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VERDE ANTIQUE MARBLE

Plate IX P. 117.

A PRACTICAL MANUAL OF

HOUSE-PAINTING

GRAINING, MARBLING

AND

SIGN-WRITING

CONTAINING

FULL INFORMATION ON THE PROCESSES OF HOUSE-PAINTING IN OIL AND DISTEMPER, THE FORMATION OF LETTERS AND PRACTICE OF SIGN-WRITING, THE PRINCIPLES OF DECORATIVE ART, A COURSE OF ELEMENTARY DRAWING FOR HOUSE-PAINTERS, WRITERS, ETC.

AND A COLLECTION OF USEFUL RECEIPTS

With Nine Coloured Illustrations of Woods and Marbles, and numerous Wood Engravings

BY ELLIS A. DAVIDSON

AUTHOR OF "BUILDING CONSTRUCTION," "DRAWING FOR CARPENTERS AND JOINERS," "DRAWING FOR MACHINISTS," "THE AMATEUR HOUSE CARPENTER," "THE GRAMMAR OF COLOURING ADAPTED FOR THE USE OF DECORATORS," ETC., ETC.

THIRD EDITION, CAREFULLY REVISED

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PREFACE.

The essentially practical character of this manual would almost seem to render a preface unnecessary; these introductory lines are therefore penned more in accordance with custom, than for the purpose of supplying a want.

The trade of a House Painter is too often supposed to consist of manual processes only, and it is thought by many, that a young man has only to follow others in order to become a competent workman.

This idea, not only in relation to House Painting but other trades also, had, during many years, been accepted in this country; but happily a great change has taken place, and it is now universally admitted, that every effort should be made to give technical instruction to our artisans, to teach them the principles on which their practice is based, to interest their minds in the higher branches of their trades, and to show them that the more the mind comprehends the requirements, the better will the hand execute the work.

These objects have been borne steadily in view in the manual now placed before House Painters, Grainers, and Sign Painters, and the earnest hope is entertained, that the instruction given in their different departments, the lessons in practical Art, together with the general information pervading the book, will be found both useful and interesting.

INTRODUCTION TO THE SECOND EDITION.

The very favourable reception accorded to this book, both by the trade and the public, has induced the necessity for the issue of a second edition, at an early period. This result, it is unnecessary to say, is very satisfactory to the author, who is also naturally gratified with the numerous and excellent reviews of the book which have appeared in the trade and general periodicals. The suggestions made in these have received consideration, and the whole manual has been subjected to a careful revision. Special attention has been paid to the coloured illustrations of woods and marbles, which have without an exception been deemed highly satisfactory. It must, however, be borne in mind that these, produced by a complex process, and by means of numerous printings, are seen under a disadvantage owing to their not being varnished—a process which would in this case have added most seriously to the cost of the book, and thus the object of the publisher—to produce it at a price within the means of those for whom it is intended—would have been to a certain extent defeated, whilst the illustrations would not, in point of instructional character, have been improved.

If any member of the trade desires to make suggestions as to improvement in any of the processes given, his communication, addressed to the author (care of the publisher), will be carefully considered in connection with subsequent editions of the work.

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A

PRACTICAL MANUAL

OF

HOUSE PAINTING, GRAINING, MARBLING AND SIGN-WRITING.

PART I.

THE PROCESSES OF HOUSE PAINTING IN OIL AND DISTEMPER.

CHAPTER I.

THE IMPLEMENTS USED.

THE MULLER and SLAB, two of the painter's first requisites, are described in relation to the method of grinding colours; and in connection with these the PALETTE KNIFE must be mentioned. This is a long and very flexible knife, with blunt edges and rounded at the end. As its name implies, it is intended for mixing colour on, or scraping it off from, the palette; but a similarly shaped implement is made of a larger size, to be used in connection with the slab, and this is called a STONE KNIFE.

In using the palette knife, it should be held as flat as possible, so as to avoid making indentations in the palette.

The STOPPING KNIFE is used in stopping cracks, &c.,

with putty, or "stopping," the process of which is explained in another chapter. The knife is shorter in proportion than the palette knife, is spear-shaped, broad, and stiff, so as to be adapted to bear the force necessary to press the stopping into the crevices, &c.

The BRUSHES used are of various sizes and kinds. The largest are called pound brushes. The large brushes are also termed "four O," "six O," and "eight O," the latter being the largest. These are made both round and flattened, or elliptical.

It is a common error to call this form *oval.* Oval means egg-like in shape, that is, broader at one end than at the other, whilst an ellipse has both ends equal. The precise difference, and the geometrical method of drawing the figures, is shown in Figs. 120-127.

These elliptical brushes are found very convenient in practice, as they take less time to work into the shape required for spreading the paint. Paint-brushes are bound either with string or with copper wire. They are sometimes used as dusters before being put into oil, by which they become softened; but, for reasons explained in connection with the use of the duster (page 9), this plan is not to be recommended.

The smaller brushes are called "TOOLS," or "SASH TOOLS," and may be obtained in about a dozen different sizes, some bound with string, others fixed in tin. The smallest hog-hair brushes are called FITCHES, and are used for putting in small work, where the tools would be too large. The smallest brushes are the CAMEL'S HAIR, with long or short hair, according to the work to be done.

It may be advisable in this place to mention that, when the work of the day is finished, the paint collected round the inside of the paint-pot should be removed by the brush, from which it should then be scraped by means of the palette knife. The brushes should afterwards be placed in water, and the remaining paint also covered with water, which is to be poured off when the paint is again required.

The DUSTING BRUSH has longer hairs than the painting brushes; and these are so bound that they spread outward at their points, which are thus prevented adhering; and the dust is more easily shaken from them.

VARNISH BRUSHES may be had in different sizes, and are also made flat and of different breadths, for varnishing pictures and other fine work.

The PALETTE is used when only a small quantity of colour is required—as in painting a narrow moulding or beading—a very small brush or camel's-hair pencil being used. It is, of course, employed by the marbler and the letter painter to the entire exclusion of the paint-pot.

Palettes are made of Mahogany, or of Satin or other light woods, which are to be preferred to those made of Mahogany whenever light tints are to be mixed on them. They should be of as little weight as possible, and should diminish in thickness towards their distant end. The oblong form is to be preferred to the elliptical, as it affords more room for colours. New palettes should be prepared for use by rubbing raw linseed oil repeatedly over them, until they will absorb no more, the last coat being allowed to dry in, as much as possible, and the palette being then well rubbed, it will not after this be stained by absorption of colour.

The palette should be carefully cleaned each time it has been used, and paint must not by any means be allowed to harden upon it. When all the colour has been scraped off with the palette knife, carefully observing not to make scratches or indentations, the surface should in the first place be washed with a small quantity of turpentine, and should then be rubbed with a piece of silk rag dipped in nut oil, the edges being well attended to, so that no accumulation may take place.

Should it be desired to save a small quantity of the colour for the next day's use, it may be scraped up from the palette, and placed in a little heap in a saucer and covered with water, which may subsequently be poured off and the paint will be found ready for use. Or the paint may be placed in a small piece of tinfoil, which may then be folded up, forming a temporary metallic tube, in which the colour may be preserved for several days.

In connection with the palette must be mentioned the MAHL-STICK. This is simply a smooth stick, having a ball of wool, covered with a piece of kid or wash-leather at its end; it is used as a rest for the hand in letter painting, or other fine work; it should therefore be quite stiff, so that it may not bend under the weight of the hand.

CHAPTER II.

OF THE GRINDING OF COLOURS.

PAINTS are prepared for use by grinding the dry pigments with oil. This is done on a large scale in a colour mill, and otherwise by means of a stone SLAB and MULLER. As we have already said, colours ready for work are sold at the colour shops, but these are not always to be depended upon, unless they are obtained at houses of known respectability; and further, several of the colours, such as Lakes and Prussian blue, deteriorate in quality by being kept long after grinding, and it is therefore important that these should be prepared by the painter himself.

The SLAB is a flat piece of Porphyry, Marble, or other very close-grained stone, and the MULLER is a semi-ellipsoidal boulder cut in halves, or flattened at one end; it should not, for general purposes, be less than four inches across the flat base, and should be sufficiently high to allow of its being grasped by both hands. Where this is not the case, and when the muller does not afford sufficient purchase for the hands, it is apt to tilt over towards the back or front, and thus these edges become rounded, and the under surface of the muller becomes curved instead of being perfectly flat.

If the dry pigment is in lumps, and of a brittle character, it should, in the first instance, be pounded in a mortar, and passed through a rather fine sieve: it should then be mixed with a sufficient quantity of linseed oil to form a thick paste. A portion of this is then to be taken on the palette knife, and placed on the slab to be ground by the muller. If, however, the dry pigment is of a very soft character, like Chrome-Yellow, or in powder, like Ultramarine, it will not be necessary to employ the mortar, but the colour may be mixed with oil on the slab by means of the palette knife, and when just saturated, the muller may be used. Brittle colours should, however, never be worked in this way, as they chip under the knife or muller, and great waste and other inconveniences are the consequences.

In grinding the colour, the muller must be worked towards and from the workman, and also occasionally in a circular direction; but the backward and forward motions are the best, as a certain amount of pressure can better be brought to bear on the colour, and the flat surface of the muller is better preserved. As the work proceeds, the paint should be scraped up by means of the palette knife from all parts of the slab, to be again brought under the influence of the muller, from the edge of which it should also be gathered. There is no economy in placing a large quantity of colour at one time on the slab; a small portion, spread over the whole surface, will form a thin film, and will thus be more quickly and more efficiently ground than a thicker mass. As soon as this quantity of colour is sufficiently smooth, it is to be removed, and a further supply placed on the slab.

It may be well to hint to the workman that the muller should be used in the same way that a carpenter uses a saw, or a joiner works a plane—that is to say, force should only be used in pushing the muller *from*, and not in drawing it towards, the body. The workman should stand with one foot in advance of the other, and press on the muller in the forward motion, but slightly raising it as he draws it back, moving it each time a little towards one side. The whole of the colour will thus be worked into a straight line near the distant edge of the slab, and can then be conveniently gathered by the palette knife to be either ground again or to be removed from the slab. The colour at this stage should be of the consistence of butter, and will, of course, require to be thinned, either with oil, turpentine, or certain proportions of both.

In mixing or thinning paints for use, it must be pointed out that, for outdoor work, boiled oil is principally or wholly employed, unless it be for decorative parts of houses, when a portion of turpentine and pale linseed oil is often added. For indoor work, linseed oil, turpentine, with a little driers, are generally used in the same way. The smaller the proportion of oil employed for the purpose, the less will be the gloss and the greater the ultimate hardness of the coating. For flatted white, &c., the colour being ground in oil, requires scarcely any further addition but turpentine, the object being to keep it flat or dull. The subject of driers and drying oils is considered in a subsequent chapter.

CHAPTER III.

OF PLAIN PAINTING IN OIL

THE processes of plain painting are in themselves extremely simple, and depend so much on manipulative skill, that a description of them must be taken only as a general guide, not by any means sufficient in itself to make a good workman. This result is not arrived at by theoretical knowledge alone, however sound, but by long-continued and earnest practice.

We must, however, on the other hand, urge on the attention of our readers the fact, that practice alone will not accomplish the end desired; a man who can only spread a quantity of paint over a given surface, is little better than a machine, and we therefore hope by the instruction given in the following pages, to awaken the interest of the house painter, and to show him that his occupation is not merely manual, but that each branch of the trade, if properly understood, will afford scope for the exercise of mental acquirements, and for the application of knowledge.

Before the workman can commence the absolute processes of painting new work, it is necessary that he should clear it from any drops of glue, whitening, &c., which may have fallen on the surface, or which may have been accidentally left by the carpenter or joiner.

In this operation he uses the "stopping knife," already described. This knife is held so that a large portion of its edge may touch the surface, and it is slanted so as to be nearly horizontal, and thus the edge works as it were *under* the pieces of glue, putty, &c.,

and *lifts*, rather than *scrapes*, them off. Care must be taken that the knife is not held so that its surface would be perpendicular to the wood, and that only the smallest possible pressure is used, otherwise indentations might be made, and thus more harm than good would be done.

It must also be borne in mind that this process is not to be a universal scraping; it is merely remedial,—viz., to remove any excrescences which may exist, but its purpose is not to scrape or plane the wood. This is supposed to have been already done by the joiner, and if it has not, a tool different from the stopping knife would be used.

The dusting brush, generally called the "duster," must be freely used during this process, so that all the particles scraped off may be removed. The largest of the brushes used for painting, viz., the "pound brush," is sometimes employed as a duster previously to being devoted to its proper purpose, in order that it may be rendered softer; but this is not a good plan, for a certain amount of dust necessarily finds its way up the brush, and is liable to work out when it is being used for painting purposes, thus giving the work a coarse and gritty appearance, and causing much annoyance.

The next stage of preparation is that called "knotting," the purpose of which is to guard against the knots appearing in the finished work, by stopping their absorbent quality, or closing the apertures of the fibre, and thus preventing the effusion of gum or sap. It is of course strongly urged that wood should be thoroughly dry before it is used; but this is not within the power of the painter to control, he must take the wood as he finds it, and must do his best to counteract the effects of the new wood on his work.

It must be remembered, that in the knots, the origin of which is explained at page 135, the *ends* of fibres, which are so many open tubes, are exposed, and thus, if all the sap or gum has exuded, they will present spots very much more absorbent than the surface of the board itself, whilst if the wood be new, and the gum and sap fresh in it, these will from time to time exude, and force off the paint, or cause it to become sticky.

PATENT KNOTTING may be purchased at the colour shops, and the following are two excellent receipts for making similar compositions, which are to be applied with a brush of the second size, called a "tool."

1. Add together a quarter of a pint of japanner's gold size, one teaspoonful of red lead, one pint of vegetable naphtha, and seven ounces of orange shellac. This mixture is to be kept in a warm place whilst the shellac dissolves, and must be frequently shaken.

2. White or red lead powder mixed with glue size, and applied whilst warm.

The following is quoted from an eminent authority:— "Knotting is a composition of strong size, mixed with red lead for the first knotting, which prevents the gum coming through; the second knotting is a composition of white lead, red lead, and oil; but in principal rooms where the knots happen to be very bad, they are often silvered, which is done by laying on a coat of gold size, and when properly dry, a silver leaf is placed on them, which is sure to prevent the knots appearing.

"When the knots are more than usually bad they must be cut out."

The first process of painting is called PRIMING, which consists in laying on a coat of paint for the special purpose of diminishing the absorbent quality of the wood or plaster. The paint used for this purpose is generally a mixture of white lead, and red lead, with a proper proportion of driers; but when the finishing colour is to be black, dark green, dark brown, &c., the priming may be done with a lead colour made of vegetable black and white lead in equal quantities.

These colours should be mixed with boiled oil for out-of-door, and with linseed oil for in-door work, a small quantity of turpentine being added in either case, the proportions being three parts of oil to one of turpentine. The paint should be rather thin, so that it may be well adapted for rapid absorption by the new wood or plaster.

Some painters, in order to save the oil coats, have resorted to the objectionable practice of spreading a coat of size mixed with water and whiting, called CLEARCOLE, over the new work.

This may serve for temporary purposes, but it will soon be seen that it should not be adopted in good work or where durability is expected. To a certain extent the size stops the absorbent powers of the wood or plaster, but it prevents the proper adhesion of the oil paint, which soon cracks or peels off. Clearcole may, however, be used with advantage in old work, where the grease would prevent the proper drying of the oil paint, but even in such cases it is best, when possible, to scrape the wood or plaster until a new surface is reached, on which the oil paint may be successfully applied.

When the priming is thoroughly dry, it is to be rubbed down with glass paper, and this operation, although in itself simple, requires a certain amount of care, so that the rubbing may be equally effective over the whole surface. In order that this result may be attained, the glass paper used should not be a mere scrap, rubbed carelessly about in various directions, by which means some parts will be passed over oftener than others, and the paint may be nearly rubbed off in one spot, whilst it is left almost untouched on another. A piece of the paper should be wrapped round a flat piece of wood, say 4 in. long, by 3 in. wide, and 1 in. thick, forming a kind of brush, and this should be rubbed equally over the whole surface, which will thus be nicely smoothened, whilst its perfectly level character will not be injured. A piece of glass paper which has been used several times in this way, should be saved for use in the later stages of the work, when great refinement is required. A strip of glass paper may be wrapped over the edge of a piece of wood shaped like a chisel, for use in the edges of panels and similar situations; or round the finger or a piece of rag for the curved parts of mouldings, great care being taken that a stiff edge, such as is formed by a sudden bend in the glass paper, may not come in contact with the work, producing scratches which are very troublesome to get rid of. All the dust caused by the glass paper must be carefully removed by means of the duster. When the priming has been properly rubbed down, the next operation is that of stopping.

STOPPING consists in filling in and making good all nail-holes, bad joints, cracks, &c., with putty, or with a paste made of putty and white lead, called *hard stopping*—this is done with the stopping knife.

This is another of the operations which, although simple, require a certain amount of care, lest instead of contributing to, they may mar, the success of the work. Thus let it be required to "stop" a crack in a panel—it will not be sufficient merely to press into the interstice a small quantity of stopping, and then smooth it over—for as the stopping dries, it contracts and sinks below the surface, and the crack becomes just as great an eye-sore as ever.

In such a case, the stopping should be forced as far down into the crack as possible; this may be done with the edge of the stopping knife, or with a thin piece of wood, leaving the stopping, however, slightly raised above the surface. In a day or two, before the second painting is proceeded with, the stopping will, owing to a certain amount of shrinking during drying, be found nearly level with the panel, and may then be smoothened down with the stopping knife.

The circumstance calling for the greatest care in stopping, is where a panel or other part of the work has received a blow, and a delve, or shallow concavity is formed; for it will be clear, that the mere skin of stopping required to level up such a spot, would be almost certain to crack off, leaving the place totally uncovered by paint. The best way to avoid such a result, is to deepen the recess in parts, by pricking holes in it with a bradawl, and these should incline in different directions, and should be more closely placed, and more numerous near the edges than in the middle of the space. The point of the stopping-knife may be used for this purpose, and deep fissures will be formed thereby; into these fissures or holes, the stopping is to be forced, and the portion spread over the delve will thus be as it were nailed to the wood by the filaments penetrating into the holes.

We are quite aware that in proposing that this process should be slowly done, an interval being allowed to elapse between the first and second stopping, we are supposing a condition which cannot always be fulfilled; the exigencies of business in these days of high pressure, demanding that work shall be pushed on with the utmost rapidity; but we desire to point out the means by which failure may be avoided, and the intelligent workman, knowing this, will be able in most cases to arrange his work in such a way, that some portions may be proceeded with whilst the necessary delay is afforded to others—and thus, by economy of time, and proper organisation of labour, the desired end may be accomplished.

The surface having been again touched off with the glass paper, the second painting is to be proceeded with. For the second coat, the same paint used for the priming, or white lead thinned with oil, and a little turpentine and driers may be employed, the proportion of driers for ordinary cases being 1½ oz. to 10 lbs. of white lead, but in winter, or in a damp climate, the proportion of driers must be increased. The following useful hints are quoted from Mr. Spon's excellent work, "Workshop Receipts"—"It should be observed, that second colour for new work is made up chiefly with oil, as it best stops the suction of the wood; but second colour for old work is made up chiefly with turpentine, because oil colour would not dry or adhere to it so well.

"The colour should be spread on as evenly as possible, and to effect this, as soon as the whole, or a convenient quantity is covered, the brush should be passed over it in a direction contrary to that in which it is finally to be laid off—this is called *crossing*. After crossing, it should be laid off softly and carefully in a direction contrary to the crossings, but with the grain of the wood, taking care that none of the cross brush marks be left visible. The criterion of good workmanship is, that the paint be laid evenly and the brush marks be not observed. In laying off, the brush should be laid into that portion of the work already done, that the joining may not be perceived. Every coat should be perfectly dry, and all dust carefully removed before the succeeding one is laid over it."

In the third painting, some approach is made to the finishing colour. Thus, if the finishing colour is to be lavender, the third coat should consist of white, slightly tinted with that colour. In some cases it is desirable that the coat preceding the finishing, should be darker than that which is to be laid over it.

In the third painting, the oil and turpentine should be used in equal proportions.

The fourth may be considered as the finishing coat, although a fifth is often given, and always with great advantage. The finishing coat must not by any means be applied unless the third coat proves perfectly satisfactory, that is, unless the surface has dried absolutely uniform, as regards surface, for if one part is glossy, and the other dull, it will be clear that the absorbent quality is not stopped, and the third painting must be repeated.

In commencing to repaint old work, the surface should, in the first case, be gone over with the stopping knife, removing all excrescences, and it is then to be rubbed with pumice stone and water; the greasy parts being well rubbed with turpentine.

Parts from which the paint has been entirely removed and decayed patches must then be gone over with a coat of priming colour, and cracks, holes, &c., are to be made good with stopping. The first coat is then to be given, and this is to be mixed with turpentine. The quality of the next coat will depend on the manner in which it is to be finished. If it is to be painted twice in oil, and flatted, the next coat should be mixed up chiefly in oil, and tinted like the finishing colour to form a ground for the flatting. The greater the gloss of the ground, the more dead will be the finishing coat, or flatting; likewise, the more dead the ground, the better will the finishing oil shine. It is, therefore, a general rule, that for finishing in oil, the undercoat should be turpentine, and for finishing flat, the undercoat or ground colour should be oil; but all turpentine grounds must have a little oil mixed with them, and all oil undercoats must have a small quantity of turpentine added to them, excepting the priming or first coat in new work.

In order to attain an absolutely solid appearance, some painters apply two coats of the finishing colour, by which no doubt uniformity is secured, but the expense is of course materially increased thereby. There are, however, pigments of a cheaper but still permanent character, which approach in tone to the very best, and these may with advantage be used as a first finishing coat, over which the final colour may be applied. Such colours must be carefully selected, and must be well covered by the finishing coat.

CHAPTER IV.

FLATTING, ETC.

When the work is to be Flatted—that is, when it is desired that the paint when dry should present a flat or dull appearance without any gloss—the paint used for the previous coat should be rather thicker than would under other circumstances be used, it should be mixed with linseed oil and turpentine, and should be rather darker than the flatting itself is to be.

Special care is necessary in laying all the coats which precede the flatting; they must be very evenly spread, and must be smoothened with glass paper in order that they may be perfectly level, otherwise the smallest irregularities will appear in the finished surface, to the injury of that perfectly flat appearance in which the beauty of the work consists.

The paint used in flatting consists of white lead, with which of course the necessary colouring matter is mixed, turpentine alone being used as the medium with which the paint is thinned. The colour should be rather lighter than is required, as it darkens a little whilst drying; a brushful should therefore be tried before the whole surface is painted, in order to avoid subsequent disappointment. In order to assist in drying, japanners' gold size is sometimes used instead of patent driers.

Although it is of course necessary that the coat preceding the flatting should be dry, it ought not to be absolutely hard, for it is necessary that the flatting, which is mixed with turpentine only, should slightly dissolve the surface, so as to become in a degree incorporated with it, by which much beauty and solidity is obtained; whereas, if the previous coat had become quite hard, the flatting would in most cases appear streaky when dry, and would be liable to crack or peel off.

Owing to the special composition of the paint used in flatting, it dries very rapidly, and two men should be engaged at once in flatting a wall. A plank placed across two step-ladders, or otherwise supported, is placed in front of the wall, at about half the height from the ground. One of the men stands on this, whilst the other stands on the ground. The last mentioned commences the work, painting a strip about 18 inches wide, and carrying it up as high as he can conveniently reach, he works rapidly, crossing occasionally, so that no brush marks in any one direction may be visible, "laying off" very lightly—that is, continuing the action of his brush, withdrawing it gradually, so that the points of the hairs may only skim lightly over the work.

The man above proceeds with the operation from the line where his fellow-worker left it, and carries it up to the top of the wall, the first man meanwhile getting on with another strip; both men being exceedingly careful that no break shall occur, and that the lines at which their work join, shall not be visible in the slightest degree.

Brushes called STIPPLERS are much used; these are broad and flat, and in form resemble a hairbrush. In practice, the stipplers are gently dabbed against the wet paint, producing a level grain over the whole surface, something like the tooth on the drawing paper called "not hotpressed." These brushes may be obtained of various shapes—the handles of some being continuous with the back, whilst in others it is fixed above, like that of a black-lead brush. The adoption of either form is, of course, a matter of taste.

In flatting a door, the panels must be finished first, great care being taken to carry the paint clean into the edges and corners. The styles or framing should then be done. It is convenient to paint the muntins, or munnions first; these are the upright pieces in the middle of the door. Next to these come the upper, middle, and lower rails, the horizontals which cross the door, and lastly the upright styles, or external vertical portions of the frame of the door. The brush marks, should any appear at the parts where the work is necessarily in cross directions, will correspond with the joints which would in reality exist at these parts.

To Paint Plaster.

The first coat is composed of white lead mixed with linseed oil and a small quantity of litharge, the paint being rather thinner than would be used for general purposes, in order that it may soak well into the absorbent surface of the plaster. The next coat should also be thin, so that the plaster may be thoroughly saturated. This will be only partially absorbed, and it will be necessary to make the third coat much thicker, mixing with it spirits of turpentine, and some of the colouring matter approaching the future tint of the room. The fourth coat should be thicker still, and should be mixed with equal parts of oil and spirits of turpentine, together with the dry ingredient, sugar of lead, instead of litharge. The colour should be much darker than that which is to constitute the finishing coat. All these coats must be laid on with the greatest attention as to smoothing, and they should each be thoroughly dry before the succeeding coat is applied, and should be well rubbed down with glass paper. The last coat which is to precede the flatting, however, should not be quite hardened before the finishing is applied, for reasons previously explained. The process of flatting has already been described.

To Paint New Walls or Stucco.

The following directions for this purpose are given by the eminent authority Mr. Peter Nicholson. It does not appear that any painting in oil can be done to any good or serviceable effect in stucco, unless not merely the surface is dry, but the walls have been erected a sufficient time to permit the mass of brick-work to have acquired a sufficient degree of dryness.

