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FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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WORK WORLD.

SHEFFIELD ivory-cutters have plenty of work, there being a good demand for table-knife handles, chiefly of the commoner varieties. Ivory still maintains its high prices, choice cut pieces ranging from 32s. to 60s. per pound.

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One of the largest colliery wire ropes made in Sunderland has just been sent from Messrs. Glaholm & Robsen's. It is six miles in length, and weighs twenty-four tons. It required two heavy waggons and twenty horses to transport it from the works to the railway station.

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An uncommon way of using enamel in jewellery—viz., where it is quite transparent, or *à jour*, as it is called—is now to be well seen in a pearl, diamond, and enamel bracelet, which forms part of Mrs. H. Bolckow's bequest in the South Court of the South Kensington Museum.

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Machine-cut files are being turned out in Sheffield in great perfection, the process being to machine-cut them first, and then cross-cut them by hand. There would be no objection to this provided the goods were sold as partly machine and partly hand-cut, but complaints are abroad that the machine-cut files are sold as hand-cut.

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In connection with the Leather Trades Exhibition, to be held at the Agricultural Hall, Islington, N., from the 4th till the 18th of April next, the committee have decided to hold a series of competitions for students and craftsmen in various branches of the boot trade. Twelve silver medals will be given as first prizes, and for the second best in each class a certificate will be awarded.

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The dock deliveries of timber for London still show a considerable decrease, owing mainly to the late strikes. The returns up to the present show a decrease of 1,887 standards under the delivery for the same period last year. The demand for all kinds of timber is just now very limited, and the stagnation is pervading every department of the trade. Some prime parcels of Tabasco and Cuba mahogany were sold recently, and realised good prices, one log, containing 175 ft. sup., fetching as much as 1s. 9½d. per foot.

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There is little change to notice in the heavy iron trades of Sheffield. Prices remain unaltered, and there is not much prospect of improvement, excepting special lines, such as railway material. The slight improvement noticeable in the cutlery trades has just continued, and matters are moving more freely, so far as the home markets are concerned. In the departments and markets where trade was moderately good last year there is a large falling-off, not only in common goods, but also in the more expensive class of merchandise.

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Fashion is as paramount in furnishing and decorating as with ladies' costume, of which fact the new season's designs in grounded paperhangings give irrefutable testimony. Stripes—in half-satin and talc effects of plain colours and self-tones—we have in plenty with which to satisfy the present craving for drawing-rooms in "the French style." In best bedroom lines, and for morning rooms, etc., there is a surfeit of charming semi-natural floral designs, all very full and harmonious in colour, although approaching too dangerously near imitations of nature to be satisfactory as designs for wall-coverings. Imitation tapestry papers are also in strong demand, chiefly for dining-rooms, for which they are very suitable, if selected with judgment and hung with skill.

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The dinner of the Birmingham Jewellers' and Silversmiths' Association, which was postponed from last month on account of the death of the Duke of Clarence, is to be held to-day at the Great Western Hotel, Birmingham, with Mr. Chamberlain in the chair as usual. Have those people anything to announce this year? They have had something to say on three occasions. First, there was a lecture on jewellers' art by Mr. Chamberlain, with comparisons and illustrations drawn from Egypt. Another year he announced the starting of a jewellers' technical school at Birmingham; and last year that they had so moved the authorities at the City and Guilds Institute here in London as to get the subject of goldsmiths' work officially recognised, thus showing London the way. But is this creditable to London? Goldsmiths' Company—wake up!

To facilitate the transportation of exhibits for the Chicago Exhibition, arrangements have been made with five hundred railways and steamship lines. The British railways have undertaken to carry goods for English exhibitors to and from the port of shipment at half rates. The American railways will charge the usual rates to Chicago, but will bring back the goods free. Many of the steamship companies have reduced their tariffs to 11s. per ton, and have consented to adopt a reduced passenger tariff for exhibitors and their employees.

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The Midland Counties Trades and Industrial Exhibition will be held at Bingley Hall, Birmingham, from April 11 to May 14. It will embrace twenty sections, including Engineering and Machinery, Mining and Metallurgy, recent inventions of all descriptions, Decoration, Furniture, Gas and Electricity, Domestic Appliances, etc. Sections 19 and 20, for which free space will be allotted and medals and certificates awarded, are set aside specially for the artisan classes. No. 19, Women's Industries, will include Carving, Ceramics, Domestic Furniture Designs, Artificial Flowers, Painting, etc. No. 20, Artisans' Industries, will embrace Models, Designs, Fretwork, Inventions, Specimens of Handiwork, etc.

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In Halifax the engineers' tool trade is still depressed. Many of the shops are working short of usual hands, while others are dividing the work into week "shifts." No large contracts are on hand, except, perhaps, one or two local contracts for pipes in the foundries. The prospects of the small and thick wire-drawing trade show improvement. Coating weaving and worsted spinning are also depressed; while Brussels carpet weaving remains firm, and tapestry shows slight improvement. Card-making, depending on the textile trades, remains moderate, as is also the leather-belting industry. There is a strike in the brush trade, which, combined with the present high price of materials, is likely to make difficulties with the masters. The Halifax County Council have received powers from the Board of Trade to construct electric-lighting stations and supply current through the principal thoroughfares. This will, no doubt, brighten the prospects of trade in the electric engineering departments.

INDUCTION COILS: HOW TO MAKE AND WORK THEM.

BY G. E. BONNEY.

Introduction—Definition of Induction—Professor Oersted's Discovery—Professor Faraday's Experiments—Uses of Induction Coils—Batteries for Induction Coils—Voltaic Battery—Chromic Acid Battery—Batteries for Medical Coils, etc.

Introduction.—On seeing the title of this series of papers, the reader may be inclined to ask—What is induction? and what are induction coils? The word "induce" comes to us from the Latin, and means to influence, to persuade, to impel, to allure. Induction, then, is the act of inducting—that is, influencing, persuading, impelling, or alluring. An induction coil is, therefore, a coil employed for inducting purposes. By general consent the term is confined to a coil of wire employed in inducing electricity.

How does a coil of wire induce electricity? It will be my business to show, in the following series of papers, how this is done. But before I set about describing a coil and its mode of action, it will be instructive to briefly trace the history of the discovery which led up to the invention of the induction coil and its numerous congeners.

Whilst Professor Oersted, a Danish philosopher, and Secretary to the Royal Society of Copenhagen, was filling the office of Doctor of Philosophy to the University of that city, he made a most important discovery, which, when published, attracted the attention of philosophers in all parts of the world. He found that when a magnetic needle was brought near to a wire conveying an electric current, the needle appeared to be influenced by the current, for it immediately deviated from its usual position of lying with its ends pointing to north and south, and placed itself across the path of the current. It was rendered clear by repeated experiments, that the electric current exerted an inductive influence on the needle, causing it to swerve aside from its usual line of magnetic attraction. This discovery received close attention from French scientists, who found in their experiments, that the electric current in a conducting wire not only exerted an influence on a magnetic needle, but also affected the current passing in another wire laid parallel to it—in fact, the current in both wires influenced each other. M. Ampère made the discovery that two conducting wires laid parallel to each other, exerted a mutual attraction whilst the currents passing in both were in the same direction, but when the currents were passing in opposite directions the wires exerted a mutual repulsion.

In 1831 Professor Faraday wound a long copper wire around a wooden cylinder, with the coils at a slight distance from each other. In the spaces between these coils he wound another copper wire, carefully insulated from the other. He connected the two ends of this second coil to a galvanometer, and the two ends of the first coil to a powerful battery. On the instant, when closing the circuit of the first coil, a current was induced in the second coil, and its presence demonstrated by a deflection of the galvanometer needle. A similar deflection was caused at the instant when the wires of the first coil were disconnected. By winding a coil of wire around some steel needles and connecting this to the second coil, the needles became magnetised by making and breaking contact with the first coil and the battery. This proved that the current passing in the first wire possessed the power of inducing a current in the second wire wound on the cylinder parallel to the first, but separated from it by an insulating substance.

Out of these most important discoveries in electrical science, have grown the splendid achievements in the application of this science enjoyed by all the world at the present day. Induction coils play a most important part in nearly all electrical instruments and machines. The discovery of Professor Oersted led to the invention of the single needle telegraph instrument, the galvanometer, and some forms of ammeters. The discovery of Professor Faraday, and his subsequent researches and experiments in the same direction (some of which were published in 1837), led to the invention of electric bells, the Morse telegraph instrument, electric relays, electro-motors, dynamo-electric machines, electric transformers, and many more electric instruments, in all of which induction coils are employed. The tiny electro-magnets employed in telegraph instruments, and the monster coils on the largest electric light dynamos, are all induction coils, depending for their efficiency on the inductive influence of electric currents circulating in coils of wire.

Were I to deal with all of these in the present series of papers, I should monopolise entirely quite two volumes of WORK, and it would then become solely an electrical journal. As, in Vol. I., under the heading of "Burglar Alarms," I have shown how electric bells are made, and in Vol. II., under the heading of "Model Electric Lights," I have shown how dynamos are made and used, I propose in the following papers to deal only with one or two other forms of induction coils, paying special attention to those little coils made and used for purposes of amusement and recreation.

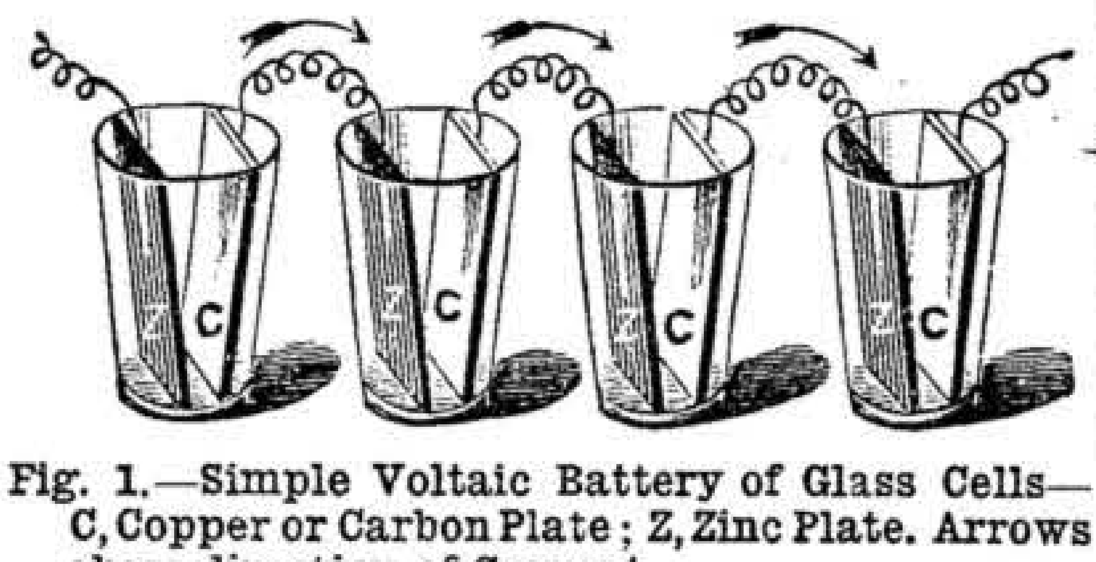


Fig. 1.—Simple Voltaic Battery of Glass Cells—C, Copper or Carbon Plate; Z, Zinc Plate. Arrows show direction of Current.

Batteries for Induction Coils.—Before we can obtain an induced current of electricity, we must have some means at hand of generating a primary current. The generator may be a dynamo-electric machine, a magneto-electric machine, or a battery of voltaic cells. It matters very little what kind of generator we employ, but we must have one.

A Voltaic Battery.—A battery of voltaic cells is the generator usually employed with induction coils for purposes of amusement. Voltaic cells are those in which zinc is oxidised or consumed to furnish a current of electricity. They are sometimes named galvanic cells, and a number of them connected together form a galvanic battery. One cell alone may contain a galvanic pair or a voltaic pair, but cannot be said to form a galvanic or a voltaic battery. We need more than one cell to form a battery. The most simple voltaic battery is one made up of two or more glass tumblers for cells, each of which contains a strip of sheet zinc and a strip of sheet copper, immersed in water made acid by adding to it a few drops of oil of vitriol or of common vinegar. The electric current from a battery of this kind will be very feeble and inconstant, but will serve the purpose of furnishing current for first experiments. A copper wire must be soldered to each zinc plate and each copper plate. The cells must be connected in a row by twisting the wire from a zinc plate in one cell to the wire from the copper plate in the next cell, as shown in Fig. 1. When connected thus, the cells are said to be connected in series. By adding cell to cell in this way, we increase the pushing power of the battery—that is, the power to push its current through a high resistance. This rule holds good in all batteries, and is therefore given here to act as a guide when it is desired to increase the pushing power of a battery.

This small battery may be used for first experiments, such as those mentioned further on, but would be useless in working a real induction coil. For this purpose we must have a constant battery, giving a strong volume of current. The shocking coils met with in the streets, at fairs, and sometimes at bazaars, are usually worked by a Bunsen battery, this being the strongest and most constant battery. As the nitrous fumes exhaled by this battery (easily detected by their odour) are noxious and injurious, the use of it is inadmissible in a room. We therefore dispense with it in favour of the chromic acid battery.

A Chromic Acid Battery.—This battery may be as easily made as the simple voltaic battery just described. We may even employ the same cells, for glass cells are preferable to those of any other material. For a small coil, say 3 in. in length by 2 in. in diameter, glass tumblers will be large enough, but glass jars with an incurved top, or the wide-mouthed vessels known as pomade jars, are preferable, because the acid liquid is not so readily spilt from these as it would be from glass tumblers. The pint size is also preferable to the half-pint size, if required for long experiments, as the charge in a large cell lasts in working order for a longer period than that in small cells. The plates required in a chromic acid battery are made of zinc and carbon—that is to say, there is one plate of zinc and an opposite plate of carbon in each cell. The zinc plate may be of any thickness from $\frac{1}{8}$ in. to $\frac{1}{4}$ in., but it is not advisable to employ thin plates, because these soon get cut through by the action of the charging acid mixture. The width and length must be regulated by the diameter and height of the cell. It should be slightly longer than the depth of the cell and slightly narrower than its width. Each zinc plate must be coated with mercury—that is, amalgamated before it can be used; and it will need to be frequently cleaned and re-amalgamated to prevent waste of zinc and ensure full power from the battery. Connection may be made by means of a stout copper wire soldered to the upper edge of the plate before it is amalgamated, or by means of a brass clip sold for the purpose, and named a binding-screw. The last method is preferable, because, when thus connected, we can turn the plate when the lower end is worn, and thus use up the last scrap of zinc, and can also keep the connection clear. The carbon plate may be cut from gas retort carbon, or it may be bought from dealers in electrical instruments, cut to any required size. It should not be less than $\frac{1}{4}$ in. in thickness, and should have a surface area slightly in excess of that of the zinc plate. The highest efficiency is secured when the zinc plate is suspended in the cell between two carbon plates, one on each side, as then both sides of the zinc wear away equally, and the larger surface of carbon secures more constancy in the current, together with a lower internal resistance of the cell. A very handy arrangement of the plates, easily made by amateurs, is here directed. Procure plates of zinc and carbon of a size suitable to the cells about to be used. Get two pieces of hard wood, ½ in. in thickness, ¾ in. in width, and long enough for the two ends to rest on the edges of the battery cell; cut a recess in each piece of wood to fit the zinc plate on each side when the plate is clipped between them; then give each piece three coats of varnish, or soak them well in melted paraffin. The two strips of wood are then to be placed on each side of the zinc plate, with ½ in. of its top above the wood, and the two pieces fastened together with brass screws at the ends. A binding-screw on the zinc will hold it up and serve as a terminal, and a wide-jawed brass clamp will secure the two carbon plates on each side of the wood.* When the battery is not in use, these clamps can be loosened, and all the plates put into water, to cleanse them from traces of the solution.

Solution for Chromic Acid Battery.—The mixture for charging the cells of this battery is made up of 3 ozs. of chromic acid dissolved in one pint of water, to which must be added 3 fluid ozs. of sulphuric acid. The mixture must be allowed to cool before placing it in the battery cell. If chromic acid cannot be obtained, a similar mixture with bichromate of potash may be employed, but chromic acid is preferable to bichromate of potash.

