—As every ray of light is composed of all the colours of a rainbow; some things reflect one of these colours, and some another.

Why do some things reflect one colour, and some another?—Because the surface of things is so differently constructed, both physically and chemically.

Why is a rose red?—Because the surface of a rose absorbs the blue and yellow rays of light, and reflects only the red ones.

Why is a violet blue?—Because the violet absorbs the red and yellow rays of the sun, and reflects the blue only.

Why is a primrose yellow?—Because the surface of the primrose absorbs the blue and red rays of solar light, and reflects the yellow ones.

Why are some things black?—Because they absorb all the rays of light, and reflect none.

Why are some things white?—Because they absorb none of the rays of light, but reflect them all.

Why are the leaves of plants green?—Because a peculiar chemical principle, called chlo'rophyll, (signifying green leaf,) is formed within their cells; which has the property of absorbing the red rays, and of reflecting the blue and yellow, which (being mixed together) produces green.

Why are some things transparent?—Because every part between the two surfaces has a uniform refracting power, or (in other words) has in every place the same density, and, therefore, the rays of light emerge on the opposite side.

Why are some things not transparent?—Because the particles which compose them are separated by minute pores or spaces, which have a different density from the particles themselves. Therefore, the rays of light are too often reflected and refracted to emerge.

NEW SURGICAL HOSPITAL AT STOCKTON-ON-TEES.

(See page 12.)

We take from the *Builder* a very pretty design of the New Surgical Hospital at Stockton-on-Tees.

The elevation is carried out in red pressed brick with stone dressings, relieved with black bricks and ornamental string-courses. The portion now in course of erection consists of two blocks, viz.:—The administrative department and the south-east wing. The former contains, on the ground-floor, medical officer's room, matron's room, surgery office, operating ward, with kitchen, scullery, washhouse, and other accommodation. On the first floor of the block is a large convalescent ward to contain three beds, six beds for special cases, and bed-rooms for the various officials, servants, &c. In the basement are three large store-closets. The other block forming the south-east wing contains on the ground-floor an accident ward, two beds, and a main ward with ten beds. This ward has also a bath-room and water-closets attached in addition to a nurse's room and a store-room. On the first floor the arrangement is precisely the same as on the ground-floor. The building is so arranged that three extra wings can be erected on the same plan as the south-east wing. The administrative department is also so combined that four wings can be worked in it. The hospital will now contain thirty beds for patients, and when the other wings are erected it will accommodate 102 beds. The estimated cost of the present building is 4,500*l*, exclusive of land and furnishings. The complete hospital is arranged for 120 beds.

A New Paint-Solvent.—It is stated in a Suffolk paper that Mr. H. P. Hayhoe, painter, of Bury St. Edmunds, has invented a new paint-solvent. It is said that the solution is simply applied to the paint with a brush, and is then left for a short time, after which the paint may be scraped off with facility. The number of coats of solution depends upon the number of coats of paint; four, which may be applied within a quarter of an hour or so of each other, will probably be sufficient in the most hardened case. The solution, which it is alleged causes no injury whatever to the hands or to the brushes, is inexpensive, and produces no smell.

AIDS TO THE ART OF DRAWING. (See page 22.)

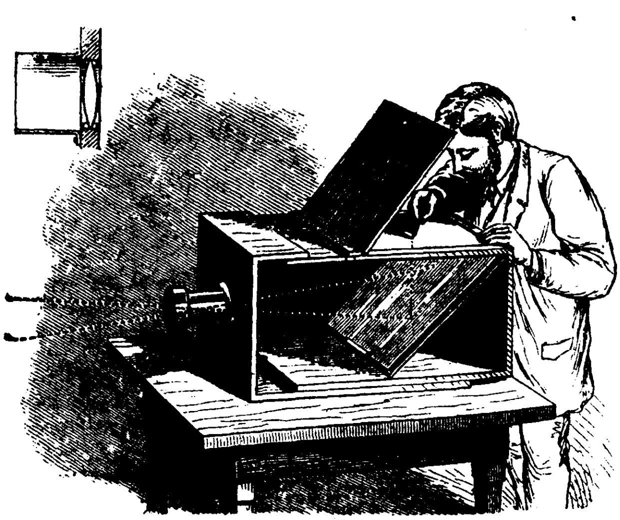


FIG. 8.—THE CAMERA OBSCURA.

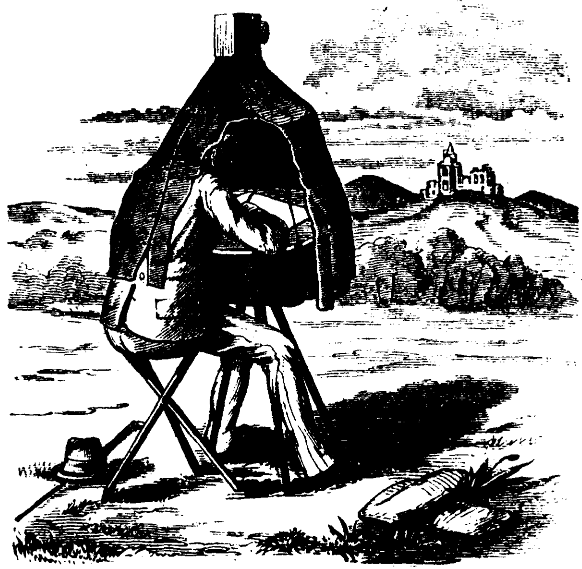


FIG. 9.—THE FIELD CAMP.

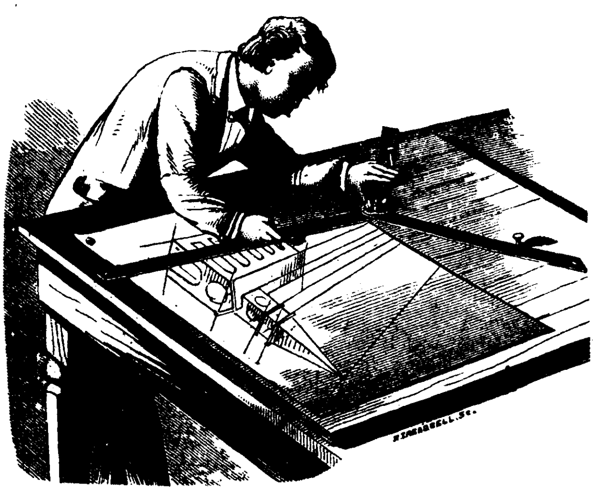


FIG. 12.—THE PERSPECTIVE RULER.

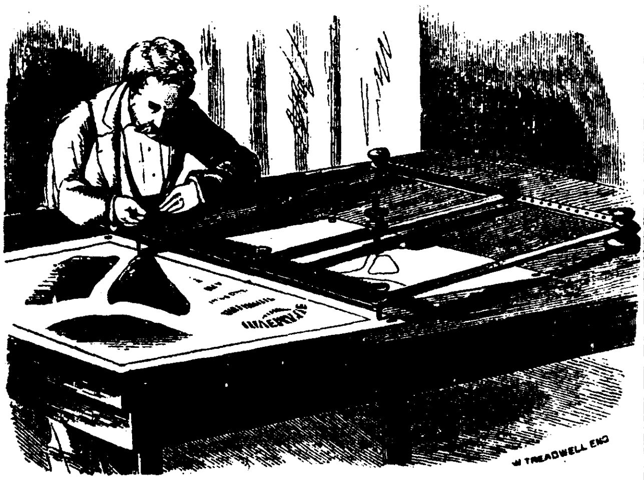


FIG. 13.—THE PANTAGRAPH.