When stucco is on battened work, it may be painted over much sooner than when prepared as brick. Indeed, the greater part of the mystery of painting stucco so as to stand or wear well, certainly consists in attending to these observations; for whoever has observed the expansive power of water, not only in congelation, but also in evaporation, must be well aware that when it meets with any foreign body obstructing its escape—as oil painting, for instance—it immediately resists it, forming a number of vesicles or particles, containing an acrid lime water, which forces off the layers of plaster, and frequently causes large defective patches extremely difficult to get the better of.

Perhaps in general cases, where persons are building on their own estate or for themselves, two or three years are not too long to suffer the stucco to remain unpainted; though frequently in speculative works as many weeks are scarcely allowed. Indeed, there are some nostrums set forth in favour of which it is stated, in spite of all the natural properties of bodies, that stucco may, after having been washed over with these liquids, be painted immediately with oil colours. It is true there may be instances, and in many experiments some will be found, that appear to counteract the general laws of nature; but on following them up to their causes it will be found otherwise.

Supposing the foregoing precautions to have been attended to, there can be no better mode adopted for priming or laying on the first coat on stucco than by linseed or nut oil boiled with driers, with a proper brush, taking care in all cases not to lay on too much, so as to render the surface rough and irregular, and not more than the stucco will absorb. It should then be covered with three or four coats of ceruse or white lead, prepared as described for painting on wainscoting, letting each coat have sufficient time to dry hard.

If time will permit, two or three days between each layer will not be too long. If the stucco is intended to be finished of any given tint, as grey, light green, apricot, &c., it will then be proper, about the third coat of painting, to prepare the ground for such tint by a slight advance towards it.

CHAPTER V.

OF CERTAIN PROPERTIES OF OIL PAINTS.

WITH the view of affording the house painter an opportunity of becoming acquainted with the investigations of M. Chevreul, we give the following extracts from a very important article by that eminent French chemist, published in the "Annales de Physique et de Chimie," 1857 :—

"Painting is done with two objects in view—either to change the natural colour of the surfaces of various articles, or to protect those articles by rendering their surfaces less easily altered by air, rain, dust, &c.

"Three conditions must be fulfilled.

"First.—The paint must possess sufficient fluidity to spread with a brush, and also be viscous enough to adhere to the surface without running, and to leave coats of equal thickness when the surfaces are inclined or even vertical.

"Second.—The applied paint must become hard.

"Third.—After hardening it must adhere firmly to the surface on which it has been applied.

"I have proved that the hardening of white lead or zinc white paints is due to the absorption of the oxygen of the atmospheric air. And since pure oil hardens, we see that the hardening is the effect of a primary cause which is independent of the drier, white lead, or zinc white.

"Besides, my experiments demonstrate that white lead and oxide of zinc manifest a drying property in many cases, and that this property exists also in certain substances which are painted—lead, for instance.

"The painter, therefore, who is desirous of knowing, at least approximately, the length of time necessary for his work to become dry, will have to consider all the causes which produce that effect. Consequently, a *drier* will not be considered as the *only cause* of the drying phenomenon, since this phenomenon is assisted by several substances, having also the property of drying under certain circumstances. Moreover, there is this remarkable fact, that the *resultante* or sum of the activities (drying powers) of each of the substances entering into the composition of the paint cannot be reckoned by the sum of the activities of each substance. Thus, pure linseed oil, the drying power of which is represented by 1·985, and oil treated by manganese with an activity of 4·719, will, when mixed, possess an activity of 30·828.

"If there be substances increasing the drying properties of pure linseed oil, there are others which seem to act in an opposite direction. For instance, linseed oil, with one coat applied upon glass, was dry after seventeen days. The same oil mixed with oxide of antimony, took twenty-six days to dry. In this case the oxide of antimony was an anti-dryer. Linseed oil mixed with oxide of antimony, and applied upon a cloth painted with white lead was dry after fourteen days. The same oil mixed with the arseniate of protoxide of tin, and applied upon the same cloth, was not hard after sixty days.

"Oak wood appears to possess the anti-drying property to a high degree, since, in the experiment of December 22nd, 1849, three coats of oil took 159 days to dry.

"In the experiment of May 10th, 1850, a first coat of linseed oil was dry only on the surface after thirty-two days.

"Poplar seems to be less anti-drying than oak, and Norway fir less than poplar.

"In the experiment of May 10th, 1850, three coats of linseed oil took to dry, twenty-seven days for poplar wood, and twenty-three days for Norway fir.

"If there be a drying activity, and a contrary one, in certain substances, I have no doubt that there are also circumstances under which linseed oil is not influenced by the nature of the surface on which it has been spread. For instance, in the experiments of May 10th, 1850, one coat of linseed oil was given upon surfaces of copper, brass, zinc, iron, porcelain, and glass, and in every case the oil was dry after forty-eight hours.

"I hasten to say that I do not pretend to classify all the substances in contact with linseed oil, or any other drying oil, into drying, anti-drying, and neutral or indifferent, because the circumstances under which these substances are placed may cause variations in their properties. I believe that a substance may be drying or anti-drying under different circumstances, whether it be due to the temperature or the presence or absence of another substance, &c. For instance, metallic lead is drying towards pure linseed oil, whereas white lead, which is well known as possessing drying properties, is anti-drying towards linseed oil applied upon metallic leaf.

"If painters desire to understand their operations well, they must consider the drying of their painting in the same manner as I have just pointed out. By so doing, and in certain determined cases differing one from the other, they will be enabled to modify and improve their ordinary methods. Linseed oil is naturally drying, and this property increases almost always by its admixture with white lead, and in certain cases with oxide of zinc. If the mixture be not sufficiently drying, recourse is to be had to an addition of oil boiled with litharge or manganese. At the same time it is necessary to consider the nature of the surfaces painted over; whether it be a first, second, or third coat; the temperature of the air, the light, &c.

"From our present point of view, drying oil, boiled with litharge or manganese, loses part of its importance, because it may be dispensed with for the second and third coats, and even for the first one if the natural drying is aided by the temperature.

"Moreover, pigments themselves may act as substitutes for it, as in the case of light colours, which are altered by yellows or browns, if the painter has derived profit from some of the observations indicated in this memoir.

"Thus, linseed oil, exposed to the air and to light, becomes drying, and loses its colour; it may therefore be employed with white lead or zinc white, without impairing the whiteness of either. Since by associating oxide of zinc with carbonate of zinc it is possible to dispense with a drier, we have a new way of avoiding the inconvenience of coloured dryers; at the same time, it gives a hope that new combinations of colourless substances will be found presenting greater advantages than those just noted.

"My experiments demonstrate that the processes generally followed by colour manufacturers for rendering oils drying—that is, by heating them with metallic oxides—are open to the objections of waste of fuel and colouration of the product. Indeed, I have shown—(1) that oil kept at the temperature of 70° C. for eight hours, had its drying powers considerably increased; (2) that if peroxide of manganese be added to the oil kept at this temperature, it becomes sufficiently drying for use; (3) that a very drying oil will be obtained by heating linseed oil for three hours only with 15 per cent. of metallic oxide, and at the temperature generally adopted by the colour-merchants.

"My experiments explain perfectly well the *rôle* of linseed oil or, more generally speaking, of drying oil in painting. Indeed, when oleic acid is mixed with metallic oxide, which may solidify it, it passes instantaneously from the liquid to the solid state, and there is no uniformity in the *ensemble* of the molecules of the oleate. The effect is different when a drying oil, absorbing oxygen, passes progressively to the solid state: the slowness with which the change takes place allows of the symmetrical arrangement of the oily molecules, which would appear transparent if there were not opaque molecules between them. But, if the latter do not predominate, the arrangement is such that the painting is glittering, and even brilliant, because the light is reflected by the dry oil as by a looking-glass."

CHAPTER VI.

PAINTING IN DISTEMPER.

THIS mode of colouring, which, when applied to fine art purposes, is termed *tempera* painting, is undoubtedly the most ancient, and derives its name from the fact that colours are mixed or "tempered" with some liquid or medium to bind their separate particles to each other, and to the surface on which the paint is applied.

The following is quoted from "Painting Popularly Explained" (Gullick and Timbs). The Italian noun *tempera* admits of the widest application, and would include any medium, even oil; but, in its restricted and proper acceptation, it means a vehicle in which the yolk of egg, beaten sometimes with the white, is the chief ingredient, diluted as required with the milky juices expressed from the shoots of the fig-tree. This is the painting strictly termed *à nuovo* by the Italians. Vinegar probably replaced the fig-tree juice among the northern artists, from the difficulty of obtaining the latter, and in modern use vinegar is substituted. Haydon says vinegar should be used to prevent the putrefaction of the yolk of egg; but the early Italian painters preferred the egg vehicle when it had been suffered to stand until it had become decomposed; hence the phrase "*a putrido.*"

The artist is often compelled to have recourse to very offensive media to make known his most refined revelations. On walls, and for coarser work, such as painting on linen, warm size was occasionally used; but the egg vehicle, undiluted, was generally preferred for altar-pieces on wood. For various purposes, and at different periods, however, milk, beer, wine, and media composed of water, and more or less glutinous ingredients, soluble at first in water, such as gums, &c., have also been used. Such are the media or vehicles described by the chief Italian writers, as used in the days of Cimabue, Giotto, and Fra Angelico, and by the early painters before the invention and improvement of oil painting. Pliny also mentions milk and egg vehicle as employed for ancient wall paintings. The finer egg tempera in dry climates has been found to attain so firm a consistence as to withstand ordinary solvents. The use of wine in diluting these glutinous vehicles was common for a long period. Buffalmacco, of whom so many humorous stories are told by Boccaccio and Vasari, is related to have persuaded some nuns, for whom he painted, to supply him with their choicest wines, ostensibly for the purpose of diluting the colours, but really to be imbibed by the thirsty painter himself. The northern artists were sometimes compelled to content themselves with beer. In the works of the northern tempera painters there are, however, very marked differences observable in the *impasto* or body of colours. It is certain, therefore, that these painters employed media of different degrees of consistency. In the distemper of scene-painting, the medium is weak size of glue (glue dissolved); but plaster-of-paris, sufficiently diluted, is worked with the colours. The carbonate of lime, or whiting, is less active as a basis for colours than the pure lime of fresco, but it is entirely destructive of transparency. When the more viscid media were employed by the tempera painters, the effect must, with their purer use of the colours —some of which were, moreover, transparent—have been very lustrous and powerful in comparison with modern scene-painters' "distemper," and these qualities were heightened by the addition of a strong varnish; still, however, "tempera" fell far short of oil painting in richness and transparency.

The carbonate of lime, or whiting, employed as a basis is, however, less active than the pure lime of fresco. The vehicles of both modes are the same, and their practice is often combined in the same work. Water is their common vehicle, and to give adhesion to the tints and colours in distemper painting, and make them keep their place, they are variously mixed with the size of glue, prepared commonly by dissolving about 4 oz. of glue in a gallon of water. Too much of the glue disposes the painting to crack and peel from the ground, while with too little it is friable and deficient of strength. In some cases glue may be abated, or altogether dispensed with, by employing plaster-of-paris sufficiently diluted and worked into the colours, by which they will acquire the consistency and appearance of oil painting, without employing their limpidness or allowing the colours to separate, while they will acquire a good surface, and keep their place in the dry with the strength of fresco, and without being liable to mildew, to which animal glue is disposed, and to which milk, and other vehicles recommended in this mode, are also subject.

For further information as to tempera painting, we refer the reader to "The Grammar of Colouring,"* Chapter XXVII., and now proceed to speak of this branch as referring to trade purposes, under the name of "distempering," a style of painting specially adapted for ceilings, and for walls which are covered with plaster. We cannot agree with some writers who assert the superiority of distemper over oil in dark situations; for to say the least in favour of oil, it can be washed and scrubbed, whilst distempering requires to be re-coloured. There can be no doubt that distempering has its manifold advantages, and that when well done it possesses a degree of clearness and brightness, especially in white, pink, blue, lilac, &c., which is not attainable in oil colours, owing to the admixture of the various oils, and to the changes likely to occur in them subsequent to the application of the colours.

* "The Grammar of Colouring," by G. Field, revised and enlarged by Ellis A. Davidson.

A fruitful cause of failure in distemper work is the neglect of proper precaution in preparing the surfaces to be coloured—the great point at starting, assuming that the wall has been well smoothened, or if necessary scraped, in order that the surface may present no roughnesses or inequalities whatever. We are aware that this first stage is but seldom attended to by painters, who assume that the plasterer, as a matter of course, leaves the wall properly finished; but this must not always be taken for granted. At all events even if the work has been carried as far as it is the plasterer's duty to take it, there is no reason why the next stage should not be considered to belong to the painter, who is so well aware of the conditions on which a good result to his work depends. We admired some distemper work in the Paris Exhibition in 1867, it was so smooth, and yet perfectly flat (we mean, not glossy, and this should be the character of distempering), that we at first thought it was done by some new process. We walked round, and came up to a group of men engaged on the same work; we watched and inquired, and obtained full information as to the process employed. And here, in justice to working men we may remark, that although until recently but little trouble has been taken to give instruction to them, they are ever ready to give information to any person evincing an interest in their work, and we have found them, both in England and on the Continent, willing to spend time, which to them is money, in explaining their work to an inquirer in a manner which, we have often thought, puts to shame many persons engaged in the higher walks of life.

The process, then, consisted in this: the plasterers having left the walls, the painters took them in hand. They were each armed with a bucket of water, a sponge, a rag, and a slab of deal wood, 6 in. broad and 7 or 8 in. long, on the back of which a handle made of leather was placed; and it must be mentioned that the wood was cut *crosswise*, each board being, as it were, a slice of a tree. The workman wetted the wall with his sponge, and applied his wood brush, for this the instrument practically became, since the ends of the fibres, directed towards the wall, acted like so many closely packed hairs.

The wood brush was rapidly worked in a circular direction, the wall being kept moistened with the sponge; and finally the surface was washed clean and well rubbed with the cloth, and was then to be allowed to become thoroughly dry. A smooth surface was thus produced; and the next process was to stop the absorbent properties of the plaster, and here the continental process ends. The mixture used in this country is thoroughly well adapted for its purpose, and is compounded in the following manner:—

Saturate about 12 lbs. of best whiting with water, and beat it up, with a constant addition of water, until the mixture assumes the consistency of a soft paste. Add sufficient size to bind the colour: 2 oz. of alum and 2 oz. of soft soap, each dissolved in water. Mix all these ingredients thoroughly well, and strain through a coarse cloth or metal strainer. Care should be taken that too much size is not used,—in fact, rather than use the mixture altogether too strong, it is preferable to give two coats of medium consistency, which, in effect, are better than a single thick one. If the wall is known to be damp, the remedy given at page 31 should be used, either instead of or in addition to the above; but it must be understood that such remedies must only be considered as of a temporary character. No amount of care, and no application on the one side of a wall, will keep it dry if it is pervious to moisture on the other or from below. The source of the evil must be sought for, and efforts should, in the first place, be applied to the removal of the cause rather than to ameliorating the injurious effects.

The first and most general application of distempering is the process known as WHITEWASHING. In commencing to whitewash, the walls should be prepared as described above; but, of course, if they have been coloured before, they will merely require washing with clean water, scraping smooth in rough patches, the cracks being stopped and made good, the whole being then passed over with the wood brush. Care should be taken that all the scrapings and other débris are swept away before the walls are finally rubbed down with a cloth and the colouring is commenced. The whitewash is made by mixing whiting. which has previously been allowed to soak for twelve or fourteen hours in water, to about the consistency of cream, care being observed that the mixture is very smooth. One teacupful of size is then to be added to two gallons of the whitewash, or, if a perfectly white wash is required, potato starch may be used. In laying on the wash, a large flat brush is employed; and, if this is not overcharged, a ceiling or walls may, with a certain amount of care, be white or colour washed with little or no splashing; in fact, we know of workmen white-washing the ceilings of rooms without the pictures being removed from the walls, and without making what servants call any "mess" whatever, cloths spread over the floor or furniture being the only precaution necessary.

The following mixture will be found useful for common work:—½ bushel of lime, 1 lb. of common salt, ½ lb. of sulphate of zinc, and 1 gallon of sweet milk.

For brickwork exposed to damp:—½ peck of fresh well-burnt lime, with water sufficient to make it into a thin paste; pass through a fine sieve; add a gallon of clean salt which has been dissolved in boiling water. Make a thin paste of 1 lb. of rice flour and ¼ lb. of best glue; mix this paste, whilst hot, with the previously made compound, and add ¼ lb. of Spanish whiting dissolved in 1 quart of water. Stir all well together, cover over, and let the whole stand for a week, when it is to be applied whilst quite hot.

The following, written by "an experienced workman" in a weekly technical paper, is quoted here, as it is felt that the hints are so very practical that they will be of interest and real service to artisans. We can only regret that the name of the writer is not known to us, as we should have had great pleasure in affixing it to the quotation.

"In order to produce good work, two things are essentially necessary in the mixing of the distemper; namely, clean and well-washed whiting and pure-jellied size. The whiting should be put into soak with sufficient soft water to cover it well and penetrate its bulk. When the whiting is sufficiently soaked, the water should be poured off, which will remove any rust or foreign matter from the whiting; it should then be beaten up or stirred until all the lumps are broken, and it becomes a stiff, smooth paste. A good workman will do this carefully with his hand, and will manipulate it until it is quite smooth; but it may be done most effectually with a broad stick or spatula, and then strained through a metal or other strainer. The size should now be added, and the two lightly but effectually mixed together. Care should be taken not to break the jelly of the size any more than can be avoided, and this may be best done by gently stirring the mixture with the hand. If the jellied state is retained intact, the colour will work cool, and lay on smooth and level. The size, whether made of parchment clippings, glue, or any other material, should be dissolved in a sufficient quantity of water to form a weak jelly when cold. In practice we find that distemper mixed with jellied size will lay on better and make a better job than when the size is used hot. Colour mixed on the former plan works cool and floats nicely; while the latter works dry, and drags and gathers, thus making a rough ceiling or wall; and the difference in the labour required is very much in favour of jellied size. A little alum added to the distemper has a good effect in hardening, and helps it to dry out solid and even."

In distemper painting, or, as it is more frequently called, "colouring," the base generally used for all the tints is the finest whiting, which is prepared in large quantities by various manufacturers. All the colours should either be ground very fine, or should be washed over, so as to ensure the most minute division of their particles.

It will require two coats, and sometimes more, of any of the tints to cover plaster well, and to bear out with absolute uniformity. When old plastering has become disfigured by stains, it is necessary, in the first place, to properly scrape and prepare the wall, and then to give it one or two coats of white lead ground in oil, the second being mixed with an additional quantity of turpentine; this, if well and sufficiently done, will cover all the stains, and will take the size colours very kindly.

In order to produce an absolutely level tint in distemper, great care should be exercised in carrying on the work. Whilst the colour is being laid on, the windows and doors should be closed, and all draughts prevented, so that the wash may not dry too quickly, in which case the brush drags, and all piecings or brush marks will show when quite dry; but the moment the work is finished, all windows and doors are to be opened, in order to afford free ingress to the fresh air, for the moment the whole of the colour is laid on, the sooner it dries the better. In order to ensure uniformity in drying, and to avoid parts becoming shady, the wash must be laid on evenly: and when the ground is once covered, no portion of it should be retouched; for such portion would then receive an additional coat, and would without fail present a more solid and brighter appearance than the rest; at the same time there is every chance that the brush, passing over the half-dry or partially set colour underneath, would rub up some of it, and cause a rough appearance, whilst the edges of the retouched part would be visible, giving the idea of a patch having been applied over the spot.

The colours of which the various tints are to be composed should be ground up separately, and should be carefully added to the white body. As far as can be calculated, as much of any particular tint as may be required for one room or job should be compounded at once, to avoid the trouble of matching. Powder colour should never be added to the body white. If only a small quantity of any additional colour is required, it should be well ground on a slab, and taken on the point of the palette knife, or at the end of a stick, and thus mixed with the general mass. Where this is not done, the white gathers around each separate particle of the powder colour, making a minute ball, with a coloured centre and as it were a white shell: a number of these become agglutinated. The inexperienced workman or amateur thinks the colour is well mixed, because he has, during mixing, lost sight of the particles of colour; but when he comes to spread the wash on the wall, the dark specks emerge from their temporary cases, and, as they are dragged along by the brush, cause lines and streaks of more or less breadth, according to the number of particles which have been bound together. These may not perhaps be noticed whilst the colour is wet, but will soon appear as it dries; and the evil result will not be in appearance only, for as these specks of colour have not been bound by the size with which the whole mass has been mixed, the spots and streaks caused by them will rub off, leaving the original colour of the plaster, or of the previous wash, visible. Sometimes, too, when the powder colour is of a heavier character than the mass, it finds its way to the bottom of the bucket or pot; and when the quantity is nearly used, the last part of it will be found to become gradually darker than that previously used; whilst if the brush be allowed to touch the bottom, it will bring up a quantity of dark colour which will be deposited with the first stroke on the wall.

Great care must be taken in mixing tints; for some colours, such as Prussian blue, &c., are so strong that a very little of them will produce the desired effect, and thus, if they are used without consideration, it becomes necessary to add more and more white, a greater quantity of the tint required is compounded, and waste results. The safer plan for beginners is to mix a small quantity of the tint in a jar or on a piece of glass, and, having spread this on a piece of paper, they will be able, when it is dry, to judge of the shade, and to form an idea as to the relative quantities of the different colours required. Other colours again, as orange lead, are of such density, that they will separate from the others and sink to the bottom, and therefore tints compounded with these must be worked in a size jelly; this, too, will be learnt by trial and experience.

CHAPTER VII.

OF MIXED TINTS.

WE now proceed to give some of the principal tints used in house painting. Nearly all of these may be used in either oil or distemper painting; the white, in the one case, being White lead, diluted, of course, with oil and turpentine, and, in the other, whiting mixed with size.

STRAW COLOUR.

White Lead, Massicot (in oil).
Whiting, Dutch Pink (in distemper).
   ,,   Chrome Yellow.

LAVENDER, LILAC, AND FRENCH GREYS.

Produced according to the predominance of white, blue or red.

White, Lake, Indigo.
   ,,   Lake, Prussian Blue.
   ,,   Indian Red, Prussian Blue.
   ,,   Vermilion, Prussian Blue.
   ,,   Indigo, Rose Pink.

PEARL GREY.

White, Black, Prussian Blue.

GREY TINTS.

Of a blue hue.

White, Verditer.

White, Blue Black.
„ Lamp Black.
„ Indigo.

Grey Tints.

Of a brown hue.

White, Madder Brown, Prussian Blue.
„ Madder Brown, Prussian Blue, Yellow Ochre.
„ Indian Red, Indigo.
„ Light Red, Prussian Blue.
„ Burnt Sienna, Lake, Indigo.

Brown Tints.

White, Lake, Prussian Blue, Yellow Ochre.
„ Lake, Indigo, Yellow Ochre.
„ Raw Sienna, Madder Lake, Prussian Blue.
„ Light Red, Indigo.
„ Vandyke Brown, Lake, Indigo.
„ Burnt Sienna, Indigo.
„ Burnt Sienna, Lake.

Green Tints.

White, Italian Pink, Antwerp Blue.
„ Italian Pink, Prussian Blue.
„ Yellow Ochre, Indigo.
„ Burnt Sienna, Indigo.
„ Brown Pink, Indigo.
„ Raw Umber, Indigo.

Pea Green.

White, French Green.
„ Olympian Green.
„ Brunswick Green.
„ Prussian Blue, Chrome Yellow.

Sage Green.

White, Prussian Blue, Raw Umber.
„ Antwerp Blue, Stone Ochre.

Olive Green.

White, Raw Umber, Prussian Blue.

Orange Tints.

White, French Yellow.
,, Orange Lead.
,, Dutch Pink.
,, Chrome Yellow, Vermilion.

Pink Tints.

White, Rose Pink.
,, Crimson Lake.
,, Scarlet Lake.

Salmon Colour.

White, Venetian Red.
,, Vermilion.

Peach Tints.

White, Vermilion, Indian Red, Purple Brown.
,, Vermilion, Indian Red, Purple Brown, Burnt Stone Ochre.

Violet Tints.

White, Vermilion, Prussian Blue, Lamp Black.

Chocolate.

White, Spanish Brown, Venetian Red, Vegetable Black.

Sky Blue.

White, Prussian Blue.

Flesh Tint.

White, Light Red, Yellow Ochre.
,, Lake, Vermilion, Naples Yellow.

Fawn.

White, Burnt Sienna.
,, Burnt Umber, Venetian Red.
,, Stone Ochre, Vermilion.

Buff.

White, Yellow Ochre, Venetian Red.

Cream-colour is produced by a great predominance of white.

Drab and Stone Colour.

White, Burnt Umber.
,, Raw Umber.
,, Yellow Ochre.
,, Yellow Ochre, Lamp Black.
,, Raw Umber, Lamp Black.

Lead Colour.

White, Black.
,, Black, Indigo.

It must of course be understood that the colours are not to be mixed in equal quantities, but in such proportions as will produce the required hue; the slightest predominance of any one of the pigments gives the prevailing tone of the tints, whilst the addition of a further quantity of white produces all the numerous gradations, from lavender and lilac to French grey.

All colours in distemper are lighter when dry than they appear in a wet condition.

White is the basis of all tints, and is necessary in compounding the endless variety of pale colours required by the painter and decorator. Thus, White tinted with Blue, &c., affords Paris white, French greys, Silver greys, &c.; while among the Red tints we have Pink, Carnation, Coquilicot, &c.; and Yellow with White gives Primrose, Straw-colour, Isabella, &c. To the colours compounded more or less with White we owe the innumerable tints of Lilac, Lavender, Peach blossom, Pea green, Tea green, &c., as shown in the preceding list of tints.

The student is advised to mix the tints in different hues, giving in each experiment a predominance to one or other of the component colours.

PART II.

OF THE COLOURS USED IN HOUSE PAINTING.

CHAPTER VIII.

CLASSIFICATION AND COMBINATION OF COLOURS.

THE house painter who wishes to obtain a correct knowledge of his trade should, in the first place, endeavour to make himself acquainted with the nature and properties of the materials he is constantly using.