Bichromate of Potash Battery.—The bottle form of bichromate of potash battery may also be employed in working an induction coil, or any one of the box batteries described in No. 89, Vol. II., of WORK, in the series of papers on "Model Electric Lights."

Bunsen and Grove Batteries.—The best effects from spark induction coils are obtained from them when worked with current from a battery of Bunsen cells or of Grove cells. Persons who have these cells and object to the nitrous fumes given off by the nitric acid in the porous cell, may substitute for this a solution of chromic acid, using the same cells and the same elements.

Batteries for Medical Coils.—Almost every generator of electricity known, and almost every form of battery invented, has been and is used to work these coils. The simple voltaic arrangement of copper and zinc plates immersed in dilute sulphuric acid, held in glasses, as shown at Fig. 1; Dr. Wollaston's improvement of zinc plates enclosed in a loop of sheet copper; Smee's battery, with platinised silver plates opposed to zinc; Walker's battery of carbon plates opposed to zinc; and many other single fluid cells worked with dilute acid, have all been used for the purpose. Some inventive minds have launched out into modifications of these batteries, and have called the modified batteries by their own names. Similar modifications have been made, and named from batteries in which carbon, surrounded with peroxide of manganese, forms the negative element, and zinc, in a solution of sal-ammoniac, forms the positive element, as seen in the well-known Leclanché battery. The sulphate of mercury series of batteries, such as the Marie Davy and Latimer Clark cells, and also the chloride of silver series, represented by the Gaiffe, Warren de la Rue, Skrivanow, and Schanchieff cells, have all had attention from the modifiers of batteries for medical coils. In all these inventions, portability and freedom from messy liquids and noxious vapours has been the chief aim. The closely-sealed forms of batteries have therefore been in most favour. For pocket coils (those ingenious little instruments for giving unpleasant electric shocks to unwary and meddlesome outsiders) a compact and non-messy form of battery became a necessity; hence these have been generally operated by some modification of the silver chloride series of batteries. These have the disadvantage of soon running down, so to speak, and ceasing to give current after a short period of activity.

Lithanode Battery.—Perhaps the best battery for these coils is the sealed lithanode battery, manufactured by Messrs. Cathcart, Peto, & Radford, the electrical engineers, for lighting portable electric lamps. These cells are made small enough to go into the inside pocket of a coat, and are curved to fit the body. As the electro-motive force of each pair of elements is 2·3 volts, and the cells are only of pocket-book weight, a most powerful battery can be easily carried without inconvenience. When once charged, they remain in this condition ready for action during a period of several months; they yield a large quantity of current, and when exhausted can be easily re-charged, as accumulators are charged, by sending a strong current through them from another battery or from a dynamo machine.

The E. S. dry battery, the Gassner, and other so-called dry cells, may also be employed in working small medical coils. These have the advantage over ordinary cells in that they are unbreakable, and contain no liquid to be spilled by overturning the cells.

* Illustrated in WORK, p. 36, Vol. III.

MICRO-PHOTOGRAPHY WORK.

BY ARTHUR RENAUD (B.A. OXON.).

PHOTOGRAPHY, as an accessory to scientific research, is making daily advances, and a knowledge of its principles is becoming more and more necessary to the student. Whether one is a devotee of the telescope or the microscope, or even the chemical laboratory, one finds the process of delineating the objects under one's notice which photography gives us of immense value in prosecuting one's studies. And photography is quite capable of doing all that we want done in that way if we first master the principles of the art. As Dr. Emerson, the Naturalistic Photographer, says, in a description which certainly does not fail in its object for want of elaborateness of expression:—"Not content with her vast triumphs over the infinitely great, she dives down to the infinitely small, and stores up for us portraits of the disease-bearing generation of *Schizomycetes*, the stiff-necked *bacteria* and the wriggling *vibrio*, the rolling *micrococcus* and the fungoid *actinomycosis*, with deadly tresses: these she pictures for us, so that we may keep them on small plates, or else she throws them on screens, so that we are able to study their structure. On those screens, too, we can gaze on the structure of the Proteus-like white blood-corpuscle, and we are able to study the very cells of our tongues, our eyes, our bones, our teeth, our

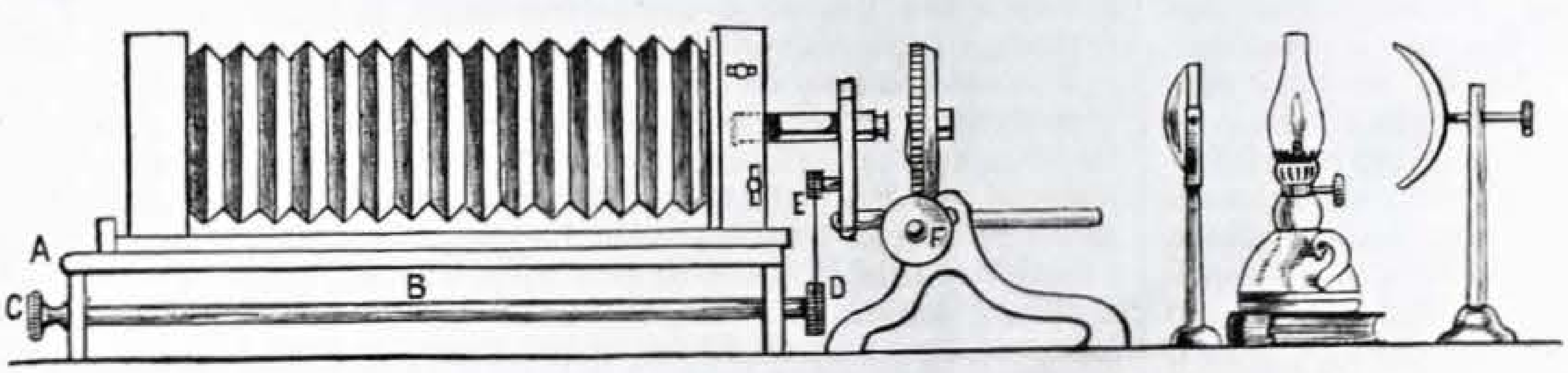


Fig. 2.—A Convenient Arrangement for Fine Adjustment—A, Stand for Camera; B, Connecting-Rod turned by Milled Head, C; D, Pulley connected with Fine Adjustment, E; F, Screw for roughly focussing Object.

Fig. 1.—Method of arranging Camera and Microscope for Work by Lamplight—A, Microscope, the Tube of which is inserted in the Front of the Camera, C, and the Joint rendered Light-tight by means of the Velvet, B; D Lamp, the Light from which is reflected from the Concave Mirror, F, and concentrated on the Object by the Bull's-eye Condenser, E. The Object is placed at G.

hairs, and to keep drawings of them such as man never had before. So the kindly goddess stints us in nothing, for wherever the microscope leads she is at our bidding. With the greatness of an all-seeing mind, it matters not to her whether she draws the *protococcus* or the blood-cells of an elephant, whether she depicts the eroding cancer-cell or the golden scale on the butterfly's wing. Anything that we ask of her she does, if we will but be patient."—("Naturalistic Photography," p. 2.)

This is flowing language, and goes to prove that the writer, however extraordinary his views on the focus question may be regarded by some people, is at any rate an enthusiastic admirer of his art. We are only concerned, at present, with the latter part of his eulogium—viz., the making of photographs of microscopic objects, chiefly with a view to turning them into lantern slides. It is frequently thought to be a very complicated subject, and so many books have been written descriptive of the process, which have represented it as carried out by means of such elaborate apparatus, and made use of such voluminous scientific terms, that the mind of the average amateur has been appalled at the thought. As a matter of fact, it is an extremely simple affair, and though (as in most other pursuits) you *can* have expensive and elaborate apparatus if you like, it does not follow that you will get any better results therewith. In these papers it will be my aim to give directions for accomplishing the feat in a plain and straightforward manner, and by means of very simple apparatus which most amateurs will have already, or at any rate will be able easily to make for themselves.

First of all, as to the microscope. This must, of course, be a good instrument, if the results are to be good; unless the definition is very good the negative does not stand much chance of being sharp, and then where will the definition be when it comes to be made into a lantern slide and magnified hundreds of times? The microscope should, therefore, have the benefit of any superfluous cash you may have to spend upon it, and the photographic part of the business can be simplified to make matters equal. The particular make of microscope does not much signify; preferably it should be a *monocular*, as you could only use one tube of a binocular, and it would be a very awkward performance. If selecting a microscope after reading this, with a view to microscopic photographs, you should select one that will not only stand erect vertically, but also turn (with a screw joint on the base), so that the tube is horizontal. This is much more convenient to the beginner, as it renders elaborate apparatus for the photographic work quite unnecessary; but if the reader has already a microscope in his possession which will only stand vertically, there are still several methods whereby the difficulty may be overcome, with a little more expenditure of time and trouble.

To begin with, I will assume that we have at our disposal a microscope of the first kind —viz., one that will stand with the tube in a horizontal position. The first thing to do is to fasten it in this way: if it has a screw joint it can be firmly clamped; if not, as a general rule the friction of the sides of the joints will keep it steady, but if it is loose it must be carefully supported, by hooks or otherwise, during the work, for the slightest movement during exposure will, of course, completely ruin the photograph.

I may say here that when the microscope is in this position only mounted objects can be used, as the glass is standing on edge; consequently, if objects in a cell, or living specimens, are to be photographed, the microscope must be placed vertically, and one of the methods referred to above employed.

A good deal of the scope for the work which we have depends on the object-glass of the microscope. This may be a power of fifty diameters, and for a beginner it is best not to exceed this limit. With this power, or lower, the work can be done either by day or night. For higher powers sunlight has to be employed, which generally involves the use of a *heliostat*, which is rather an expensive piece of apparatus.

The *camera* may be of any ordinary type, preferably a modern bellows-bodied one, and the longer the bellows the better for our purpose. Some people say that a camera as much as 6 ft. in length should be used, but practically this is quite unnecessary, as the ordinary length answers well; it should, however, rack out to 18 in., if possible. If it will not do this, an extra extension must be made of stout cardboard, for temporary use.

The camera and microscope being provided, and the latter arranged horizontally on its stand, the camera must be supported by books or boxes, at such a height that the hole for the lens is just on a level with the tube of the microscope. The tube of the latter has now to be inserted in the front of the camera. They should not be rigidly attached to one another, but at the same time they must be temporarily so fixed that movement of either during exposure, or shifting of their positions when drawing the slide, or otherwise (it is a very difficult thing to draw the slide of a camera simply placed on a book, without its tripod screw to hold it, without shaking it), is practically impossible. A very good way to join camera and microscope together is the following:

Take off the ordinary lens used with the camera, and fit into the flange a piece of brass tube about 1½ in. long, and wide enough for the tube of the microscope to slip into it. The tighter the microscope tube fits into it the better, and, by having an "adapter" outside, it can be fitted to the flange, however small it may be. When the microscope tube is inserted in this tube, the joint has to be made light-tight. To do this, a cylindrical bag of thick black velvet, open at both ends, is made, and one end being slipped over the tube fixed to the camera, the other end goes over the microscope tube; two elastic bands are placed to fasten it round each of the tubes, and a perfectly light-tight joint is the result.

This arrangement having been made, and the object slide placed on the stage of the microscope, the source of illumination has to be considered. Those who can give up time to work by daylight, and prefer that method of illumination, can use a condenser to concentrate the rays of the sun on to the object, but this being liable to produce a considerable amount of heat, which may crack the slide, it is generally thought necessary to place a small trough of alum solution between the condenser and the object: this cuts off some of the heat-rays, without materially affecting the light. If working by sunlight, the course of the rays must be so arranged as to be parallel with the axis of the object-glass, and a continuation of it.

Most workers, however, prefer lamplight, for obvious reasons—the sun not being always at our disposal. A good paraffin lamp gives out more actinic rays than gaslight, and should, therefore, be employed. Any strong lamp will do; the three-wick lantern used for the optical lantern will also serve for this purpose. In front of the lamp is placed a bull's-eye condenser to concentrate the rays on the object; behind the lamp is placed a concave mirror to add to its illuminating powers. To produce the best effect, the axis of object-glass, condenser, and mirror must all be in the same plane. Fig. 1 will show the arrangement of the different parts of the apparatus.

The practical details of taking the photograph are, of course, simple enough to anyone accustomed to photographic work. The object is first firmly fixed on the stage of the microscope, in the centre of the field of view. If the microscope stage is provided with springs for the purpose, well and good; if not, the glass must be fixed by means of clips or wire springs, so that no movement at the wrong time is likely to occur. The object is now roughly focussed on the ground glass by means of the ordinary microscope screw, after which the fine adjustment is used to get it quite sharp. Great care is needed in focussing, for if the negative is not sharp in the extreme the lantern slide will be of no practical value. There is no room for naturalistic "focalising" here, whatever may be thought of it elsewhere. A magnifying focusser should be used to get the picture sharp on the ground glass. When it is sharp enough, the dark slide is inserted, and the plate exposed in the ordinary way.

This is a simple enough arrangement, and will not take long to put together. There are, however, several points on which success is more or less dependent, and which I will, therefore, enumerate.

The tube of the microscope must be placed accurately horizontal, and so must the camera, and the axis of the tube of the microscope must be coincident with that of the tube fixed in the front of the camera, the former being thus exactly in the centre of the latter.

It is a moot point whether the eye-piece should be left in the tube of the microscope or not. It really depends on the eye-piece itself, some adding to the clearness of the picture and some detracting from it; the operator must, therefore, be guided by circumstances. If it is used the picture may be made larger; but, except for this, some writers say that they have seen pictures taken both with and without the eye-piece which were quite undistinguishable. If the eye-piece is not used, the tube of the microscope can be abolished, and the tube containing the objective used alone. The tube holding the eye-piece limits the field to a certain extent, and it is not wanted if the eye-piece is not used.

High powers are very difficult to manage to obtain good pictures. The beginner had, therefore, better begin with a low power—say 1 in.—and proceed to higher powers when he has mastered the beginning of his craft. He will find that ¼ in. or ⅛ in. are as high as he can work with comfort, but using sunlight one can get much higher than that, with skill.

There is one curious fact which, seeming trifling enough in itself, may influence the resulting negative, and therefore must be allowed for. Unless the microscope is a very first-class one, on looking at the object when in focus it will be found that it is surrounded by a *red* ring in one position, but if the plane of focus is slightly altered the object will be just as sharp, but surrounded by a *blue* ring. This is owing to the glass of which the object-glass is made not being achromatic. The latter position, in which the object is surrounded by the *blue* ring, is the one to be employed, as red, being a non-actinic colour, will produce a black band round the object in the photograph, while the blue, being actinic, does not interfere with the white ground behind it.

One obstacle, which slightly interferes with the results obtained, consists in the diffraction images of parts of the object. These are more likely to be formed by the higher powers, as they depend mainly on the relative sizes of the object and the aperture of the object-glass. This is one reason why better photographs are generally obtained with lower powers. One writer says that the difficulty may be overcome by throwing the light from the source of illumination on to a translucent screen, and making this surface the source of illumination. The exposure, however, will of course be far longer under such a system of lighting.

A practical difficulty with which the worker has to contend is, that the long extension of the camera necessary places him so far from the fine adjustment of the microscope that it can sometimes only be reached with the tips of his fingers, and turned at the risk of upsetting the whole concern. This difficulty can be overcome in the following way, which is used by Messrs. Perken & Rayment in their micro-photographic apparatus. A table A (see Fig. 2) is made of sufficient length to support the camera when racked out to its farthest limits, and of a height to make the camera when placed on it of the right height for the microscope. Through the centre of the supports (which are of the same length as the breadth of the top) is fixed a bar (B), having a milled head (C) at one end and a pulley (D) at the other. This latter is connected with the fine adjustment (E) of the microscope by means of an endless band, so that the fine adjustment can be moved by the milled head (C). The focussing is now begun by means of the screw (E), and the remainder accomplished by turning the milled head (C), which can of course be easily accomplished while keeping the head under the focussing cloth.

Ordinary ground glass is too coarse to focus upon, if very great accuracy is required. Two surfaces of ground glass can be rubbed together with a little of the finest emery powder, which will render the frosting finer; or an ordinary negative glass can be coated with the following mixture and substituted for the ground glass:—Gum mastic, 40 grains; gum sandarach, 160 grains; ether, 4 ozs.; benzol, $1\frac{1}{2}$ ozs.