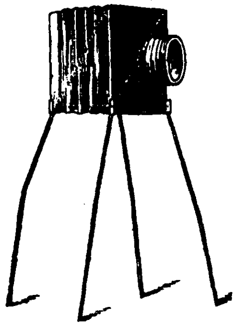


FIG. 10.

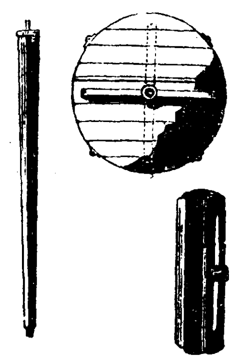


FIG. 10.

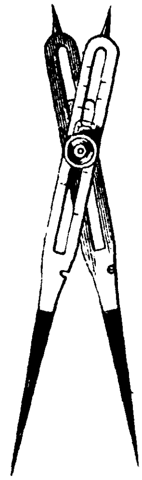
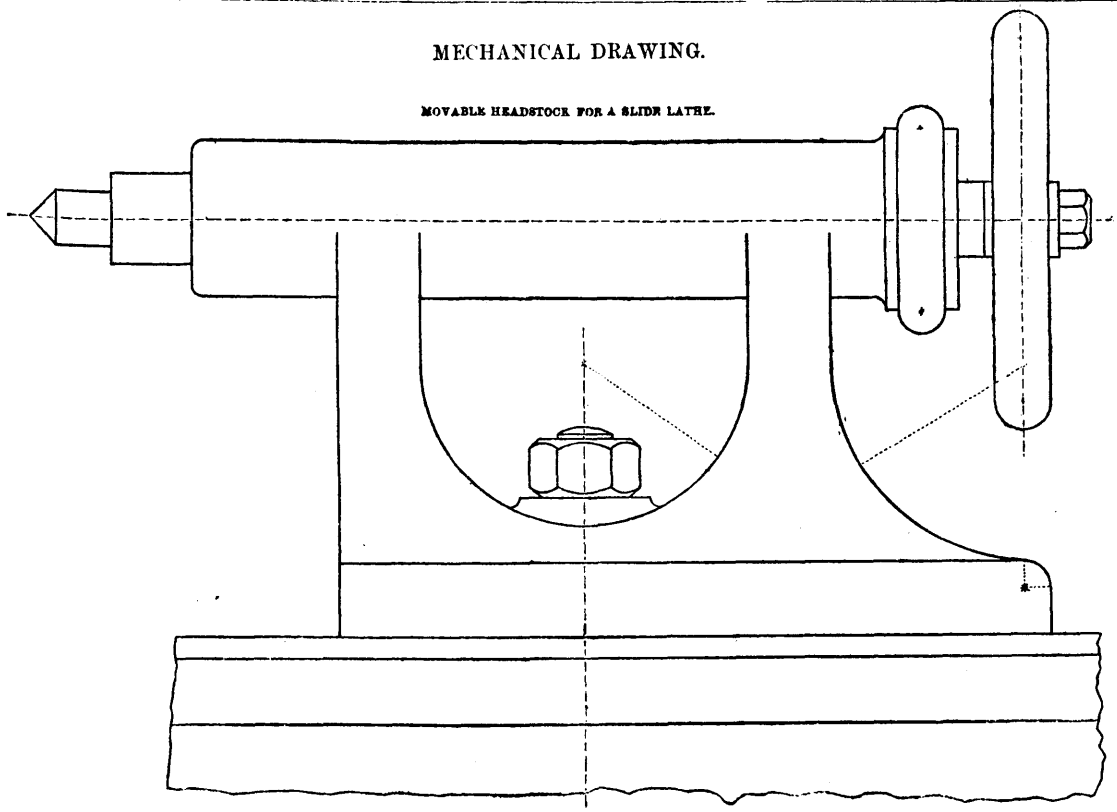


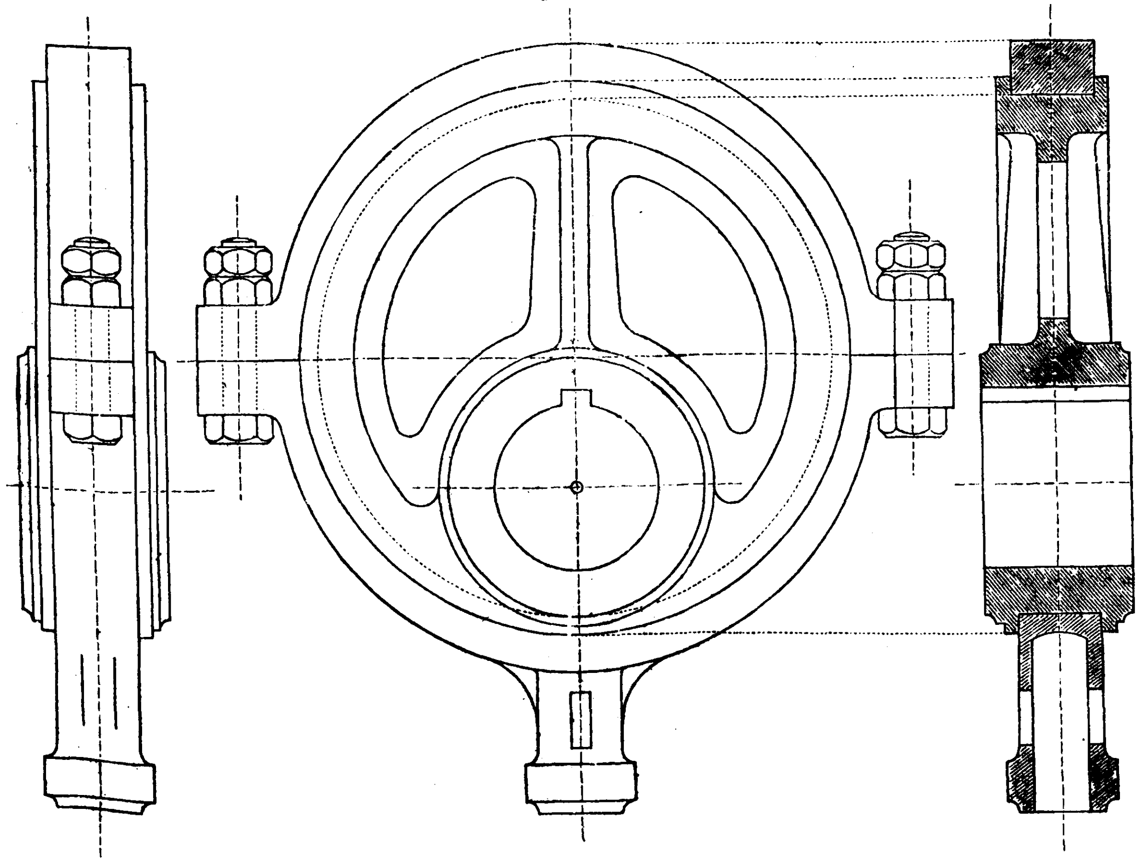
FIG. 11.