The ambition of a man of intelligence should be to rise above the position of a mere drudge, and he should therefore, by availing himself of the opportunities of culture at his command, endeavour to develop the faculties with which Almighty Providence has endowed him.

We have already pointed out that success in work, is not the result of merely manual dexterity, but of mental culture combined with it; for it will be clear that the hand acts best when under the guidance of the mind, and this forms the difference between mere labour and skilled work.

Nor will the time spent in the acquirement of knowledge be wasted, for good workmanship will always command its price; and thus a workman, who improves his scientific and technical education, will without fail rise in the social scale, with benefit to himself, his family, and his country.

The facility with which ready-prepared colours can now be obtained has no doubt led to a neglect of information as to their composition or special qualities, a small amount of knowledge only being picked up in the course of practice from the men with whom each artisan is associated, and who have obtained their own information in a similar unreliable manner.

It is not here intended to advocate the idea that each workman should, as in olden times, manufacture his own colours and varnishes,—the rate of wages as compared with the expenses in the present day wholly forbid such a system; but it is strongly urged that the painter should know the qualities of the various substances he employs, in order that he may judge of their fitness for every kind of work, and likewise that he should be able to prepare them, if circumstances require him to do so.

The whole subject of colour is separately treated in another volume of this series, and to this the student is referred for full information as to the principles of contrast and harmony. It will be sufficient here to initiate the study, in the hope that further instruction will be sought from the source indicated.

Yellow, Red, and Blue are called the *primary colours*, the presence of which, either pure or in combination, is found to be necessary to satisfy the eye. They have each a different relation to light, and must therefore be used in proportions which fulfil these conditions. Any two of these primaries being mixed, a *secondary* colour is produced: thus—

Blue and Yellow form Green,
Blue and Red ,, Purple,
Yellow and Red ,, Orange.

In like manner, by the mixture of any two of the secondaries, *tertiary* colours are formed: thus—Orange and Green produce *Citrine*, or the set of tints of a greenish-yellow character approximating to citron; Orange and Purple form *Russet*, or warm brown; whilst Purple and Green produce *Olive*, or dull brownish green.

By the varied and due admixture of these colours an infinite number of hues, shades, and tints are produced; whilst by an indefinite and disproportionate mixture of the three colours, or of the whole together, will be produced the hues usually called dirty, or the anomalous colour, *brown*.

The following extract from Field's "Chromatography" is here given as the clearest exposition of this branch of the subject:—

"There are five classes of colours, viz., the neutral, the primary, the secondary, the tertiary, and the semi-neutral.

"Neutral colours are three only—White, Black, and Gray. According to the laws of optics, the two first comprise all others synthetically, and afford them all by analysis. These are sometimes called 'extreme' colours, grey being their intermediate.

"Thus, if Black and White are mixed, Gray is formed; or if a transparent Black is washed over a white surface, a corresponding effect is produced.

"Primary colours are three only, viz., Yellow, Red, and Blue. They are such as yield others by being compounded, but are not themselves capable of being produced by composition of other colours. By way of distinction they are occasionally designated 'entire' colours. Secondary colours are three only—Orange, Green, and Purple. Each of these is composed of, and can be resolved into, two primaries: thus Orange is composed of Red and Yellow, Green of Yellow and Blue, and Purple of Blue and Red.

"Tertiary colours are three only—Citrine, Russet, and Olive. Each of these is composed of, or can be resolved into, either two secondary colours or the three primaries: thus Citrine consists of Green and Orange, or of a predominant Yellow with Blue and Red; Russet is compounded of Orange and Purple, or of a predominant

Red with Blue and Yellow; and Olive is composed of Purple and Green, or of a predominant Blue with Yellow and Red.

"The last three genera of colours comprehend in an orderly gradation all those which are positive or definite; and the three colours of each genus, united or compounded in such subordination that neither of them predominates to the eye, constitute the negative or neutral colours of which black and white have been stated to be the opposed extremes, and greys their intermediates. Thus Black and White are constituted of, and comprise latently, the principles of all colours, and accompany them in their depth and brilliancy, as shade and light.

"Semi-neutral colours belong to a class of which Brown, Marone, and Grey may be considered types. They are so called because they comprehend all the combinations of the primary, secondary, and tertiary colours with the neutral black. Of the various combinations of black, those in which yellow, orange, or citrine predominates have obtained the name of brown, &c.; a second class, in which the compounds of black are of a predominant red, purple, or russet hue, comprise marone, chocolate, &c.; and a third class, in which the combinations of black have a predominant hue of blue, green, or olive, include grey,* slate, &c.

"It must be observed that each colour may comprehend an infinite series of *shades* between the extremes of light and dark, as each compound colour may comprise a series of *hues* between the extremes of the colours composing it; and as the relations of colours have been deduced regularly from white or light to black or shade, so the same may be done inversely from black to white. On this plan the tertiaries, Olive, Russet, and Citrine, take the place of the primaries,

* According to Mr. Field, the colour grey is a semi-neutral, and denotes a class of colours of a joint character, and tinged with various hues: thus we have blue greys, olive greys, purple greys, &c. Gray is a neutral, composed of black and white alone.

Blue, Red, and Yellow; while the secondaries still retain their intermediate station and relation to both.

"Thus, Russet and Olive compose, or unite in, dark Purple; Citrine and Olive, in dark Green; Russet and Citrine, in dark Orange. The tertiaries have therefore the same order of relation to Black that the primaries have to White; and we have black primaries, secondaries, and tertiaries inversely, as we have White primaries, secondaries, and tertiaries directly. In other words, we have light and dark colours of all classes."

It is important to the painter that he should understand the difference between *hues, tints,* and *shades.* By mixing white with the original colour, a *tint* is produced; by mixing colour with colour, compound colours or *hues* are formed; whilst from the mixture of colours or tints with black, *shades* result.

CHAPTER IX.

WHITE.

HAVING thus given a general outline of the principles of colour, and assuming that the student purposes following up the subject in the work which has been already mentioned, we now proceed to treat of the colours used in the special trade which forms the subject of the present volume. The colours in their original condition are called "pigments," by which term is meant all such solid bodies as require to be mixed with some fluid before they can be spread on or made to adhere to any surface that is to be painted.

Irrespective, then, of their classification as primaries, secondaries, and tertiaries, but for trade purposes generally, the colours may be generally grouped under the following heads :—

White	Black	Red	Blue	Yellow
Green	Orange	Purple	Brown;	

and from these every tint that can be required in any kind of painting may be obtained by admixture.

White is the basis of nearly all colours used in house painting, and in opaque painting generally. It should be as pure and neutral in colour as possible, for the better mixing and compounding with other colours, so that it may not have any effect on them other than lightening their tint without changing their hue, whilst at the same time it adds to their body or opacity.

White is the most advancing of colours; that is, it comes forward and catches the eye before all other colours with which it may be mixed, by rendering their tints lighter and more vivid; hence it appears to cause other colours to recede when they are placed near it, whilst it powerfully contrasts dark colours, and black most of all. The term *colour* is, however, equivocal when attributed to the neutrals white, black, and grays. Yet the artist is bound to regard them as colours, and in philosophic strictness they are such, latently compounded and compensated; for a thing cannot but be that of which it is composed, and the neutrals are composed of and comprehend all colours.

Among all colours, white is the nearest allied to yellow, and is in itself a pleasing and cheerful colour, which takes every hue, tint, and shade, and harmonizes with all other colours. It is the contrast to black, added to which it gives solidity in mixture with other colours, as already stated.

It will thus be seen that white is of more extensive use in painting than any other colour, and hence it is of the first importance to the painter to have its pigments of the best quality. The following are the whites most generally used:—

White Lead

Is the body colour for most whites used in oil painting. It is made by suspending rolls of thin sheet lead, or small bars, over malt vinegar or pyroligneous acid in close vessels, the evaporation of the acid being kept up by the vessels being placed in some substance engendering heat, or in a steam bath. The commercial white lead is generally adulterated with native sulphate of baryta, or heavy spar, and sometimes with chalk.

The following is a simple method by which pure White lead may be prepared when it may not be possible to obtain the article by purchase, and in these days of emigration such circumstance may very possibly arise:—Procure an earthen vessel having a cover something like a colander, but having bars across instead of being pierced with holes. This should be of earthenware, and may be made of strips of clay strongly burnt, or, for temporary purposes, it may be made of wood. Pour vinegar into the vessel until it nearly reaches the bars, and on these place narrow strips of common lead rolled up into scrolls: these should be carefully scraped before being used, so that they may be freed from all dirt; they may be placed all over the bars, care being taken that they do not touch each other. The pot is then put over a gentle heat, and the fumes of the vinegar corroding the lead reduces it to a white powder ready for mixture.

The White lead for oil painting is sold ground up in oil to a thick paste; of course, infinitely too thick for use: it therefore requires further admixture. Having placed some of it in a pot, pour on it a small quantity of oil and turpentine, and stir with a stiff palette knife or flat stick until the particles of the pigment are separated and a perfectly smooth mixture is obtained; still, however, of too great consistency for use. It should next be passed through a tin strainer or a piece of canvas, after which driers are to be added, and the paint diluted to the proper consistency for work.

When the White lead is to form the basis of a tint, the staining colour should be separately ground in oil, and should be added, a very little at a time, to the white. In this matter the utmost caution must be used, for, as some colours are more powerful than others, the careless use of them frequently causes great waste, by necessitating the addition of more white in order to lower the tint, and thus a greater quantity than is required for use has often to be mixed. A small portion of the required tint should be first mixed in a gallipot, or on a palette, so that an idea may be formed of the relative proportion of staining colour required; and in order that the effect may be tried, the quantity for use can then be compounded to match this sample.

The following are other white oxides of lead. The heaviest and whitest of these are the best, and in point of colour and body are superior to all other whites.

They are all, when pure and properly applied in oil and varnishes, safe and durable, and dry well. Excess of oil, however, discolours them, and in water painting they are changeable even to blackness. They have also a destructive effect on all vegetable lakes, except the madder lakes and madder carmines. They are equally injurious to Red and Orange leads, or Minium, King's and Patent Yellow, Massicot, Gamboge, Orpiment, &c.; but Ultramarine, Red, and Orange Vermilion, Yellow and Orange chromes, Madder colours, Sienna, earth, Indian Red, and all the Ochres, compound with these whites with little or no injury. As already stated, in oil painting white lead is essential in the ground in dead colouring, in the formation of tints of all colours, and in scumbling, either alone or mixed with other pigments; it is also the best local white when neutralised with black. But these pigments should not be employed in water-colour painting, distemper, crayon painting, or fresco,* nor with any having an inflammable basis, or liable to be destroyed by fire; for with all such they occasion change of colour, either by becoming dark themselves or by causing the colours with which they are mixed to fade.

Cleanliness in using these colours must be specially enjoined, for although (Field) not virulently poisonous, they are pernicious when taken into or imbibed by the pores or otherwise, as are all other pigments of which lead is the basis.

Flake White

Is an English white lead in the form of flakes or scales, from which it derives its name. It is equal or sometimes superior to Crems white, and is an oxidized carbonate of lead, not essentially differing from the last mentioned. Other white leads seldom equal it in body, and when levigated it is called "body white."

Flake white ranks next in body or density to White lead, and is employed in the better class of work where

* The colours specially adapted for these branches are given in "The Grammar of Colouring."

great purity of tone is required; it is mostly used over white lead, which, possessing greater body, is used as a base.

London and Nottingham Whites.

The best of these do not differ in any essential particular from the white leads of other manufactories; the latter, being prepared from flake white, is generally the greyest of the two. The inferior white leads are adulterated with whiting or sulphate of barytes and other earths, which injure them in body and brightness, dispose them to dry more slowly, to keep their places less firmly, and to discolour the oil with which they are applied.

The above are carbonates of lead, and are liable to froth or bubble when used with aqueous, spirituous, or acid preparations. There are no better whites for architectural painting, and for all the purposes of common oil painting; they are kept in the shops under the names of best and common white leads, ready ground in oil, and require only to be diluted with linseed oil, and more or less turpentine, according to the work.

Krems, or Kremnitz, or Crems White.

This is a white carbonate of lead which derives its name from Krems, or Crems, in Austria, or Kremnitz in Hungary; and is also called Vienna white, being brought from Vienna in cakes of a cubical form. Though highly reputed, it has no superiority over the best English white leads; and varies, like them, according to the degree of care or success with which it has been prepared.

French White (Blanc d'Argent, or Silver White).

These are all names given to a white lead which is brought from Paris in the form of drops. It is exquisitely white, but of less body than flake white, and has all the properties of white leads; but, being liable to the same changes, is unfit for general use as a water colour, though good in oil or varnish.

Roman White

Is of the purest white colour, but differs from the former only in the warm flesh colour of the external surface of the large square masses in which it is usually prepared.

Sulphate of Lead

Is an exceedingly white precipitate from any solution of lead by sulphuric acid. It much resembles French white, and has, when well prepared, most of the properties of the best white leads, but is rather inferior in body and permanency.

Zinc White.

The foregoing are the principal whites of lead, but there are many other whites used in painting; amongst these must be mentioned zinc white, which is an oxide of zinc. It is perfectly durable both in oil and water, but is unfortunately wanting in body, which renders it less useful to the house painter, who is restricted as to the thickness and number of the coats he applies, than to the artist, who is more free in this respect; and the use of zinc white is only resorted to where extreme delicacy is necessary.

Spanish White.

Bougeval white, Gypsum, Rouen white, and White of Troyes are all preparations of the clay or chalk of various countries, as their names import, and are used in painting in distemper. Spanish white is the common whiting, which is made from chalk, None of the above pigments incorporate well with oil, nor do they possess lustre or durability when used with oil or varnish; but if used with size, and suffered to dry, may be varnished and look nearly as well as oil colour.

CHAPTER X.

BLACK.

Black* is the last and lowest in the series or scale of colours descending—the opposite extreme from white, the maximum of colour. To be perfect it must be neutral with respect to colours individually, and absolutely transparent or destitute of reflective power in regard to light; its use in painting being to represent shade or depths, of which it is the element in a picture and in colours, as white is of light.

As there is no perfectly pure and transparent black pigment, black deteriorates all colours in deepening them, as it does all warm colours by partially neutralising them, but it combines less injuriously with cold colours. Though it is the antagonist or contrast of white, yet, added to it in minute portions, it in general renders white more neutral, solid, and local, with less of the character of light. Impure black is brown; but black in its purity is a cold colour, and communicates this quality to all light colours: thus it *blues* white, *greens* yellow, *purples* red, and degrades blue and other colours: hence the artist errs who regards black as of nearest affinity to hot and brown colours.

It is the most retiring of all colours, which property it communicates to other colours in mixture. It heightens the effect of warm as well as light colours by a double contrast when opposed to them, and in like manner subdues that of cold and deep colours; but in mixture or glazing these effects are reversed, by

* "Grammar of Colouring."

reason of the predominance of cold colour in the constitution of black. Having, therefore, the double office of colour and of shade, black is perhaps the most important of all colours to the artist, both as to its use and avoidance.

Black is to be considered as a synthesis of the three primary colours—the three secondaries or the three tertiaries, or of all these together; and, consequently, also of the three semi-neutrals, and may accordingly be composed of due proportions of either tribe or triad. All antagonistic colours or contrasts, also, afford the neutral black by composition; but in all the modes of producing black by compounding colours, blue is to be regarded as its predominating colour, and yellow as subordinate to red, in the proportions, when their lines are true, of eight blue, five red, and three yellow. It is owing to this predominance of blue in the constitution of black, that it contributes, by mixture, to the pureness of hue in white colours, which in general incline to warmth; and it produces the cool effect of blueness in glazing and tints, or however otherwise diluted or dilated. It accords with the principle here inculcated, that in glass-founding the oxide of Manganese, which affords the *red* hue, and that of Cobalt, which affords the *blue*, are added to the brown or *yellow* first, to produce a velvety-black glass; and that the dyer proceeds to dye black upon a deep *blue* basis of indigo, with the *ruddy* colour of madder, and the *yellow* of quercitron, galls, sumach, &c., and experience coincides in principle in these practices; but, if the principle be wanting, the artist will often fail in his performances.

All colours are comprehended in the synthesis of black; consequently, the whole sedative power of colour is comprised in black. It is the same in the synthesis of white, and, with like relative consequence, white comprehends all the stimulating powers of colour in painting. It follows that a little black or white is equivalent to much colour, and hence their use as colours requires judgment and caution in painting;

and, in engraving, black and white supply the place of colours, and hence a true knowledge of the active or sedative power of every colour is of great importance to the engraver.

By due attention to the synthesis of black it may be rendered a harmonious medium to all colours, and it gives brilliancy to them all by its sedative effect on the eye, and its power of contrast; nevertheless, we repeat, as a pigment it must be introduced with caution in painting, when *hue* is of greater importance than shade; and black pigments produced by charring have a disposition to rise and predominate over other hues, and to subdue the more delicate tints by their chemical bleaching power upon other colours, and their own disposition to turn brown or dusky.

And for these reasons, deep and transparent colours, which have darkness in their constitution, are better adapted, in general, for producing true, natural, and permanent effects.

Black is to be regarded as a compound of all other colours, and the best blacks and neutrals of the painter are those formed with colours of sufficient power and transparency on the palette; but most of the black pigments in use are produced by charring, and owe their colour to the carbon they contain,—such as *ivory* and *bone black, blue black, Frankfort black,* &c. The three first are most in use, and vary according to their modes of preparation or burning; yet fine *Frankfort black,* though principally confined to the use of the engraver and printer, is often preferable to the others.

The following are the blacks in general use in house painting:—

Vegetable Black.

This pigment is now very extensively employed, superseding to a great extent the use of lamp black, to which it is in every way superior. Mr. Callingham, in his excellent work, says, "It is not quite so intense as ivory black, but possesses more friendly and agreeable qualities. The best way to procure it is to bu it in a dry state, in which it resembles soot, and is so exceedingly light, that an ounce or two will fill a gallon measure. It is free from grit, and only requires to be 'rubbed up' with a palette knife on a marble slab, instead of grinding. It should never be diluted with linseed oil, because, if it were, it would never dry; and it is not advisable to employ turpentine, but always the best boiled oil, and a little varnish will improve it. A small quantity of driers should be added, to ensure its drying with a uniformity of surface."

Lamp Black.

This very useful pigment is simply the soot obtained from resinous woods, tallow, coal tar, &c. It is thus a pure carbonaceous substance, and, as will be easily understood, it is of very fine texture; it is intensely black, and is very durable; it works well, but dries badly in oil. The simplicity of its manufacture will be understood when it is stated, that for immediate use in water-colour painting, it may be prepared by holding a plate over the flame of a lamp or candle, and adding gum water to the colour thus obtained. A good substitute is thus obtained for Indian ink, the colouring basis of which appears to be lamp black.

We have already stated that we desire to help those who cannot at the moment obtain by purchase the materials they require; we therefore give the following receipts, culled from various sources, for making this pigment:—

To make Lamp Black (on a small scale)—

1. A conical funnel of tin plate, furnished with a small pipe to convey the fumes from the apartment, is suspended over a lamp fed with oil, tallow, coal tar, or crude naphtha, the wick being large, and so arranged as to burn with a full smoky flame. Large, spongy, mushroom-like concretions, of an exceedingly light, very black, carbonaceous matter, gradually form at the summit of the cone, and must be collected from time to time. The funnel should be united to the smoke-pipe by means of

a wire, and no solder should be used for the joints of either.

2. (On a large scale.) Lamp black is made by burning bone oil, previously freed from its ammonia or common coal tar, and receiving the smoke in a suitable chamber. In the patent process of Messrs. Martin and Grafton, the coal tar is violently agitated with lime water, until the two are well mixed; after which, it is allowed to subside, and, the lime water being drawn off, it is washed several times with hot water: after subsidence and decantation, it is put into stills and rectified. The tar, or liquor in the receiver, is then put into a long cast-iron tube, furnished with numerous large burners, underneath which is a furnace to heat the pipe to nearly the boiling point. Over each burner is a sort of funnel, which goes into a cast-iron pipe or main, which receives in a similar way from all the burners From this the smoke is conveyed by large pipes to a succession of boxes or chambers, and thence into a series of large canvas bags, arranged side by side, and connected at top and bottom alternately. Fifty to eighty of these bags are employed, the last one being left open to admit of the escape of the smoke which has thus been made to traverse a space of about four hundred yards. As soon as the bags contain any considerable quantity of black, they are removed and emptied. The black deposited in the last bag is the finest and best, and it becomes progressively coarser as it approaches the furnace.

The state of minute division in which the carbon exists in good lamp black is such as cannot be given to any other matter; not even by grinding it on porphyry or "washing it over" with water. On this account, it goes a great way in painting. It may be rendered less oily and dryer by gentle calcination in close vessels, when it is called "burnt lamp black," and may then be used as a water colour.

Ivory Black and Bone Black.

These are ivory and bone charred to blackness by strong heats in closed vessels. These pigments vary principally through want of skill and care in preparing them. When well made, they are fine neutral blacks, perfectly durable, and eligible for oil and water painting; but when insufficiently burnt they are brown, and dry badly; and when too much burnt, they are cineritious, opaque, and faint in colour. Of the two, ivory black affords the best pigment; but bone black is commonly used.

Ivory black, Cassel black, Cologne black, are made by exposing fragments or turnings of ivory, and the like osseous parts of animals, to heat in close vessels until they are reduced to charcoal; when the whole has completely cooled, the hard, carbonaceous residuum must be pounded and ground on porphyry with water, washed in a filter with water, and dried. Bone black of commerce is the residuum of the distillation of bone spirit: it is used as a pigment for making blacking, as a material for moulds of founders, for clarifying and bleaching liquids, and for removing lime from syrup in refining sugar; it is the ivory black of commerce.

Black furnished by bones has a peculiar reddish tint. That produced by ivory is more beautiful; it is brighter than peach-stone black. When mixed in proper proportions with white lead, it forms a beautiful pearl gray.

Frankfort Black

Is made of the lees of wine, from which the tartar has been washed, by burning in the manner of ivory black. Similar blacks are prepared from vine twigs and tendrils which contain tartar; also from peach-stones, &c., whence almond black and peach black; and the Indians employ for the same purpose the shell of the cocoa-nut. Inferior Frankfort black is, in fact, merely the levigated charcoal of woods, of which the hardest, such as box and ebony, afford the best. Fine Frankfort black, though almost confined to copper-plate printers, is one of the best black pigments we possess, being of a fine neutral colour, next in intensity to lamp black, and more powerful than that of ivory. Strong light has the effect of deepening its colour; yet the blacks employed in the printing of engravings have proved of very variable durability It is probable that this black was used by some of the Flemish painters, and that the pureness of the grays is attributable to the property of charred substances to prevent discolourment.

Blue Black.

This is a well-burnt and levigated charcoal, of a cool neutral colour, and not differing in other respects from the common Frankfort black. Blue black was formerly much employed in painting, and, in common with all carbonaceous blacks, has, when duly mixed with white, a preserving influence upon that colour in two respects, which it owes chemically to the bleaching power of carbon, and chromatically to the neutralising and contrasting power of black with white. A superior blue black may be made by calcining Prussian blue in a close crucible, in the manner of ivory black; and it has the important property of drying well in oil. Innumerable black pigments may be made in this way by charring.

CHAPTER XI.

YELLOW.

YELLOW is the first of the primary or simple colours, nearest in relation to, and partaking most of the nature of, the neutral white, mixed with which it affords the faint hues called straw-colour, &c. It is accordingly a most advancing colour, of great power in reflecting light. Compounded with the primary Red it constitutes the secondary Orange (see diagrams in "The Grammar of Colouring") and its relatives, Scarlet, &c., and other warm colours.

It is the ruling colour in the tertiary Citrine. It characterizes in like manner the endless variety of the semi-neutral colours called Brown, and enters largely into the complex colours denominated Buff, Bay, Tawny, Tan, Drab, Chestnut, Roan, Sorrel, Hazel, Auburn, Isabella, Fawn, &c. Yellow is naturally associated with red in transient and prismatic colours, and they comport themselves with similar affinity and glowing accordance in painting, as well in conjunction as composition.

In combination with the primary Blue, Yellow constitutes all the varieties of the secondary *green*, and, subordinately, the tertiaries *russet* and *olive*. It enters also in a very subdued degree into cool semi-neutral and broken colours, and assists in minor proportions with Blue and Red in the composition of black.

As a pigment, Yellow is a tender, delicate colour, easily defiled, when pure, by other colours; and, on the contrary, it assists vision, and becomes more distinct as a colour, in a neutral, somewhat declining light. These powers of colours upon vision require the particular attention of the colourist. To remedy the ill effect arising from the eyes having dwelt upon a colour, they should be gradually passed to its opposite colour, and refreshed in the clear light of day.

In a warm light, Yellow becomes totally lost, but is less diminished than all other colours, except white, by distance. The stronger tones of any colour subdue its fainter hues in the same proportion as opposite colours and contrasts exalt them. The contrasting colours of Yellow are a Purple inclining to Blue when the Yellow inclines to Orange, and a Purple inclining to Red when the Yellow inclines to Green, in the mean proportions of thirteen Purple to three of Yellow, measured in surface or intensity; and Yellow being nearest to the neutral white in the natural scale of colours, it accords with it in conjunction. Of all colours, except white, it contrasts black most powerfully.

The sensitive effects of Yellow are gay, gaudy, glorious, full of lustre, enlivening and irritating; and its impressions on the mind partake of these characters, and acknowledge also its discordances.

The substitution of gold, &c., for Yellow by the poets may have arisen not less from the great value and splendour of the metal, than from the paucity of fine yellows among those nations who celebrated the Tyrian Purple or Red, and the no less famed Armenian Blue. So, in the beautiful illuminated manuscripts of old, and in many ancient paintings which glowed with Vermilion or Ultramarine, the place of Yellow was supplied by gilding; and, in most cases, the artist trusts to the gilding of his frame for some portion of this colour in his picture, and in every case of decorating with gilding similar allowance should be made.