Mr. G. E. Davis, in a book recently written by him, advises the use of an idea of his own for focussing, which entirely dispenses with the ground glass. It is, he says, much preferable to the old plan.

The ground glass slide is removed, and another of mahogany is substituted for it. This is pierced with a series of seven holes, into each of which the ordinary A eye-piece of the microscope will fit. The thickness of the slide is such that, when the eye-piece is pushed in as far as it will go, the diaphragm lies in the same place as the surface of the glass slide. It is very important not to make the slide thicker or thinner than this, or the surface of the plate will not be in the same place, and the picture will therefore be more or less out of focus. "To anyone accustomed to focus by the old method," says Mr. Davis, "the present system will be found a considerable improvement, it being easy, under these circumstances, to obtain a sharp focus with an ordinary paraffin lamp when using the $\frac{1}{16}$ in. objective."

BENT IRON WORK, AND HOW TO DO IT.

BY J. H.

THE ADVANTAGES OF ITS PURSUIT—THE STRIPS OF IRON EMPLOYED—TOOLS—TINMEN'S SNIPS—PLIERS—CUTTING PLIERS—ROUND-NOSED PLIERS—LONG-NOSED PLIERS—PINCERS—PUNCHING HOLES—VICE AND ANVIL—GLOVES—ELEMENTARY FORMS—HOW TO BEND CURVES—DIFFICULTIES—TEMPLET RODS AND PINS—VARIOUS CURVES.

The Advantages of its Pursuit.—Since the Italian Exhibition was held in London, this branch of amateur work has been steadily growing in favour. It has many claims to recommendation. It is almost the only kind of metal-work that can be pursued by ladies and invalids. It is inexpensive, for though prices charged for the iron strips—the chief expense—are prohibitory to many, I shall show how they may be obtained for the merest trifle of cost. The work when finished is saleable at moderate prices. When followed as a pastime many very pretty articles of domestic service can be wrought in it, which, unlike wood-work, are unaffected by temperature, and are not so liable to fracture and distortion. It opens an extensive field for amateur design, and for an endless variety of pretty detail. It is much more easily mastered than most amateur pastimes, than repoussé work, for example, or wood-turning or carving, or the construction of elaborate designs in fret-work; and much show can be made in very little time. There is practically no limit to the kind of work that may be made or ornamented with bent iron. It is applied to lamps, lanterns, vases, hyacinth-stands, wall-brackets, ornamental chains, candlesticks, panellings, lamp-shades, screens, flower-bowls, and kindred articles. There is scope, not only for variegation of form, but also of colour, not only by the use of paint and varnish, but by the combination of tin, and copper, and brass with iron. There is no doubt, therefore, that this branch of work will ere long become very popular. At present it is in its infancy, and many are seeking information about materials, methods, and designs. I will treat of the first in this article, and of the latter in subsequent papers.

The Strips of Iron Employed.—The bent iron work is formed, for the most part, of narrow strips of thin sheet iron, of about 20 gauge. It is usually cut in three widths, $\frac{3}{8}$ in., $\frac{3}{16}$ in., and $\frac{1}{8}$ in. The first is employed for main frameworks, the second for minor and ornamental details, the third for clips to hold the work together. These strips are sold in coils at from 1s. to 3s. per pound. Now this involves a heavy and an unnecessary outlay. As the sheet iron from which the strips are cut does not cost more than $1\frac{1}{2}$d. per pound wholesale, and as small quantities can be bought at about 3d. per pound, it is clear that an enormous profit is made by the ironmongers who cut the strips from the sheet metal. For those, therefore, who intend to do much work in bent iron it is much cheaper in the end to purchase a stout pair of shears, buy, say, half a sheet of iron, which would measure about 3 ft. by 3 ft., line it out, and cut it into strips by hand. A half-sheet, costing 6s. or 7s., would thus provide a stock of strips sufficient to make a large number of articles. Many might be able to borrow a stout pair of shears of a friendly blacksmith, and so save their cost. Working in this economical fashion, the cost of material need not become a deterrent to taking up this beautiful department of work which all can do.

When the strips are cut out they should be kept ready for use in a small compass by rolling them into little coils of about 3 in. diameter, and binding them with clips cut from the narrowest strips.

Tools.—There are other expenses to be incurred besides those for material. A few plain tools are necessary. But, at the outside, these need not cost more than 30s. The essential tools are the following:—

Tinmen's Snips.—Fig. 1 shows a pair of tinmen's snips. A pair 8 in. long costs about 2s. 3d. These are used for cutting off the strips of iron to the lengths required.

Pliers.—Pliers of various sorts and sizes are used for bending the iron. Their numbers and size will, of course, depend upon the cash available. With a wider range of tools a wider range of work can be done, with less of makeshift and lost time.

Cutting Pliers.—First there is the pair of cutting pliers (Fig. 2). These comprise flat jaws (A) and a cutting edge (B). The latter is not required so much, because the snips fulfil the purpose. Nevertheless, the pliers will cut off the narrower strips of iron if the snips do not happen to be at hand. The primary function of the pliers, however, lies in the jaws. Between their flat, roughened-up faces short lengths of strip are flattened out and straightened, curves that are not regular are corrected, the kinks being pressed out, and one end of a strip is held while the length left free is bent to any curvature required, or waved, or twisted.

Round-nosed Pliers.—The curves are imparted to the strips by means of round-nosed pliers (Fig. 3). These range from 4 in. to 8 in. in length. A single pair from 7 in. to 8 in. in length is the most generally useful. To this a smaller pair may be added at discretion. The jaws of the pliers being taper, give a gradation in diameter that renders them adapted for a slight range of curvature. But, for the most part, the curves formed do not correspond with the curvature of the pliers, being much larger, and much of the art to be acquired consists in the regular formation of these curves without being alternately flat and curved or "kinked." The only portions whose curves correspond with those of the pliers occur at the commencement of the volutes.

Long-nosed Pliers.—The long-nosed pliers (Fig. 4) are used both for turning round the larger curves and for correcting the flatter portions that occur during their formation. They are also employed in clinching the clips by which the scrolls and other ornamental portions are secured to one another and to the framings, the iron clips being pinched between their jaws upon the work.

Pincers.—Common pincers are also used for a variety of purposes in the manipulation of the strips.

Punching Holes.—Holes have to be punched in the iron for rivets. The punches are made of steel. What are called "brad punches" will do, being about $\frac{1}{16}$ in. in diameter at the point (Fig. 5, A). The iron (B) is laid upon the end grain of a block of hard wood (C) for support, while the punch is being driven through. A bench hammer of about $\frac{3}{4}$ lb. weight is also required.

Vice and Anvil.—A bench vice is also wanted. A watchmaker's vice will do very well, but a small parallel bench vice is better, because more suitable for the heavier work of the framings. A small anvil (Fig. 7, A), or a stake (B), or both of them, will also be very serviceable for bending and riveting upon. These can be pinched in the vice.

Work is commenced, and held in the vice during some sections of its manipulation.

and during filing. Upon the vice iron strips may be flattened, and upon its beak some curved portions can be more conveniently bent and hammered than with the flat- and round-nosed pliers.

Gloves.—For ladies' delicate hands, a pair of old kid gloves is almost indispensable. Without them the rough edges of the cut iron will scratch, and make the fingers sore. The inconvenience of working with gloves on will wear off with practice.

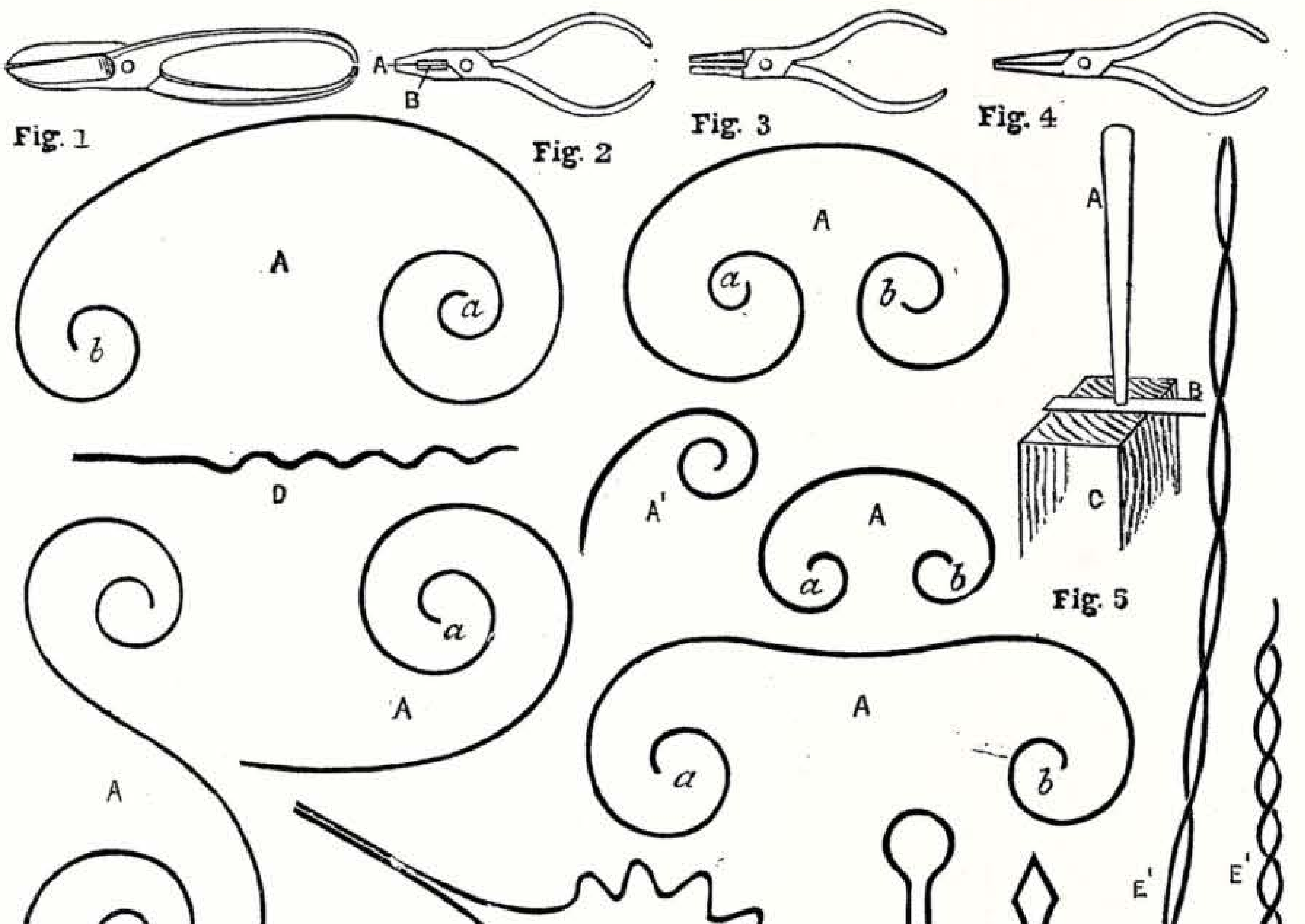
Elementary Forms. — Most of the elementary forms of curves used in the bent iron work are shown in the group (Fig. 8). They are not numerous, but are turned in many sizes and united in many combinations. Before attempting to construct any design in this work, it is better to devote a few hours to practice in these elementary forms.

How to Bend Curves.—In any of the volute or scroll forms marked A proceed as follows :—

Take the strip to be bent in the left hand, or in the jaws of the flat-nosed pliers held in the left hand, take the round-nosed pliers in the right hand, and twist the free end of the iron into the small curve, *a*. Work the pliers gradually outwards, forming in detail the enlarging curves of the volute, and so diminishing down to the small curves, *b*.

Difficulties. — But I must be a little more precise than this ; for it is not so easy to form these curves as the description would seem to imply. The difficulty is to form flowing curves without flats or kinks. The first efforts will produce these results, and the way to prevent this is to work very deliberately, not trying to bend too much at once, and, where practicable, to avail oneself of the aid afforded by templet curves. The chief error to be avoided in bending curves is that of trying to do too much at a time. The small curves, whose diameters correspond pretty closely with the diameter of the pliers, are easily done ; the difficulty lies in the flatter ones. The flatter parts should, therefore, be bent by a succession of rapid movements of the pliers, a very slight bending of the iron being imparted in each successive position of the pliers.

Templet Rods and Pins.—Have also a number of tapered rods of wood or metal handy. The curves can be bent quickly and accurately around these, the gradual increase in the curves being obtained by moving the work from one section of the rods to others. Also a number of short wooden pins of various curvatures can be tenoned into a board (Fig. 9), standing up only about half an inch, and the iron bent around these. Very many curves can be finished perfectly with such an appliance. The pins also afford a ready means of testing the uniform accuracy of a number of similar curved scrolls. Again, when finishing the smaller parts, *a* and *b*, it is better, when the terminal curve is very small, not to turn it completely with the wire pliers, for the force requisite to turn it is apt to alter the curvature of adjacent portions and produce kinks. It is better, then, to insert the small end of a mandrel and *pinch* the terminal curve round it with the flat-nosed pliers.



Bent Iron Work. Fig. 1.—Tinmen's Snips. Fig. 2.—Cutting Pliers. Fig. 3.—Round-nosed Pliers. Fig. 4.—Long-nosed Flat Pliers. Fig. 5.—Punching Holes in Iron. Fig. 6.—Rymer. Fig. 7.—Small Anvil and Stake. Fig. 8.—Elementary Curves and Forms. Fig. 9.—Templet Pins.

There is this advantage about bending the work : that the iron being so thin, all flats can be pinched out and good curves ultimately produced ; but a great deal of time is wasted thus, so that it is better to learn the art of producing perfect curves at once, even though the process may seem tedious until practice produces expertness in the art.

Various Curves. —In Fig. 8 the curve, A′, is one of the minor curves that occur plentifully, being fastened with clips (shown enlarged at H) to the major curves, A. The curves at B are slightly modified forms of A, but they are very useful and very common. C and C′ are leaves, and are most easily bent. The centre of C′ is filled in with a midrib and scrolls : these are frequently formed in copper. For the tendrils (D) the iron is simply bent backward and forward with the wire pliers. E, E are tendrils of a different type, that lie closer to their scrolls than D. E′, E′ are supension chains, formed by twisting the iron continuously in one direction with two pairs of pliers. F, F are double curves, extensively used in ornamentation. G is a chain link used in bent iron work. H is one of the clips for binding the curves together. J is an ornamental border, carried round a panelled design.

We shall meet with the applications of these forms in subsequent articles, so that I need not dwell on them now. In the meantime, I want my readers to become familiar with their outlines, and to practise their formation. Strips of tin cut from old biscuit-tins will serve for preliminary practice, and cost next to nothing. In our next paper we shall treat, among other points, of riveting and the methods of punching holes ; and so lead our students on by easy stages to a useful knowledge of Bent Iron Work.

AN ARTISTIC PARLOUR BOOKCASE.

BY F. JERMAN.

INTRODUCTION—DIMENSIONS—WOOD—PLINTH AND DRAWER—SIDE PANELS—ORNAMENTAL GALLERY—SHELVES—CONCLUSION.

THE accompanying drawings show how a very useful piece of furniture may be made ornamental, without the application of expensive material and fittings to attain this desirable object. Besides this, I have endeavoured to give a character of its own to the design, and at the same time to be careful not to violate the rules of good taste and proportion.

I have refrained from giving elevations, plans, etc., as they take up a good deal of room which might otherwise be filled with more interesting matter, and perhaps it might not be found convenient to adhere to the sizes given in such elevations. The sketch sufficiently shows the design and general appearance of the bookcase, so that the reader may easily get out his own working drawings from it, and the following description if he is so inclined. I should, however, mention a few sizes of the object from which the sketch is taken. The height from floor to cornice is 5 ft.; height to top, 2 ft. 7 in.; height to bottom of plinth, 1 ft. 4 in.; width along front, 2 ft. 10 in.; depth of bottom part, 1 ft. 3 in.; depth of bookshelves, 9 in. If these measurements are thought too small, they can easily be enlarged, care being taken to keep the same proportions: for instance, if it is advisable to make the case higher, the width and depth should be increased in similar proportion.