MECHANICAL DRAWING.

MOVABLE HEADSTOCK FOR A SLIDE LATHE.



ECCENTRIC AND STRAPS.

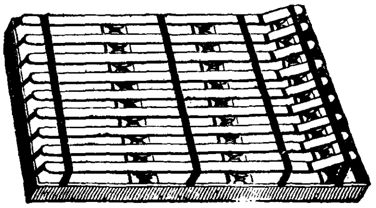


END VIEW. FRONT VIEW. SECTION.

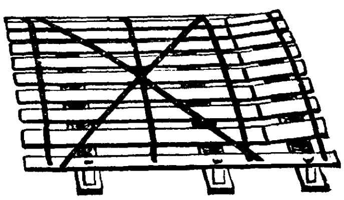
WHITESIDE'S PATENT IMPROVED SPRING BED.

Among the many articles in this line exhibited at the late Ontario Provincial Exhibition at Ottawa, there was nothing that we saw equal in point of durability and comfort to

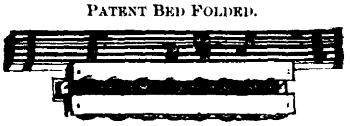
WHITESIDE'S POPULAR SPRING BED.



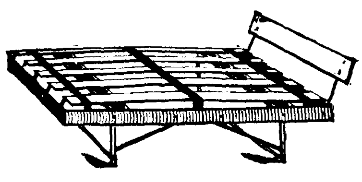
"IMPROVED" SPRING BED



PATENT BED FOLDED.



PATENT CAMP BED.



PATENT SPRING SLAT.

It is so constructed that it possesses the highest degree of elasticity, as the slats rest upon *Steel Springs*, which never lose their elastic temper, and by the peculiar method in which the webbing is applied, the strain upon the springs is equalized. There is another great advantage which it possesses over many *Spring Beds*, viz: it is perfectly *noiseless* which to a nervous sick person is a matter of much consideration. This *Patent Bed* can be converted into a neat, simple and convenient *folding bed*, making it exceedingly portable. We afford an illustration of it, also of his *Spring Slat* and *Patent Camp Bed*, which is a combination of a *Folding Bed* and *Bedstead*. Mr. Whiteside was awarded first prizes at the Exhibition. His *Beds* however are widely known in the Dominion as being very superior and substantial.

But to parties who may not know the firm and wishing to send orders, we may state that the address is H. WHITESIDE & Co., College street, Montreal.

NEW CABLE TO AMERICA.—A new and powerful competition threatens the Anglo-American Telegraph Company. It is that a French Company is being formed, and it is expected that next year will see the opening of a fresh telegraphic line to the United States.

THE VANGUARD.—Attention has recently been called to the fact, hitherto overlooked, that the double bottom of the Vanguard, which ought to have added materially to her buoyancy, really helped her to the bottom. When the ship made her steam trial in 1870 she was so crank as to be unsafe, heeling 17 deg. without a rag of sail being spread, in a good breeze. To give her stability, the space between her outer and inner bottom was filled up to a great extent with bricks and cement. The Vanguard is not the only ship afloat in the same condition, and they are thus deprived of a protection against foundering which it was expressly intended they should possess.

CIRCULAR *vs.* BAND SAWS. — The German industrial papers are discussing the question of the disadvantages of circular saws as compared with band saws: 1st. Circular saws are very dangerous to the workmen; 2nd. They require a much greater power to drive them than any other kind; 3rd. They make a much wider cut, producing more waste, and thus fewer products from a given amount of material. The only advantage is, that the first cost of procuring a circular saw is less than that of a band saw; but, notwithstanding, the Mechanics' Association of Muehlhausen have already published in their yearly report the advice to abolish their use wherever it is practically possible to do so; and this is of course the case in a great majority of circumstances.

ALLAN'S FLOATING CABIN.

(See page 29.)

This year has witnessed the failure of two noteworthy attempts to overcome the horrors of the Channel passage, to which the public at large had for a long time looked forward with much anxiety and hope. The *Bessemer* and *Castalia* have both been tried and found wanting. The latter vessel, indeed, is steady enough and comfortable enough, but as we were always afraid she would be, she is so excessively slow that she is practically useless for the service for which she was designed; and the swinging saloon of the *Bessemer*, apparently, will not swing. At all events, an ominous silence has been preserved upon the subject, which has culminated at last in a decided confession of failure by the vesssl being advertised for sale. We must confess that we never quite understood how a single man, transcendent genius though he might be, could possibly anticipate the movements of a vessel when he had not the slightest means of knowing beforehand what they where going to be. The action of waves is, unfortunately, by no means regular, and when we add enormous bilge-keels to our ships, as was done with the *Bessemer*, we get extraordinary jerks and stoppages when we least expect them that any system which depends upon apparatus worked by human skill alone for taking out of a swinging cabin the roll which it would naturally have, contains so few inherent elements of success, and presents so many natural difficulties to contend with, that we very much doubt its ever being satisfactorily accomplished. It may be that too many cooks have spoiled the broth, as we might be led to infer from the tone of the correspondence on the subject which has been carried on in the columns of one of our contemporaries by the principal parties concerned. Whoever may be to blame, the ship is for sale, and the question of the Channel passage remains *in statu quo*. It may possibly be solved by means of the projected tunnel; but that cannot be completed for a long time to come, and meantime sufferers are every day crying out for immediate alleviation. Possibly, however, they will not have to cry out long, for there is some evidence that the problem has at last been solved by Mr. Alexander Allan, of Scarborough, the well-known inventor of the straight link-motion.