Yellow is a colour abundant throughout nature, and its class of pigments abound in similar proportions. It may be observed of yellow pigments, that they much resemble whites in their chemical relations in general, and that yellow being a primary, and therefore a simple colour, cannot be composed by the admixture of any other colours. The following are the principal yellows used in house painting:—

Chrome Yellow.

This pigment may be obtained in three degrees of colour—pale or lemon, middle, and deep. It is of modern introduction into general use, and there are several varieties of it, mostly chromates of lead, in which the latter metal more or less abounds. They are distinguished by the pureness, beauty, and brilliancy of their colours, which qualities are great temptations to their use in the hands of the painter; they are, notwithstanding, far from unexceptionable pigments, yet they have a good body, and go cordially into tint with white, both in water and oil; but, used alone or in tint, they lose their pure colour, after some time becoming even black in impure air; they nevertheless resist the sun's rays during a long period. Upon several colours they produce serious changes, ultimately destroying Prussian and Antwerp blues, when used with them in the composition of greens, &c. They are very soft and smooth in quality, and are easily ground.

King's Yellow.

This pigment is also known under the names of Chinese Yellow, Arsenic Yellow, and Yellow Orpiment. It is a sulphuretted oxide of arsenic, of a beautiful, bright, and pure yellow colour, not extremely durable in water, and less so in oil. In tint with White Lead it would soon destroy it. It is not subject to discoloration in impure air. This property is not, however, sufficient to redeem it with the artist, as it has a bad effect upon several valuable colours, such as Naples Yellow, and upon the chromates, Masticot, Red Lead, and most other oxides of metallic colours; but with colours dependent for their hues upon sulphur or other inflammables it may be employed with less danger, and was probably so employed by the old painters, with ultramarine, in the composition of their greens, and is well suited to the factitious or French Ultramarine.

Although this pigment is not so poisonous as white arsenic, it is dangerous in its effect upon health. Yellow Orpiment is of several tints, from bright cool yellow to warm orange, the first of which is most subject to change; and it has appeared under various forms and denominations. These seem to have been used by several of the old masters with especial care to avoid mixture, and as they dry badly, and the oxides of lead used in rendering oils drying, destroy their colour, levigated glass was employed with them as a drier; or, perhaps, they were sometimes used in simple varnish. They are found in a native state under the name of zarnic, or zarnich, varying in colour from warm yellow to green. But Orpiment, in all its varieties, powerfully deprives other substances of their oxygen, and therefore is subject to change, and to be changed by every pigment whose colour depends on that element, and more especially all metallic colours; if employed, they must therefore be so in a pure and unmixed state.

Naples Yellow.

Naples Yellow is a compound of the oxides of lead and antimony, anciently prepared at Naples under the name of Giallolini. It is supposed also to have been a natural production of Vesuvius and other volcanoes, and is a pigment of deservedly considerable reputation. It is not so vividly coloured as either of the preceding, but is variously of a pleasing light warm yellow tint; like all the yellows already mentioned, it is opaque, and is in this sense of good body, and covers well. It is not changed by the light of the sun, and may be used safely in oil or varnish under the same management as the whites of lead; but, like these latter pigments also, it is liable to change even to blackness by damp and impure air, when used as a water colour, or unprotected by oil or varnish. Iron is also destructive of the colour of Naples Yellow, on which account great care is requisite in grinding and using it, not to touch it with the common steel palette knife, but to compound its tints on the slab or palette with a spatula of ivory or horn. For the same reason it may be liable to a change in composition with the ochres, Prussian and Antwerp blues, and all other pigments of which iron is an ingredient or principle. Oils, varnishes, and in some measure strong mucilages, are preventive of chemical action in the compounding of colours, by intervening or clothing the particles of pigments, and also preserving their colours; and hence in some instances heterogeneous and injudicious tints and mixtures have stood well, but are not to be relied on in practice.

Used pure or with White lead (the affinity with which gives permanency to their tints), Naples Yellow is a valuable and proved colour in oil, in which also it works and dries well.

YELLOW OCHRE,

Called also Mineral Yellow, is a native pigment found in most countries, and abundantly in our own. It varies considerably in constitution and colour, in which latter particular it is found from a bright but not very vivid yellow to a brown yellow, called *spruce ochre*, and is always of a warm cast. Its natural variety is much increased by artificial dressing and compounding. The best yellow ochres are not powerful, but, as far as they go, are valuable pigments, particularly in fresco and distemper, being neither subject to change by ordinary light, nor much affected by impure air or the action of lime; by time, however, and the direct rays of the sun, they are somewhat darkened, and by burning are converted into light reds.

The ochres, which are amongst the most ancient of pigments, may all be produced artificially, in endless variety, as they exist in nature, and iron is the principal colouring matter in them all.

Oxford Ochre.

This pigment is a native of the neighbourhood of Oxford; it is semi-opaque, of a warm yellow colour, and of a soft argillaceous (or clayey) texture, absorbent of water and oil, in both of which it may be used with safety, according to the general character of yellow ochres, of which it is one of the best. Similar ochres are found in the Isle of Wight, in the neighbourhood of Bordeaux, and various other places.

Stone Ochre

Has been confounded with the preceding, which it frequently resembles, as does also Roman ochre. True stone ochres are found in balls or globular masses of various sizes in the solid body of stones lying near the surface of rocks among the quarries in Gloucestershire and elsewhere. These balls are of a smooth compact texture, in general free from grit, and of a powdery fracture: they vary exceedingly in colour, from yellow to brown murrey and grey; but do not differ in other respects from the preceding, and may be safely used in oil or water in the several modes of painting. Varieties of ochreous colours are produced by burning and compounding with lighter, brighter, and darker colours, but often very injuriously and adversely to the certainty of operation, effect, and durability.

Raw Sienna

Is a ferruginous (or impregnated with iron) native pigment, and appears to be an iron ore which may be considered as a crude, natural yellow lake, firm in substance, of a glossy fracture, and very absorbent. It is in many respects a valuable pigment, of rather an impure yellow colour, but has more body and transparency than the ochres; and being little liable to change by the action of either light, time, or impure air, it may be safely used, according to its powers, either in oil or water, and in all the modes of practice. By burning, it becomes more transparent and drying, and changes colour to a red brown. Raw sienna is a valuable colour in graining.

Yellow Lake.

There are several pigments of this denomination, varying in colour and appearance according to the colouring substances used, and modes of preparation; they are usually in the form of drops; and their colours are in general of a bright yellow, very transparent, and not liable to change in an impure atmosphere—qualities which would render them very valuable pigments were they not soon discoloured and even destroyed by the opposite influences of oxygen and light, both in water and oil, in which latter vehicle, like other lakes in general, they are bad dryers, and do not stand the action of white lead or metallic colours. If used, therefore, it should be as simple as possible.

CHAPTER XII.

RED.

Red is the second and intermediate of the primary colours, standing between yellow and blue, and in like intermediate relation also to white and black, or light and shade. Hence it is preeminent among colours, as well as the most positive of all, forming with Yellow the secondary orange, and its near relatives scarlet, &c.; and with blue, the secondary purple and its allies, crimson, &c. It gives some degree of warmth to all colours, but most to those which partake of yellow. It is the archeus or principal colour in the tertiary *Russet;* enters subordinately into the two other tertiaries, *Citrine* and *Olive;* goes largely into the composition of the various hues and shades of the semi-neutral, *Marone* or *Chocolate*, and its relatives, *Puce*, *Murrey*, *Morella*, *Mordore*, *Pompadour*, &c., and more or less into browns, greys, and all broken colours.

It is also the second power in harmonizing and contrasting other colours, and in compounding Black and all neutrals, into which it enters in the proportion of five, to blue eight, and yellow three. Red is a colour of double power in this respect also, that in union or connection with yellow it becomes hot and advancing, but mixed or combined with blue it becomes cool and retiring. It is, however, more congenial with yellow than with blue, and thence partakes more of the character of the former in its effects of warmth, of the influence of light and distance, and of action on the eye, by which the power of vision is diminished upon viewing this colour in a strong light; while, on the other hand, Red itself appears to deepen in colour rapidly in a declining light as night comes on, or in the shade.

These qualities of Red give it great importance, render it difficult of management, and require it to be kept, in general, subordinate in painting; hence it is rarely used unbroken or as the predominating colour, on which account it will always appear detached or insulated, unless it be repeated and subordinate in the composition. Accordingly, nature uses red sparingly, and with as great reserve in the decoration of her works as she is profuse in lavishing green upon them, which is, of all colours, the most soothing to the eye, and the true compensating colour, or contrasting or harmonizing equivalent of Red, in a proportional quantity of eleven, to five of Red, according to surface or intensity; and is, when the Red inclines to Scarlet or Orange, a Blue Green, and when it inclines to Crimson or Purple, a Yellow Green.

Red breaks and diffuses with White with peculiar loveliness and beauty, but it is discordant when standing with orange only, and requires to be joined or accompanied by their proper contrasts to resolve or harmonize their dissonance. In landscapes, &c., abounding with views allied to green, a red object, properly placed, according to such hues in light, shade, or distance, conduces wonderfully to the life, beauty, harmony, and connection of the colouring; and this colouring is the chief element of beauty in floral nature, the prime contrast and ornament of the green garb of the vegetable kingdom.

Red being the most positive of colours, and having the middle station of the primaries, while black and white are the negative powers or neutrals of colours and the extremes of the scale, Red contrasts and harmonizes these neutrals; and as it is more nearly allied to white or light than to black or shade, this harmony is most remarkable in the union or opposition of white and red, and this contrast most powerful in black and red.

As a colour, Red is, in itself, preeminently beautiful, powerful, cheering, splendid, and ostentatious, and communicates these qualities to its two secondaries, and their sentiments to the mind.

Red, being a primary and simple colour, cannot be composed by mixture of other colours; it is so much the instrument of beauty in nature and art, in the colour of flesh, flowers, &c., that good pigments of this genus may, of all colours, be considered the most indispensable; we have, happily, therefore, many of this denomination, of which the following are the principal.*

Vermilion

Is a sulphuret of mercury, which, previous to its being levigated, is called *Cinnabar*. It is an ancient pigment, which is found in a native state and produced artificially. The Chinese possess a native cinnabar so pure as to require grinding only to become very perfect Vermilion, not at all differing from that imported in large quantities from China; but, besides the beauty of the natural pigment, it is supposed that the Chinese have a process of manufacture which is not known to us, by which the superior brilliancy is imparted to the colour. Chinese Vermilion is of a cooler tone than that generally manufactured from factitious cinnabar in England, Holland, and different parts of Europe. The artificial, which was anciently called minium—a term now confined to Red Lead—does not differ from the natural in any quality essential to its value as a pigment: it varies in tint from dark red to scarlet, and both sorts are perfectly durable and unexceptionable pigments. It is true, nevertheless, that vermilions have obtained the double disrepute of fading in a strong light and of becoming black or dark by time and impure air. But colours, like

* "Grammar of Colouring."

characters, suffer contamination and disrepute from bad association; it has happened, accordingly, that Vermilion, which, in order to give a crimson tone to it, has been mixed with Lake or Carmine, has faded in the light, and that when it has been toned to the scarlet hue by Red or Orange Lead, it has afterwards become blackened by impure air, &c.: both of these adulterations were formerly practised, and hence the ill-fame of Vermilion. Mr. Field, an eminent authority, however, says, "We therefore repeat that neither light, time, nor foul air effects sensible change in *true* vermilions, and that they may be used safely in either water, oil, or fresco, being colours of great chemical permanence." Good vermilion is a powerful, vivid colour, of great body, weight, and opacity: when pure, it will be entirely decomposed and dissipated by fire in a red heat, and is therefore in respect to the above mixtures easily tested. When red or orange lead has been substituted for or used in adulterating vermilion, muriatic acid applied to such pigments will turn them more or less white or grey; but pure vermilions will not be so affected by the acid, nor will they by pure or caustic alkalis which change the colour of the reds of iodine. Powder vermilion may also be tested in the following manner:—Place a small quantity on a piece of paper on a hard surface, cover it with a card or another piece of paper, and rub the back of this with the thumb nail, the handle of a penknife, or other hard substance. If the vermilion be pure, it will, on removal of the paper, present a smooth surface of the uniform original colour; but if adulterated with Red Lead, &c., the surface will appear orange or yellow. And further, when vermilion has been mixed with either oil, size, or gum-water, and allowed to stand for a few moments, the yellow or other pigment with which it is mixed will separate and rise to the top, so that, in using the secondary quality, it is necessary to stir up the paint before a brushful is taken, or the work will not dry even in colour.

The name *vermilion*, derived from *vermiculus* (*vermis*, a worm), seems to have had its origin in very early days, and would appear to be the scarlet referred to in the Bible (Exod. xxviii. 5), where the colour rendered in the authorised version "scarlet" is, in the original Hebrew, called "Tolaath Shani" (*shining worm*).

The term vermiculus used by the Moors referred to the insect they called kermes, and hence it seems the name kermesino, or cremèsino, which has in our day become "crimson."

By burning more or less, vermilion may be brought to the colour of most of the red ochres.

The finest European vermilion was, until lately, made at Utrecht in Holland, and this manufactory supplied nearly all Europe. It is now, however, manufactured in other places, particularly in Istria. The process of manufacture of vermilion is thus given in "Workshop Receipts," by Mr. E. Spon:—"1. Vermilion is prepared by melting one part of sulphur and adding to it gradually five or six parts of mercury; the heat is continued until the mixture swells up, then cover the vessel and remove it from the heat; when the mixture is cold, reduce it to powder, and sublime it in a closed vessel so placed in a furnace that the flames may play freely around it to about half its height. The heat is gradually increased until the lower portion of the subliming vessel becomes red hot; the cold sublimate is broken into pieces, ground in water to a fine powder, passed through a sieve, and dried. At first the mixture becomes black—takes the name of Æthiops mineral, or black sulphuret of mercury; this substance is then reduced to powder, and sublimed in appropriate vessels, when a crystallized mass is obtained, composed of bright filaments of a violet tint; by trituration it becomes of a scarlet colour. But the mere grinding will not be sufficient to give a bright tone to the vermilion: various methods are employed for that purpose which are not generally known. Some manufacturers grind their ingredients up with plain water or with urine, and afterwards boil it for some time; others treat it with nitric acid; but it does not happen that any of the methods hitherto employed for heightening the colour of vermilion obtained by sublimation give the same brightness as Chinese Vermilion, the preparation of which is not known."

A process invented by Kirchoff is employed in most manufactories for making the finest qualities of vermilion. It is called the humid process, from the employment of water, with which the ingredients are triturated at a temperature of not more than 130° F., until the mixture, which is first black, turns a brownish red, when the temperature is lowered to 114° F., and steadily maintained at that until the brightest colour is obtained; it is then allowed to subside, the liquor is decanted off, and the residue washed in clean water.

INDIAN RED.

This pigment belongs to the class of red ochres, comprehending also Light Red, Venetian Red, Scarlet Ochre, Indian Ochre, Redding, Ruddle, Bole, &c., besides other absurd appellations, such as English Vermilion and Spanish Brown or majolica.

The red ochres are, for the most part, rather hues and tints than definite colours, or more properly classed with the tertiary, semi-neutral, and broken colours; they are, nevertheless, often very valuable pigments for their tints in dead colouring, and for their permanence, &c., in water, oil, crayons, distemper, and fresco, and in a low tone of colouring have the value of primaries. The greater part of them are native pigments, found in most countries, and very abundantly and fine in our own; but some are productions of manufacture, and we have produced them in the variety of nature by art.

Indian Red is a native mineral production brought from Bengal. It is a very rich iron ore—hematite or peroxide of iron. It is an anomalous red, of a purple-russet hue, of a good body, and valued when fine for the pureness and warm tone of its tints. In its rough state it is a coarse powder, full of extremely hard and bright particles of a dark appearance, somewhat magnetic, and is greatly improved by grinding and washing over. Its chemical tendency is to deepen; nevertheless, it is very permanent, neither light, impure air, mixture with other pigments, stone, nor fire effecting in general any sensible change in it; and, being opaque, it covers well. This pigment varies considerably in its hues, that which is most rosy being esteemed the best, and affording the purest tints: inferior red ochres have been formerly substituted for it, and have procured it a variable character; but it is now obtained abundantly, and may be had pure of respectable colourmen. Indian Red is artificially manufactured by calcining sulphate of iron until the water of crystallization is expelled; it is then roasted in a fierce fire until acid vapours cease to rise; it is then cooled and washed with pure water until the water ceases to affect litmus paper; it is then dried.

In using Indian Red as a ground, there are two ways of mixing it. 1. With turpentine, to which a small quantity of gold size or varnish is added to bind the colour. This dries very rapidly, but with a flat or dull surface, and therefore requires varnishing. 2. With boiled oil and a little driers. This does not dry as quickly as the other, and its surface is glossy; not absolutely requiring varnish, but a coat of varnish improves the appearance, and acts also as a preservative.

Light Red

Is an ochre of a russet-orange hue, principally valued for its tints. The common Light Red is brown ochre burnt; but the principal yellow ochres afford this colour best, and the brighter and better the yellow ochre is from which this pigment is prepared, the brighter will the red be, and the better flesh-tints will it afford with white. There are, however, native ochres brought from India and other countries which supply its place, some of which become darkened by time and impure air; but in other respects Light Red has the general good properties of other ochres, dries admirably, and is much used both in figure and landscape painting.

Venetian Red.

This pigment, which is sometimes called scarlet ochre, is said to be a native ochre; but the colours sold under this name are prepared artificially from sulphate of iron, or its residuum, in the manufacture of acids. They are all of redder and deeper hue than Light Red, are very permanent, and have all the properties of good ochres.

Red Lead.

This is a very ancient pigment, and has been called Minium or Saturnine Red. It has also by some old writers been confounded with Cinnabar, and called *sinoper* or *synoper*. It is a deutoxide of lead, prepared by subjecting massicot to the heat of a furnace with an expanded surface and free accession of air. It is of a scarlet colour and fine hue, warmer than common vermilion, bright, but not as vivid as the biodide of mercury, though it has the body and opacity of both these pigments, and has been confounded even in name with vermilion, with which it was formerly customary to mix it. When pure and alone, light does not affect its colour; but white lead, or any oxide or preparation of that metal, mixed with it soon deprives it of colour, as acids do also, and impure air will blacken and ultimately metallize it.

On account of its extreme fugitiveness when mixed with White lead it cannot be used in tints; but employed unmixed with other pigments in simple varnish or oil, not rendered drying by any metallic oxide, it may, under favourable circumstances, stand a long time: hence red lead has a valuable character for durability. It is in itself, however, an excellent drier in oil, and has in this view been employed with other pigments; but, as regards colour, it cannot be mixed safely with any other pigments than the ochres, earths, and blacks in general. Used alone it answers, however, as a good red paint for common purposes.

Red lead is often adulterated with brickdust, which may be detected in the following manner:—Heat the red lead in an iron crucible, and then treat it with nitric acid diluted; the red lead will thus be dissolved, but the brickdust will remain.

CARMINE,

Or Carmin (Arabic *Kermes*). Although this colour is not one generally used in house painting, a few particulars concerning that splendid colour may prove useful and interesting. The name was originally given only to the fine feculences of the tinctures of kermes and cochineal, but now generally denotes any pigment which resembles them in beauty, richness of colour, and fineness of texture; hence we hear of blue and other coloured carmines, though the term is principally confined to the crimson and scarlet colours produced from cochineal by the agency of tin. These carmines are the brightest and most beautiful colours prepared from cochineal, of a fine powdery texture and velvety richness; they vary from a rose colour to a warm red, work admirably, and are in other respects —except the most essential, the want of durability— excellent pigments both in water and oil; they have not, however, any permanence in tint with white lead, and in glazing are soon discoloured and destroyed by the action of light, but are little affected by impure air, and are in other respects like the lakes of cochineal, all the pigments prepared from which may be tested by their solubility in liquid ammonia, which purples lakes prepared from the woods, but does not dissolve their colours.

Carmine was first prepared by a Franciscan monk, who discovered it accidentally whilst compounding some medicine containing cochineal and, in 1656 it began to be manufactured. It is the finest red colour known. One process for its preparation is to digest 1 lb. of cochineal in 3 gallons of water for fifteen minutes;

then add 1 oz. of cream of tartar, heat gently for ten minutes; add ½ oz. of alum, boil for two or three minutes, and, after allowing any impurities to settle, the clear liquid is placed in clean glass pans, when the carmine is slowly deposited; after a time the liquid is drained off, and the Carmine dried in the shade. In the preparation of Carmine much depends on a clear atmosphere and a bright sunny day, as the pretty colour of carmine is never so good when it has been prepared in dull weather; and this accounts in a great degree for the superiority of French Carmine over that prepared in England. The great expense of fine Carmine has led to the fabrication and vending of several substitutes. Cochineal consists simply of the bodies of female insects of a species of *coccus*, called the *cochineal cacti*, because it feeds on plants of the cactus family, —particularly on one, which is therefore designated the cochineal plant, but known in Mexico as the *Napal*, which is nearly allied to the prickly pear. It assumes a somewhat tree-like form, and its fruit, although eatable, is very inferior to that of the prickly pear. It is a native of Mexico and other warm parts of America, and is assiduously cultivated in order to what may be called the cultivation of the valuable insect which it supports. This cultivation was carried on by the Mexicans long before the country was known to the Europeans: it is now carried on also in some parts of the West Indies and in the island of Teneriffe. The Cochineal plant and insect have been introduced into Algeria; but no considerable success has yet attended the attempts to introduce them into the East Indies, although the East India Company once offered a reward of £6,000 for their introduction.

The Cochineal insect is a small creature, a pound of cochineal being calculated to contain 70,000 of the insects in a dried state. The male is of a deep red colour, and has white wings. The female, which is wingless, is of a deep brown colour, covered with a white powder: the body is flat beneath and convex above. When a plantation of the Cochineal plant has been formed by cuttings, which are ready to receive the insects in eighteen months, the cultivator, who is termed *napalero*, procures branches laden with cochineal insects, and keeping the branches until the mother insects have laid their eggs, he places their bodies, with the eggs which they cover, in little nests formed of some cottony substance, upon the cochineal plants, and the young insects, when hatched, soon spread over the branches.

The gathering of the Cochineal is very tedious, and is accomplished by brushing the branches with the tail of a squirrel or other animal. The insects are killed by boiling water, by heating them in ovens, or by exposure to the heat of the sun. They must be speedily killed to prevent them from laying their eggs, which diminishes their value. When killed and dried they may be kept for any length of time without injury.

The different appearances presented by Cochineal as brought to market are ascribed to the different modes of killing the insect. Cochineal is one of the most important exports of Mexico.

Lake.

The name given to this series of red and other coloured pigments is derived from the lac or lacca of India; they are prepared for the most part by precipitating coloured tinctures of dyeing drugs upon alumine and other earths, &c. The lakes are hence a numerous class of pigments, both with respect to the variety of their appellations and the substances from which they are prepared. The colouring matter of common Lake (drop lake), is Brazil wood, which affords a very fugitive colour. Superior red lakes are prepared from cochineal, lac, and kermes; but the best of all are those prepared from the root of the *Rubia tinctoria*, or madder plant.

Drop Lake is made by dropping moist lake through a small funnel on to a slab; the colour thus forms itself into small conical drops, which are afterwards dried by a gentle heat; a very little gum-water is commonly added to the paste.

Scarlet lake is also prepared in the form of drops from Cochineal, and is of a beautiful transparent red colour and excellent body, working well both in water and oil, though like other lakes it dries slowly. Strong light discolours and destroys it, both in water and oil; and its tints with white lead, and its combinations with other pigments, are not permanent; yet when well prepared and judiciously used in sufficient body, and kept from strong light, it has been known to last many years: but it ought never to be employed in glazing,* nor at all in performance that aims at high reputation and durability. It is commonly tinted with vermilion, which has probably been mixed with lakes at all times, to give them a scarlet hue and add to their body. Florentine lake, Hamburg lake, Chinese lake, Roman and Venetian lakes, are but varieties of the same pigment.

Rose Pink

Is a coarse kind of lake, produced by dyeing chalk or whole whiting with a decoction of Brazil wood, &c. It is a pigment much used by paperstainers and in the commoner distemper painting, but is too perishable to be used in a higher class of work.

* Glazing is a term used by artists to designate the method of spreading colour very much thinned over parts of the picture to which it is desired to impart extra richness and depth. The colours which when mixed with the proper richness become transparent, are called glazing colours.

CHAPTER XIII.

BLUE.

Blue is the third and last of the primary or simple colours, and bears the same relation to shade that yellow does to light; hence it is the most retiring and diffusive of all colours, except purple and black; and all colours have the power of throwing it back in painting in greater or less degree, in proportion to the intimacy of their relation to light—first white, then yellow, orange, red, &c.

Blue alone possesses entirely the quality technically called *coldness* in colouring, and it communicates this property variously to all other colours with which it happens to be compounded. It is more powerful in a strong light, and appears to become neutral and pale in a declining light owing to its ruling affinity with black or shade and the power of absorbing light; hence the eye of the painter is liable to be deceived when painting with blue in too low a light, or towards the close of the day, to the endangering of the warmth and harmony of his work.

As already stated, blue mixed with yellow forms *green*, and mixed with red it forms *purple;* it characterizes the tertiary *olive*, and is also the prime colour of the neutral *black*, &c., and also the semi-neutral *greys, slate, lead-colours*, &c.: hence blue is changed in hue less than any colour by mixture with black, as it is also by distance. It enters also subordinately into all other tertiary and broken colours; and, as nearest in the scale to black, it breaks and contrasts powerfully and agreeably with white, as in wachet or pale blues, the sky, &c. It is less active than the other primaries in reflecting light, and therefore sooner disappears by distance.

It is an ancient doctrine that the azure of the sky is a compound of light and darkness, and some have argued hence, that blue is not a primary colour, but a compound of black and white; but pure or neutral black and white compound in infinite shades, all of which are neutral also, or *gray*. It is true that a mixture of black and white is a *cool* hue; because black is not a primary colour, but a compound of the three primary colours, in which blue predominates, and this predominance is rendered more sensible when black is diluted with white.

Blue is discordant in juxtaposition with green, and in a less degree so with purple, both of which are cool colours; and therefore *blue* requires its contrast—*orange*—in equal proportion,* either of service or intensity, to compensate or resolve its dissonance and correct its coldness.