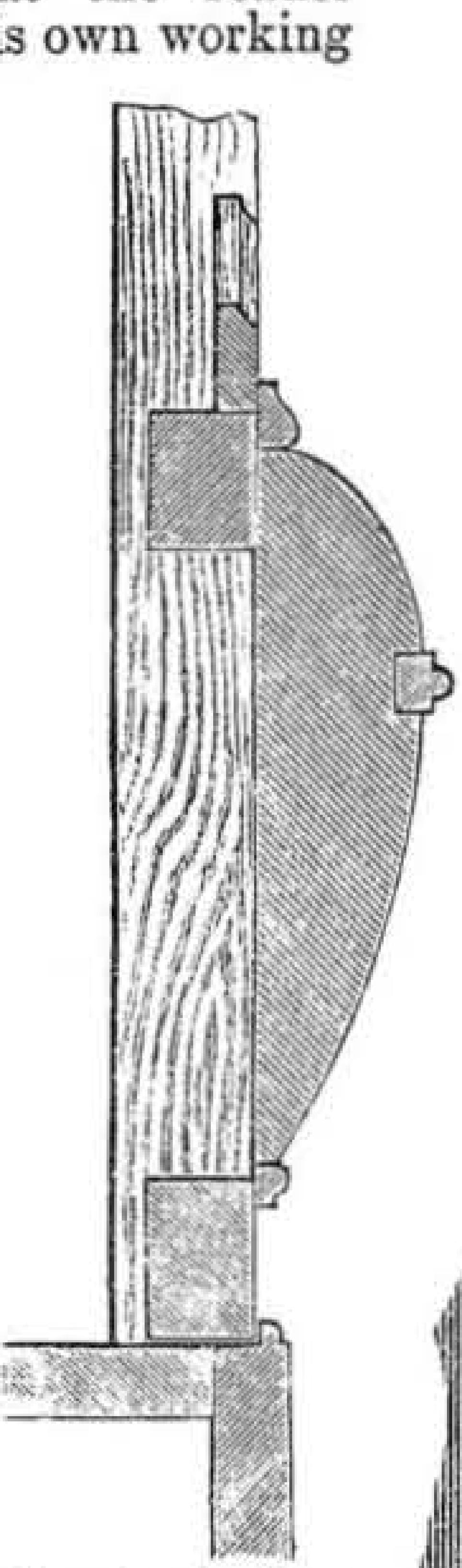


Fig. 5.—Section of Plinth, etc.

Walnut is about the best wood for the execution of this design, but it can be made cheaply in white deal. In this latter case the wood should be selected of an even grain and without large or loose knots. It is better to pay a higher price for the wood than to have cheap material covered with these defects. Brass fittings will afford a pleasing contrast with the wood. Figs. 6 and 7 show suitable designs for the handles and escutcheon.

Fig. 6.—Handle.

The legs are $1\frac{1}{2}$ in. square, and taper, with brass shoes at the bottom for their protection. All the rails are $1\frac{1}{4}$ in. square, tenoned into the legs. Fig. 5 is a section through the bottom part of the front, and, as the reader will observe, shows the manner in which the boldly projecting plinth is made up, moulded fillets being applied in three places and the angles mitred properly. If the bookcase is made in walnut I would strongly recommend that the plinth be inlaid with lines of narrow brass, which will give a very charming effect. Care must be taken in setting out the contour of this plinth, as it makes a great difference if the profile is correct or not. The plinth gives an appearance of strength and solidity to the lower part of the bookcase. Small cut aprons are introduced to connect the legs and plinth.

The drawer is intended for the reception of loose prints and drawings. In making its front, allowance must be made for the projecting half-bead. This detail is very frequently met with on the edges of the door in old clocks. The drawer is otherwise made in the ordinary way with hidden dovetails. In fitting together, the front mould is apt to get damaged, and the necessary precautions should be taken to avoid this. Fig. 4 is the section of a mould run round the edge of the top. The two side panels are filled in with $\frac{1}{2}$ in. stuff, fitting at the back into rebates in the legs, etc. An excellent method of ornamenting it is to fill up the front with a design in fretwork. If this is cut out and filled in closely against the sides, it will have the rich appearance of sunk or "incised" work, as it is technically called, in which the ground is removed, leaving a flat projecting design. Fig. 2 is an original design which would prove suitable for the panel. It may be applied to various other purposes, apart from this bookcase. An ornamental brass-headed nail is shown in the centre.

Fig. 2.—Fretwork Panels at Sides.

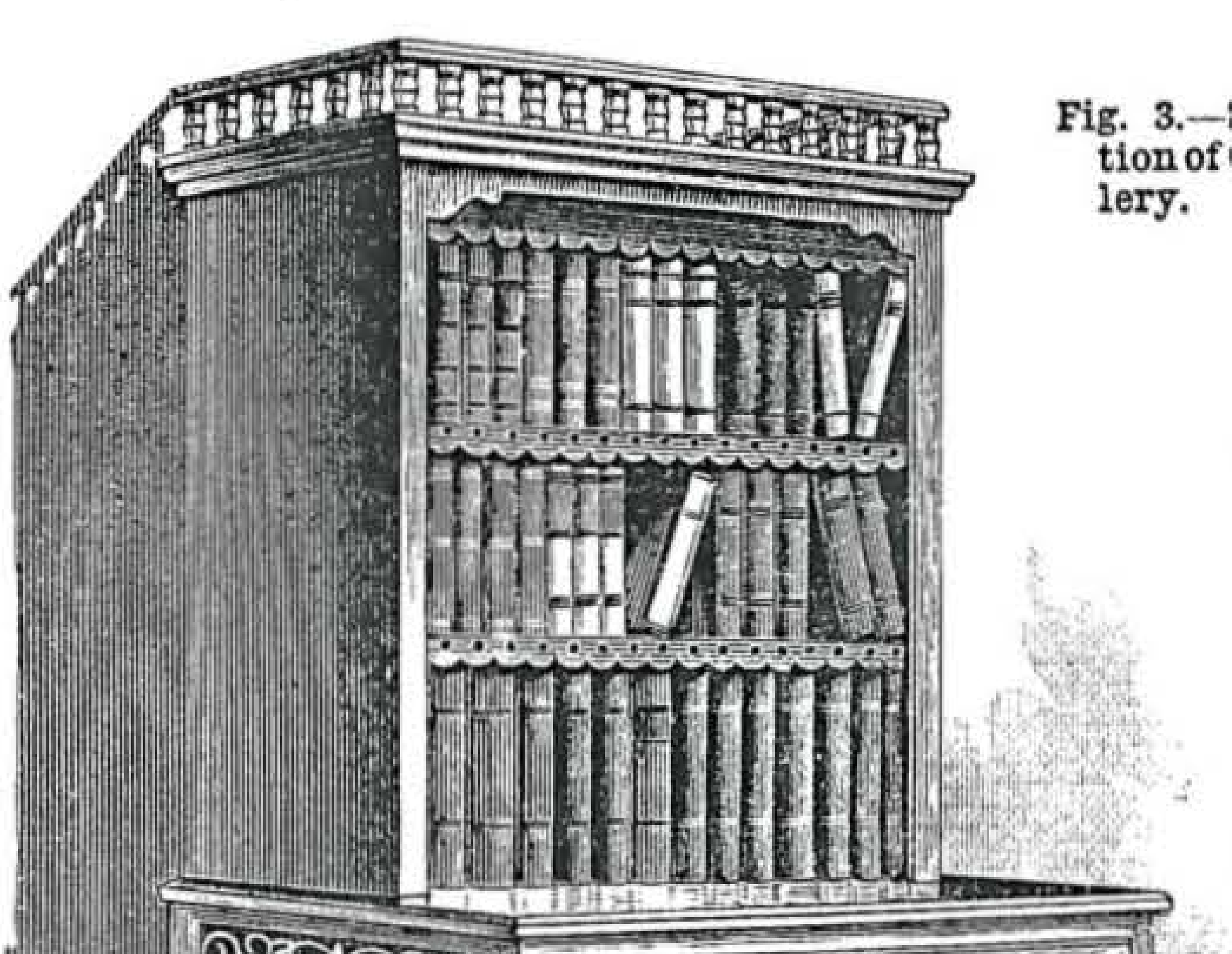


Fig. 1.—Perspective Sketch of Parlour Bookcase.

Fig. 3 is a section of the cornice and the gallery above. This latter is formed of a top and bottom rail (the former has a mould worked on the edge). The turned balusters, or "spindles," are $2\frac{1}{2}$ in. high sight size—that is, between the rails—but allowance must be made for circular pins at top and bottom. When these have been procured from the turner's, the centre of each pin must be marked in the proper place, at equal distances apart on the rails, and the holes bored to admit them, being careful not to bore too deeply into the top rail. After trying the pins and holes, they are glued and put together. The top will accommodate a few vases or other ornamental articles.

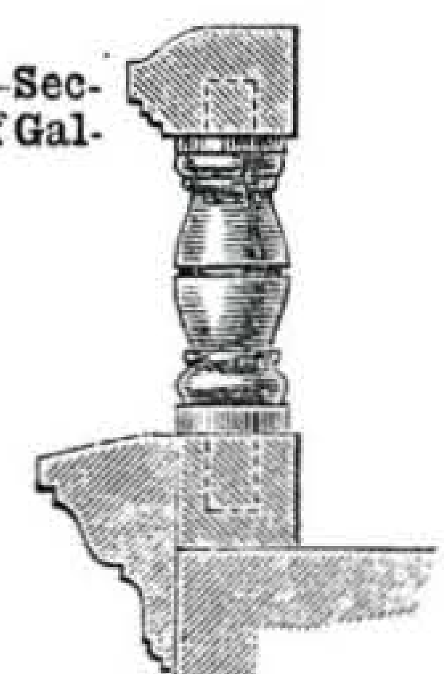


Fig. 3.—Section of Gallery.

The bookcase proper is formed of $\frac{3}{4}$ in. sides and shelves, the latter fitting into grooves cut in the sides. The shelves should be fixed to suit the size of the majority of volumes which they are required to accommodate. A row of books of different heights does not look well in a parlour. This bad effect is partly obviated by a leather bordering, cut to a scalloped or other ornamental pattern, and nailed with brass-headed nails to the shelf, at the heads of the books. The border also helps to keep out the dust from settling on the tops of the books.

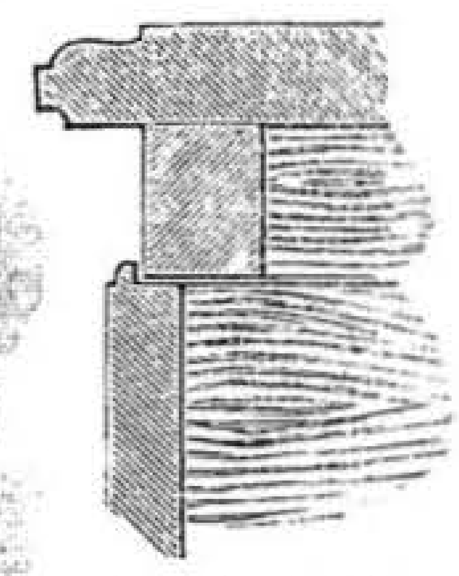


Fig. 4.—Section of Top.

In conclusion, I might add that the design will admit of much alternative treatment. Besides enlargement, as explained before, the plinth may be omitted and another drawer put in similar in size to the one above (in which case, of course, the apron piece must still remain), or the gallery may be removed and an ordinary or a circular pediment inserted at the top.

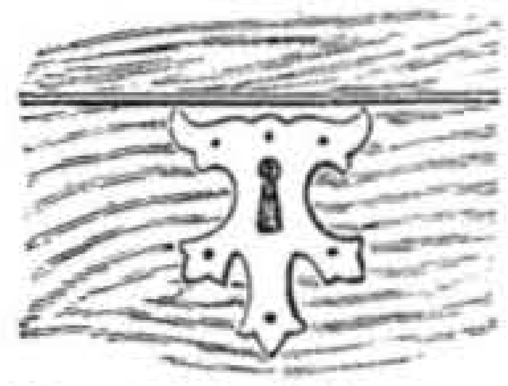


Fig. 7.—Escutcheon.

Much might be added concerning matters of detail, but as "Shop" is open to all readers of WORK, any question which it may be necessary to ask will be speedily answered in that part of our Journal. Thus, if any reader should be in difficulty about markets and prices for woods, I will willingly answer his queries, or possibly our specialist A. J. H. will do so. Then as to polishing or staining, so much has already appeared in WORK upon these subjects that little need be said on this head. Yet our Editor would prefer that no reader should debar himself the privilege of asking any specific questions on any matter not clear to him. With all this encouragement, then, wood-workers can safely go ahead with the present design.

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OUR PROGRAMME. — With the present number of WORK this publication enters upon the fourth year of its successful, vigorous existence and influence, the latter extending —as the "Shop" columns constantly evidence—to the remotest corners of the world. A sense of this wide and rapidly-growing acceptance of the publication has led to a desire to still further extend the sphere and usefulness of WORK as a journal for workers; and it is with this view that arrangements have been made to incorporate those many new and important features announced in our previous number—features which will have the effect of rendering WORK unique amongst journals of its class. As the present number indicates, the variety, character, and excellence of matter and illustrations will continue as heretofore, while the new and important papers which have been arranged for publication in the present volume will show that much new ground will be opened up in nearly every branch of professional and amateur work. Most important, however, is the position which WORK will in the future occupy in relation to the Trade and Labour market—a position in which we are sure to have the cordial support of our thousands of well-placed readers. Already arrangements have been made for a weekly supply of Trade and Labour notes, and news from the chief home workshops and industrial centres; while from time to time will be presented direct intelligence from Colonial districts offering fields and opportunities for emigrants and workers who suffer from the overstocked condition of the home labour market, the fluctuations in which so immediately affect the workman, and in which he cannot but feel the deepest interest. Thus WORK enters upon something of a new existence, with a much wider and more extended field of usefulness before it.

ELECTRIC LIGHTING.—With a fitfulness which has hitherto been characteristic of this species of illumination, the electric light is once more disputing the place of gas in London. The St. Pancras parish authorities are making experiments which bid fair to become a complete success. The huge standards along the centre of the Euston Road are a great improvement upon the roadside uprights, inasmuch as a better distribution is afforded for the light, and the shadows, which were so great a defect in some of the experiments in other parts of London, are avoided. When the Euston Road lighting is completed, one of the worst thoroughfares by night in London will be transformed into a perfectly safe and valuable route for increased vehicular and pedestrian traffic. Hatton Garden—an important spot, as being the centre of the diamond trade, and where any day merchant and dealer may be seen disputing, in true Semitic style, the colour and carat value of treasures from Kimberley, Brazil, and New South Wales—is also to have the new light. This, too, in the offices as well as the street. Remembering the eight months of black, foggy weather which this climate affords us annually, the electric light will be a priceless boon to the buyers and sellers of precious stones who here do congregate.

BETTING.—No greater evil besets working men and youths in shops and factories than the disastrous habit of betting in small sums, especially upon horse-racing—a mischievous system which seems to have obtained with a class, who can least afford it, throughout the length and breadth of the land. With the flat-racing season in the immediate future, it is well to sound a note of warning against this pernicious practice, and to urge all employers of labour to exert themselves to an endeavour to abate the nuisance. Remedial measures are sorely wanted, and it is not difficult to indicate the direction from which these should spring. Schemes to make saving and habits of thrift more tempting to the working man are chiefly required. Betting and gambling largely obtain because the interest which the workman can get for his superfluous shillings is not worth his thinking of, and it is not surprising that the Post Office Savings Bank has no attraction for him. It ought to be within the power of every working man to become a part proprietor in the business—even though it be a small one—in which he has spent, or hopes to spend, the best years of his life; and when this system is liberally considered and carried out by masters and directors, a most effective blow will be given to the hopelessly unsound betting transactions in which working men somehow find time and money to engage—of course profitlessly. From time to time the bishops and ministers decry the evil from congress rostrum and pulpit. This is not enough. A practical effort is needed, and here a real piece of work is presented to the heads of religious denominations in this country. With the machinery at the command of the bishops, for instance, and their personal knowledge of the wants, ways, and means of their dioceses, it is not unreasonable to assume that many plans might be formed of a local nature for the profitable employment of monies of the poor, which as savings should come under the trusteeship of the bishops. Co-operative stores in every parish ought to be possible, and these with working results which, not forgetting the element of perfect security, ought to offer some better return for the invested savings than the Government $2\frac{1}{2}$ per cent. Some little practical effort of this kind would do more good than much pulpit oration in abating the betting evil amongst factory hands and shopmen.