Mr. Allan takes advantage of the natural tendency of a vessel containing a fluid, when set in motion, to rotate round the fluid, which will keep its proper level so long as no wave is generated in it, as would necessarily be the case with any body of water having a large horizontal surface, Mr. Allan, however, though he deals with a large body of water, by giving it a small exposed surface prevents any independent movement being set up in it. The plan he proposes is shown in the engraving, and consists of a hemispherical dock fitted in the ship, and containing water, in which floats another hemispherical vessel of such a diameter as only to leave a space of some three or four inches between it and the outer vessel or dock. The inner vessel is weighted down to its required water-line by means of ballast, sufficient allowance being made for the extra weight of the passengers whom it is to carry. As the ship pitches and rolls, the water between the floating cabin and the deck always maintains its horizontal level—for there is not surface enough for it to set up an independent roll—and the floating cabin therefore also remains level, being kept by an arrangement of a pillar and universal joint from being projected against the sides of the dock. The entrance to the cabin is by means of a circular staircase, leading from the upper deck to the centre of the floor of the cabin, to which it is fixed. It is evident that there is pratically no limit to the number of things which may be kept steady by this system in a passenger ship, so long as there is room for fitting the hemispherical dock. Thus a single sleeping berth or a platform with a table and seats may be supported in this way. In theory, there is no doubt that there is nothing to prevent this system being perfectly successful. Mr. Allan, however like Mr. Bessemer, was not satisfied with mere theory, but determined to put this idea to a practical test; but whereas Mr. Bessemer's hydraulic apparatus required him to make his expements on a large scale, and then necessitated his confining himself to imitating the roll of a ship with his well-known working model in his own garden at Denmark Hill, Mr. Allan's principle did not cramp him to a similar extent, but allowed him to make his trials with a working model at sea. Considering that the most crucial test of its efficiency would result from experiments with a small model, since the bigger it was the more natural inertia it would possess, and therefore the less tendency to partake of any of the movement of the vessel rolling about it, Mr. Allan constructed a model of which the outer hemisphere was only ten inches in diameter. The difference between this and the inner floating bowl or cabin was one-fourth inch, so that they were separated by a film of water one-eighth inch in thickness. The floating cabin was fitted with a central pillar and universal joint, as before explained, and was also provided with an index-arm pointing vertically upwards when the apparatus was at rest, and so arranged as to show upon a sector attached to the outer bowl angles of inclination of 80° on either side of the vertical. A spirit-level was also placed on the deck of the floating cabin, so that the slightest movement could be detected. A line drawn across the upper part of the arm corresponded with a line drawn on the sector, so that any upward or downward motion of the floating cabin was visible. The model having been prepared, a day suitable for trying it was anxiously awaited—one on which a chopping sea should set into the bay of Scarborough being the desideratum. This arrived at last on the 31st ult. ; it blew a strong northerly gale, which raised so heavy at sea that over 100 yawls and smacks ran into the harbor for shelter, and no steamers went out. By the following day the wind had gone down, leaving a considerable season ; so the model was shipped on board a tug steamer about fifty feet in length, and the first experiment was conducted with it. In steaming out in the wind's eye the seas were met end on, and pitching motion only was imparted to the vessel ; the pitches however, were quick and frequent amounting at times to as many as sixteen per minute. The index-arm showed angles of inclination ranging from 2° to 9°, but the spirit-level proved that the deck of the cabin itself remained horizontal throughout. The apparatus was at first placed upon the quarter-deck, but was afterwards removed to the bridge, and still the same results were obtained. On the bridge, too, there were shocks and vibrations as the single engine passed its centres, and it was expected that an upward and downward motion would have been imparted to the cabin ; but though it was most carefully watched, not the slightest shake, oscillation, or vibration was perceptible. The effect of rolling was then tried, with equally good results, the angles of inclination being greater, ranging up to 15°. Experiments were also tried with the sea on the quarter ; but the angles of inclination were only then from 2° to 2½°. It was then determined to subject the model to a more severe test still, and it was therefore taken out of the tub and put on board a small coble, and the same ground was traversed for an hour. The cabin still behaved perfectly, maintaining its level exactly. Finally, a china cup, two and one-fourth inches in diameter, was filled with water and placed upon the deck of the cabin, when not a drop was spilt, and it was therefore perfectly evident that the cabin did not move one-thirty-second of an inch even out of the horizontal.

The extraordinary success thus obtained leads us to hope that a practical solution has at last been arrived at of the problem of the best means of securing a comfortable passage across the Channel, which so many inventors have cudgelled their brains to find out ; and the simplicity of Mr. Allan's arrangement, and the ease with which it could be fitted to existing vessels, leads us to hope that, before long, we shall be able to start from London on a Continental tour without shuddering as we think of the fatal strip of blue water which has to be traversed before we arrive at our destination.—*American Artisan.*

COTTRELL & BABCOCK'S PERFECTING-PRESS FOR WOODCUT PAINTING—NEW ROTARY ATTACHMENT.

(See page 29.)

Messrs. Cottrell & Babcock are well-known manufacturers of printing-presses. They have lately completed the press illustrated in the engraving, shown on page 29, which comprises a new rotary attachment, patented through the American Artisan machine. The latest form of the Cottrell & Babcock's drum-cylinder press, which embraces the Cottrell improved air-spring and governor, is the foundation of the press. The rotary attachment consists or two cylinders, one for curved stereotyped plates of the matter to be printed, and the other to give the required impression. These cylinders are fed from a suitable feed-board, as shown at the left upper part of the engraving. The cylinders are caused to rotate in the proper relation to each other by the usual gear-wheel attachment, making two revolutions to every one of the drum-cylinder of the main press. The sheet, when printed on one side from a curved stirrup-press, is seized by a supplementary set of grippers on the drum-cylinder, which carry it in perfect register to the flat pair on the bed on the main press. On this form it is printed on the other side, and then piled in the usual manner. The type-cylinder is supplied with ink from a distributing apparatus for three form-rollers, which roll the form twice as it revolves twice before printing. This is considered an excellent feature in itself, as a much more perfect distribution is effected than could be done in a single revolution. There are four vibrating rollers, which break up and distribute the ink thoroughly before it is contributed to the form-rollers. The space on the type-cylinder not occupied by the curved plates serves for an ink-table. The vibrators are raised and dropped at the right times and places by a simple device, which prevents them from ever coming in contact with the stereotype plates. A very simple and reliable mechanical device acts to throw off the impression at every alternate revolution of the impression-cylinder, and by this means perfect harmony in the working of the complete rotary attachment with the drum-cylinder of the main press is secured.

From an excellent article describing this press, published in the *Scientific American*, the following explanations of one of the difficulties attending most perfecting-presses, and the way in which it has been surmounted in the invention, is taken :

"The great difficulty that most perfecting-presses have to contend with is their tendency to set off. This difficulty is thoroughly overcome in the press under consideration by the introduction of slip-sheets, which are fed to the drum-cylinder, the grippers, which carry the slip-sheets, bring so manipulated as to hold each sheet for two impressions before yielding it to the piling apparatus, where it is smoothly and evenly piled for future use.

"These presses being designed particularly for illustrated periodicals of large circulation, the plain forms are printed by the new rotary attachment, and the cut forms on the flat bed of the main press by the drum-cylinder. The superiority of the Cottrell air-spring and governor-attachment over the old coiled wire springs enables a press of the printing magnitude of 42 + 60 inches to keep up a durable speed of over 1,200 impressions per hour. After allowing for the time consumed in making ready forms of long numbers, and the stoppages incident to removing printed paper and supplying fresh piles to the feed-boards, the manufacturers assert that an average of over 10,000 sheets per day, printed on both sides, will pass through the machine. The new patent rotary attachment accomplishes its share of the work independently, and in proper season to pass the half-printed sheet to the drum-cylinder to be perfected without interfering in any way with the time of the main press ; so that we thus have a clear issue of more than 20,000 single impressions per day of ten hours.

"The usual method of making ready this class of illustrated work is by hard packing, the overlays of the cuts being made from certain cardboard well known to the practical cylinder-press printer, and the whole finally covered by a blanket of well-worn billiard-cloth. On the drum-cylinder of the main press, of course, the *modus operandi* in the same as on the ordinary drum-cylinder machine ; while the rotary attachment is supplied with the necessary conveniences for the same class of make-ready."