Of all colours except black, blue contrasts white most powerfully. In all harmonious combinations of colours, whether of mixture or neighbourhood, blue is the natural ruling tone, universally agreeable to the eye when in due relation to the composition, and may be more frequently repeated therein pure or unbroken than any other of the primaries. These are, however, matters of taste, as in music, and subject to artificial rules founded on the laws of chromatic combination.

As Blue cannot be composed by mixture of other pigments, it is an original and primary colour. The paucity of blue pigments, in comparison with those of yellow and red, is amply compensated by their value and perfection. The following are the blues most generally used in house painting.

* See diagrams of colour in "The Grammar of Colouring," Vol. 186 of this series.

PRUSSIAN BLUE.

This deep blue pigment was discovered in the year 1720 by Diesbach, a colour-maker in Berlin, and it has hence been called *Berlin* blue. The mode of manufacture was published in England by Dr. Woodward, in 1724. It may be prepared in several ways. (1.) By the addition of a solution of yellow prussiate of potassa (ferrocyanide of potassium) to a solution of sulphate of iron (green vitriol). The blue compound thus produced deepens in tint when exposed to the air; and where it is required of greater consistence or more *body,* some alum and carbonate of potassa are added to the prussiate solution before mixing with the iron solution. (2.) By mixing solutions of yellow prussiate of potash and perchloride of iron, which yields the variety known as *Paris blue.* (3.) By adding a solution of the red prussiate of potash to a solution of sulphate of iron; and this mode of preparation gives *Turnbull's blue.* The Prussian blue settles to the bottom of the mixing vessels, and may be collected and subsequently dried by exposure to air, when it is obtained as a blue powder. If heat be applied during drying, the material cakes, and when cut exhibits a lustre and hue like copper. When alum has been used in the manufacture, the product has an earthy fracture. In other processes for the manufacture of Prussian blue numerous animal substances, such as dried blood, hair, wool, waste from skins and leather, flesh, animal oils, soot, bone black, &c., are employed.

Prussian blue is a deep and powerful colour, of vast body and considerable transparency, and forms tints of much beauty with white lead, though they are by no means equal in purity and brilliancy to those of cobalt and ultramarine, nor have they the perfect durability of the latter.

When used alone it can scarcely be distinguished as a blue, having more the appearance of a fine deep black, whilst all blacks, when placed near it, appear grey; it is therefore absolutely necessary that white, varying in quantity according to the tone of the colour required, should be added to it.

Although Prussian blue lasts a long time under favourable circumstances, its tints fade by the action of strong light, and it is purpled or darkened by damp or impure air. It becomes greenish also, sometimes by a development of the yellow oxide of iron, and it is therefore desirable to add to it a very small quantity of crimson lake, which in a great degree counteracts this tendency. The colour of this pigment has also the singular property of fluctuating, or of going and coming, under some change of circumstances, which property it owes to the action and reaction by which it acquires and relinquishes oxygen alternately, and time has a neutralising tendency upon the colour. It must be used carefully in mixing, as it is very powerful; and so much of the colour with which it is to be mixed is often required to produce the desired tint, that a greater quantity is compounded than is wanted at the time, and waste is thus caused. The most advisable plan, therefore, in mixing green, is to place the yellow on the slab, and to add the blue to it little by little, until the exact colour is obtained, each colour having been previously properly ground up in oil; the green is then to be put into the paint-pot and thinned for use.

Prussian blue dries and glazes well in oil; but its great and principal use is in painting deep blues, in which its body secures its permanence, and its transparency gives force to its depth. It is also valuable in compounding deep purples with lake, and is a powerful neutraliser and component of black, and adds considerably to its intensity. It is a pigment much used, when mixed with white lead, in the common offices of painting.

Antwerp Blue.

This is a lighter coloured and somewhat brighter Prussian blue—or ferro-prussiate of alumine—having more of the terrene basis, but all the other qualities of that pigment except its depth. Haarlem Blue is a similar pigment.

Brunswick, Celestial, and Damp Blue.

Brunswick or Celestial Blue is made by precipitating the alumine from a solution of alum by carbonate of soda, washing the precipitate, and adding sulphate of baryta, sulphate of iron, yellow prussiate of potash, and some bichromate of potash.

When dried, this mixture is known as Brunswick or celestial blue; but when the sulphate of baryta is left out, and the material is not dried, it is called *damp blue.*

French and German Ultramarine.

The high price of genuine Ultramarine places that celebrated blue quite beyond the list of colours used by house painters, and the factitious ultramarines are excellent substitutes for the genuine article. It appears that the French chemists, Clement and Desormes, in studying the curious process of obtaining pure ultramarine from lapis lazuli, by mixing it with resin, &c., were led to an analysis of the colouring matter; that suggested to Guimet the idea of composing it artificially. In this he succeeded, and obtained for his discovery the prize of 6000 francs offered by the Société d'Encouragement des Arts. Almost simultaneously Gmelin, in Tübingen, gave an analysis and a synthetic process, which also succeeded; and artificial ultramarine is now a regular article of manufacture.

Chemical skill, however, is necessary to success, and the manufacturers' formulas are very various, differing in the quantities of the ingredients and the order of mixing them. The German manufacturers are very successful, and some of them have recently produced a fine *green* ultramarine. The following formula, which is recommended by Professor Miller, is one of the simplest:—100 parts of finely washed kaolin, or porcelain clay (silicate of alumina), 100 of carbonate of soda, 60 of sulphur, and 12 of charcoal are mixed and exposed in a covered crucible to a bright heat for three hours and a half, when a green unfused residue should be left. This residue, after being well washed and dried, must be mixed with a fifth of its weight of sulphur, and exposed in a thin layer to a gentle heat, so as just to burn off the sulphur. When this is accomplished, more sulphur must be added and the washing repeated, and so on until the mass acquires a light blue colour, which is usually the case after the third roasting. There is reason to believe, from the experiments of Wilkins, that ultramarine is composed of two portions, one of which is constant in its composition, and is the essential colouring matter, containing about 40 parts of silicic acid, 26 of alumina, 13 of sulphur, and 21 of soda, arranged as a mixture of two silicates of alumina, sulphite of soda, and sulphide of sodium, the blue colouring principle being a compound of the two latter; while the other portion differs from the former in resisting the action of hydrochloric acid, and contains a variable amount of sand clay, oxide of iron, and sulphuric acid.—(*Chambers's Encyclopedia.*)

The factitious ultramarines are in general of deep rich blue colours, darker and less azure than fine ultramarine of the same depths, to which, of course, none of them are equal. Fire generally darkens these colours, which are also deepened by mixture with oil. When used with size or gum as a medium great care is required in mixing; for if too much of the medium be used, the colour will dry much darker than the original powder,—and if too little, the blue will not be fixed, but will rub off. When thus mixed, the colour should be tried before it is taken into use.

COBALT.

This is a modern improved blue prepared with metallic Cobalt or its oxides, although it properly belongs to a class of pigments, including *Saxon blue, Dutch ultramarine, Thenard's blue, Royal blue, Hungary blue, Smalt, Zaffre* or enamel blue, and *Dumont's blue.* These differ principally in their degrees of purity, and the nature of the earths with which they are compounded.

The first is the finest Cobalt blue, and may not improperly be called a blue lake, the colour of which is brought up in the manner of enamel blues; and it is, when well prepared, of a pure blue colour, tending neither to green nor purple, and approaching in brilliancy to the finest ultramarine. It has not, however, the body, transparency, and depth, nor the natural and modest hue, of the latter; yet it is superior in beauty to all other blue pigments. Cobalt blue works better in water than ultramarine in general does, and is hence an acquisition to those who have not the management of the latter, and also on account of its cheapness. It resists the action of strong light and acids, but its beauty declines by time and impure air.

Indigo,

Or Indian blue, is a pigment manufactured in the East and West Indies from several plants, but principally from the Anil, or *Indigofera*. It is of various qualities, and has been long known and of great use in dyeing.

In painting it is not so bright as Prussian blue, but is extremely powerful and transparent: hence it may be substituted for some of the uses of Prussian blue, as the latter now is for indigo.

It is of great body, and glazes and works well both in water and oil. Its relative permanence as a dye has obtained it a false character of extreme durability in painting—a quality in which it is very inferior even to Prussian blue.

Indigo is injured by impure air; and, in glazing, some specimens are firmer than others, but not durable,—in tint with white lead they are all fugitive: when used, however, in considerable body in shadow it is more permanent, but in all respects inferior to Prussian blue in painting. *Intense blue* is Indigo refined by solution and precipitation, in which state it is equal in colour to Antwerp blue. By this process Indigo becomes more durable and much more powerful, transparent, and deep. It washes and works admirably in water: in other respects it has the common properties of indigo.

The Indigo plant, in its general appearance, is not unlike the lucerne of our fields. The seed is sown in drills, about 18 in. apart, and soon makes its appearance above the ground, when it requires incessant care to keep the weeds down, which would otherwise soon choke so tender a crop. In about two months the plants begin to flower, and are then cut down, but shoot up again and give two or three more crops in the same year. Formerly indigo was carefully dried after being cut, and even fire heat was sometimes used for the purpose; but now, at least in India, the practice is abandoned, and it is found in every respect better to use the plant whilst fresh and green. The first process is to place in a shallow wooden vat as much as will loosely cover the bottom of it; water is then let in so as to cover the plants about three inches, and heavy wooden frames are put on the top to prevent them from floating. Being left in this state for from fifteen to twenty hours, fermentation is set up, and much gas is disengaged, the water becoming a light green colour. The green liquor is then run off into the second vat, which is placed below the level of the first, in which, whilst the fermentation process is being repeated upon a fresh supply in the first vat, it is violently agitated by being beaten with poles; this causes the *grain*, as it is called, to separate, and the green matter suspended in the liquor becomes blue and granular, and this change is promoted by the addition of a little lime-water from time to time. When this operation is sufficiently advanced the contents of the vat are allowed to settle, and in a short time the now-intensely blue granular matter has sunk to the bottom, leaving the supernatant liquor almost as clear as water; this is then run off nearly to the bottom, and the sediment is run into the third vat, which is below the level of the second; here it awaits several other additions from successive operations, and, a sufficient quantity being accumulated in the third vat, it is suffered to subside, and when thoroughly settled the clear liquor is drawn off, and the granular matter is removed and filled into coarse bags, which are hung up to drain. When sufficiently drained the blue paste is filled into very small boxes, about three inches square, and set to dry in the sun, which soon renders it fit for packing.

There are, of course, several other blues; but the above will be sufficient for all purposes, and the house-painter is urged not to adopt others until he knows their qualities from actual trial, and from having watched the effect which time and exposure to atmospheric action have had upon them.

CHAPTER XIV.

ORANGE.

Orange is the first of the secondary colours in relation to light, and is composed of yellow and red. A true and perfect *Orange* is such a compound of *red* and *yellow* as will neutralise a perfect *blue* in equal quantity of either surface or intensity, and the proportions of such compound are five of perfect *red* to three of perfect *yellow*.

When Orange inclines to red, it takes the name of *scarlet*, *poppy*, &c. In *gold* colour, &c., it leans towards Yellow. It enters into combination with green in forming the tertiary colour *citrine*, and with purple it constitutes the tertiary *russet;* it forms also a series of warm semi-neutral colours with black, and harmonizes in contact and variety of tints with white.

Orange is an advancing colour in painting; in nature it is effective at a great distance, acting powerfully on the eye, diminishing its sensibility in proportion to the strength of the light in which it is viewed, and it is of the hue and partakes of the character of the vividness of sunshine, as it does also of all the powers of its components, red and yellow.

Orange is pre-eminently a *warm* colour, being the equal contrast in this respect, as it is also in colour, to blue, to which the attribute of *coolness* peculiarly belongs; hence it is discordant when standing alone with yellow or with red, unresolved by their proper contrasts.

The list of original Orange pigments is so deficient that in some treatises Orange is not even named as a separate colour, most of them being classed amongst the reds or yellows. The place of the original orange pigments may be supplied by mixture of the two latter colours, by glazing the one over the other, by stippling, or other modes of breaking or intermingling them in working according to the style or effect required. Mixed pigments are inferior to the simple or homogeneous, in colour, working, and other properties; yet some pigments mix and combine more cordially than others. In oil, the compounding of colours is more easily effected than in water; but even in paint mixed with oil there will be a tendency of the heavier component, the red—generally vermilion—to sink to the bottom, and this tendency is of course greater in proportion to the thinness of the paint, the greater quantity of oil and turpentine giving greater freedom to the particles of colour. It is therefore necessary that the paint should be very often stirred whilst it is being used; otherwise, whilst one part of the surface painted will be covered with the yellow pigment only, another (as the colour approaches the bottom of the paint-pot) will be painted orange, and at last the paint will be red only. The paint should not be stirred with the brush, for some of the red particles will lodge between the hairs and work out from time to time, producing dark streaks which are difficult to remove, and which destroy the level appearance of the painted surface.

Chrome Orange.

This is a beautiful orange pigment, and is one of the most durable and least exceptional of chromates of lead, and not of iron, as it is commonly called, or *Mars scarlet*—another misnomer of this pigment, which is truly a subchromate of lead.

It is, when well prepared, of a brighter colour than vermilion, but is inferior in durability and body to the latter pigment, being liable to the changes and affinities of the chrome yellows in a somewhat less degree, but less liable to change than the orange oxide of lead.

Laque minérale is a French pigment—a species of chromic orange, similar to the above. This name is also given to orange oxide of iron and *chromate of mercury*, which is improperly classed as a red with vermilion; for though it is of a bright ochreous-red colour in powder, it is, when ground, of a bright orange-ochre colour, and affords with white very pure orange-coloured tints; it is nevertheless a bad pigment, since light soon changes it into a deep russet colour, and foul air reduces it to extreme blackness.

Orange Ochre,

Called also *Spanish ochre*, &c., is a very bright yellow ochre burnt, by which operation are acquired warmth, colour, transparency, and depth. In colour it is moderately bright, forms good flesh tints with white, dries and works well, both in water and oil, and is a very durable and eligible pigment.

Orange Lead

Is an oxide of lead of a more vivid and warmer colour than *red lead*, but in other respects it does not differ essentially from that pigment in its qualifications for working.

CHAPTER XV.

GREEN.

GREEN, which occupies the middle station in the general scale of colours and in relation to light and shade, is the second of the secondary colours. It is composed of the extreme primaries, yellow and blue, and is most perfect in hue when constituted in the proportions of three of yellow to eight of blue of equal intensities; because such a green will perfectly neutralise and contrast a perfect red in the proportions of eleven to five, either of space or power, as adduced in the scale of chromatic equivalents given in "The Grammar of Colouring" (Vol. 186 of this series).

Of all compound colours Green is the most effective, distinct, and striking, affecting the mind with surprise and delight when first produced by the mixture of blue and yellow; so dissimilar in its constituents does it appear to the untutored eye. Green mixed with orange converts it into the extreme tertiary, *citrine*, and mixed with purple it becomes the other extreme tertiary, *olive;* hence its relations and accordances are more general, and it contrasts more agreeably with all colours, than any other individual one.

It gives the beautiful verdant garb to the vegetable creation, affording the greatest repose to the eye, and supporting, at the same time that it harmonizes with, the variously coloured flowers with which this garden of the world is adorned. It is indeed in every respect a central or middle colour, being the contrast and compensatory of the middle primary, *red*, on the one hand, and of the middle tertiary, *russet*, on the other; and, unlike the other secondaries, all its hues, whether tending to blue or yellow, are of the same denomination.

The principal discord of Green is blue, and when they approximate or accompany each other they require to be resolved by the opposition of warm colours; and it is in this way that the warmth of distance and the horizon reconcile the azure of the sky with the greenness of a landscape. Its less powerful discord is yellow, which requires to be similarly resolved by a purple red or its principles.

In its tones Green is cool or warm, sedate or gay, either as it inclines to blue or to yellow; yet it is in its general effects cool, calm, temperate, and refreshing; and, having little power in reflecting light, is in a mean degree a retiring colour, and readily subdued by distance; for the same reasons it excites the retina less than most colours, and is cool and grateful to the eye. As a colour individually, Green is eminently beautiful and agreeable, but it is so more particularly when contrasted with its compensatory colour, *red*, as it often is in nature, and even in the green leaves of the young shoots of plants and trees, and they are the most generally attractive of all colours in this respect. They are hence powerful and effective colours on the feelings and passions, and require therefore to be subdued or toned to prevent excitement and to preserve the balance of harmony in painting.

Green being a compound of *blue* and *yellow*, these colours may be used to supply the place of green pigments by compounding them according to the manner of working.

In common oil-painting greens are formed by the mixture of the ordinary blue and yellow pigments with additions of white; but these are less durable than the original green pigments prepared from copper, of which there are many different kinds. But the yellow ochres with Prussian blue afford more eligible pigments than the brighter mixtures of Chrome yellow. Cobalt greens, Chrome greens, and Prussian greens are names for similar mixtures.

Brunswick Green.

This is one of a large class of pigments grouped under the name of *copper* greens, comprehending amongst their number Verdigris, Verditer, Malachite, Mineral green, Schweinfurt or Vienna green, Green bice, Scheele's green, Emerald green, Green lake, Mountain green, African green, French green, Saxon green, Prussian green, Patent green, Marine green, Olympian green, &c.

The general characteristics of these greens are brightness of colour, well suited to the purposes of house painting, but not adapted in general to the modesty of nature in fine art. They have considerable permanence, except from the action of damp and impure air, which ultimately turns them black, to which they have also a tendency by time. They have a great body, and dry well in oil, but, like the whites of lead, are all to a certain extent deleterious substances.

Emerald Green.

This is a copper green upon a terrene base. It is the most vivid of this tribe of colours, being rather opaque, and powerfully reflective of light, and appears to be the most durable pigment of its class. Its hue is not common in nature, but it is well suited for brilliant works. It is difficult to manage in oil, and dries badly. The only true Emerald Green is, however, that of chrome, with which metal nature gives the green colour to the emerald. Emerald Green may be purchased ready ground in oil; and in this condition it is best to obtain it, as it is a very difficult powder to incorporate with oil, and a saving of time and trouble is thus effected. It has not much body, and the best plan to use it is to mix a small quantity of white lead with the first coat, using the colour by itself for finishing; for the admixture of white, of course, gives the emerald green a pale hue, which is anything but agreeable. It is a bad dryer, and requires therefore the admixture of patent dryers.

Chrome Green.

The greens commonly so called are compound pigments, of which Chrome Yellow is the principal colouring substance. These are also called *Brunswick green*, &c., and are compounds of chromate of lead with Prussian and other blue colours, constituting fine greens to the eye, suitable for some of the ordinary purposes of mechanical art, but unfit for fine art.

There is, however, a true Chrome Green, or *native green*, the colouring matter of which is the true oxide of chrome, and, being free from lead, is durable both against the action of the sun's light and impure air. It is of various degrees of transparency or opacity, and of several hues more or less warm or cool, which are all rather fine than brilliant greens, and afford pure, natural, and agreeable tints. True Chrome Greens neither give nor receive injury from other pigments, and are eligible for either water or oil painting, in the latter of which they usually dry well. As already stated, it is to this substance that the emerald owes its green colour.

Verdigris,

Or Viride Æris, is of two kinds, common or impure and crystallized or distilled verdigris—or, more properly, refined verdigris. They are both acetates of copper, of a bright colour inclining to blue. They are the least permanent of the copper greens, soon fading as water-colours by the action of light, &c., and becoming first white and ultimately black by damp and foul air. In oil, verdigris is durable with respect to light and air; but moist and impure air changes its colour, and causes it to effervesce or rise to the surface through the oil. It dries rapidly, and might be useful as a siccific with other greens or very dark colours. Fresh ground in varnish it stands better, but is not, upon the whole, a safe or eligible pigment either alone or compounded.

Mineral Green

Is the commercial name of green lakes, prepared from the sulphate of copper. These vary in hue and shade, and have all the properties before ascribed to copper greens, and afford the best common greens. Not being liable to change of colour by oxygen and light, these greens stand the weather well, and are excellent for the use of the house-painter, &c., but are less eligible in the nice works of fine art, having a tendency to darken by time and foul air.

Prussian Green.

The pigment celebrated under this name is an imperfect prussiate of iron, or Prussian blue, in which the yellow oxide of iron superabounds, or to which yellow tinctures of French berries have been added, and is not in any respect superior as a pigment to the compounds of Prussian blue and yellow ochre. A better sort of Prussian green is formed by precipitating the prussiate of potash with nitrate of cobalt.

CHAPTER XVI.

PURPLE.

Purple, the third and last of the secondary colours, is, as already stated, composed of *red* and *blue* in the proportion of five of the former to eight of the latter, which constitute a perfect purple, or one of such a hue as will neutralise and best contrast a perfect yellow, in the proportions of thirteen to three, either of surface or intensity. It forms, when mixed with its co-secondary colour, green, the tertiary colour *olive;* and when mixed with the remaining secondary colour, orange, it constitutes in like manner the tertiary colour, *russet.* It is the coolest of the three secondary colours, and the nearest also to black in respect to shade, in which respect, and in never being a warm colour, it resembles blue. In other respects also purple partakes of the properties of blue, which is its ruling colour; hence it is to the eye a most retiring colour, which reflects light little, and declines rapidly in power in proportion to the distance at which it is viewed, and also in a declining light. It is the most retiring of positive colours.

Purple is, next to green, the most pleasing of the consonant colours, and has been celebrated as a regal or imperial colour, as much, perhaps, from its rareness in a pure state as from its individual beauty. When inclining to the rose or red, this colour takes the name of Crimson, as it does those of Violet, Lilac, &c., when it inclines towards the other constituents, which latter colours it serves to mellow, or falls well into shade.

The contrast or harmonizing colour of Purple is

Yellow, on the side of light and the primaries, and it is itself the harmonizing contrast of the tertiaries *citrine* on the side of shade, and less perfectly so of the semi-neutral *brown*.

Purple, when inclining towards redness, is a regal, magisterial, and pompous colour. In its effects on the mind it partakes principally, however, of the powers of its archeus, or ruling colour, blue.

As the extreme primaries Blue and Yellow, when either compounded or opposed, afford the most pleasing consonance of the primary colours, so the extremes Purple and Orange afford the most pleasing of the secondary consonances; and this analogy extends also to the extreme tertiary and semi-neutral colours, while the mean or middle colours afford the most agreeable contrasts or harmonies.

Purple pigments are rare, and lie under a peculiar disadvantage as to apparent durability and beauty of colour, owing to the neutralising power of yellowness in the grounds upon which they are laid, as well as to the general warm colour of light, and the yellow tendency of almost all vehicles and varnishes by which this colour is subdued; for the same reason this colour disappears by candle-light.

Purple, then, being a secondary colour, composed of *blue* and *red*, it follows of course that any blue and red pigments which are not chemically at variance may be used in producing mixed purples of any required hue, either by mixture or by working them together according to the method of painting in which the colour is required. It will of course be understood that, in such compounding, the more perfect the original pigments, the better will be the colour produced. In these ways, *Ultramarine* and the rose colours of madder constitute excellent and beautiful purples, which are equally permanent in water and oil, in glazing or in tint, whether under the influence of the oxygenous or the hydrogenous principles of light and impure air by which colours are subject to change. The blue and red of cobalt and madder afford good purples. Good purples may be made by the mixture of *Ultramarine* and *Vermilion*, *Prussian blue* and *Lake*, &c., with varied proportions of White, and the predominance of either of the pigments which may be required to give the colour a blue or red tendency; whilst by the further addition of white the various tints of lavender, lilac, &c., are produced. For further information as to the various purples used in the arts, and also for an account of the tertiary colours, we refer the reader to the "Grammar of Colouring."

CHAPTER XVII.

BROWN.

As a colour, according to the regular scale descending from white, properly ceases with the tertiary *olive*, the neutral black would here naturally terminate the series; but as, in a practical view, every class or tribe combines with black as it exists in pigments, a new series or scale of compounds arises having black for their bases; these have been distinguished by the term semi-neutrals, comprehending Brown, Maroon, and Grey.

The term *brown* has, in its widest sense, been used to comprehend every denomination of dark broken colour, and in a more limited sense is the rather indefinite appellative of a very extensive class of colours of warm or tawny hues. Accordingly we have browns of every denomination of colour except blues; thus, we have yellow brown, red brown, orange-brown, purple brown, &c. But it is remarkable that we have in this sense no blue brown, nor any other coloured brown, in any but a forced sense, in which blue predominates, such predominance of a cold colour immediately carrying the compound into the class of grey, ashen, or slate-colour; hence brown comprehends the hues called dun, hazel, auburn, &c.

The term *brown* therefore properly denotes a warm broken colour, of which yellow is the principal constituent; hence brown is in some measure to shade what yellow is to light, and warm or ruddy browns follow yellows naturally as shading or deepening colours. It is hence also that *equal quantities* of either of the three primaries, the three secondaries, or their three tertiaries produce variously a brown mixture, and not the neutral black, &c., because no colour is essentially single, and warmth belongs to two of the primaries, but coldness to blue alone. Browns contribute to coolness by contrast, when opposed to pure colours; hence their vast importance in painting, and the necessity of keeping them from other colours to which they give foulness in mixture.

The wide acceptation of the term brown has occasioned much confusion in the naming of colours, since broken colours in which red, &c., predominate have been improperly called brown, and a tendency to red or hotness in browns obtains for them the reproachful appellation of *foxiness*. This term brown should therefore be confined to the class of semi-neutral colours, compounded of, or of the hues of, either the primary yellow, the secondary orange, or the tertiary citrine *with a black pigment*, the general contrast or harmonizing colour of which will consequently be more or less purple or grey; and with reference to black and white, or light and shade, it is of the semi-neutrals the nearest in accordance with white and light.

Brown is a sober and sedate colour; grave and solemn, but not dismal; and contributes to the expression of strength, stability, and solidity, vigour, warmth, and in a minor degree to the serious, the sombre, and the sad.