DESIGN FOR MILKING-STOOL OR PLAQUE.

BY FLORENCE HUDSON.

THIS design may be carried out in various ways. It works out very effectively in wood carving, in low relief, with a roughened ground, and also may be treated in either of the ways suggested for carrying out the design for a chess-table in Vol. III., p. 769. It would look still better carried out in brass repoussé work.

As a decoration for a plaque, various methods suggest themselves. It may be painted in the natural colours of flowers and leaves on ordinary red terra-cotta, leaving the natural red as background; or on white terra-cotta or china, a soft blue background, gradually merging into brownish-green at the base, would blend well with the leaves and stalks there.

It might also be treated conventionally—the flowers white, or any fancied colour, with a gold or silver centre, the leaves and grasses in such colours as would contrast or harmonise well. The background might be entirely gold, or silver, or any metallic bronze, or the design might be outlined with gold after painting, and the background of one colour diapered with gold. It would help the student to have the natural corn and daisy before him or her.

Ox-eye Daisy and Corn Design for Wood Carving, Painted Plaque, or Milking-Stool; or for Repoussé Work.

HOW TO WHITEWASH A CEILING.

BY E. DICKER.

THE first thing is to have the room as clear as possible, and tack a width of old newspapers round the walls half an inch from the ceiling to protect the wall-paper. The best way to tack the paper up is to cut sections or slices about a quarter of an inch thick off some ordinary corks, and drive the tacks through these, then through the paper into the plaster, making drawing-pins of them, as it were, with cork-heads.

Our next object is to thoroughly wash off the old distemper or whiting from the ceiling, being careful to wash the *ceiling* only, and not to let the dirty water run down the paper or splash all over the place.

It is of the utmost importance to have a scaffold board, at such a height from the floor that you can comfortably reach the ceiling. Have a pair of steps at each end of the board, though two chairs will answer the purpose, or even the table alone. Now, with a pail of clean water, a distemper brush, a large piece of sponge, and a piece of coarse canvas on the board or table beside you, start at one end of the room to lay or soak in a patch with water, gently stirring the old distemper with the brush. Get the old distemper thoroughly soaked, then wash it off with the canvas, finishing with the sponge, frequently rinsed in water. *The object for this is to get rid of every trace of the old distemper or whiting.* Do not wet the ceiling more than is absolutely necessary, and frequently change the water as it gets dirty. If the distemper is difficult to get off on account of the original coat having been "bound down," as it is called, instead of being washed off before it was re-whitened (and this is very often done for the sake of cheapness), two pennyworth of liquid ammonia in half a pail of water—in a separate pail—when you are soaking in, will greatly assist you. I should caution you against touching the paper with the brush, but to finish the last inch or so from the paper with the sponge or canvas.

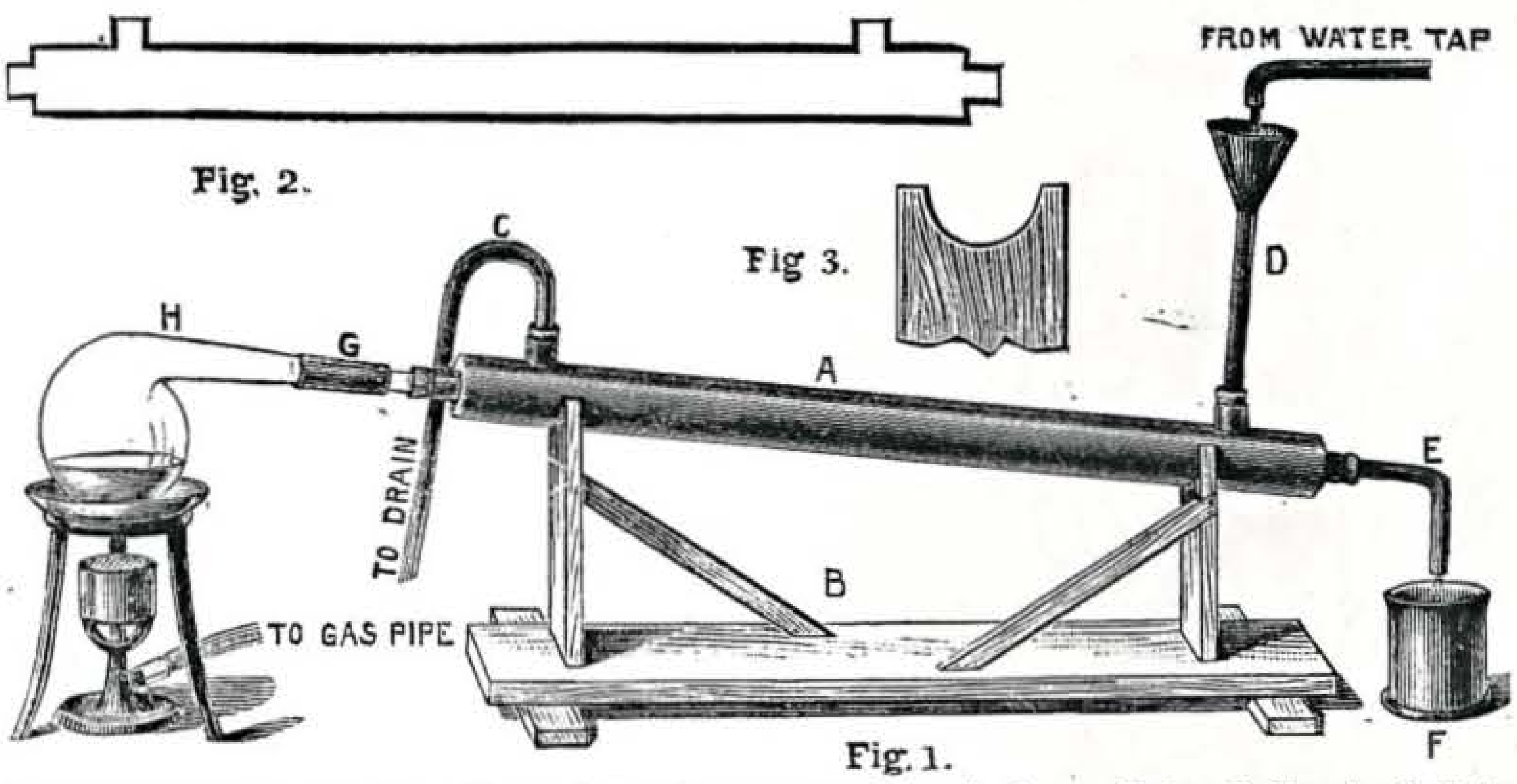
If there are any cracks in the ceiling they should now be repaired by filling in with a stopping-knife a little plaster-of-Paris mixed with water. Any loose plaster in the cracks should be got rid off before filling in. A little whiting mixed with the plaster will keep it from setting too quickly. Any dirty stains in the ceiling should have a coat of thin white paint, and if you have to paint any stains I should paint the cracks when they are dry. Now put a double handful of Young's patent size in a saucepan with about two pints of water, and put it on the fire until it thoroughly melts, stirring it all the while, being careful not to let it either boil or burn. When quite dissolved, turn it into a clean pail, and give the ceiling a coat of the size with your distemper brush, which must have been thoroughly washed before using it for this purpose. Of course, any paint, etc., on the ceiling must be dry before doing this, and you must take care to cover every part of the ceiling with the size. Do not take up a lot at a time in your brush, but simply dip it in the size about two inches.

To prepare the whitewash, break up into large pieces about four balls of whiting into a pail, and, just covering it with cold water, let it stand all night. In the morning pour off all water that will run away, and thoroughly mix the wet whiting with your hand until it becomes a thick, even paste. Now add about half an egg-cupful of dry ultramarine blue, stirring it well in with the whiting. Next put 2 lbs. of Young's patent size in a saucepan over the fire, with only just sufficient water to keep it from burning, and stirring it all the time, taking great care that it neither boils nor burns. When it is thoroughly dissolved pour it on the whiting, and mix the whole well together. Now set it aside in a cool place until it turns to a jelly. When it is quite cold, with a distemper brush rub it through a coarse piece of canvas stretched over the top of a clean pail, and it will then be ready for use. Now lightly rub over the whole of the ceiling with a piece of fine glass-paper, to take off any little knots or brush-hairs left by the clear-coleing. Dust the ceiling, and whiten it. The way to lay the distemper on is not to take up too much in the brush, and, whatever you do, be careful not to flick the brush at the end of each stroke, or you will splash everything. You can work the brush in any direction, but be sure that every part of the ceiling is covered with distemper, taking care to keep the edges of the various patches going—that is to say, do not let any edge get dry before you come to it again. This is why it is so essential to have a scaffold that is easily movable from one end of the room to the other. The whitening must be done very expeditiously; in fact, any ceiling over 14 ft. square should not be attempted single-handed without some previous practice.

If there is an ornamental cornice in the room too niggling to be got at by the brush, a smaller brush called a "distemper tool" is used both in the washing off and whitening. In using this brush in the whitening, push it up, as it were, into the ornamental parts as you would a stencil brush; in fact, it does not much matter how you get it on, so long as it is put on evenly and all covered.

A new distemper brush should be worn in a bit before you attempt to whiten a ceiling. The fact of washing off a ceiling will be almost sufficient to wear it in. After it is done with, wash it out thoroughly and lay it by, but particularly bear in mind, before you attempt to use it on any other occasion, to soak it in water, or you may find that the hairs will fall out through it being too dry. This last remark applies to nearly all brushes used in house decorating. The price of a good 12 oz. distemper brush is about 5s. or 6s., and a distemper tool 1s. The rest of the materials—which you would most likely have to purchase at an oil shop—are as follows:—4 lbs. size, 4d.; 4 balls of whiting, 2d.; $\frac{1}{2}$ bag plaster, 2$\frac{1}{2}$d.; blue, 1d.; $\frac{1}{2}$ lb. paint (if necessary), 3d.

The next paper of this series will be on How to Paper a Room—a most important consideration in view of coming hot days (which are certainly due to us) and the callousness of the average landlord respecting the comfort of tenants.



Liebig Condenser. Fig. 1.—View of Condenser complete—A, Large Tube; B, Stand; C, Tube through which heated Water escapes; D, Tube with Funnel at End; E, End of Glass Tube; F, Receiver for Condensed Liquid; G, Indiarubber Connecting Tube; H, Vessel in which Liquid is heated. Fig. 2.—Section of Tube. Fig. 3.—Upper Part of Support.

HOW TO MAKE A LIEBIG CONDENSER.

BY R. W. C.

The Liebig condenser is an instrument which is used in distilling operations. It is suitable for distilling water for photographic purposes, or for manufacturing scents.

Fig. 1 shows the condenser when completed, and the manner in which it is set up when in use. It consists of a large tube (A), which rests in a slanting position on a wooden support (B). Each end of the tube is stopped up with a metallic plate, and a long glass tube is passed through it and projects at both ends, but is bent at E and straight at the opposite end. A vessel (F) is placed under E to catch the distilled liquid as it drips out. The upper part of the large tube is pierced with two holes, into which are inserted a tube (D), having a funnel fixed to its upper end, and another tube (C), which is bent over as shown in the illustration. A retort or other vessel (H), in which the liquid to be distilled is boiled, is connected to the glass tube by a piece of indiarubber tubing (G).

The first part of the condenser which we will construct is the large tube (A). Procure a metal tube about 30 in. long and 3 in. in diameter; solder a piece of sheet zinc over each end so that it is quite water-tight. A hollow brass curtain-rod will form a very good tube, and will have a neater appearance than an ordinary soldered tube. Then bore four holes about $\frac{3}{4}$ in. in diameter, two through the centres of the metal plates and two through the top in the position shown in Fig. 1. These holes can be easily made by an ordinary metal drill fitted into a brace. Get a piece of brass tube 1 in. in diameter and 8 in. long, and cut it into four pieces, each two inches in length. Then solder one of these pieces over each of the holes which you have made in the large tube, which will now have the appearance presented by Fig. 2. Having done this, solder a flap of metal under the large tube about 3 in. from each of its ends. These flaps are to prevent it from slipping downwards when placed on the stand. Fit each of the four tubes with a sound cork, and paint all the metal work with any colour that you please. The tube may now be set on one side to dry while we proceed with the construction of the stand.

The shape of the stand is shown in Fig. 1. It consists of a base about 7 in. wide, on to which two upright pieces are fastened. These uprights support the tube: one is about two inches higher than the others, and the top part of each is hollowed out so that the tube will fit into it. The shape of the uprights is shown in Fig. 3. They are further strengthened by fastening braces, the position of which is shown in Fig. 1, on to the side of each and on to the base. In fixing the uprights on to the base they must be arranged so far apart that the distance between them is equal to the distance between the metal flaps which you soldered on to the large tube.

We will now construct the tubes C and D (see Fig. 1). The former is simply a brass tube bent into the shape shown in the figure. It is fitted on to the large tube by inserting it into a hole bored in the cork which was fitted into the small brass tube nearest to the end where the vessel which holds the liquid to be distilled is. The tube D is also a brass tube, and is fixed on to the large tube in the same manner as E. A tin funnel is soldered on to the top of it.

The glass tube which passes down the centre of the tube A must now be fitted into its place. It is about $\frac{1}{2}$ in. in diameter, and can be procured from any chemist's. It is fitted into the metal tube in the same way that C and D are.

The condenser is now completed. To use it, the water or other liquid to be distilled is placed in a glass retort, which is connected, as was before observed, to the glass tube by a short piece of indiarubber tubing. The metal tube is filled with water by pouring some into the funnel until it begins to run out at the tube C, under which a vessel is placed to catch the overflow. The water in the retort is then boiled by placing a spirit-lamp or gas-burner underneath it. In a short time the distilled liquid will begin to drip out at E. Fresh water must be continually poured into the funnel, which will expel the heated water through C. This operation is performed by allowing water from a tap to drop slowly into the funnel.

STORY OF THE ST. GOTHARD TUNNEL.

BY HENRY FRITH.

There are five great European tunnels, each one of which has something to specially recommend it, whether as a marvel of engineering skill, for its elevation, for its peculiar scenery, or for difficulties of construction overcome. Of the Alpine railways connected with the great tunnels, the St. Gothard and the Arlberg will here chiefly claim our attention. But the Semmering line was the pioneer railway over the Alps of Europe. It connects Vienna with Trieste, and was opened in 1854. The Brenner railway is the most lofty; but, unlike the Semmering and other Alpine lines, it boasts no "summit" turned. The Mont Cenis tunnel was, in 1871, an easy first in magnitude until St. Gothard was pierced, and this magnificent success put all the other tunnels in the shade most completely.

Before the St. Gothard Railway was built, there was no direct line from frequented Switzerland into Italy. In 1869 M. Favre accepted the contract for this stupendous undertaking—how stupendous, how toilsome, and how dangerous comparatively few people stop to consider. What amount of work is represented by the railway? Just glance at a few simple facts and figures before peeping into the tunnel itself.

The line occupied nearly ten years in construction—from 1872 to 1882. It was opened on the 1st of June in the latter year. The cost of the line was 238,000,000 francs; or, roughly, £9,520,000. It climbs from the level of the Lake of Lucerne to a height of 3,786 ft., and its greatest gradient is 1 in 4. It will give some idea of the work generally performed if we state that there are altogether fifty-six tunnels of more than twenty-five miles collectively in length; there are forty-two viaducts and bridges of considerable size and span, besides arches. The wonderful spiral tunnels are a peculiar feature of this truly magnificent route.

On the 6th of December, 1871, the St. Gothard Company was formed; the chairman was Doctor Escher, of Zurich. To the aggregate amount already mentioned as finally required, Italy, Germany, and Switzerland contributed in certain proportions: Italy paid about £2,250,000, and the others £1,500,000 each as subsidy.

The construction of the tunnel through the summit of the pass was confided to M. Louis Favre, who took it in hand on the 12th of September, 1872. The preliminary work of pushing in the headings was performed at Göschenen on June 4th, 1872, and at Airolo on July 2nd. The obstacles met with were almost sufficient to damp the boldest spirits. At first only hand-labour was employed, and the hard, stubborn rocks, the invading water, the unyielding clay, the giving way of masonry caused by pressure, all militated against M. Favre and his army of workmen. The springs tapped were formidable, the want of air trying; still the labourers persevered. Four thousand men, all of the nationalities interested, dug and carted and bored doggedly day by day.