Messrs. Cottroll & Babcock have their office at No. 8 Spruce Street, New York.

New Tanning Process.—*Le Havre* of the 23rd ult. gives the following account of some interesting experiments which took place at Havre on that date in connection with a new and rapid tanning process :—"A numerous concourse of merchants, brokers, manufacturers, &c., assembled at the Salle Saint Cécile to-day to witness some experiments in unhairing and tanning by the Montoison process. Dr. Limon, of Manchester, superintended the proceedings. A variety of skin of a calf just killed to the old skins of sheep and goats burnt and hardened by the sun of the tropics. There was, of course, some difference in the treatment of each kind, more time being required to unhair the dry hard skin than that fresh from the abattoir. A short time was occupied in preparing the skins for the unhairing chemical by soaking them in hot water. Subsequently they received two coats of a pasty liquid on the inside, and were piled up, inside to inside, to undergo the action of the composition. Many questions were put in relation to the process, the reply to one of these being that the skin could bear the action of the composition for two entire days without being at all injured. After the skins had been soaked for a short time the wool came from them absolutely intact, and quite equal to that shorn from the living animal. The manner in which the wool came away from the skin by a touch of the hand created considerable astonishment. In a few seconds the skins were dipped in two special baths to neutralise the unhairing composition, and the afternoon was devoted to tanning experiments, which proved the invention to be a complete success. Many competent gentlemen did not hesitate in declaring their opinion that the rapidity of the process was little short of marvellous, and that the leather produced under it was to all appearance fully equal to that produced by the tedious methods now employed."

THOMPSON'S APPARATUS FOR EXTINGUISHING FIRES AT SEA. (See page 28.)

FIG. 1.

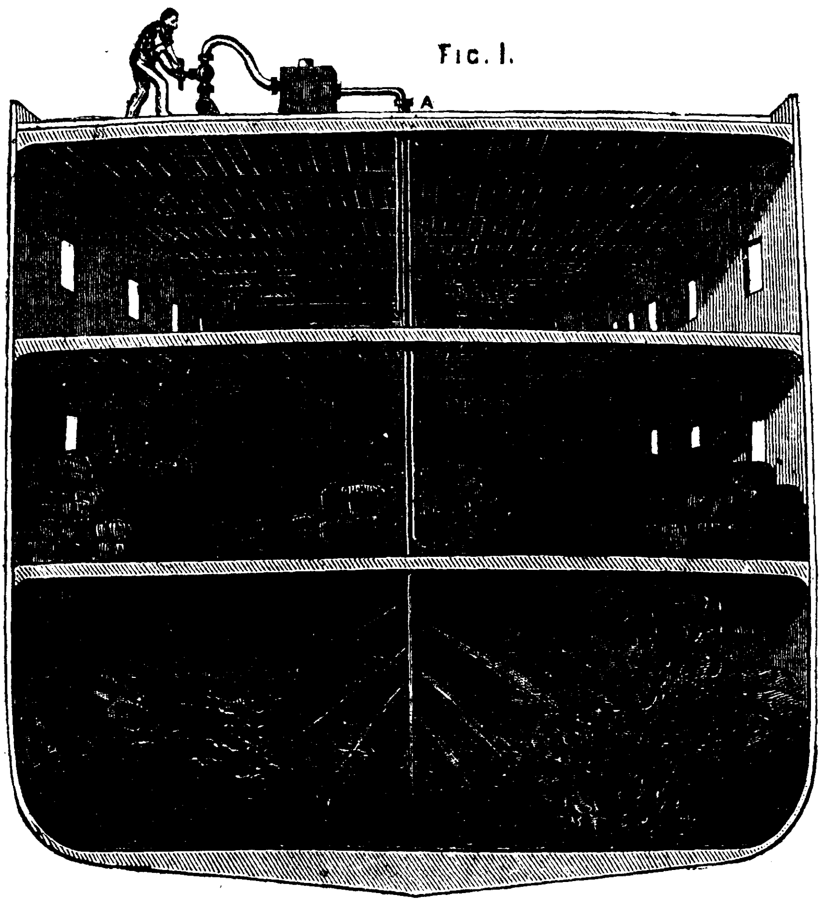


FIG. 2.