The list of brown pigments is very long, and that of mixed browns literally endless; it being obvious that every warm colour mixed with black will afford a brown, and that equal portions of the primaries, secondaries, or tertiaries will do the same; hence there can be no difficulty in producing them by mixture when required, which is seldom, as there are many browns which are good and permanent pigments. (*Field.*)

Brown Pink.

This is a vegetable lake, precipitated from the decoction of French berries and dyeing woods, and is sometimes the residuum of the dyer's vat. It is of a fine, rich, transparent colour, rarely of a true brown; and being in general of an orange broken by green, it falls into the class of *citrine* colours, sometimes inclining to greenness, and sometimes to the warmth of orange. It works well both in water and oil, in the latter of which it is of great depth and transparent, but dries badly. Its tints with white lead are very fugitive, and in thin glazing it does not stand. It is not upon the whole considered an eligible colour in general house painting.

Burnt Sienna.

This pigment is the Terra di Sienna ("Raw Sienna," page 65) burnt, and is of an orange-russet colour. It is richer in colour, deeper and more transparent, and works and dries better, than raw sienna; but in other respects has all the properties of the original pigment, and is permanent and eligible wherever it may be useful, and it is very valuable in graining. Burnt Sienna is the best colour for shading gold; it works well on gold leaf when mixed with a small quantity of ox gall in water-colour painting, or with varnish in oil-painting. When Burnt Sienna is used in shading gold, it should in the darkest parts be mixed with burnt umber or vandyke brown.

Umber.

This pigment, commonly called raw umber, is a natural ochre abounding with oxide of manganese, said to have been first obtained from ancient Ombria, now Spoleto, in Italy.

It is found also in England and in most parts of the world; but that which is brought from Cyprus under the name of *Turkey umber* is the best. It is of a brown citrine colour, semi-opaque, has all the properties of a good ochre, is perfectly durable, both in water and oil; it is one of the best drying colours we possess, and injures no other good pigments with which it may be mixed. Although not so much employed as formerly, Umber is perfectly eligible according to its colour and uses in graining.

Burnt Umber

Is the previous pigment burnt, by which process it becomes of a deeper and more russet hue. It contains manganese and iron, and is very drying in oil, in which it is employed as a drier. It may be substituted for vandyke brown, is a perfectly durable pigment in water, oil, and fresco, and may be produced artificially. It is semi-transparent, and is very useful in shading, supporting, or deepening burnt sienna. It gives excellent stone colours when mixed with white lead.

Brown Ochre,

Sometimes called spruce ochre, is a dark-coloured yellow ochre. It is much employed, and affords useful and permanent tints. This and all natural ochres require grinding and washing over to separate them from extraneous substances, and they acquire depth and redness by burning. They form with Prussian blue a variety of greens used in landscape painting, and they are also of use in mixture with other colours.

Spanish Brown.

Spanish Brown, or *majolica,* is an individual pigment belonging to the class of red ochres; amongst which are comprehended Indian red, light red, Venetian red, Scarlet ochre, Indian ochre, redding, ruddle, bole, &c.

These pigments are for the most part rather hues and tints than definite colours; they are, nevertheless, often very valuable pigments for their tints in dead colouring, and for their permanence.

The greater part of these are native pigments, found in most countries, and very abundantly and fine in our own; but they have been produced in great variety by manufacture.

Vandyke Brown.

This pigment was much esteemed and used by the celebrated painter Vandyke, whose name it bears. It is a species of peat bog earth, of a fine, deep, semi-transparent brown colour. It is said to have been brought from Cassel, and this seems to be justified by a comparison of *Cassel earth* with the browns of Vandyke's pictures.

The Vandyke Browns in use at present appear to be earthy pigments of a similar kind, purified in grinding and washing over: they vary sometimes in hue and in degree of drying in oil, which they do in general but tardily, owing to their bituminous body, and are durable both in water and oil. Vandyke Brown is quite transparent, and is very much used by grainers.

Purple Brown.

This is a pigment of a reddish-brown colour, not so pure as Indian red, and is very useful for outside work. In general tone it resembles a mixture of vermilion and black, by which it may in fact be imitated. It should not be mixed with linseed oil, by which its drying is impeded: boiled oil, with a little varnish, should therefore be employed, a small quantity of dryers being added, in order that the paint may present a uniform appearance when dry.

PART III.

OF GRAINING AND MARBLING.

CHAPTER XVIII.

GRAINING.

GRAINING is the imitation of the natural veining, curl, &c., of woods, and is performed in the first case by laying an opaque ground in strong oil paint of the general colour of the wood to be imitated, but lighter, and, when dry, covering this with a coat of transparent colour, of the proper hue and full depth, prepared either with turpentine or water colour.

The operations which are given in detail in the description of the methods of imitating the various woods are performed with common brushes, and as soon as the latter coat is dry the process called the *over-graining* is commenced. This is executed by a variety of tools, consisting of broad, flat, and thin brushes, used either spread, turning the hand, or edgewise,—hair pencils of various sizes, combs, and rubbers, which being, as occasion requires, dipped into turpentine or water, are passed quickly and lightly over the graining as required, and exhibiting the ground between; the various lines, eyes, veins, knots, &c., are then touched and re-touched until the desired effect is obtained, the work being subsequently varnished.

Of course the skill and practice of the grainer is greatly called into requisition in these operations, which are so admirably performed by some as to imply, in spite of much that has been said to the contrary, a degree of taste, observation, and dexterity of hand that places this art in rank far above that of plain painting. The process is apparently modern, and is said to have been first practised in this country, where the best workmen are to be found.

The grainer, however, who has the ambition to rise above mediocrity must bear in mind that he will not accomplish his object by merely following the written instructions here given, by copying the examples, or even by following the generally accepted pattern adopted by the mass of painters. He must think for himself, must examine and carefully study nature, and in this way he will understand the exact character of each wood, and will be able to produce good and natural representations of it.

We give, in a subsequent chapter, an account of the structure, growth, and ornamental characters of the various woods, to which we ask the special attention of our readers; and we would further suggest that each grainer should form for himself a small collection of specimens of woods, which he may do at a very small outlay. He may, for instance, purchase a few feet or so of veneers cut from each of the woods named, or such others as he can obtain. These may be glued, either by himself or any cabinet-maker, on common deal boards, and French polished or oil rubbed; an excellent set of examples of the most perfect character will thus be obtained, the uses of which will quite compensate for the trifling cost and small amount of trouble by which they have been obtained.

The plain painter having previously given the new wood three or sometimes four coats of paint, the grainer commences his work by laying what is called the graining ground, which differs in composition according to the wood to be imitated. The following colours and methods of manipulation are those adopted by a London grainer of eminence, and the hints given may therefore be depended upon.

BIRD'S-EYE MAPLE. (Plate I.)

The ground is to be mixed of White lead and Vermilion, of which, however, only sufficient must be used to neutralise the blue tinge of the White lead, but not to give it a pink tint. The mixture must be rather "oily," that is, it must contain a good quantity of oil, in order that the graining colour may not be so much absorbed as it would be if the surface were flatted, that is, coated with colour mixed principally with turpentine.

In order that the graining colours which are mixed with beer may adhere to the ground which has been painted in oil, it is necessary that the surface should be prepared. This is done by passing over it with a sponge moistened with beer and rubbed with whiting; when this is dry, the distemper colour will work freely over the oil, and will adhere to it. This process is called *cissing*.

The graining colour, which is to be ground with beer, consists of Vandyke Brown, or Raw Sienna and Vandyke Brown, or Brown Lake and Drop Black, or similar colours, according to the tint required, whether brown, yellow, or black maples.

With a tool lay the colour over the whole panel, and work it level with a hog-hair mottler—a flat tool mounted in tin; then take out some lights from the still wet colour by dabbing it with the mottler, at the same time drawing it along, by which means the colour is removed in certain places.

Soften the whole with a badger softener, which is a broad flat brush, the hairs of which are so set that they spread outward, and may thus be rapidly and lightly drawn over the work without leaving any brush marks, at the same time softening down the edges and otherwise smoothening the whole. Next, with a thinner mottler work round the edges of the lights, giving a pointed tendency to their forms, at the same time filling in the finer work in the darker spaces. When this has again been softened, take a hog's hair dotter—a short round brush, which may be obtained of an even form at the end, or somewhat pointed, or the latter form may be given to it by singeing against a red-hot iron—and with this draw from the lights to the darker parts of the work.

This part of the process must be done very rapidly, as it must be completed whilst the colour is wet; it is therefore obvious that such a portion only should be taken in hand as can be completed at once.

The next process is that of over-graining. The heart, which is indicated by numerous fine lines, which spread over a portion of the work in graceful wavy curls, can be produced by a sable pencil dipped in Venetian red, Indian red, or any other suitable colour mixed with beer; or an easier method is to use a red chalk pencil: but for larger surfaces an implement called the "sable tube over-grainer" must be used; this consists of a number of sable pencils fixed in one broad tinned handle.

The "eyes" are now to be added. The following method will be found very effectual:—Roll a piece of cloth, previously saturated with the over-graining colour, until a point is formed; this point must however be open, like the aperture in a funnel, but it must be semicircular in shape, and with this the impressions are to be made at the points marked by the dotter.

The over-graining of maple should be done on the same day as the mottling. When the graining is quite dry, it is to be varnished, a light varnish being used; and it is to be noticed that all graining executed in distemper should receive two coats of varnish.

Pollard Oak. (Plate II.)

The ground for graining this wood varies according to the exact tint required; it is composed in the present example (Plate II.) of White lead and Yellow Ochre, or

Venetian Red and Yellow Ochre, and the various tints resulting from the mixture of these, or Orange Chrome in different proportions with White lead may be used; for it must be understood that the tone of the whole work in graining is in a very great degree influenced by the colour of the ground. The ground in this, as in the last example, should be rather oily; the *cissing*,* however, should be done with whiting and *water* instead of beer. The graining colour is to be made of Vandyke Brown, mixed entirely with water, the work being rubbed in with the tool and mottler, as already described.

Next, with a tool dipped in a very dark mixture of the graining colour, dab patches on the wet work where the knots are required to be, then with a damp coarse sponge dab the dark knots well over, and with another piece of sponge draw round the knots, connecting them into groups.

In commencing the over-graining next day, pass over the whole with the same colour as before, but very much thinner, and with the softener draw the colour into the groups of knots; next take out some lights, and nicely soften the whole in every direction with the badger softener.

In first-class work, before over-graining dip a small sable pencil in Vandyke Brown, and draw fine free veins from each of the groups of knots to the others, or to such spots as will allow of free play of the lines.

By using water only in mixing the graining colour, the grainer is enabled to over-grain without previously applying a coat of varnish to bind the work, which would be necessary before he could apply a second wash, if beer had been used in the first colour. When dry, two coats of pale oak varnish are to be applied.

SATIN WOOD. (Plate III.)

The ground for satin wood is to be composed of White lead, just tinted with Chrome Yellow, Raw Sienna, or Yellow Ochre. The work is to be "cissed in" with whiting and beer.

The graining colours may be made of either of the following pigments mixed with beer :—Middle Chrome and Drop Black, Vandyke Brown, Raw Sienna and Vandyke Brown or York Brown: the work is to be rubbed in level with a tool and hog's-hair mottler.

Now moisten a rather coarse sponge in beer, and draw it down the work so as to leave it in rather broad streaks running in a slightly wavy or oblique direction, and soften the work with the badger softener.

Next, with a clean moist camel's hair mottler, work down the edges of the streaks with a jerking movement, so as to give that varied and fanciful appearance so much admired in the natural wood.

The over-graining colour is to be mixed in beer, and is to be composed either of tints of Vandyke, York Brown, and Black, or other pigments of similar character, but differing from those used in the ground. The heart must be done with a small sable pencil, the work being slightly brushed up with the badger.

The rest of the over-graining is to be done with a sable-tube over-grainer, or with a sable flat over-grainer, the hairs of which have been separated with a comb.

Mahogany. (Plate IV.)

There are many shades of mahogany; the following are however the colours generally used, and these may be varied according to taste, or may be darkened by the addition of pigments of a deeper hue. The ground colour is to be mixed of Venetian Red, Yellow Ochre, and White lead; or orange chrome may be substituted yellow ochre, the cissing being done with whiting and beer.

The graining colour is to be made of Vandyke Brown, Vandyke Brown and Black, Burnt Sienna and Black, or Vandyke Brown, to suit the ground. The colour, which is to be mixed with beer, is to be rubbed in dark with the tool and mottler, then with a clean and moist camel's hair mottler proceed according to the method described in relation to satin wood; or, to produce a feather or curl, draw the colour with the badger from the sides towards the middle of the panel. Much taste and skill are required in the next process, which consists in working up the feather or "curl;" this is done by gathering up, as it were, the grain from each side to culminate in the middle, working towards a point which must become more and more elongated.

The process and effect are difficult to describe, but the workman is advised to adopt nature as his model; and when he once understands the result to be attained, and the means at his disposal, he will, with a small amount of perseverance and industry, soon discover the method of working by which he may best achieve his purpose.

The curl and mottling of satin wood are so much like those of mahogany that the same manipulative processes can be adopted for both, with the exception that the "pattern" in the former is smaller than that in the latter.

The over-graining colour in mahogany is made of Vandyke Brown, or Vandyke Brown with a little Crimson Lake. The tools used are the hog's hair or sable over-grainer and a small over-graining comb. In a curl or feather the over-graining must follow the direction of the curl, rising from the centre and becoming gradually more pointed until it is lost in the general mottling of the wood: if the wood is to be mottled only, the over-graining must run in the direction of the mottling.

Should the work, when finished thus far, be found too light in colour, or not sufficiently rich, it must be varnished or "megilped," the megilp being made of boiled oil and turpentine. When this is dry, a mixture of Brown Lake and black, or Burnt Sienna and black, or Vandyke Brown and Crimson Lake may be rubbed over it, until the required tint is obtained; the whole is then to be nicely stippled with a softener, and, when dry, is to be again varnished.

Walnut. (Plate V.)

The ground for walnut is mixed of Venetian Red, Yellow Ochre, and a small quantity of Burnt Umber with White lead; the work is then to be "cissed in" with whiting and water.

The graining colour is to be Vandyke Brown mixed with water: it is to be rubbed in with a tool and mottler, then mottled in the manner described in the first process for Maple, and well softened.

When the colour is quite dry, take a sponge dipped in beer, and damp the whole well with it; and when this is dry, commence the over-graining. The colour for this process is Vandyke Brown and Drop Black mixed with beer.

With a light tint of this mixture, just sufficient to show, and a hog's hair over-grainer sketch the general design of the grain, and soften. When dry, with the same tools, the over-grainer being divided by a comb, and with a darker shade of the same colour, work up the graining to the required design, softening continually during work. After this, a good effect can be produced by dabbing the work with a damp piece of coarse sponge, and then softening upwards, or in the direction taken by the grain.

In superior work the above must be varnished, and, when dry, the whole is to be washed over with Vandyke Brown or Burnt Sienna and water; it is then to be mottled and well softened; after this it is to be varnished again.

Wainscot Oak. (Plate VI.)

The ground for wainscot oak is Yellow Ochre and White lead, or Venetian Red, Yellow Ochre, and White lead, &c. The graining colour is a mixture of turpentine, linseed oil, patent driers, and raw or burnt umber with black, according as the oak is required to be light or dark.

The work is to be well rubbed in, level and clear; then, with a gutta-percha comb, pass over the parts required to be veined; then, with a steel comb, repeat the process with a wavy motion.

Next wrap a piece of soft rag over the thumb, or over a piece of horn (called a "thumb-piece") shaped like the end of the handle of a spoon, and wipe out the light markings, taking care that no dark edges are left where the colour is wiped away—a result which is achieved by moving the cloth over the thumb or thumb-piece after each stroke.

The over-graining is now to be commenced by well damping the work with a sponge dipped in fuller's earth, pipe-clay, or whiting and water. The colour to be then used is Vandyke Brown mixed with water, and applied with a broad hog's hair over-grainer, to be drawn straight down the figured work. On the stiles, &c., of doors a mottler may be used in order to darken certain parts, the whole being well softened and subsequently varnished.

Rosewood.

There is so great a variety of form in the colour of this most elegant wood, that it is almost impossible to find two specimens alike. This renders it all the more necessary that our advice, to obtain various specimens of veneers, should be followed, in order that the general character of the curl may become thoroughly impressed on the mind. The learner will by this means form his style upon the variety in nature, and will be more likely to produce varied and truthful representations than if he trusted to his own fancy to *design* the woods.

The ground is prepared with Vermilion, Lake, and Flake White, mixed into a rosy tint, partaking more of pink than scarlet. When the ground is quite dry and smooth, take Vandyke Brown nearly opaque, and with a small tool spread the colour in various directions over the ground, then with another dry tool beat the colour, whilst wet, against the grain—that is, in the opposite direction to that in which it was laid on. Before the colour is dry, take a piece of wash-leather, spread over the thumb or thumb-piece, and with great freedom take out the lighter veins; have ready the darkest tint of Vandyke Brown, and with a sable pencil give free and strong touches under the parts taken out with the leather, and in other parts where required; blend off the whole with a badger-softener, and varnish when dry.

Another Rosewood.—This method will produce a wood of a more brilliant character. The ground is composed of Lake, Vermilion, and White, which must be allowed to become perfectly dry before the work is proceeded with. The graining colour is formed of Vandyke Brown and Rose Pink, ground very finely in beer; this is laid on with a common tool, but not too thickly; then taking a common quill, draw the feather in various directions over the wet colour, giving the hand a tremulous motion in parts where it is desired to give a wavy appearance to the grain; then take out the small bright lights with the wash-leather or cloth, and afterwards blend the whole with the softener. When this is dry, which will be in a few minutes, give very dark touches under the light parts with Vandyke Brown and Rose Pink nearly opaque. The whole is, of course, to be well varnished when dry.

Another and lighter Rosewood may be represented in the following manner:—The ground is formed as in the last specimen, the graining colour being Vandyke Brown and Rose Pink. This is put on, not in a mass, but with an over-grainer like a wide-toothed comb. The grain is to be spread on in streaks in a curled direction, as if winding round a knot. When this is nearly dry, it is to be passed over across the grain with a rather coarse graining-comb, and some dark veins curling down the length of the wood are to be added. The work will be completed by subsequent varnishing.

Another excellent Rosewood—.The ground is Chrome Yellow, Vermilion, and White lead. The graining colour is composed of Ivory Black, with Burnt Sienna ground very fine, the whole being well softened after laying on. When dry, over-grain in a curly figure with a small graining-brush and ivory black; shade up the knots with a camel's hair brush, and finally glaze with Rose Pink.

Having thus described, as far as possible, the manipulative processes employed in the imitation of woods, we shall now give the colours only which are used in representing others, leaving the grainer to adopt the methods already indicated, according to the work to be done.

Yew-tree.—(1.) Ground, Raw Umber mixed with White lead. Graining colour, Vandyke Brown and Burnt Sienna in equal parts, and ground in beer; add a small quantity of Raw Sienna. The knots and other markings to be worked with the graining colour when that previously laid on has become thoroughly dry. (2.) Ground colour, a mixture of White, Yellow Ochre, and Venetian Red. Graining colour, Vandyke Brown and Burnt Sienna, in beer, with a small quantity of Raw Sienna. The eyes or knots as above.

Hairwood.—(1.) For the first coat, mix a light grey, of White lead, ground in boiled oil, with a very small portion of Prussian blue, and mixed with turpentine. The ground colour is the same, very much thinned with turpentine. The graining colour is the same, with the addition of a little more Prussian blue, and applied with a feather in long veins. The over-graining is done with the ground colour. (2.) Ground colour, white lead, tinted with equal quantities of Prussian Blue and Black, and thinned with turpentine. The graining colour is a mixture in ale of Prussian Blue and Raw Sienna.

Graining and Marbling by Mechanical Means.

With the view of aiding the grainer and marbler, graining and marbling rollers have recently been introduced. These consist of cylinders fixed in frames, by means of which the pattern engraved on the rollers is repeated. They are no doubt efficient in certain classes of work, but the use of them does not come within the scope of this manual.

CHAPTER XIX.

MARBLING.

WE have in the chapter on Graining recommended the student to obtain pieces of veneers and to use them as examples for his work. It is not quite so easy to obtain specimens of marbles, but still they may be had at the various marble works in and about London and most large towns, whilst fine specimens may be seen in the Geological Museum in Jermyn Street. It is much to be desired that the various trade-unions throughout the country would add to the many excellent objects they have in view that of promoting the technical education of their younger members, and this might be materially aided by the formation of collections of the various raw and manufactured materials, such as, for instance, specimens of woods and marbles; for although neither graining nor marbling are to be absolute and servile copies of single specimens, but rather general renderings of the natural features, still this can only be accomplished by one who possesses the knowledge of what are the peculiarities of those natural features, and the precise points in which one may differ from another. This education can only be obtained by careful and accurate study from natural specimens. We give the method of imitating some of the most generally used marbles.

SIENNA MARBLE. (Plate VII.)

The ground of Sienna marble is White lead: the work is then to be evenly gone over with white paint mixed with equal quantities of turpentine and oil. After this, mix two light tints, the one consisting of Yellow Ochre and White lead, and the other of Vermilion and White lead, both mixed with equal quantities of oil and turpentine, and with separate tools dab patches on the white paint whilst yet wet, and with a brush well soften the patches together, great care being taken not to allow the red tint to be too dominant.

On a palette, on the side of which is placed a tin dipper containing turpentine, place a small quantity of Blue Black (the oil colours sold in collapsible metal tubes are the best for marbling) and a small quantity of Purple Lake; then with a sable pencil dipped in turpentine take a thin wash of the blue black and vein on the wet work, and soften; then work up the veins further with more Blue Black, so that the colour may be a little darker, but still thin; after this, with a flat camel's hair fitch dipped in turpentine, and a small quantity of the Purple Lake and Blue Black mixed, apply very thin washes in some of the open spaces, and soften lightly. When dry, put in whites, with White lead mixed with turpentine, using a sable pencil, and subsequently softening the work with a badger. When the paints are quite hard, apply a light varnish.

Italian Pink Marble. (Plate VIII.)

Over a white ground apply a coat of white paint as in the last case, compound tints of Ultramarine and White lead, and Vermilion and White lead, each being mixed with equal quantities of oil and turpentine, and with these dab patches, as already described, and soften.

On the palette place some Indian Red, and with a small pigeon feather dipped in turpentine, and some of the Indian Red, work the pattern and well soften. When this is dry, mix some White lead mixed rather thinly with turpentine, and flat the whole of the work; then with a feather dipped in turpentine scumble over the work, and subsequently put in whites with White lead and turpentine. When the work is perfectly hard, it is to be varnished.

Verde Antique. (Plate IX.)

The ground of Verde Antique is either black or dark green, the marbling colours being dark brown and green. Scumble over the work with these, then with Brunswick green and White lead scumble over again and soften with a badger; next with a fitch paint masses of white of various shapes, squares, irregular triangles, &c., and similar masses of black, as in the illustration.

The student may here be reminded of the difference between *scumbling* and *glazing:* in the latter, the colours are thinly *mixed* so as to be transparent; in the former, the colour is mixed thick, and thinly *spread* or *rubbed* on it with a hard brush.

Egyptian Green Marble.

This marble in colour nearly resembles the Verde Antique: it is a superior serpentine; and there are several sorts, which are called by different names, which would be of but little service to the painter, as they are all for his purposes comprehended under the above title. Egyptian Green differs from Verde Antique in the form of the veins, which run in a more horizontal direction, having a greater quantity of small fossil substances mixed with it, and the dark veins frequently running in streaks which often appear as if broken by violence.

Serpentine.

Of the whole of this class of marbles Mr. Whittock, in his "Painter's and Glazier's Guide," says, "The same kind of marble, though not so variegated in vein or colour, is found in Germany, Russia, and England. It is called serpentine from its supposed resemblance to the skin of the serpent, and in its rich variety of colour and almost indestructible hardness, and is therefore eminently suitable for architectural ornaments.

"Noble or Precious Serpentine has nearly the same appearance with the green marbles of the East, called Egyptian Green. The green is generally the cold ...our of the leek, but varies in shades, some appearing in the darkest olive. The veins which appear black sometimes run in a horizontal direction, and then suddenly break and appear nearly upright; in other cases they seem to have undergone a violent concussion, and become broken and shivered to small pieces. It is the business of the geologist to explain the cause of this appearance in one of the most solid of minerals: it is sufficient for the painter to note the character, so as to reproduce it as far as possible by means of his art.

"The common Serpentine is found in great abundance in the Isle of Anglesea. It is not so bright or so varied as the precious; the dark shades of green are much broader, and the light veins not so fine and reticulated, and consequently the fossil remains that are white show more distinctly in small, long, square pieces of various sizes and forms. The black vein is so mixed with the darkest shades of green as to be scarcely perceptible in some instances; and this renders the marble somewhat dull, and not fit for ornamental painting."

The mode of producing all the green marbles, both in oil and distemper colour, must be the same as that directed for Verde Antique. The ground must in all cases be black, and the different shades of green must be formed by scumbling the white over the black, more or less thickly according to the variety of shade required, and, when the whole is finished, glazing with green according to the tint of the marble.

White-veined Marble.

The ground for this marble is White laid perfectly smooth: the first vein will be found, on inspecting a specimen, to be very faint; it is (says Mr. Whittock) the broad vein of the mica seen through a great depth of the semi-transparent body of the white. The shadows of white always partake of a yellow hue, and thus the faint vein will appear of a reddish grey, which is formed by mixing white, black, and Indian red to a proper tint. This must be scumbled or spread very thinly in the forms that it is intended that the veins should take. In relation to the formation of marbles, it must here be observed, that they are beds of rock that are veined by metallic or other substances running amongst them, and that the veins always run in the direction of the strata, precisely as thin streams of water would if poured upon an inclined plane, such as the top of a table slightly raised on one side. If this experiment is tried, it will be found that the streams, if they commence regularly, will, from some inequalities of the surface, soon alter their course and turn in various directions, sometimes joining together, forming a sort of star, and then spreading into finer threads, while others will join and form a thick vein, but still running in various forms towards the bottom. This is precisely the way in which the various substances spread themselves on the limestone, of course penetrating the surface and interspersed with the strata.