Boring machines—Ferroux perforators—were employed, and worked by air compressed into one-twentieth of its volume by water-power at hand. This air was stored in large reservoirs, and admitted by means of pipes into the workings, where the rock perforators were forced by it with the greatest velocity of the pistons. Eighteen hundred strokes a minute, each stroke hitting the rock with an estimated force of two hundred pounds, meant business!

The cutting of this immense tunnel was proceeded with in a straight line from both ends simultaneously. When a number of holes had been perforated by the machines, dynamite was introduced, the match was lighted, a horn blown to warn the men, and then, after an anxious pause, a tremendous explosion shook the mountain. The smoke was driven out by compressed air, the shattered masses removed, and the boring was recommenced.

An "air locomotive" was employed to drag the train of trucks laden with the *débris*. The appearance of the workings was fantastic in the extreme. A deep, dripping aperture, in the gloomy depths of which lanterns could be seen flitting about, the sound of trickling water and rushing cascade, a dull explosion, the rattling of the "engine," the banging of trollies, the glistening rocks, the sense of impending danger, and the consciousness of 6,000 ft. of solid mountain overhead, were quite sufficient to occupy one's senses and furnish food for reflection.

But not to Nature alone were all the difficulties to be ascribed. A riot occurred amongst the workmen in July, 1875, and serious consequences were feared. But it was quelled after a while. Then the burning of Airolo interrupted operations in 1877; but of all the saddest days in those sad years of toil was the 19th of July, 1879, when M. Louis Favre died.

He was visiting the works with some friends, and speculating upon the completion of the work, when, inside the tunnel, he was struck by an apoplectic fit, and fell into the ready arms of his companions. Every possible remedy was tried, but in vain: he died almost immediately, on the scene of his great undertaking, amid the darkness and the turmoil of the works.

This untoward event, however, could not be permitted to interfere with the progress of the tunnel. A touching tribute to the energetic and practical Favre was paid by his workmen to his remains, and a public funeral attested the estimation in which his native canton held him. He "should have died hereafter!" Meantime, the great work proceeded.

During the month of February, 1880, it became evident that the tunnel would be perforated shortly. The workmen could hear each other, and speculation was rife concerning the point at which the first perforation would be made. Would the men and machines meet? Had the levels been correctly estimated? Had the direction been properly maintained? More than nine miles of solid earth, and still more solid rock, had originally separated the workmen. Would they meet within the mountain depths, or were they pursuing each other in vain? Were those echoes or the tapping of the rival machines?

On the 29th of February, 1880, all doubts were set aside. The last thin stratum betwixt the northern and southern armies of labourers was pierced. The men greeted each other cheerfully, delighted that the bore had been so true. But for awhile the hand-grips were withheld. A small case containing a portrait of Louis Favre was the first thing to pass from hand to hand. So the men recognised their master, and honourably gave him the *pas*.

There was only 2 in. difference in the levels, and only 13 in. in the directions of the cuttings, through all those miles of mountain! The actual length of the tunnel proved to be just 25 ft. shorter than the estimate calculated in surveys! Well might we exclaim "Prodigious!" in the face of such close calculations as these.

The men had met, but the tunnel was by no means yet completed. It was not actually finished until New Year's Day, 1882—now ten years ago. The cost of the tunnel was about £2,320,000. Its length is 16,308·9 yards—9½ miles. Its elevation varies from 3,638 ft. north to 3,756 ft. south, above the sea, and 3,787 ft. in the centre. It is 2,930 yards longer than the Cenis Tunnel; the slope is 6 in 1,000 on the Swiss, and 2 in 1,000 on the Italian side.

The St. Gothard Tunnel has a double line of rails, and is lighted by lanterns. There is no inconvenience in the transit of sixteen or seventeen minutes; and last year the writer experienced no sense of discomfort, save "blacks," even outside the carriage. The "helicoidal" tunnels are unique, but we have no space to describe them here. The other tunnels are lengthy. Of all on the line, fifty-six in number, twenty-seven are to the north and twenty-eight to the south of the Great St. Gothard Tunnel.

In our next paper in this Series of Great Engineering Triumphs we shall hope to interest our young readers especially in another not less wonderful example of labour and enterprise; and from time to time so extend the stories as to gradually make our readers familiar with the greatest among these vast monuments of skill and patience.

SCIENCE TO DATE.

Diamonds in Meteorites.—During the early part of last year a discovery was made of several masses of meteoric iron in Arizona. An examination of these meteorites in the laboratory has revealed the interesting fact that they contain diamonds, both black and white. They are small, and of little commercial value, but the discovery is interesting mineralogically, as it is the first time that diamonds have been found in meteorites, though their presence has been suspected.

Carbon and Iodine Compound.—A very interesting compound of carbon and iodine, of which the formula is CI_4, has been recently discovered by M. Moissan, the eminent French chemist, who is so well known by his experiments on fluorine. Carbon tetra-iodide, as the compound is called, is prepared by heating boron iodide (a substance which has also been recently discovered by M. Moissan) and carbon tetra-chloride in a sealed tube for one hour at a temperature of 80° to 100° C. The new substance is, after purification and sublimation *in vacuo*, obtained in magnificent brilliant red crystals, resembling the artificial rubies prepared some time ago by M. Fremy. It possesses very remarkable chemical properties, acting energetically with many substances. One particularly interesting reaction is that when dissolved in carbon tetra-chloride and warmed with silver fluoride it gives off gaseous carbon tetra-fluoride.

Electricity and Light.—M. Blondlot has recently made a determination of the velocity of propagation of electro-magnetic waves. He finds it to be approximately 186,000 miles per second. This agrees with the best determinations of the velocity of light, and lends valuable evidence in support of the conclusion that luminous vibrations are only particular cases of electro-magnetic vibrations.

New Alloy of Aluminium.—A new alloy of aluminium and titanium has been discovered by Mr. Langley, the well-known American astronomer, which possesses a hardness almost equal to that of steel, while it is not much heavier than aluminium itself. The proportion of titanium added must be less than ten per cent., for if it exceeds this quantity the alloy becomes too brittle for ordinary purposes. It is very probable that this alloy will become of great industrial importance.

NOTES FOR WORKERS.

British oak timber is stronger than that grown in Canada and Dantzic.

Ivory can be made soft and nearly plastic by soaking in phosphoric acid. If washed with water, pressed, and dried, it will regain its former consistency.

The best wood for an aquarium is East India teak. No metal should be exposed to the water.

Edison will exhibit at the St. Petersburg Electrical Exhibition a speaking watch. The dial represents the human face, and within is a phonograph. The mouth opens and tells the hours, half-hours, and quarters. It can also be used as an alarum, remarking several times running at the set time, "It is time to get up."

Canada Balsam can be cleaned from microscopical slides by rubbing them with a rag dipped in spirits of turpentine or benzine.

The velocity necessary to carry a gaseous molecule from the moon to the earth is a little over two miles per second.

Fifty-three per cent. of all the sugar now sold is obtained from the beetroot, the remaining forty-seven per cent. coming from the sugar-cane.

When first tried—about one hundred years ago—the amount of sugar got out of a beetroot was only two to three per cent.; it is now about fourteen. This is due to improved machinery and to the improvement of the roots themselves from careful cultivation.

During the late earthquake in Japan there were seven hundred and thirty distinct shocks. This earthquake is thought to have been caused by a mountain, which has disappeared, falling into one of the bottomless underground cavities which are known to exist.

The quantity of blood in the human body varies, but is generally about one-tenth the total weight of the body.

TRADE: PRESENT AND FUTURE.

CYCLE TRADE.—The season 1892 has opened auspiciously. Makers and wholesale dealers are everywhere jubilant over the reception given their representatives and the large orders placed with them for the season just opening. Apart from home consumption, so to speak, large consignments of cycles are exported to America, our colonies, as well as the continent of Europe. These consignments are larger and earlier than in any preceding year. The St. George's Engineering Co. despatched to the Continent last month the largest consignment that ever left Birmingham. The magnitude of the orders placed this season may be gathered from the fact of a Glasgow firm of dealers having received from a Birmingham maker a consignment of 1,000 safety bicycles, and in little more than two weeks they had sold of them over 150. The run on these machines has been so great that the firm has raised the prices. This firm can show a stock of 1,500 machines. A Wolverhampton maker—by no means the largest—has orders on his books amounting to £5,000, and is prepared to turn out 2,500 machines during the present season.

TIMBER TRADE.—As an instance of the great increase in the consumption of wood in London, it is worth noting that, while in 1855 it was 6,802,000 pieces, in 1890 the number had increased to 33,198,000. Padouk—an East Indian wood very similar to mahogany, but of a redder colour—is now making its way in the market, and is much used for handrails, bath-tops, panels, and for furniture, as it looks very beautiful when polished. Some ceiling ornaments made of wood-pulp in imitation of plaster were offered up at a timber sale-room in London last week, and were sold at prices varying from 2s. to 9s. 6d. each, according to pattern and size.

JOINERY TRADE.—At the last meeting of the Edinburgh and Leith joiners, a report from the Conciliation Board was submitted, embodying the draft of the working rules. A good deal of discussion took place, but ultimately it was agreed to accept them in the meantime, and to modify them afterwards in the light of subsequent experience of their working.

PAINTING AND DECORATIVE TRADES.—Trade in London this season will be rather quiet. White lead is low in figure; leading London houses are offering "Genuine" at £20 per ton for this season's delivery. The strike of London carpenters has done for the building-trade house-painters as much injury as the recent death amongst royalty has effected in West-End trade. The uncertain condition of political matters is also very prejudicial to a good season of work in town. The prospect for the provinces generally is good. Sanitary papers are the special feature of this season's "new goods." Although, like the early Japanese leather-papers, these paper-hangings were originally chiefly noticeable for their faults, the great improvements in trade machinery that have taken place these last three years have put sanitaries in the front rank of 1892 sales. Not only are they practically perfect in artistic effect, but the prices are this year cut remarkably low. An eminent North of England house, who make "sanitaries" their speciality, have produced some cheap lines for retailing at 6d. per roll, the appearance of which is equal to many pulps and grounded papers sold at 1s. per piece.

HARDWARE TRADES.—Cutlery and silver trades, as also razor and scissors trade, and the fine kinds of steel trade, which since the opening of the year have been so depressed, are looking up a little, and if the improvement is steady we may look forward hopefully. A strike has recently been averted at a large Sheffield steel worker's by the masters conceding an advance in wages. This was only after notices had been handed in and the representatives of the trade society requisitioned. A large firm in Sheffield has taken the initiative in pensions for aged workpeople employed. There is real need of wage reform in the hardware trades, it being the lot of workers, even after working for firms for thirty years without short time, and through no fault of their own, to end their days in need and want. A great deal of talk is going on amongst the manufacturers of Sheffield as to their not sending goods to the Chicago Exhibition, and it does not appear as if very many would take part in it.

BOOT AND SHOE TRADE.—Trade is not brisk in the best London hand-sewn work. At a recent meeting of the London County Council the Joint Store Committee reported having ordered twenty pairs of boots to be made by Mr. G. Clark at 45s. per pair, and ten pairs of Mr. G. H. Beaver—these ranging from 30s. to 45s., according to height of leg—the object being to thoroughly test them before ordering a large quantity, as it has been found difficult to get the kind of boot required by men working in sewers. It was urged "that the committee be authorised to order the boots, subject to an estimate being submitted to the Council by the Finance Committee as required by statute," and this was agreed to.

GLASS TRADE.—The plate-glass market has of late been subject to some very striking fluctuations, and prices have recently been at a very low ebb. If anything comes of the talked-of Yankee patent, which is supposed to make best plate at about one-third its present cost, there will surely be a revolution in this line. This is the age of big panes, when a polished plate 200 in. by 150 in. is no rare thing.

ENGINEERING TRADE.—The present condition of the Lancashire engineering and iron trades is anything but encouraging, and unfortunately the prospects of improvement are very slight. Many of the leading firms of machine-tool makers, who for the last three years or so have been exceedingly busy, report an almost complete dearth of new orders, and several establishments are already very short of work. Most of the large stationary engine builders report a marked decrease in activity, while the locomotive-building firms are decidedly quiet. This latter fact is generally considered to indicate the likelihood of a continued absence of new business in the engineering industries. The general depression in the iron trade of the district continues, the disturbance in the coal market affecting makers' prices but slightly.

BUILDING TRADE.—There is every prospect of a good year for workmen in the building trades in Rochdale and district. Cottages, Co-operative Stores, and a new Board School and Technical School are in the hands of local firms, and, as most of the mills in the neighbourhood are fairly busy, matters may be said to be going well. In the adjoining village of Castleton some large engineering works are making rapid progress, bricks being used up at the rate of about thirty thousand per week, and much more building is expected to be done in connection with them. This improved outlook has caused the workmen to consider their interests, and one section of the building trades (the joiners) has given notice of an advance of wages, to take effect in July. This action has been taken at the instigation of the local branch of the Amalgamated Society of Carpenters and Joiners, and will most likely be followed by similar pressure on the part of the other trades.

SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

*** *In consequence of the great pressure upon the "Shop" columns of* WORK, *contributors are requested to be brief and concise in all future questions and replies.*

I.—LETTER FROM A CORRESPONDENT.

Industrial Exhibition. — The SECRETARY writes :—" Lady Jeune will open, on March 23rd, the fourth exhibition in connection with the Waterloo Road Chapel Sunday School, Lambeth, S.E. Readers of WORK may send exhibits to the Loan section, which will consist of Drawings, Paintings, Maps, etc., Models in Cardboard, Cork, etc., all kinds of Woodwork, Fret Cutting, Turnery, Photography, Models (working, etc.), Curios, Microscopical, Electrical, or other Scientific Apparatus, Engraving in Wood, Steel, and Copper; also Wood Carving, Modelling, and Pottery. Certificates of merit will be awarded."

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Battery for Small Coil.—W. W. (*Forest Gate*).—Yes, you can work a small coil with current from a pint Leclanché cell, but the coil must be very small, and the work expected from it be also small. As you have omitted to state the intended use of the coil, I cannot tell you how to construct one. As the induced current from a small coil capable of being worked with a pint Leclanché cell would be very feeble, I cannot imagine any real use for such a coil. If you will read carefully the series of articles on "Induction Coils" now appearing in WORK, you will learn how to make and work a small coil.—G. E. B.

Electrical Engineer.—W. J. M. (*West Kensington*).—(1) I do not think it possible to get your brother into a good firm of electrical engineers to learn the profession without paying what you would deem a high premium—say, from £150 to £250. (2) There are several good firms in London who receive pupils or apprentices when a vacancy occurs. You will find their names in an Electrical Directory. There are also some in the provinces, but I do not know of one in the Isle of Wight. (3) The usual term is from two to three years, without salary. (4) Undoubtedly electrical engineering is likely to prove a good profession, and there will soon be room at the top in this and other countries for many thorough good men. (5) There is a School of Electrical Engineering in Prince's Street, Hanover Square, London, W. Write to the secretary for prospectus and terms, or see him yourself, and be guided by his advice. This will be better than I can give you here, as you will have the advantage of a personal interview with him.—G. E. B.

Tools for Turning Parts of Model Engines.—S. C. T. (*Knutton*).—You should certainly get a book on Model Engine Making. Send 2s. 6d. to J. Pocock, Garth, Bangor, North Wales, and he will send you a very useful little book; we could not get such helps when we were boys. You require but few turning tools, and you can make them out of old files if you like, and if you know what shape they should be. You require, first, a graver: this is made of square steel, and will do of $\frac{3}{16}$ in. square. It would be best to buy a Stubbs' graver at a tool shop for a few pence, though you could make it from an old square file. Secondly, you want a side tool, which may just as well be made out of a saw-file about 4½ in. long. These two are shown in the sketch at Figs. 1 and 2, and they are for use on iron and steel. Also you want Figs. 3 and 4 for use on brass. Fig. 3 is called a router, and is made of

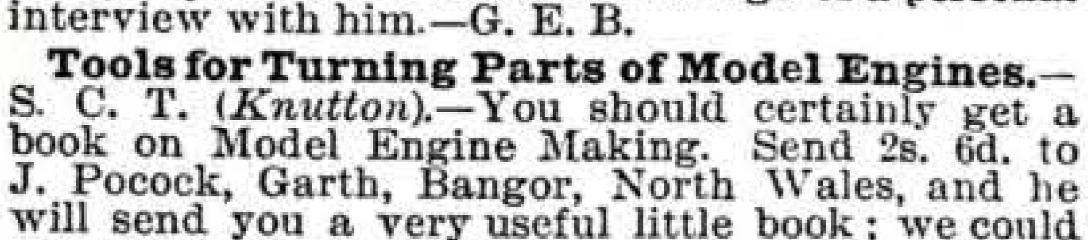


Fig. 1.