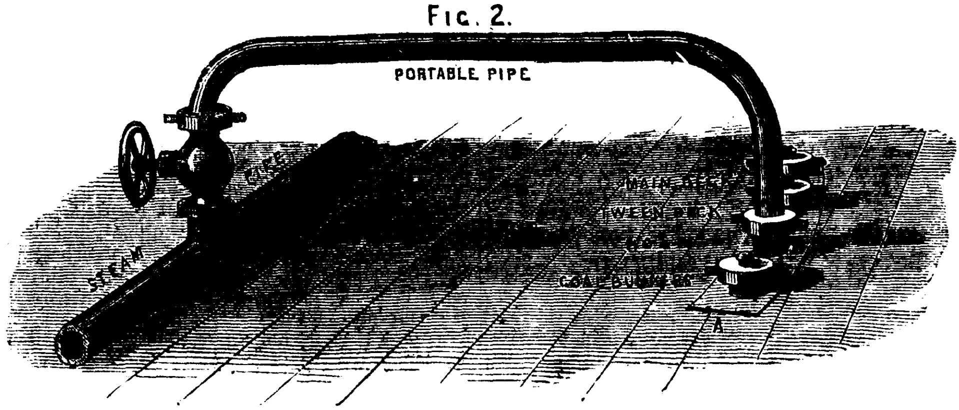
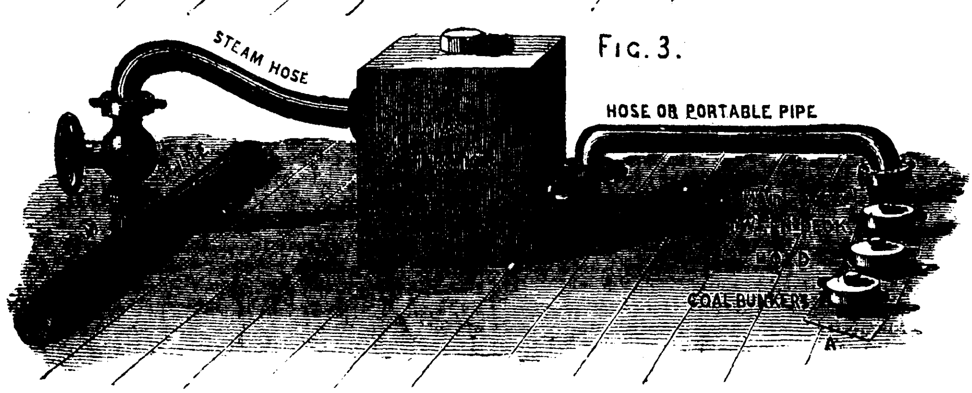
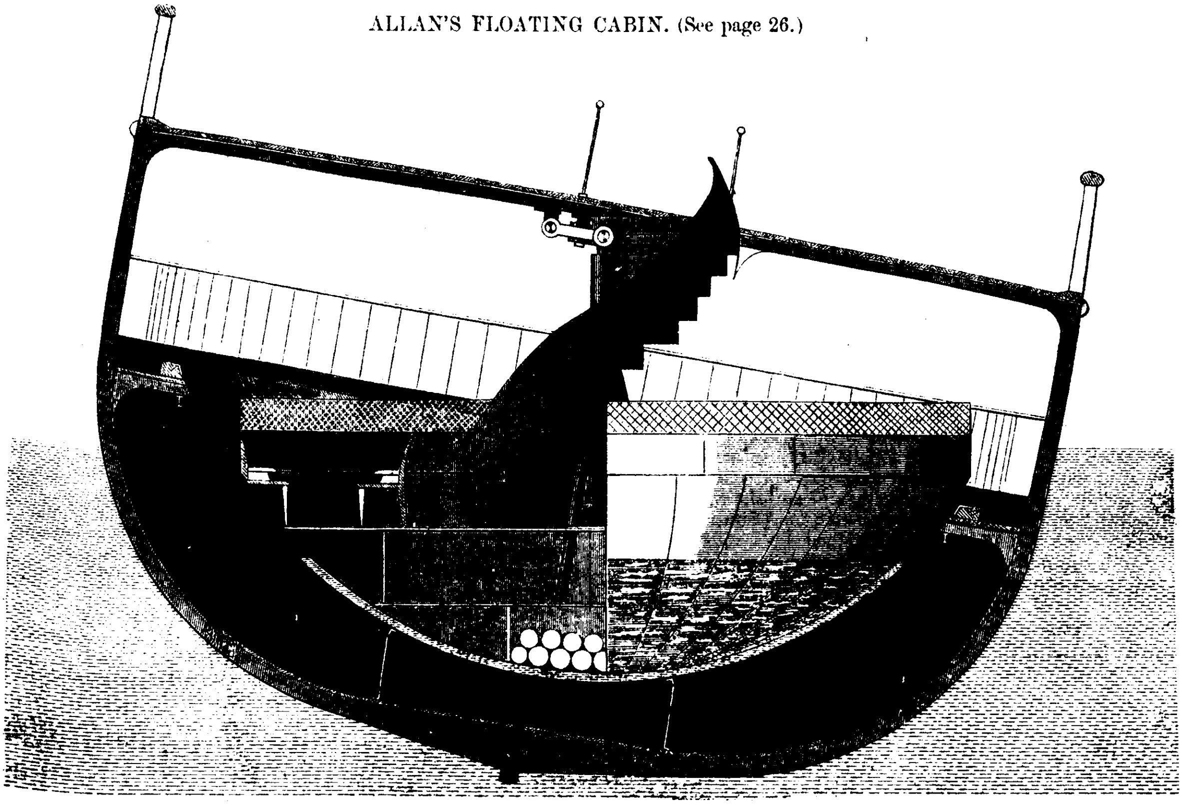
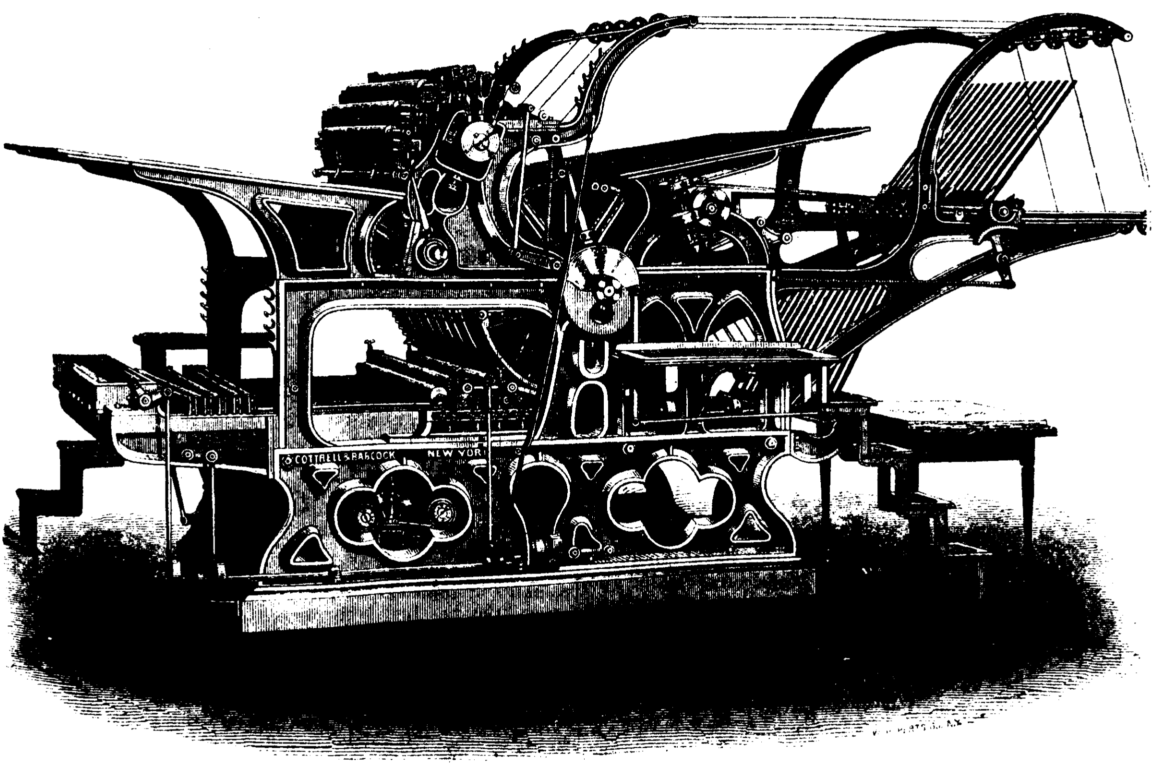


FIG. 3.



ALLAN'S FLOATING CABIN. (See page 26.)





COTTRELL & BABCOCKS PERFECTING PRESS FOR WOODCUT-PRINTING.

THOMPSON'S APPARATUS FOR EXTINGUISHING FIRES AT SEA.

(See page 28.)