From this experiment, the painter will see *that however he may vary the direction of the veins, they must all appear to be travelling to the same point by different roads*, and nothing can be more contrary to nature than those violent and eccentric breaks which painters of veined marbles usually practise. This will apply to all marbles, except Porphyry, Black and Gold, and Florentine.

(1.) The first broad vein of the marble having been rather faintly painted, the veins nearer the surface are next to be put in. They are made a little darker by the addition of Black, and are to be drawn very thin, taking the direction of the broad faint vein, and being divided according to previous studies from nature. The veins which are nearest the surface must, of course, be darker than the others; and the colour may be darkened and warmed by the still further addition of black, with a little lake and blue. This vein should be drawn with a fine sable pencil very thin, and made to take nearly the direction of the last veining. Only very little is required, but it must be put in with spirit and skill, and the beauty of the work will thereby be greatly enhanced.

The whole of these veins are put on one upon the other whilst wet, and blended together with the badger softener. When quite dry the dark vein may be retouched either wholly or in parts.

(2.) Lay on a ground of White, and put in the veins with a marbling crayon or camel's hair brush whilst the ground is wet, and soften with the badger. This is of course a much inferior method to the above, as the different degrees of depth of the veins, and the pale smooth portions caused by the confluences described, are not as well represented.

Florentine Marble.

The ground for this marble is White, Indian Red, and Black, mixed together to form a very light reddish neutral tint. The veins are Umber or Burnt Sienna: they are laid on very irregularly, while the ground colour is wet; sometimes they are very close together, and then seem to break suddenly into the forms of rocks or ruins—an effect which must be studied from natural specimens, and must be imitated by hand.

Black-and-Gold Marble.

(1.) The ground is Black: paint the large spots from which the fibrous veins are to run with Yellow Ochre and White, the bright tone of which must be heightened by the addition of a little Vermilion. These masses must be dabbed with freedom upon the ground with a brush full of colour, and, whilst quite wet, threads must be drawn from them in all directions, some of course being larger and thicker than others.

A white vein is sometimes seen running in the deepest parts of the black, with small threads attached to it, crossing each other and the yellow veins in all directions. Care must be taken that the threads are connected with, and run in some degree in the same direction as, the thicker veins. If the ground of this is properly prepared, the yellow and white veins may both be painted at once in oil colour.

(2.) In cabinet work, most beautiful imitations of the finest specimens of this marble may be produced by spreading a leaf or two of gold in any part of the work where the gold, and silver leaf where the white, veins are intended to run. The black ground is then to be rather thickly painted over the whole surface, covering the gold and silver leaf; and, after the colour has been on a short time, take a round-pointed bodkin, or similar implement, and draw the colour in small reticulated veins from off the gold and silver leaf—the metal will then show in fine lines; the larger masses are to be wiped off with the wash-leather spread over the point of the thumb, or a piece of wood. When the black is dry, the yellow and white veins are to be painted as before directed, and drawn over the gold and silver, which will by this means show through them, and give great brilliancy water when the work has been subsequently varnished.

(3.) Paint the ground a deep Ivory black; put on the veins in White, Yellow Ochre, and Burnt and Raw Sienna, using a camel's hair brush; glaze the spaces between the veins with a thin coat of grey or white, over which pass a few white veins. The veins may also be put in with gold leaf.

Porphyry Marble.

Mix the ground colour of Venetian Red with a little Vermilion and White, until it is of the tint required. The first layer of spots is produced by sprinkling in the following manner:—Mix some of the ground colour with a larger quantity of white, in a paint-pot, and use a large brush which has been well worked in the colour; hold the palette knife over the paint-pot, and press the hairs of the brush against the edge, so that as much as possible of the colour may be forced out of it; then, taking the handle of the brush between the palms of the hands, roll it to and fro with a rapid motion, the ends of the hairs being below the level of the top of the paint-pot, but not touching the paint—this is called "wringing out" the brush—and a further quantity of the paint will be thus discharged; now hold a stick firmly in front of the work, and strike the handle of the brush against it; the colour that still remained in it will thus fall on the surface in a variety of small dots. Great care on the part of the painter is necessary at this stage, so as to distribute the spots equally; otherwise, whilst one part of the work will be left only partially spotted, others may be so thickly covered that the drops will become confluent and not be visible as spots afterwards.

When this work has become sufficiently dry, the sprinkling may be repeated, by dipping the brush into a colour rather deeper than the ground: it may be Indian red, with sufficient White to give it a body. The sprinkling with this colour must be done very sparingly, and rather more in some parts than others.

The last sprinkling is to be done with a clean small tool dipped in white paint only, and the spots are to be very fine; as much colour, therefore, as possible should previously be removed from the brush, and it will be found that, when so little colour remains in the brush that it will scarcely mark a board when rubbed on it, there will still be enough to produce the fine dots when struck against the stick. The stick should be held at some distance from the work, as the farther away the finer will be the dots. In imitating some specimens, the three layers of spots are laid on, and, in addition, a narrow opaque white vein is to be run amongst the spots; from this transparent threads are drawn in various directions: these cannot be added until the whole of the sprinkling is quite dry and hard; they must then be formed with a sable pencil, and the threads drawn out with a feather.

Egyptian Porphyry.

The ground for this rare and beautiful marble is composed of Vermilion and White lead. A tint of Indian Red and Lake is then sprinkled over the ground by striking the handle of the brush containing the colour against a stick, and turning the wrist whilst striking; some of the dots will thus become elliptical instead of circular. The sprinkling of the brush must be spread in every direction, and the spots will, as already explained, be larger as the brush is struck nearer to the work, and smaller as the distance is increased. The darker spots are a strong tint of Lake, sprinkled on the previously made spots by striking the brush very smartly once or twice over that part of the work where they are required. The whole must then be left to dry; after this, a light blue tint must be sprinkled very lightly over different parts of the surface, but in no part so thickly as to overpower the red. The larger spots are to be done with white applied with a sable pencil near the darkest sprinkling. Dark spots of a tint formed with blue and lake are now to be added, and the work is to be completed by white veins drawn with a fine camel's hair pencil.

Blue-and-Gold Marble.

The ground for this marble is a light blue; and when this is quite dry, dab on in separate patches Light Blue, White, and Prussian blue, leaving portions of the ground visible. Soften these patches together, and then vein in every direction with white, and fill up some of the irregular spaces with yellow or gold paint, and finally add fine white veins.

Blue Ruby-spotted Marble.

This and the two following marbles are given by Mr. Whittock in his description of the Oxford Collection of Marbles. The Blue Ruby-spotted marble comes from Switzerland; it is a light-coloured, beautiful marble, which may be introduced either in large or small masses with equally good effect.

The ground for this marble is a very light blue, with a few patches of white in those parts where the yellow spots are afterwards to appear. Both the blue and white of the ground must be quite dry before any marbling colour can be applied. A bright tint of Prussian blue and White may be painted on in spots over the blue ground, and above this, whilst wet, a few touches of a darker tint must be laid on in large spots sufficiently apart from each other to allow the first tint to be seen between them.

The yellow spots may now be applied over the white ground; this is done with King's Yellow mixed with a little vermilion. The work must be left to dry before it can be proceeded with. The surface being quite hard, paint the dark red or ruby veins with a tint of Lake and blue. This is rather dotted than painted over the blue, taking care to avoid the yellow. These marks in some places are quite red, and for these Lake alone is used. As soon as the ruby tint is applied, mix a much stronger tint of Lake and blue, and draw the strong markings over the Lake: these lines are drawn out in a long succession of spot. over the blue. It is impossible to give a verba. description of the manner of applying the tints in the various markings of this marble; but the painter wh. keeps the general character cannot greatly err from nature.

This is a most excellent pattern for distemper colour The ground is white: the light blue is white and Prussian blue; this may be sprinkled with a large brush. The darker spots are a tint with a little more blue than the first.

Blue-veined Swiss Marble.

This marble is exceedingly splendid in colour, and not very difficult to imitate. The ground is white. Light blue spots or broken streaks are drawn over the ground, so as to let the white be seen between them. The blue must be omitted on that part of the ground where the yellow markings are seen. On these spaces a tint of King's Yellow is painted, and on this tint broad spots or touches of Burnt Sienna. The work must then be suffered to dry, after which the purple tint may be applied over the blue spots; this tint is Lake and Blue, the marking upon it is black: a glaze of Burnt Sienna in different parts will give variety of tint to the representation.

To execute this marble in distemper the blue may be sprinkled upon the ground with a large brush. The yellow is King's Yellow, touched up with Lake; the purple tint is Indigo mixed with Rose Pink; and the darkest markings are Black.

Dove-coloured Spotted Marble.

This differs from the Dove marbles commonly seen by the contrast of the strong dark and light spots, and the interspersion of thin light veins. Dove marbles are used to heighten the effect of White-veined or statuary marble in sepulchral monuments, &c. The imitation in painting is mostly required for chimney-pieces common dark work, for which it is very appropriate.

The ground for this marble is a light grey formed th Black and White, mixed to the tint required; the rinklings on the ground are done with a very dark at formed of the same colours. The large spots are ack, laid upon the sprinklings while wet with a ble pencil. The white spots and the veining may be painted while the dark sprinkling is wet, as ey will then blend with it and have a more natural ect than it would if they were painted when the dark rinkling had become dry.

The process and colours are the same if the work is quired in distemper; but as it is so easily and quickly rformed in oil, it is seldom that distemper colour for dark and common a marble can be used with dvantage.

Dove Marble.

For the ground of this marble two or three coats of good Lead-colour should be laid, and these should each nicely smoothened with glass paper. The colour for marbling is the same as the ground, but ned with turpentine. In order that the work may satisfactorily blended whilst wet, only a small portion must be taken in hand, the whole being executed piece by piece until complete. The marbling colour having been rubbed over a certain portion, small specks representing fossil remains are to be formed in it with a whitish tint, and these must be blended into the colour, but not so much as to lose their distinctions. Veins of various sizes are then to be put in with the thinned ground colour, using a small sash tool, distributing them with taste, and interspersing them with very fine veins. The colour is then to be made lighter by the addition of White lead, and with a feather dipped in this colour the broader veins are to be passed over, thus forming numerous thread-like veins. Next, with thin white in a camel's hair pencil, pass partly over the same veins with short thick touches, which may be continued in the narrower parts with a fine striping pencil. When the work has become quite hard it should be smoothed with very fine glass paper before being varnished.

Jasper Marble.

The ground is composed of Venetian Red, Red Lead, and a small quantity of Chrome Yellow, mixed with oil and turpentine in equal parts. Or additional brilliancy may be given to the colour by Vermilion or Lake, instead of Venetian Red. While the ground is wet, dab on spots of White, using either a piece of sponge or a tool, and soften with a badger, subsequently repeating the white touches in parts to give them increased brilliancy. Spots of blue, brown, yellow, &c., may be added in the same manner. When nearly dry, veins and threads may be put in with a camel's hair pencil.

Granite.

Granite is a well-known igneous rock, composed principally of three minerals—Quartz, Felspar, and Mica—united in a confused crystallization, that is, without any regular arrangement of the crystals. The following is the order in which the ingredients are proportioned :—Felspar, Quartz, Mica. The name of the stone is derived from its granular formation.

There are very many kinds of granite used in the arts. Amongst these are the gray, red, green, violet, rose-coloured, &c. Those best known for architectural purposes are the gray Aberdeen Granite and the reddish-coloured Peterhead Granite.

(1.) For the gray Granite the ground is a gray, mixed of black and white, and, over this, spots are to be splashed with black and white, used separately, the work being carried on as described in relation to Porphyry. (2.) For the various shades of Red Granite the ground is composed of Venetian Red and White, the spots being Black, White, and Vermilion. In the same way any of the other kinds may be represented.

CHAPTER XX.

OF WOODS GENERALLY: THEIR STRUCTURE, GROWTH, AND ORNAMENTAL CHARACTERS.

WE have, in a previous section, expressed our opinion that a workman should make himself acquainted with the nature of the material in which he is to work; and, in pursuance of the plan we have endeavoured to follow, we purpose now giving to men who are to imitate woods, some information as to their structure and growth, so that they may understand the natural characteristics of the various kinds of timber, and may thus be enabled not merely to copy a single specimen, or to make conventional representations, each of which may depart more and more from the original, but to produce well-designed representations agreeing with the natural types.

Upon observing the transverse action of the stem or trunk of a tree, the wood will be found to be composed of numerous concentric layers or rings, which are more or less distinct in different trees. Where the rings are well defined, they will be found to consist of two parts, the outer being hard, compact, and of a dark colour, while the inner is of a lighter tint, more soft and porous. In the centre of the tree is the pith, and on the exterior the bark; and it will be observed that the concentric rings become more soft, and contain more sap, as they recede from the pith, the more compact layers nearest the pith being termed HEART-WOOD.

The structure of a tree appears to be composed of minute vessels for conveying nutriment from the roots; the space between these vessels being occupied by cells, which are engaged in performing the functions of secretion. The various vessels in the growing tree convey the sap in a liquid state from the roots to the leaves, whence it descends in a less liquid state through the bark, and is at last deposited in an altered state between the bark and the last year's wood, forming a new layer of bark and sap-wood, the old bark being pushed outward, and the inner layers being compressed probably in an equal degree.

The sap begins to ascend in the spring of the year, and flows principally through the annual rings next the bark, which contains most sap-wood. In its ascent it would appear to dissolve some part of a substance which had accumulated in the vessels during the preceding winter for the nourishment of the buds, leaves, and new wood, and this accounts for the viscous state of the sap on its descent. As the leaves expand the sap ceases to flow, and the bark again adheres to the wood; and from the middle of June to the middle of August there appears to be a pause in vegetation, but after this period the sap again begins to flow.

As this process goes on from year to year, the fluid parts of the interior of the wood are absorbed by the new wood and leaves, and the vessels through which they flow, being pressed more closely together by the growth of new wood, become harder and harder, until at last the sap-wood is converted into heart-wood; for it would appear that there is nothing in the character of solid fibres in wood, the more compact parts being composed solely of the linings of the vessels and cells deprived of their moisture and packed closely together. When trees arrive at this stage of existence, that is to say, when the sap-wood has become heart-wood and the greater part of the moisture has been expelled, they are in a fit state to be felled for building purposes.

Besides the concentric rings, another series of lines may be observed with more or less facility in the sections of various trees. These lines radiate from the centre, and are termed MEDULLARY RAYS. They produce the beautiful flowered appearance in the oak to which the name *silver grain* has been given.

The whole of this portion of our subject is most exhaustively explained in Mr. Charles Holtzapffel's "Turning and Mechanical Manipulation," and from that excellent work, by the kind permission of the Messrs. Holtzapffel, we give the following extracts:—

"The general understanding of the principal differences of the woods will be greatly assisted by a brief examination into their structure, which is now so commonly and beautifully developed by the sections for the microscope. The Figs. 1, 2, and 3 are drawn from

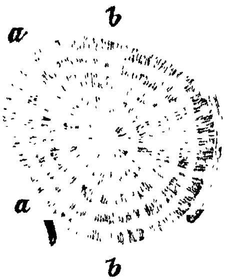


Fig. 1.

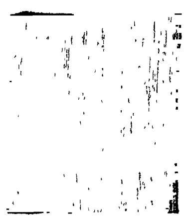


Fig. 2.

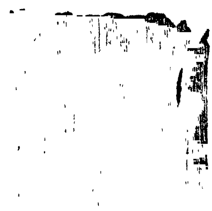


Fig. 3.

thin cuttings of Beech-wood, prepared by the optician for that instrument; the principal lines alone are represented, and these are magnified to about twice their linear distances for greater perspicuity.

"Fig. 1, which represents the horizontal or transverse section of a young tree or a branch, shows the arrangement of the annual rings around the centre or pith; these rings are surrounded by an exterior covering, consisting also of several thinner layers, which it will suffice to consider collectively in their common acceptation, or as the BARK. The fibres, which are seen as rays proceeding from the pith to the bark, are the MEDULLARY RAYS or plates.

"Figs. 2 and 3 are vertical sections of an older piece of Beech-wood. Fig. 2 is cut through a plane, such as from *a* to *a* (in Fig. 1), in which the edges of the annual rings appear as tolerably parallel fibres running in one direction, or lengthways through the stem; the few thicker stripes are the edges of the medullary rays.

"Fig. 3 is cut radially, or through the heart, as from *b* to *b* (in Fig. 1). In this the fibres are observed to be arranged in two sets, or to run crossways: there are first the edges of the annual rings as in Fig. 1, and secondly the broad medullary rays or plates.

"The whole of these figures, but especially the last, show the character of all the *proper* woods, namely those possessing two sets of fibres, and in which the growth of the plant is accomplished by the yearly addition of the external ring of the wood and the internal ring of the bark, whence these rings are called annual rings, and the plants are said to be EXOGENOUS, from the growth of the *wood* being *external*.

"In Fig. 1 the medullary rays are the more distinctly drawn in accordance with the appearance of the section, as they seem to constitute more determinate lines; whereas the annual rings consist rather of a series of tubes arranged side by side and in contact with each other, and which could not be represented on so small a scale. At the outer part of each annual ring these tubes or pores appear to be smaller and closer, and the substance is consequently more dense from the greater proportion of the matter forming the walls of the tubes, and the inner or softer parts of the annual rings have, in general, larger vessels, and therefore less density.

"In many plants the wedge-form plates intermediate between the medullary rays only appear as an irregular cellular tissue, full of small tubes or pores, without any very definite arrangement. The medullary rays constitute, however, the most characteristic parts of the structure, and greatly assist in determining the difference between the varieties of the exogenous plants, as well as the wide distinction between the entire group, and those we shall presently mention. The medullary rays also appear by their distinct continuity to constitute the principal source of *combination* and strength in the substance of the woods; most of the medullary rays, in proceeding from the centre to the circumference, divide into parts to fill out the increased space.

"In the general way the vertical fibres of the annual rings and the horizontal fibres of the medullary rays are closely and uniformly intermingled; they form collectively the substance of the wood, and they also constitute two series of minute interstices that are viewed to be either separate cells or vessels the majority of which proceed vertically, the other radially. In many, as the oak, sycamore, maple, and sweet chesnut, the medullary rays, when dissected, exhibit a more expanded or foliated character, and pervade the structure not as simple radial tubes, but as broad septa or divisions, which resemble flattened cells or clefts amongst the general groups of pores, giving rise to the term *silver grain*, derived from their light and glossy appearance: they vary considerably in size and number.

"The beech-wood (Fig. 3) has been selected as a medium example between this peculiarity and the ordinary crossings of the fibres, which in the firs and several others seem as straight as if they were lines mechanically ruled, and even in the most dense woods are in general easily made out under the microscope.

"The vessels or cells running amidst the fibres are to the plant what the blood-vessels and air-cells are to the animal: a part of them convey the crude sap from the roots or mouths of the plant, through the external layers of the wood, to the leaves, in which the sap is evaporated and prepared; the fluid afterwards returns through the bark as the elaborated sap, and combines with that in the external layers of the wood, the two constituting the *cambium;* the latter ultimately becomes consolidated for the production of the new annual ring that is deposited beneath the loosened bark, and which is eventually to constitute a part of the general substance or wood; the bark also receives a minute addition yearly, and the remainder of the fluid returns to the earth as an excretion.

"The other order of plants grows in an entirely different manner, namely, by a deposition from within, whence they are said to be ENDOGENOUS: these include all the grasses, bamboos, palms, &c. Endogens are mostly hollow, and have only one set of fibres—the vertical—which in the transverse section appear as irregular dots closely congregated around the margin, and gradually more distant towards the centre, until they finally disappear and leave a central cavity or a loose cellular structure.

. . . . . .

"The substance of the stems of the palms is not allowed by physiological botanists to be proper wood, which in all cases grows exteriorly, and possesses the two sets of fibres shown in Fig. 3, whereas the endogenous plants have only one set, or the vertical fibres. And although many of this tribe yield an abundance of valuable gifts to the natives of the tropical climates in which they flourish, only a portion of the lower part of the shell of the tree is available as wood."

CHAPTER XXI.

FIBRE, GRAIN, CURLS, KNOTS, &c.

"The ornamental figure or grain of many of the woods appears to depend as much, or more, upon the particular directions and mixings of the fibres as upon their differences of colour. I will first consider the effect of the fibre, assisted only by the slight variations of tint observable between the inner and outer surfaces of the annual layers and the lighter or more silky character of the medullary rays.

"If the tree consisted of a series of truly cylindrical rings, like the tubes of a telescope, the horizontal section would exhibit circles; the vertical, parallel straight lines; and the oblique sections would present parts of ovals. But nature rarely works with such formality, and but few trees are either exactly circular or straight; and therefore, although the three natural sections have a general disposition to the figures described, every little bend and twist in the tree disturbs the regularity of the fibres, and adds to the variety and ornamental character of the wood.

"The horizontal section, or that parallel with the earth, only displays the annual rings and medullary rays—as in Fig. 1; and this division of the wood is principally employed by the turner, as it is particularly appropriate to his works: the strength and shrinking being alike at all parts of the circumference in the blocks and slices cut out of the entire tree, and tolerably so in those works turned out of the quarterings or parts of the transverse pieces. But, as the cut is made intermediate between the horizontal line and the one parallel with the axis, the figure gradually slides into that of the ordinary plank, magnified portions of which are shown in Figs. 2 and 3, and these are almost invariably selected for carpentry, &c. The oblique slices of the woods possess neither the uniformity of the grain of the one section, nor the strength of the other, and it would be likewise a most wasteful method of cutting up the timber; it is, therefore, only resorted to for thin veneers when some particular figure, or arrangement of the fibres, has to be obtained for the purposes of cabinet work.

"The perpendicular cut through the heart of the tree is not only the hardest, but the most diversified, because therein occurs the greatest mixture and variety of the fibres, the first and the last of which, in point of age, are then presented in the same plank; but, of course, the density and diversity lessen as the board is cut further from the axis. In general, the radial cut is also more ornamental than the tangential (that from *a* to *a*, Fig. 1); as, in the former, the medullary rays produce the principal effect, because they are then displayed in broader masses, and are considered to contain the greater proportion of the colouring matter of the wood.

"The section through the heart displays likewise the origin of most of the branches which arise first as knots in or near the central pith, and then work outward in the direction corresponding with the arms of the trees, some of which, as in the cypress and oak, grow out nearly horizontally; and others, as in the poplar, shoot up almost perpendicularly.

"Those parts of wood described as 'curls' are the result of the confused filling in of the space between the forks or the springings of the branches. Fig. 4 represents the section of a piece of yew-tree, which shows remarkably well the direction of the main stem A B, the origin of the branch C, and likewise the formation of the curl between B and C. Fig. 5 is the end view of the stem at A. In many woods, Mahogany especially, the curls are particularly large, handsome, and variegated, and are generally produced as explained.

"The Bird's-eye Maple shows, in the finished work, the peculiar appearance of small dots or ridges, or of little conical projections with a small hollow in the centre (to compare the trivial with the grand, like the summits of mountains or the craters of volcanoes), but *without any resemblance to knots*, which are the apparent cause of ornament in woods of somewhat similar character—as the burrs of the Yew and Kiabooca, and the Russian Maple (or Birch-tree). This led me to seek a different cause for its formation.

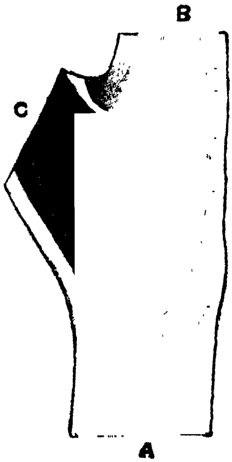


Fig. 4.

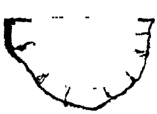


Fig. 5.

"On examination I found the stem of the American Bird's-eye Maple, stripped of its bark, presented little pits or hollows of irregular form: some, as if made with a conical punch; others, ill defined and flattened, like the impression of a hob-nail. Suspecting these indentations to arise from internal spines or points in the bark, a piece of the latter was stripped off from another block, when the surmise was verified by their appearance. The layers of the wood being moulded upon these spines, each of their fibres is abruptly curved at the respective places, and when cut through by the plane they give in the tangential slice the appearance of projections, the same as in some rose-engine patterns, and the more recent medallic, glyptographic, or stereographic engravings, in which the closer approximation of the lines at their curvatures causes those parts to be more black (or shaded), and produces upon the planed surfaces the appearances of waves and ridges, or of the subject of the medal.

"The short lines observed throughout the Maple-wood between the dots or eyes are the edges of the medullary rays, and the same piece of wood, when examined upon the radial section, exhibits the ordinary silver grain, such as we find in the Sycamore (to which family the Maple belongs), with a very few of the dots, and those displayed in a far less ornamental manner.

"In those woods which possess in abundance the *septa* or *silver grain*, described by the botanists as the medullary plates or rays, the representations of which as regards the Beech-tree are given in Fig. 3, another source of ornament exists, namely, a peculiar damask or dappled effect, somewhat analogous to that artificially produced on damask linens, moreens, silks, and other fabrics, the patterns on which result from certain masses of threads on the face of the cloth running lengthways, and other groups crossways. This effect is observable, in a remarkable degree, in the more central planks of Oak, especially the light-coloured wood from Norway and the neighbourhood of the Rhine, called Wainscot and Dutch Oak, etc., and also in many other woods, although in a less degree.

"In the Oak plank the principal streaks or lines are the edges of the annual rings which show, as usual, arallel lines more or less waved from the curvature of he tree, or the neighbouring knots and branches; and the damask pencillings, or broad curly veins and stripes, are caused by groups of the medullary rays, or septa, which undulate in layers from the margin to the centre of the tree, and creep in betwixt the longitudinal fibres, above some of them and below others. The plane of the joiner here and there intersects portions of hese groups exactly on a level with their general surce, whereas their recent companions are partly emoved in shavings, and the remainder dip beneath he edges of the annual rings, which break their continuity: this will be seen when the *septa* are purposely cut through by the joiner's plane.