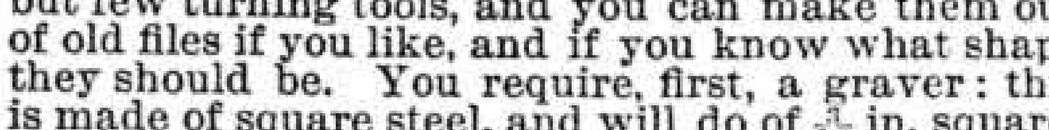


Fig. 2.

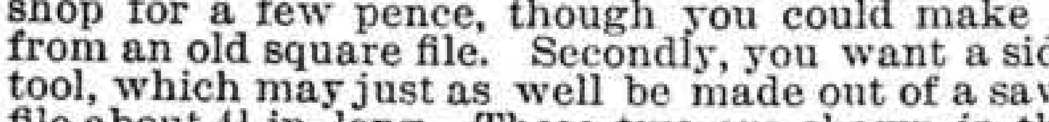


Fig. 3.

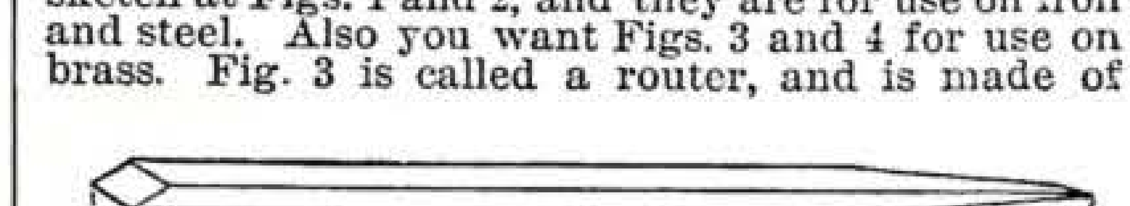


Fig. 4.

Turning Tools. Fig. 1.—Graver for Iron and Steel. Fig. 2.—Side Tool for Iron and Steel and for Scraping. Fig. 3.—Router for Brass. Fig. 4.—Scraper for Brass in Lathe and for Flat Surfaces.

square steel; you can make it from a square file, or from a $\frac{3}{16}$ in. graver, by grinding a rounded end almost squarely off: it is a good plan to have it ground square, because then you have two sharp half-round edges, and can turn it over when one side is blunt. The router is used for roughing out in brass. Fourthly, you want a flat tool or scraper for brass (Fig. 4). This will do of a flat file about 5 in. long by ¾ in. wide; a fine-cut file would be best, as you must grind off the teeth at the end, as shown; the front edge should be quite thin—say, $\frac{1}{32}$ in. thick—and, after grinding, you can rub it on an oilstone, holding it perfectly upright. No. 2 will also do for scraping iron, such as a valve-face; and No. 4 will do to scrape up the brass slide-valve to work upon it. The temper or hardness of these tools, as made from gravers and files, will be better than anything you could have forged by a smith. When you have got them, show them to a workman, and ask him if they are rightly shaped, and get him to show you how to use them.—F. A. M.

Lenses.—H. S. M. (*Highgate*).—The price of the object-glass mentioned in the note to which you refer was taken from the catalogue of H. and E. J. Dale, of Ludgate Hill. However, since your letter reached me I have written to several dealers, and find in the catalogue of Mr. Caplatzi, of Chenies Street, Tottenham Court Road, W.C., lenses of various qualities and prices, and this catalogue you should obtain. I notice that he supplies a 2¼ in. achromatic object-glass *in a brass cell* for 3s., 6s., 12s., and 21s., according to the quality. Your other question respecting the refracting telescope will be answered in illustrated papers which will shortly appear in WORK.—E. A. F.

Lithographing on Zinc.—ZINCO.—In answer to your question, How to prepare common sheet zinc for lithography, if you refer back to my answer to LITHO, in "Shop," on p. 509, No. 136, Vol. III. of WORK, I think you will find all you require to know. In etching the plate, after the drawing has been completed, use a preparation of nut-galls in preference to acids, which should not be allowed to remain on the plate longer than is absolutely necessary just to etch the work. It should then be washed off, and the plate gummed in the ordinary way; when dry, wash the plate with turpentine, without first washing off the gum (which would be done in the case of a stone); after which, roll up in the usual way. I think if you try the above etch without allowing it to remain on the plate too long, you will find the printing ink catch in the right places. It was perfectly right to use litho-writing ink to do the drawing with, and certainly lithography can be done with a hand-press.—A. J. A.

Dimensions of Dulcimers.—W. S. (*Appleby*).—There is practically no limit to the size of a dulcimer, so long as you keep the proportions correct. Thus, an octave D would be half the size of an ordinary D, and one twice the size would be called a D D (double D), and the same with F's or G's. The largest made in the ordinary way is the A, the dimensions of which would be: length in front 4 ft., at back 2 ft., depth 2 ft., compass 3½ octaves. This, however, is a rather unwieldy instrument, and is very seldom made, the most useful for all purposes being the D. The A is always made with five, or even more, strings to a note, and this necessitates a much stronger construction of the shell to stand the increased pressure, or "draught," of strings, and also a considerable strengthening of the belly by means of stays. Its tone is not nearly so pleasant as that of the smaller ones, owing to the confusion arising from the undamped strings.—R. F.

Corner Cupboard.—BARKIS, B.A. (*Australia*).—I should like to draw our readers' attention to the land of your abode as evidence of the extensive popularity of our journal. The corner cupboard which I have designed will, I believe, be acceptable to you. As you see, it is very simple; but my suggestion for the arrangement of the upper parts will provide an effective disposition of light and shade, which is desirable, as a rule, in dark corners. Make the job in two carcases, screwed together at the point immediately above the lower brackets and the bottom of the top cupboard. Unite each pair of sideboards by dovetailing, or else by mitring the

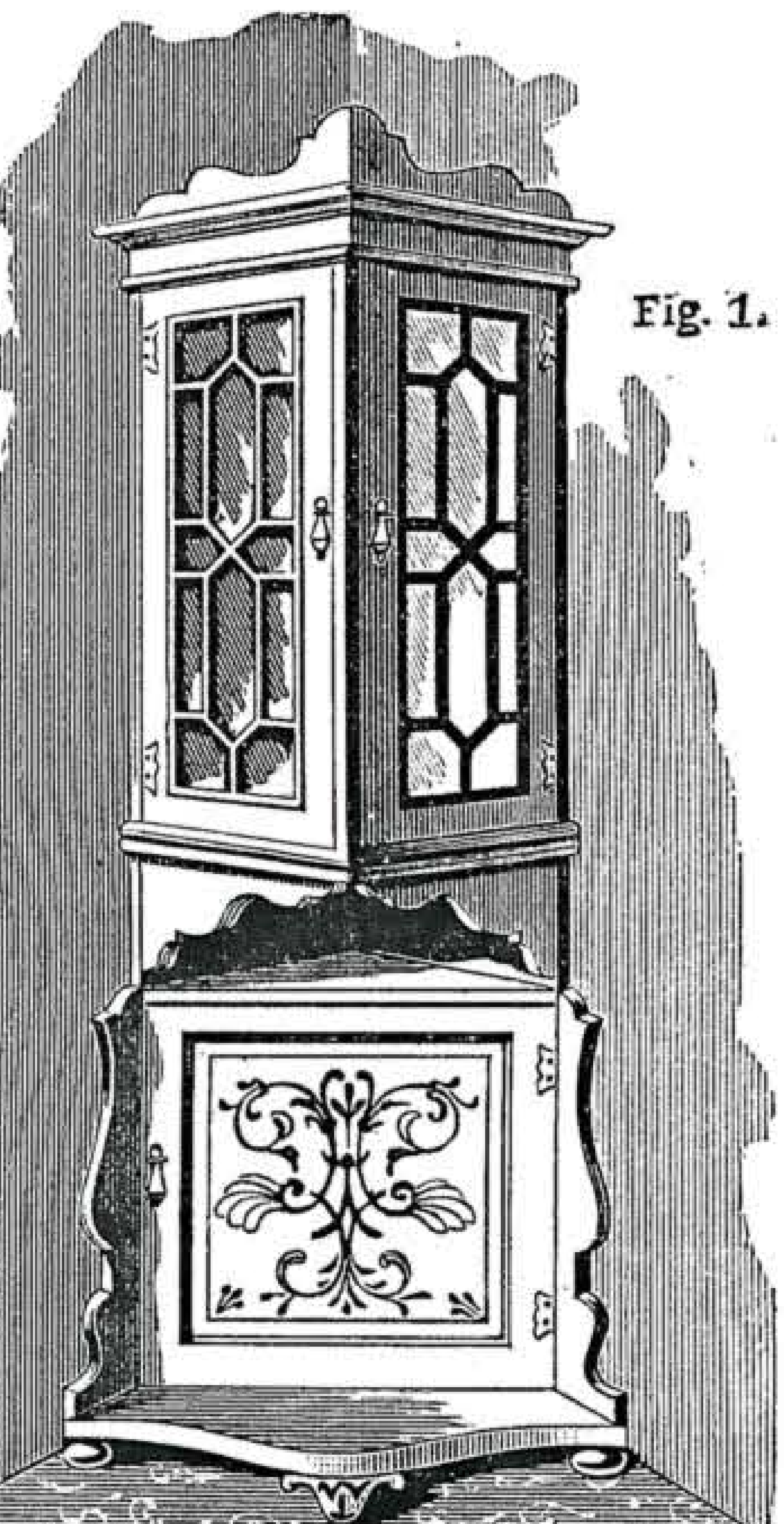


Fig. 1.

Fig 2

Corner Cupboard Design.

back edges, and screwing a stout post in the angles, as in Fig. 2. Run a post up at the front apexes between the two top doors to receive the free ends of the latter. Both the vertical edges of the lower door will need bevelling. The bottom and top boards of the upper carcase are proposed to be quite square. You can either use solid boards as back boards, or construct them as rebated frames to receive a matchboard backing. The sizes I hereafter name will be suitable, but they really depend upon the size of your room. Lower door, 20 in. wide and 24 in. high; space, 12 in. deep; total height, 6 ft. Side boards, 1 in. thick; top and bottom boards and doors, ¾ in. thick; intervening boards, ½ in. thick.—J. S.

Stage Carpentry, etc.—A NEW READER.—Articles on Stage Carpentry appeared in Nos. 140, 144, and 149; and Short Lessons in Wood-working in Nos. 138, 139, 140, 141, 142, 143, 144, 145, 146, 148, 149, 151, 152, 153, 154, 155, and 156 of WORK.

Most Useful Chuck.—CHUCK.—You are anxious to know whether the American scroll chuck is the most useful. I must suppose you have the usual fork chuck for driving wood, the driver chuck for iron, etc., to be turned between centres, and the screw-nose or cup chucks, for holding wood or other materials to be bored or hollowed out. These are the most useful, and they are supplied with all new lathes. Next to these in utility would come either a face-plate, bell chuck, or an American Universal; and which is best for you I cannot possibly tell without knowing what work you wish to do: it is almost like asking which is the most useful of carpenters' tools. A very good Universal is Cushman's 3 in., with three pinions and two sets of jaws (for inside and outside work): it costs £2 15s.; the 2 in., £1 14s.; and another £3 6s. These chucks are imported by Churchill, of 21, Cross Street, Finsbury; any ironmonger would get one for you. Then you would have to make a cast-iron flange to screw on to the mandrel nose, having a projecting fitting turned on it to fit into the recess in the back of your chuck. If you cannot do this, you will have to send the new chuck and your headstock to a workman, who will probably charge you about eight shillings for fitting the flange.—F. A. M.

Lacquer and Black for Iron Goods.—J. W. (*York*).—By describing the bronze lacquer you want, you will doubtless be able to get it (at first hand) from Tubbs & Wilkins, Hockley, Birmingham. Drop-black ground in turps, with an addition of one-eighth bulk of japanners' gold size to bind it, has been recommended as a good black for iron-work.—S. W.

Overmantel.—NEW READER.—Much has been written concerning overmantels; and I strongly advise you to obtain the indexes to Vols. I., II., and III. of WORK, which are procurable through any newsagent at 1d. each. White chestnut is a wood I rather incline to. If, after you see back numbers, you are still doubtful, write again.—J. S.

Macramé Board.—W. S. (*No Address*).—As the board described on p. 681, No. 147, differs from others only in minor matters, the method of commencing is the same as for them. I may say that the first foundation string is tied or looped on to the nail or pin at the left hand of my board (see Fig. 1, p. 681), and then tightened up as much as possible by means of the peg at the right. Two, or even three, strings are usually employed, and when strained quite taut, raise the bridges. Now comes the setting on of the strings; and the number and length of these depend entirely on the pattern chosen. But should W. S. be conversant with the stitches, he will surely have no difficulty in going ahead; if he is not, let him learn them first, and then, if he is at a loss for a "tip" or a "wrinkle," I shall be very pleased to give him either—always supposing our Editor to be sufficiently long-suffering. I might remind W. S. that macramé lace is as much out of place in the pages of WORK as knitting or crochet would be.—PASQUIN.

Incubator.—R. W. (*Fence Houses*).—All your queries have been dealt with in my replies to previous correspondents, which please refer to. Purchase the index to Vol. III.—LEGHORN.

Hot-Water Supply.—NO NAME (*Manchester*).—If you syphon the cold-water supply before allowing it to enter the return, it will prevent the water boiling back into the cistern, and you will, no doubt, find the apparatus work properly. Do not lower the cistern in putting in the syphon; it is quite low enough already. If you raise it, you must lengthen the air-pipe in proportion. You will probably find that the two leaky joints have "taken up"—*i.e.*, stopped leaking—by this time. It is not an uncommon thing for a joint to leak a little at first. If they do not stop, you must empty the pipes, rake the joints out, and re-pack them again as before.—T. W.