Of the many dangers to which travellers on sea are liable, certainly not the least is an outbreak of fire. A calamity, appalling enough on land, becomes doubly so when it occurs in mid-ocean, far away from the possibility of human aid, and with scarcely a chance of escape for life, to say nothing of the protection of property ; and it is not to be wondered at that sailors, who more than landsmen can appreciate the gravity of such a situation, should, from time to time, have turned their attention to devising schemes for diminishing so dread a danger. Thos. Captain W. H. Thompson has patented the arrangement illustrated on page, which is now being brought out by Messrs. Merryweather and Sons, of Long Acre and Lambeth. The apparatus has already been fitted to the Britannic and the Germanic (the former of which Captain Thompson commands), two of the most powerful vessels of the White Star Line, each being of about 5000 tons burthen, and the cost per steamer has been considerably under $1000. No exception can, therefore, be urged on the score of expense. Captain Thompson does not take credit for having originated the idea of using steam or carbonic acid gas as a fire extinguisher ; he claims for combining the two powers, and for the mode of their application, which appears to us to be at once simple, safe, and efficient. This will be readly understood by a reference to the accompanying engravings. Fig. 1 is a sectional view of a vessel having an arrangement for extinguishing fire by means of steam and gas combined. The steam pipe, which may be brought from the principal boilers, or from the boiler driving the winch engine, is joined by a portable connecting pipe to one of a series of vertical steam pipes which lead to the main deck, 'tween deck, hold, or coal bunkers, by means of a quadrant plate, similar to the deck-plate of a Downton's pump. Fig. 2 is an enlarged perspective view showing the steam and portable connecting pipes, which latter may be made of flexible hose or of copper, joined to the quadrant plate A. Fig. 3 is a view of the apparatus having the gas generator fixed between the steam inlet and the portable pipe. This generator, which may be constructed of iron, or of wood lined with pure lead, contains the ingredients for making carbonic acid gas in quantity sufficient, when mixed with steam, to master any fire that may break out. To extinguish any fire by steam only, all that is necessary is to connect the portable pipe to the descent pipe opening into the compartment in which the fire occurs, and open the steam cock, but when carbonic acid is to be an extinguishing agent as well as steam, the gas is released by merely unscrewing a nut on the generator, the steam is turned on, and the combined gas and steam pass on to the seat of danger. If preferred, carbonic acid gas can be used without the aid of steam. He is also prepared to fit up vessels with a fire detector somewhat similar to the electric alarms now so generally used in large private establishments. The wires will communicate with a dial in the captain's cabin, and not only will the fact of fire be indicated, but also the actual compartment in which it occurs. The captain can, with scarcely any aid, extinguish the flame, and this can be done so noiselessly that during the night no alarm need be created and the passengers may remain unaware of the danger which has been averted. These combined arrangements will, it is believed, reduce the possibility of a fire on board ship obtaining the least hold to a minimum, and their simplicity leaves but little chance of their getting out of order. There are no valves to become leaky or to be opened by mistake, neither can there be condensation in the pipes or other objectionable features. Shipowners and others interested can see the apparatus on board the *Britannic* or the *Germanic*, when either steamer is lying off Liverpool.—*From Engineering.*

POWDER FOR HEAVY GUNS.

The guns on the British iron-clad Devastation are of thirty-five tons, the largest afloat. They carry a projectile weighing 700 pounds ; but it has been found that every time they are fired they score the iron decks of the ship. This at first could not be accounted for, but it is now found to be caused by the grains of powder that have not had time to be consumed within the guns. To remedy this, the guns are to be lenghtened ; for to move so heavy a weight as the shot they throw, a slow-burning powder is essential. The grains of the powder hitherto used have been about the size of ordinary marbles. It is now proposed to increase their size to about the bulk of good-sized walnuts, and at the same time plans are being taken at the royal gun factories to construct guns of sixty tons, with the prospect of going on shortly to seventy-five tons.

QUERIES.

[1006]—Can any of your readers inform me the best way to take mildew out of linen ?—Young House Keeper.

[1007]—I am fond of keeping fowls but often lose some of them from then crops becoming as it were too full for digestion. Perhaps some will kindly inform me the cause of this—what is the best food to fatten fowls in winter, and also to make them lay ?

ANSWERS TO QUERIES.

[1001]—Printing on Canvas for Oil Painting.—Take glue and let it soak in rain water ; then boil it in a pipkin till it is quite dissolved, and of a moderate thickness for a good size. With this, after you have strained your cloth or canvas on a frame, and rubbed it smooth with a sleek stone, size it over. If you add a little honey to your size it will keep it from cracking. When your first priming is dry, whiten it over with whiting and size ; and last of all, when thoroughly dry, paint it all over with a grayish colour of white lead and a little black, ground with linseed oil, and laid on the cloth smooth and even. This being dry, you may then begin the design you intend to paint.—J. M. H.

[1004]—Headache.—Your headache arises from neuralgia, with slight derangement of the stomach, brought on, no doubt, from irregularity in your time for taking food, which avoid. When the symptoms show themselves (which you can tell by the peculiar irritation and tightness of the skin of the face) bathe the hands and face with very hot water—the hotter the better ; steep a sponge in the same, squeeze dry, and place on the back of the neck, or on the part where the pain is most severe ; take a small quantity of very hot brandy-and-water, and lie down in a darkened room, with the eyes covered. Also remember the following : =Avoid pressure on the throat at all times ; live substantially, but plainly, and not too much stimulant ; plenty of exercise in the open air ; and, above all, practise self-control, and do not suffer yourself to get excited, but learn to take things quietly. The writer will vouch for the above being efficacious in nearly every case in which it has been adopted. Should the pain not yield to the remedy, be assured the stomach in the offending member.—A Sufferer.

[1005]—By using a soft sponge on the accessible portion of the glass, and keeping a number of the common water-snails in the aquarium, the conferor will be kept down. The snails can be easily procured, even in winter, in any moss-lined springs by means of a scoop net. Gold fish also consume large quantities of the floating cells. When coral or other irregular minerals become encrusted a very diluted mixture of sulphuric acid and water destroys the deposit. A weak solution of ammonia neutralizes the acid and careful washing afterwards prevents any injurious effect on the fish.—John N. Miller.

Belting *vs.* Gearing.—The largest leather belt ever made in England has just been supplied to a large cotton spinning mill in Bolton, by W. J. Edwards, 20, Market-place, Manchester. The belt is one of Messrs. Sampson and Co.'s patent, manufactured from the best English leather, and is 38 in. wide and 90 ft. long, double (or two thickness), without a single cross-joint from end to end, and of even thickness throughout. The belt is for driving direct from the flywheel of engine, and to transmit 350 horse power indicated. The same firm have also two double belts of the same make, each 29 in. wide, driving direct from the fly-wheel of engine. The driving pulley is 28 ft. in diameter, and 5 ft. on the face, crowned or turned up for the two belts, and the belts travel through 4500 ft. per minute, transmitting 600 horse power indicated. It is claimed for this belting that it is especially adapted for main driving, and has the advantage of running perfectly straight. A prize medal for their specialities has just been awarded by the Society for the Promotion of Scientific Industry, Cheetham Hill Exhibition (this is the sixth medal awarded at various exhibitions). This system of driving direct from flywheel is becoming more general in this country every day. The patentees have lately fitted up a large spinning mill where they are transmitting 2000 indicated horse power through this class of belting.

Why is glass (which is transparent,) rendered opaque by being ground or pulverised ?—Because the whole substance, from surface to surface, is no longer of one uniform density.

DOMESTIC.

MODES OF COOKING COLD BUTCHER'S MEAT.

MINCED BEEF.—Cut into small dice remains of cold beef; and gravy reserved from it on the first day of its being served should be put in the stewpan with the addition of warm water, some mace, sliced eschalot, salt, and black pepper. Let the whole simmer gently for an hour. A few minutes before it is served, take out the meat and dish it; add to the gravy some walnut catsup, and a little lemon juice or walnut pickle. Boil up the gravy once more, and, when hot, pour it over the meat. Serve it with bread sippets.