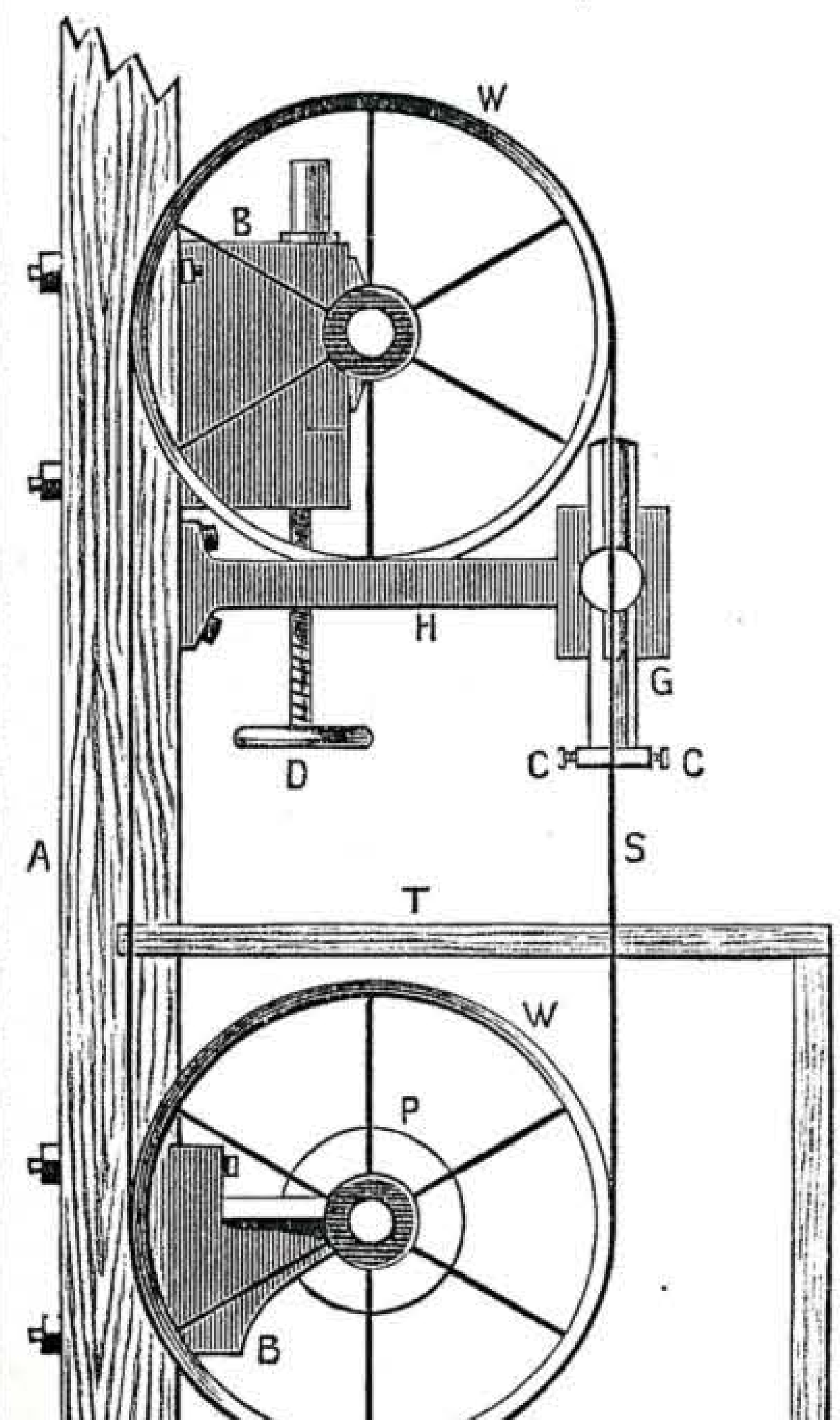
Waterproofing Canvas Shoes. — G. E. B. (*Ipswich*).—There is a solution of rubber, sold in tins by the waterproofers and indiarubber manufacturers, which is used for joining the seams of rubber-proofed material, which we think might be successfully used for the purpose named by our correspondent. We would not advise the *manufacture* of the solution, as it is both slow and troublesome. It seems to us if G. E. B. procured some of the solution, with about half a pint of strong mineral naphtha, and had his canvas shoes perfectly clean and dry, he might damp them well with the naphtha, and then apply the solution with a moderately stiff brush all over the canvas; and when the naphtha has evaporated he will find that the surface of the canvas and the interstices will be covered with a thin coat of indiarubber, which, so long as it is sound, will keep them thoroughly water-tight. He must be very careful not to use the naphtha or the solution near any lamp, candle, or gas; and as the solution thickens by evaporation, he may add some of the naphtha to produce the required consistency. The proofing of the material for an air mattress will have to be done by a firm possessing the necessary plant, machinery, and facilities, as well as experience, needed for this work.—C. E.

Saw Hammers.—A. C. R. (*Cardiff*).—In my reply (see p. 699, Vol. III.), please read, "The roundness of the faces of the cross-face hammer should not be so much in a hammer used for hammering saws after they have been ground."—A. R.

Auriphone.—AURIPHONE.—If our correspondent will apply to Messrs. J. G. Murdock & Co., Farringdon Road, E.C., he will obtain the music he requires.—G.

Small Dynamo.—C. F. W. M. (*Enfield Lock*).—To build a receptacle for a dynamo, and then build a dynamo to fit the limited space at your disposal, seems to me to be the converse of a wise arrangement. You have left me in the dark except on one point: "The dynamo must not be longer than 1¼ in." I cannot plan a dynamo for you with such meagre information, so will merely advise you to wind as much silk-covered No. 26 wire as you can get on the armature, and as much silk-covered No. 32 as you can get on the fields, connect in shunt, and drive at from 2,000 to 3,000 revolutions per minute. You *may* then get enough current to light a 4 volt 2½ c.-p. lamp, or a smaller one, as shown in your sketch. You have not told me enough. I must know more to advise you properly.—G. E. B.

Band-Saw.—N. DE P. (*No Address*).—As you want to fit this up yourself on a cheap scale, you must not expect to do it with all the latest improvements. I give a sketch of a machine. The upright (A) is a piece of timber fixed in the ground or to a beam stayed and sufficiently strong to prevent vibration; B, B are cast-iron brackets, bolted to the pillar or upright (A). The bottom bracket has a long bearing, in which the shaft runs that carries the bottom wheel. This is keyed on one end of the shaft, and on the other is a tight and loose pulley, over which a belt is driven. The top bracket is a hollow casting, in which a spiral spring is enclosed, and in which slides a plate of iron, with a pin cast in it, to carry the top wheel. D is a hand-wheel and screw; by the turning of it the top wheel may be raised, giving the saw its required tension; H is an arm to hold the saw-guide (G), which has a slot in it, so that it may be raised or lowered to suit different depths of wood; C, C are guide-screws, which keep the saw in the centre and from twisting, if small pieces of wood are placed on either side of the saw. A similar guide should be fitted underneath



Band-Sawing Machine.

the table. T is the table, which is made of wood, on which rests the wood while being sawn; W, W are the wheels on which the saw runs. These should be covered with rubber bands, to lessen the possible breakage of the saw. The top wheel should not be less than one-third lighter than the bottom wheel, which will prevent the top wheel over-running the bottom wheel; it also to a great extent prevents saws breaking. P is the pulley on which runs the belt that drives the machine. If N. DE P. finds any difficulty in getting the brackets cast, he might send a rough sketch of them to a maker of wood-working machinery, stating what he wants them for, and he will, I have no doubt, get them. If, by having iron wheels, it will be a too expensive affair, two wheels may be cut out of a seasoned piece of wood. Then bore holes in the centre and bush them with iron or, better still, brass. See that the wheels are perfectly round and properly balanced; cover them with soft leather or rubber. N. DE P. does not say by what power he intends driving his saw. If by hand, I must say that I never knew a band-saw to give satisfaction driven by hand. In reference to joining the ends of saw, the only satisfactory method with which I am acquainted is to braze them. Should N. DE P. wish for further information, let him write again, stating clearly what it is, and I will do what I can to help him.—A. R.

III.—QUESTIONS SUBMITTED TO READERS.

. *The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Roller Skates.—F. (*Huddersfield*) writes:—"Would any correspondent of WORK please tell me how to make a pair of roller skates of the ordinary pattern, giving the size of rollers and, if possible, an illustration of skates?"—[Effective roller skates can be bought so cheap—especially in London—that it seems a sheer waste of time and patience to attempt to make a pair.—ED.]

Small Brass Castings.—E. L. (*Woolwich*) writes:—"Will any brother reader inform me where I can get small castings done, and if there is any material that I can make patterns from in the way of a wax—such that it can be softened at the fire, made the required pattern, and, when cold, hard enough for putting in the sand?"

Cottage Architecture.—DORKIN writes:—"Will any reader kindly refer me to any book, at a reasonable price, giving samples of cottage architecture, either detached or for terraces, as used in the Midlands, where, from passing trains, I have noticed many charming little houses? Cost not to exceed £350, without land value."

Catgut.—CANOE writes:—"Would some kind reader of WORK inform me how to make catgut for angling purposes? It must be very fine and clear."

Soldering Flux.—GRATEFUL writes:—"Will any reader kindly inform me, through 'Shop,' what is the best ingredient to use, instead of spirit, as a flux for soldering bright iron, where it is essential that the iron should not rust?"

Lantern.—E. H. L. (*Leicester*) writes:—"Will some kind reader give me instructions as to making a small lantern for throwing colours on to the scenery of a model theatre by means of inserting coloured glasses? Also what kind of glass must be put in front of lantern?"

Fancy Articles Market.—CABINET-MAKER'S TOOL writes:—"Could any reader kindly give me names and addresses of one or two agents, etc., who would introduce and place fancy articles, such as jewel-cases, boxes, inkstands, smokers' cabinets, etc.? How and where do dealers in such articles obtain them?"

Monogram.—AMATEUR asks:—"Would some reader be so kind as to work the initials M. W. T. for cutting in fretwork with fancy background?"

Fret Monogram.—YOUTHFUL READER writes:—"Will someone give me J. T. E. for a fretwork monogram?"

Musical Combination.—E. P. B. (*Penge, S.E.*) writes:—"I saw at Olympia a flute attachment to the piano, fed by indiarubber tube, and bellows worked by right foot of operator. It simply rested upon the treble keys, and was actuated by them, the depressing of the key evidently allowing the vertical wire which rested upon it to drop, and thus open a valve in the pipe corresponding to the key depressed. I should be greatly obliged if any reader could give me instructions for making the above—premising at the outset that I am a tyro at musical instrument building, and should buy the set of pipes ready-made, but should be equal to the construction of the remainder if anyone can kindly give me a few hints as to details of same."

Brass Polish.—QUILL-DRIVER writes:—"I have fender, five brasses, dogs, and coal-box, which I cleaned with some kind of paste, purchased at an ironmonger's. Immediately afterwards the whole became dull, with blue-black patches. Could any reader please help me and instruct as to cleaning in future, so that the polish would last? The lid of coal-box is embossed."

Inlay Polish.—H. S. P. (*Brixton, S.W.*) writes:—"Will any reader kindly tell me the best way to polish pearl inlaid work after filing down, and what with?"

How to Make a Sand Yacht.—C. O. S. (*No Address*) writes:—"Can any reader give me some information as to making a boat for sailing on the sands, or the address of anyone who would do so?"

Mechanical Saw Set.—F. B. (*Rochdale*) writes:—"Will any of your readers who have tried the mechanical saw set described by M. Powis Bale state whether it sets the saw accurately, also gauge of saws set by it? State price, and where to be bought."

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Gas Engine.—M. (*Bishop Auckland*) writes, in reply to LATHE (see No. 150, p. 733):—"I should advise you to try an Otto gas engine. One fixed in this district has been very satisfactory."

Oilstone.—EDDIFRA writes, in answer to A.E.M. (*Cheshire*) (see No. 149, p. 718):—"I had an oilstone—a Washita—which, when new, had a splendid grip; but after using about a year, it became hard. I took the case off, and placed it in a deep tin full of oil for about three weeks. I think the reason the stone became so hard was that the oil—perhaps an inferior kind—set in the stone and choked it up. The best oilstones—Washitas—I have now are thin with wear, and the oil I place on soon soaks through and keeps the pores clear."

Gas Engine.—A. B. (*Blackburn*) writes, in reply to LATHE (see No. 150, p. 733):—"The area of floor space the gas engine would take up depends, to a great extent, on the power of the engine. Taking Crossley's Otto engine as a type, their vertical 'Domestic' motor, ½ horse-power, takes a space of 2 ft. 3 in. square; a 2 horse-power horizontal would require 6 ft. by 3 ft. 7 in.; a 6 horse-power horizontal takes up 8 ft. 10 in. by 4 ft. 6¼ in.; while a 50 horse-power would require a space of 12 ft. by 8 ft. 2 in. If LATHE will settle on the power he requires, he can soon get at the floor space needed from the makers or their agents. A 9 horse-power vertical would stand on a space about 4 ft. square."

Blowing Fan.—HALL writes, in reply to WAREHOUSEMAN (see No. 151, page 750):—"I think Blackman's is as good as any, if not the best. Their address is Blackman Ventilating Company, Limited, Fore Street, London; also at Manchester, Bradford, Birmingham, Glasgow, and Bristol."

Rock Drills.—PANKO BURTINA writes, in reply to MONT CENIS, on Rock Drills (see No. 151, page 750):—"I should recommend the Rand drill, manufactured in America by the Rand Drill Company, but for sale in the British market. It is a very good drill indeed when in use by practical men. It is fitted with a column and a tripod, also a duplex column. The duplex column is generally used for sinking purposes; also the tripod can be used in sinking, and is also adapted for quarrying. The single column is very good for mining or tunnelling. The same Company supplies a battery and wires of all descriptions, also exploders for blasting operations, and a much safer process of blasting than by using fuse. I have had about three years' experience with the drill I recommend, and have come to the conclusion that it is one of the best machines I ever used for drilling. I hope that MONT CENIS will give over the steam idea for a drill."

Tailors' Cutting and Fitting.—W. W. H. (8, *Albert Grove, Leeds*) writes, in answer to DODO (see No. 154, page 750):—"He can obtain a catalogue of all their published works, post free, from the John Williamson Co., 93, Drury Lane, London. He can also get prices of the West End system from Mr. F. T. Prewett, 23, Warwick Street, Regent Street, W. All the works on cutting of any practical value are expensive, and not easily understood by anyone outside the tailoring trade. If DODO finds the works I have quoted too elaborate, if he will communicate with me, I will put him in possession of systems for a much smaller sum than he can buy them elsewhere for."

Shoe Mending.—W. writes (in reply to DUMMY) (see No. 150, page 733):—"I think if DUMMY refers to No. 149, Vol. III. of WORK, he will find in the answer to A. H. (*Nottingham*), in column 2, page 716, all that he wishes to know, with diagrams of various stages of the process."

Shoemakers' Size.—W. G. writes to ONE IN A FIX:—"In answer to your second query (see No. 144, page 637), the size you ask for is made in the following manner: Ingredients, ¼ lb. yellow soap, twopenny-worth of glue, and one quart of soft water. Process: Cut the soap up fine, and break the glue into small pieces; put them into a saucepan, and pour the water over them; put it on the fire, and well stir it till it just boils. Pour it out into another vessel to cool. It is then ready for use."

Enamelling Fretwork.—LIFEBOAT writes, in reply to G. F. R. (*Bournemouth*) (see No. 150, page 750):—"He will find his troubles vanish if he will, previous to applying the enamel, give the work one or two coats of French polish. Allow this to get quite dry, then smooth down with worn glass-paper. And he will find it an advantage if he will mix a little dry colour, such as Venetian red, yellow ochre, etc., in the polish, to make it match his enamel, and so form a foundation."

Coal-dust.—HALL writes, in reply to HOUSEHOLDER (see No. 151, page 750):—"Use it as a backing, first having wetted it with water, but of course not too wet; or make a heap of it, and mix coal-tar with it to the consistency of soft putty; mould it in iron moulds brick-shape, and, if practicable, bake it in low temperature."

Machine Fan.—A. P. (*Longsight*) writes, in reply to WAREHOUSEMAN (see No. 151, page 750):—"Respecting fan for cleaning warehouse, these are made by the 'Union Engineering Co.,' Pollard Street East, Manchester, who will supply all particulars and price lists. They have fans working in all the large towns in the world."

Glass Mending.—HALL writes, in reply to H. H. (*Chacewater*) (see No. 151, page 750):—"The old Polytechnic cement is very good, also Imperial Liquid Glue; no heating required: Hayden & Co., Warwick Square, London, E.C. There is a very good cement made and sold by Keye, Filter Maker, Hill Street, Birmingham. Several excellent glues are advertised in WORK. (See WORK advertisements)."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—F. B. (*Leek*); J. G. (*Glasgow*); W. S. (*Batley*); J. H. B. (*Pendleton*); T. W. M. (*Bolton*); T. A. (*Oldham*); J. B. (*Keighley*); W. W. (*Salford*); COTTAGES; J. H. C. (*Rochdale*); A NEW READER; ELECTROLIER; ANXIOUS; W. W. (*Caverton*); LIQUORICE; F. R. S. (*Horsham*); LIQUID GLUE; J. H. B. (*Pendleton*); G. E. (*Upper Clapham*); A READER OF "WORK"; STILL WAITING; F. R. M. (*Wallsend*); W. A. G. (*London, E.C.*); T. C. (*Birmingham*); J. P. (*Reigate*); R. W. (*Liscard*); A. E. (*Birmingham*); R. F. (*Norwich*); AMATEUR; G. H. (*Swansea*); SCREEN; J. K., JUNR. (*Glasgow*); J. J. MCQ. (*Drogheda*); W. J. (*Browney Coll.*); A MONTHLY SUBSCRIBER; W. J. S. (*South Shields*); S. W. (*Chesham*); A NEW READER; WALSALL; FOUNTAIN; W. W. (*Wokingham*); W. J. H. (*Shepton Mallet*); F. W. J. (*Pottam*).