"COLD ROAST BEEF (WITH MASHED POTATOES.)—Mash some potatoes with hot milk, the yolk of an egg, some butter and salt. Slice the cold beef and lay it at the bottom of a pie dish, adding to it some sliced eschalot, pepper, salt, and a little beef gravy; cover the whole with a thick paste of potatoes, making the crust to rise in the centre above the edges of the dish. Score the potatoe crust with the point of a knife in squares of equal sizes. Put the dish before a fire in a Dutch oven, and brown it on all sides; by the time it is coloured, the meat and potatoes will be sufficiently done.

BUBBLE AND SQUEAK.—Cut into pieces, convenient for frying, cold roast or boiled beef; pepper, salt, and fry them; when done, lay them on a hot drainer, and while the meat is draining from the fat use in frying them, have in readiness a cabbage already boiled in two waters; chop it small, and put it in the frying-pan with some butter, add a little pepper and salt, and keep stirring it, that all of it may be equally done. When taken from the fire, sprinkle over the cabbage a very little vinegar, only enough to give it a slight acid taste. Place the cabbage in the centre of the dish, and arrange the slices of meat neatly around it.

LOBSCOUS.—Mince, not too finely, some cold roast beef or mutton. Chop the bones, and put them in a saucepan with six potatoes peeled and sliced, one onion, also sliced, some pepper and salt; of these make a gravy. When the potatoes are completely incorporated with the gravy, take out the bones, and put in the meat; stew the whole together for an hour before it is to be saved.

COLD FEET.—A great deal of the ill health of women is now attributed to the kind of shoes generally worn. Dr. Smith, in his Treatise on Health, says:

There is neither health nor comfort in cold feet, as too many women know only too well. They are the fertile parents of no end of discomfort and ill health. The avoidance, then, of cold feet is one of the most direct steps to the improvement of the health. For such end to be attained, the shoes must be fairly substantial and not of too soft and porous leather. Women's boots and shoes are largely made of leather tanned with terra Japonica, which is far inferior to leather tanned with bark, especially as regards the absorption of moisture. Such leather forms the soles of all cheap boots, to which class women's boots so exclusively belong. When, then, such boots are placed on a wet flagstone, or on damp roads, the leather becomes moist and then the feet become cold at once. Leather when dry is a very bad conductor of heat, and so a stocking and a leather shoe are sufficient protection for the feet in climates so cold that furs are requisite for the clothing; when wet, however, heat is quickly conducted off, and so the damp leads directly to cold feet. Any one who has lived much in the saddle knows the difference felt by the wet foot and the dry foot in reference to the iron stirrup in cold weather; when the boot is dry the stirrup is not felt, that is, as regards the sensation of heat and cold, but let the foot be put where the foot becomes moist, and then the stirrup is felt quickly and distinctly enough. For delicate women who are very susceptible to cold feet, the boots should be stout and large enough to admit of a cork sole. More particularly is such precaution necessary where there is a clay soil; this remains damp for days after rain has ceased, and strikes cold to the feet when looking temptingly dry, consequently stout boots are absolutely necessary on such soils.

A GOOD SOUP.—When soup is used as the principal dish at dinner, instead of a first course it should be rich in vegetables and made thick. Put the bone on to cook in cold water, adding salt. Let it simmer an hour or two, then boil gently two hours. One hour before serving put into the kettle cabbage and onions sliced thin. In about half an hour add sliced potatoes, pearl barley or rice, and a handful of vermicelli. Many like the taste of parsley. Add pepper if you like. Do not throw away the bones after dinner. They will make an equally good soup the second and even a third time if cracked.

WHY are dry paper and calico (which are opaque) made transparent by being oiled?—Because the pores are filled by the oil which has nearly the same density as the substance itself—by which means a uniform density is effected, and the substance becomes transparent.

USEFUL RECEIPTS.

TO IMPROVE GILDING.—Alum and common salt of each 1 oz., purified nitre 2 oz., water ½ pint. This much improves the colour of gilt articles, it being laid over them with a brush.

ECONOMICAL HAIR WASH.—Take one ounce of borax, half an ounce of camphor, powder these ingredients fine, and dissolve them in one quart of boiling water; when cool the solution will be ready for use; damp the hair frequently. This wash not only effectually cleanses and beautifies, but strengthens the hair, preserves the colour, and prevents early baldness. The camphor will form into lumps, but the water will be sufficiently impregnated.

A CURE FOR BLISTERED FEET.—Rub the feet, at going to bed, with spirits mixed with tallow, dropped from a lighted candle into the palm of the hand. On the following morning no blisters will exist.

TO REMOVE STAINS AND MARKS FROM BOOKS.—A solution of oxalic acid, citric acid, or tartaric acid, is attended with the least risk, and may be applied upon the paper and prints without fear of damage. These acids taking out writing-ink, and not touching the printing, can be used for restoring books where the margins have been written upon, without attacking the text.

TREASURES.

THAT is the best part of beauty which a picture cannot express.

BEAUTY is as summer fruits, which are easy to corrupt and cannot last.—*Lord Bacon.*

THE vapour of discontent is always most dangerous when it is confined.

THE evils of the world will continue until philosophers become kings, or kings become philosophers.

THERE is none so innocent as not to be evil spoken of; none so wicked as to merit all condemnation.—*Warwicke.*

THE mind has more room in it than most people think, if you would but furnish the apartments.—*Grey's Letters.*

GOODNESS OF HEART is man's best treasure, his brightest honour, and noblest acquisition. It is that ray of the Divinity which dignifies humanity.

THE harsh hard world neither sees, nor tries to see, men's hearts; but wherever there is the opportunity of evil, supposes that evil exists.

THERE is this difference between happiness and wisdom: he that thinks himself the happiest man, *really is so;* but he that thinks himself the wisest, is generally *just the reverse.*

LOVE one human being purely, and you will love all. The heart in this heaven, like the wandering sun, sees nothing, from the dew-drop to the ocean, but a mirror which it warms and fills.

MAN doubles all the evils of his fate by pondering over them; a scratch becomes a wound, a slight an injury, a jest an insult, a small peril a great danger, and a light sickness often ends in death by brooding apprehensions.

PEOPLE who endeavour to attract that attention by dress which they cannot obtain by their intrinsic worth, resemble the soap balloons blown by children; the thinnest bubbles are invested with the brightest colours.

THE aperture of the ear is very narrow; when, therefore, two people talk at the same time, it is like a pair of vehicles pushing on to get through a narrow lane, but constantly jarring against each other.

WHEN I see leaves drop from their trees in the beginning of autumn, just such, think I, is the friendship of the world. Whilst the sap of maintenance lasts, my friends swarm in abundance; but in the winter of my need they leave me naked.

THE weakest living creature, by concentrating his powers on a single object, can accomplish something; the strongest, by dispersing his over many, may fail to accomplish any thing. The drop by continued falling bores its passage through the hardest rock—the hasty torrent rushes over it with hideous uproar, and leaves no trace behind.

IMPROVED EMERY GRINDING MACHINE. (See page 22.)