"Upon inspecting the ends of the most handsome and showy pieces of Wainscot Oak and similar wood it will be found that the surface of the board is only at a *small* angle with the lines of the medullary rays, so that *many* of the latter 'crop out' upon the surface of the work: the medullary plates being seldom flat, their edges assume all kinds of curvatures and elongations from their oblique intersections. All these peculiarities of the grain have to be taken into account in cutting up wood when the most showy character is a matter of consideration.

"The same circumstances occur, in a less degree, in all the woods containing the silver grain, as the Oriental Plane-tree or Lace-wood, Sycamore, Beech, and many others; but the figures become gradually smaller, until at last, in some of the foreign hard woods, they are only distinguishable on close inspection under the magnifier. Some of the foreign hard woods show lines very nearly parallel and at right angles to the axis of the tree, as if they were chatters or ritters arising from the vibration of the plane-iron. The medullary rays cause much of the beauty in all the showy woods, notwithstanding that the rays may be less defined than in the woods cited.

"In many of the handsomely figured woods, some of the effects attributed to colour would, as in damask, be more properly called those of light and shade, as they vary with the point of view selected for the moment. The end of the grain of Mahogany, the surfaces of the table-cloth and of the mother-of-pearl shell, are respectively of nearly uniform colour; but the figure of the wood, and the damask, arise from the various ways in which they reflect light."

For further information, and for a detailed account of the various woods used for building purposes, and in the construction of furniture, etc., etc., we refer the reader to the descriptive catalogue of woods which forms a portion of the excellent work alluded to.

PART IV.

THE OILS AND VARNISHES USED IN HOUSE PAINTING.

CHAPTER XXII.

LINSEED OIL.

LINSEED oil is the only one which is, as a rule, used by the house painter. It is produced by expression from the seeds, either by horse, water, hydraulic, or steam power. This material varies in quality,—(1) according to the goodness of the seed from which it is expressed; and (2) according to its age and clearness; for, when a large stock is kept, it is found that, in about six months, there is a considerable amount of accumulation of refuse at the bottom of the cistern, which is only fit to be employed in mixing coarse paint for out-door work. The best is yellow, transparent, comparatively sweet-scented, and has a flavour resembling that of the cucumber. Great consequence has been attributed to the cold drawing of this oil, but it is of little or no importance (says Mr. Field) whether moderate heat be employed, or not, in expressing it. Several methods have been contrived for bleaching and purifying this oil, so as to render it perfectly colourless and limpid, but these give it more beauty to the eye, in a liquid state, without giving it any permanent advantage, since there is not any known process for preventing the discolouring after its drying; and it is, perhaps, better upon the whole that this and every vehicle should possess that colour at the time of using to which it subsequently tends, so that the painter may depend on the continuance of his tints, and avoid the disappointment and annoyance arising from a change of colour.

Linseed oil is sometimes boiled with litharge to make it dry quickly, but when it is thus treated it is unfit for best work.

The quality of Linseed oil may be determined in the following manner:—Fill a phial with oil, and hold it up to the light; if bad, it will appear opaque and turbid, its taste will be acid, and its smell rancid. The oil which is expressed from good and full-grown seeds should, when held up to the light, appear clear, pale, and bright: it is sweet to the taste, and has little or no smell.

Linseed oil may be purified by the following process:—Place the oil in a bottle or jar, and drop into it some powdered whiting, stir or shake up the mixture and allow it to stand on the hob, or in an oven, not too hot; the whiting will very soon carry down all colour and impurity, and form a precipitate at the bottom. The refined oil at the top may then be poured off.

In rare instances, where the least yellowness in the oil would be injurious, nut or poppy oil may be used with advantage; but, as already stated, linseed is the oil used for general purposes.

We are indebted for the following important remarks to Mr. Whittock:—"Oils of a nature suitable for painting are the most commodious and advantageous vehicle to colours hitherto discovered: first, because the unctious consistence of them renders their being spread and layed on a surface with more evenness and expedition than any other kind of vehicle; secondly, because, when dry, they leave a strong gluten or tenacious body that holds the colours together, and defends them much more from the injuries either of the air or accidental violence than the vehicles formed of water. The principal and most general quality to be required in oils is their drying well, which, though it may be assisted by additions, is yet to be desired in the oil itself, as the effects of the pigments used in it are sometimes such as counteract the strongest driers, and occasion great delay and trouble from the work remaining wet for a great length of time, and frequently never becoming thoroughly hard. There are some oils that have this fault to an incurable degree. The next quality in oils is the limpidness, or approach to a colourless state, which is likewise very material; for where they partake of a brown or yellow colour, such brown or yellow necessarily mixes itself with the pigments: but, besides the brown colour which may be visible in the oil when it is used, a great increase of it is apt to appear some time afterwards when the oil is not good. There are three changes which oils of the kind proper for painting are liable to suffer in their nature, and which affect them as vehicles, that are mentioned by painters under one term, viz., fattening: notwithstanding, these several changes are brought about by very different means, and relate to very different properties in the oils.

"The first is a coagulation by the mixture of the oil with some pigment improperly prepared. This, indeed, is called the fattening of the colours; but the eal change is in the oils, and the pigments are only he means of producing it. This change is generally a eparation of the oil into two different substances: the ne, a viscid body which remains combined with the igments; the other a thin fluid matter which divides self from the colour and thicker part.

"This last appears in very various proportions under ifferent circumstances, and, in some cases, it is not und where the pigments happen to be of a more thy and alkaline nature, for then only a thick mmy substance that can scarcely be squeezed out of e bladder—if it is put up in one—is the result of the ening. This fattening not only happens when oil pigments are mixed together in bladders or vessels; sometimes, after they have been laid on the proper ground for them, instead of drying, the separation will ensue, and one part of the oil will run off in small drops or streams, while the other will remain with the colour, without showing the least tendency to dry.

"The second is the change that takes place in oils from long keeping. This, if it could be afforded by the oil-manufacturer or the painter, is by far the best method of purifying linseed and other oils, as, by thus keeping, they become lighter coloured and acquire a more unctuous consistence; and, though they are said to become too fat, they are in a very different state from that before mentioned, which is caused by unsuitable pigments.

"The third is the change produced by artificial means, from exposing the oil a long time to the sun, whereby it is freed from its grosser and more feculent parts, and rendered colourless, and of a more thick and less fluid consistence than can be produced by any other treatment; but, at the same time, it is made less likely to dry, particularly when used with mineral colours, as Vermilion, Prussian blue, and King's yellow; it likewise becomes disqualified by other bad qualities that render it of little use as a vehicle for painting. Oils in this state are called also fat oils, though it is a change that has not the least affinity with either of the other, but, on the contrary, differs from both. In speaking, therefore, of the fattening of oils or colours, attention should be had to the not confounding these three several kinds one with the other.

"Linseed oil, from its cheapness, is the only oil in common use for house painting, and it may, by proper management, be made to answer for every kind of work. This oil is pressed from the seed of flax, and is best when manufactured in great quantities. The general defect in Linseed oil is its brown colour, and its tardiness in drying, both of which are in a much greater degree found in some parcels than others. There is also found such as, in consequence of its being mixed with the oil of some other vegetable accidentally growing near it, partakes of the nature of olive-oil, and cannot be made to dry by any means whatever. The faults of the colour and want of drying quality may be greatly reduced, if not entirely taken away, by keeping the oil for a length of time before it is used: it then becomes fat in the second sense of the word, as before explained, and is a good vehicle for colour without any mixture; but it is generally used with a proper drier, as it never by itself becomes sufficiently pure to use with white or other light tints, without imparting a brown colour to them."

Poppy Oil.

This is a colourless oil, and is in some instances used for d'licate works where the length of time required for drying is no object. It is much celebrated in some old books, under the name of Oil of Pinks, and Oil of Carnations, as erroneously translated from the French *œillet*, or *olivet*, a local name for the Poppy in districts where its oil is employed as a substitute for that of the *olive*. It is, however, inferior in strength, tenacity, and drying to Linseed oil, although next to it in these respects; and, though it is of a paler colour, and slower in changing, it becomes ultimately not so yellow, but nearly as brown and dusky, as Linseed oil, and therefore is not preferred to it.

Nut Oil

Is the oil of Walnuts, and is used in ornamental painting, as it is nearly colourless, and can be used with Flake white and other delicate colours, without the slightest danger of tingeing them.

Driers.

Driers are used to hasten the drying of paints. ɔese are ground up in oil, and are mixed in small quantities with the colour; some colours, in fact, vill not perfectly harden without them, but remain ticky, or, as painters term it, "tacky," until sufficient ust has clung to them to render their external surface least apparently dry; though, as can well be understood, it will remain disagreeable to the touch, and much injured in colour. Red Lead is a good drier, but, of course, can only be used in situations or in paints where its colour is not objectionable. Sugar-of-lead is, however, the best drier, but is more expensive than the others. Patent Driers, ground up in oil, may be purchased at the various colour-shops.

Drying Oils.

All the fixed oils have an attraction, more or less powerful, for oxygen, and by exposure to the air they either become hard and resinous, or they only thicken slightly, and become sour and rancid. Those which exhibit the first property in a marked degree—as the oils of Linseed, Poppy, Rape, and Walnut—are called drying oils, and are used as vehicles for colours in painting: the others are termed *glutinous* or non-drying oils.

The resinifying or drying qualities of the oils is greatly increased by boiling them, either alone or along with *litharge*, *sugar-of-lead*, or *white vitriol*, when the product forms "boiled oil," or drying oil of commerce. The efficacy of the process, according to Liebig, depends on the elimination of substances which impede the oxidation of the oil.

The following methods of preparing drying oils are culled from various sources; the quantities of each formula are given as in the originals, but these can, of course, be used in relative proportions, when the preparation is to be carried on on a smaller scale.

1. Linseed oil 1 gallon, powdered litharge $\frac{3}{4}$ lb. Simmer, with frequent stirring, until a pellicle begins to form; remove the scum, and when it has become cold, and has settled, decant the clear portion. Dark coloured, used by house painters.

According to M. Chevreul, three hours' boiling, with litharge one-tenth in weight of the oil, renders the oil more perfectly drying than when the boiling is continued for a much longer time, when the oil acquires a darker colour, and so becomes injured in transparency the longer it is boiled. M. Chevreul has also pointed out that merely heating Linseed oil to 170° Fahrenheit, along with a small quantity of peroxide of manganese, as completely renders it siccative as any amount of boiling, and without any deterioration to its colour or transparency. It appears probable that litharge acts more by its mere presence in inducing the oxidation of the oil than by actually giving up oxygen to it, and those engaged in boiling oils have remarked that the old litharge, upon which Linseed oil has been already boiled, acts more energetically in producing the siccative property in it than new litharge.

2. Pale Linseed or Nut-oil 1 pint, litharge or dry sulphate of lead in fine powder 2 oz.; mix, let it stand, frequently stirring it for ten days, then set the bottle in the sun, or in a warm place, to settle, and decant the clear portion.

3. (Liebig.)—Sugar of lead 1 lb., dissolved in ½ gallon of rain water; 1 lb. of litharge in fine powder is then added, and the mixture is gently simmered until only a whitish sediment remains; 1 lb. of levigated litharge is next diffused through 2½ gallons of linseed oil, and the mixture is gradually added to the lead solution previously diluted with an equal bulk of water; the whole is now stirred together for some hours with heat, and is lastly left to clear itself by exposure in a warm place. The lead solution which subsides from the oil may be used again for the same purpose by dissolving in it another pound of litharge as before.

4. (Wilks's patent.)—Into Linseed oil, 236 gallons, pour oil of vitriol 6 or 7 lbs., and stir the two together for three hours, then add a mixture of fuller's earth 6 lb., and hot lime 14 lb., and again stir for three hours. Next, put the whole into a copper, with an equal quantity of water, and boil for about three hours; lastly, withdraw the fire, and, when the whole is cold, draw off the water, run the oil into any suitable vessel, and let it stand for a few weeks before using.

5. Pale Drying Oil.—The oil should be macerated two or three days at least upon about an eighth of its weight of litharge, in a warm place, occasionally shaking the

mixture, after which it should be left to settle and clear; or it may be prepared, without heat, by levigating the litharge in the oil. Acetate of lead may be substituted for litharge, being soluble with less heat, and its acid, being volatile, escapes during solution and bleaches the oil, to which coarse smalt may be added to clear it by subsidence, increase its drying, and neutralise its brown colour. This affords *pale* drying oil for light and bright colours.

Boiled Oil.—The above mixture of oil and litharge, gently and carefully boiled in an open vessel till it thickens, becomes strong drying oil for dark colours. Boiled oil is sometimes set on fire purposely, in making printer's varnish and printing ink, and also for painting and the preparation of japanner's gold size. As dark and transparent colours are in general comparative ill driers, japanner's gold size is sometimes employed as a powerful means of drying them. This material may be prepared in the following manner:—Asphaltum, Litharge or Red lead, Burnt Umber or Manganese, finely powdered, of each 1 oz., stir them into a pint of linseed oil, and simmer the mixture over a gentle fire, or on a sand bath, till solution has taken place, scum ceases to rise, and the fluid thickens on cooling, carefully guarding it from taking fire. If the oil employed be at all acid or rancid, a small portion of powdered chalk, or magnesia, may be usefully added, and will assist the rising of the scum and the clearing of the oil by its subsidence; and, if it be kept at rest in a warm place, it will clear itself, or it may be strained through a cloth and diluted with turpentine for use. Gold size for gilding is commonly made of Boiled Oil and fine Oxford ochre.

Note.—There is often a difficulty in obtaining the oils "bright" after boiling or heating them with the lead solutions: the best way, on a small scale, is either to filter them through coarse woollen filtering paper, or to expose the bottle for some time to the action of the sun, or to place it in a warm situation; on a large scale, the fine oils are often filtered through Canton flannel bags.

The litharge and sulphate of lead used in the above processes may be again rendered available for the same purpose by washing them in hot water to remove the adhering mucilage.

Leclaire's Drier for Zinc White.

Mr. Leclaire * gives the following as the result or his researches on the subject of a drier for Zinc White which should be more powerful than litharge, and should thus counteract the tendency of colours mixed with that pigment to dry more slowly than others.

Purified Linseed oil is boiled for six or eight hours, and to every 100 kilogrammes of boiled oil there are added five kilogrammes of powdered peroxide of manganese, which may be kept in a bag like litharge. The liquid is boiled and stirred for five or six hours more, and then cooled and filtered. This drying oil is employed in the proportion of from five to ten per cent. of the weight of Zinc White, and it should be added during the grinding of the pigment in oil—the admixture then being more thorough.

Leclaire's Drying Oils.

Oil oxidized by the peroxide of manganese, Mr. Leclaire says, may be thickened to the point of solidification, when it will produce the same effect as litharge.

Fifteen parts of lime made into paste with water are added to 100 parts of oil oxidized by the peroxide of manganese. The whole is boiled or heated by steam until the water has evaporated; the oil then forms with lime a thick product which is a drier. It is sold in lumps or in powder, or ground with an equal weight of oxidized oil. It may be ground with the ordinary essence of turpentine, or with that of Venice, but the dryer is less powerful than when it has been mixed with oxidized linseed oil. Three to five per cent. of this drier are sufficient for a rapid desiccation.

* We are indebted for the following three receipts to "A Practical Treatise on the Manufacture of Colours," by Messieurs Riffault, Vergnand, and Toussaint.

Other driers may be made by combining lime with resins and essence of turpentine in the proportions indicated for fixed oils.

Guynemer's Powdered Drier.

In a patent taken out by him for this purpose, Mr. Guynemer says:—"For a long time it has been a desideratum to find an impalpable white powder, which may be intimately incorporated with Zinc White, and which will accelerate desiccation."

The society of the Vieille Montagne, represented by Mr. Guynemer, has become the owner of the patents by Mr. Leclaire, and gives the following receipt for a new manganese drier in powder:—Pure sulphate of manganese 1 part, pure acetate of manganese 1 part, calcined sulphate of zinc 1 part, white oxide of zinc 97 parts = 100 parts. The sulphate and acetate are ground in a mortar to an impalpable powder, which is passed through a metallic sieve. Three parts of this powder are dusted over the 97 parts of oxide of zinc, spread over a board or a slab; the whole is then thoroughly mixed and ground. The resulting white and impalpable powder, mixed in the proportion of $\frac{1}{2}$ to 1 per cent. with Zinc White, will enormously increase the drying property of this product, which will become dry in from ten to twelve hours.

Volatile Oils,

procured by distillation from *turpentine* and other vegetable substances, are all almost destitute of the strength of the expressed oils, having hardly more cementing power in painting than water alone, and are principally useful as solvents, and media of resinous and other substances introduced into vehicles and other varnishes. In drying they partly evaporate, and partly, by combination with oxygen, form resin and become fixed. They are not, however, liable to change colour like expressed oils of a drying nature, and, owing to their extreme fluidness, are useful diluents of the latter; they have also a bleaching quality, whereby they in some degree correct the tendency of drying and expressed oils to discolourment. Of the essential oils, the most volatile and nearest in this respect to alcohol is oil of *sassafras;* but that most used in painting is the

Oil of Turpentine.

The rectified oil, improperly called *spirits of turpentine,* is preferable only on account of its being thinner and more free from resin. By the action of oxygen upon it, water is either generated or set free, and the oil becomes thickened; but is again rendered liquid by a boiling heat upon water, in which the oxygen and resin are separated from it. When coloured by heat or otherwise, oil of turpentine may be bleached by agitating some lime powder in it, which will carry down the colour. The great use of this oil, under the cant name of *turps,* is to thin oil paints, and, in the larger use thereof, to flatten white and other colours, and to remove superfluous colour in graining. It, however, weakens paint in preventing its bearing out; and when used entirely alone, it will not fix the paint.—(*Field.*)

The name of turpentine is applied to a liquid, or soft solid product of certain coniferous plants, and of the Pistachia terebinthus.

There are several varieties, as follows:—

American or white turpentine.
Bordeaux turpentine.
Venice turpentine.
Strasburg turpentine.
Canadian turpentine, or Canada balsam.
Chio turpentine.
Frankincense.

In nearly all cases the processes of collecting are similar. A hollow is cut in the tree yielding turpentine, a few inches from the ground, and the bark removed for the space of about 18 inches above it. The turpentine trickles down into vessels placed to receive it. The incisions are made about the close of March, and the turpentine continues to run throughout the vegetative season, especially during the summer months. In general character these turpentines have much in common: they are oleo-resins, varying slightly in colour, consistency, and smell: they enter into the composition of many varnishes.

Oil of turpentine is obtained by distilling American turpentine, which has been melted and strained with water, in an ordinary copper still. The distilled product is colourless, limpid, very fluid, and possessed of a very peculiar smell.

Turpentine is imported in barrels weighing from 2 to 2½ cwt., and has the appearance and consistence of honey. The residuum, after the distillation of the oil or spirits of turpentine, is the common resin, or rosin, of trade.

CHAPTER XXIII.

OF VARNISHES.

It will not, as a rule, be economical for persons residing in large towns to make these for themselves, as they may be purchased both cheaper and in most cases better than they could make them. At the same time it is well to know how to make these important compounds, for it may so occur that the materials may be obtained where the varnish itself could not, or other circumstances may render it desirable that the process should be carried on at home; a few receipts for the purpose are, therefore, given.

Table Varnish.—(1.) Take of oil of turpentine 1 lb., beeswax 2 oz., colophony 1 drachm. (2.) Dammar resin 1 lb., spirits of turpentine 2 lbs., camphor 200 grains. Allow the mixture to stand for twenty-four hours; and the portion poured off is fit for immediate use.

Furniture Varnishes.—(1.) Dissolve 1½ lb. of shellac in 1 gallon of naphtha, and it will be ready for use as soon as the dissolution is complete. (2.) Dissolve 12 oz. of shellac and 3 oz. of copal (or an equivalent of Copal Varnish) in 1 gallon of naphtha. (3.) Dissolve 2 oz. mastic, 1½ lb. shellac, 4 oz. seed lac, 4 oz. sandarach, in 1 gallon of rectified spirits of wine, benzoin, and dragon's blood: turmeric and other colouring matters may be added as required.

Mahogany Varnish.—Gum sandarach 2 oz., shellac 1 oz., gum benjamin ½ oz., Venice turpentine 1 oz., spirits of wine 1 pint. Colour red with Dragon's

Blood, or yellow with Saffron; place the vessel containing these ingredients in a warm spot, until the gum has dissolved, then strain for use.

White Furniture Varnish.—Dissolve 6 oz. of white wax in 1 pint of oil of turpentine by gentle heat, or white wax 6 parts, petroleum 48. To be applied to the work whilst warm; allowed to cool, and then to be polished by rubbing with a coarse cloth.

Dark Varnish for light wood-work.—Shellac 16 parts, gum sandarach 32, gum mastic 8, gum elemi 8, dragon's blood 4, anatto 1, white turpentine 16, alcohol 256. Dilute also with alcohol, if required.

Varnish which resists boiling water.—Linseed oil 1½ lb., amber 1 lb., pulverized litharge 5 oz., powder white lead 5 oz., minium 5 oz. Boil the linseed oil in an untinned copper vessel, and suspend in it the litharge and minium in a small bag, which must not touch the bottom of the vessel. Continue the ebullition until the oil has acquired a deep brown colour; then take out the bag, and put in a clove of garlic: this is to be repeated seven or eight times, the boiling being continued. Before the amber is added to the oil, it is to be mixed with 2 oz. of linseed oil, and melted over a fire that is well kept up. When the mass is fluid, it is to be poured into the linseed oil: this mixture is to be boiled and stirred continually for two or three minutes. Afterwards, filter the mixture, and preserve it in a bottle well corked up. When this varnish is used the wood must be previously well polished, and covered with a thin coat of soot and spirits of turpentine. When this coat is dry, some of the varnish may be applied with a sponge, taking care that it is equally distributed on every part. This operation is to be repeated four times, being always careful that each coat be well dried before another is put over it. After the last coat of varnish the wood must be dried in an oven, and afterwards polished.

Turpentine Varnish.—One pint of spirits of turpentine, 10 oz. clear resin pounded; put it in a tin can on a stove, and let it boil for half an hour. When the resin is dissolved, and the mixture has cooled, it will be ready for use.

White, hard, spirit Varnish.—(1.) In three pints of rectified spirit (65 overproof) dissolve 1 lb. of gum sandarach, and add 6 oz. of turpentine. (2.) Dissolve 4 oz. gum mastic, ½ lb. gum juniper, in 4 pints rectified spirit; add to the mixture 1 oz. of turpentine. (3.) Which may be used on metals, and polishes well. Mastic in tears 2 oz., sandarach 8 oz., gum elemi 1 oz., Chio turpentine 4 oz., rectified spirit (65 overproof) 1 quart.

Mastic Varnish.—Immerse 10 oz. of the clearest gum mastic in 1 pint of turpentine; place the vessel containing the mixture in a sand bath until the mastic is all dissolved, then strain it through a fine sieve, and it will be ready for use: if too thick, it may be diluted by the addition of spirits of turpentine.

Copal Varnish (spirit).—(1.) Melt 8 parts of powdered copal gum in an iron pot by slow heat, and 2 parts balsam capivi previously warmed. Then remove from the fire, and add 10 parts spirits of turpentine, also warmed, in order to reduce to the necessary degree of thickness for working.

Note.—Gum Copal is made more soluble in spirits of turpentine by melting the powdered crude gum, and allowing it to stand for some time loosely covered. (2.) Powdered copal 24 parts, spirits of turpentine 40, camphor 1 (white), 4 oz. copal, ½ oz. camphor, 3 oz. White Drying oil, 2 oz. essential oil of turpentine. Reduce the copal to powder, mix the camphor and Drying oil, then heat it on a slow fire; add the turpentine and strain. As other soft resins are sometimes substituted for mastic, so inferior hard resins are sometimes employed in the place of copal, in the composition of varnishes celebrated as Copal Varnishes. Copal is of difficult solution in turpentine and linseed oils, both of which enter into the composition of the ordinary Copal Varnishes, which are employed by the coach painter and herald painter, and afford the best varnishes used by the house painter and grainer. Combined, however, with linseed oil and oil of turpentine, Copal Varnish affords a vehicle superior in texture, strength, and durability to mastic and its megilp, though in its application it is a less attractive instrument, and of more difficult management. As copal swells while dissolving, so its solutions and varnishes contract, and consequently crack, in drying, and thence linseed oil is essential to prevent its cracking. The mixture of Copal Varnish and linseed oil is best effected by the medium of oil of turpentine, and for this purpose heat is sometimes requisite.

Iron-work, Varnish for.—Dissolve in about 2 lbs. of tar oil, ½ lb. of asphaltum and a like quantity of pounded resin; mix hot in an iron kettle, care being taken to prevent any contact with the flames. When cold the varnish is ready for use. This varnish is for outdoor work and iron-work.

Common work, Varnish for.—Place 3 lbs. of powdered resin in a tin can, and add 2½ pints of spirits of turpentine; shake well, and allow the mixture to stand for a day or two, shaking it occasionally. Then add 5 quarts of boiled oil; shake the whole, and allow it to stand in a warm room until clear. The clear portion is then to be poured off for use, and may be reduced in consistency by the addition of turpentine. This varnish is intended for protecting surfaces against the effects of exposure to the atmosphere, and has been used with great advantage for coating wood and iron-work.

PART V.

OF LETTER PAINTING
OR
SIGN WRITING.

CHAPTER XXIV.

GENERAL CONSIDERATIONS IN RELATION TO INSCRIPTIONS AND SIGN-BOARDS.

It is much to be desired that the members of the trade would settle amongst themselves what should be the name of this very important branch of practical art. It is not *sign* painting, because signs consisted in forms, not words; they were, in fact, symbols used instead of inscriptions, and to impress themselves on the memory, thus:—"The Bell," "The Crown," "The Elephant and Castle," were absolute illustrations of the names; they were, in fact, a sort of crest: thus the Vintners' Company mark their swans with two nicks cut in the beak, and hence this became an appropriate sign for taverns. A leading hostelry at an old coaching-house in Lad Lane, London, adopted this sign, which, becoming distorted in course of time, was afterwards known as "The Swan with two *Necks;*" and a bird thus accommodated (perhaps as a safe resource in case of diphtheria) was long seen adorning the wall of the building.

Again, the art under consideration is not *writing*, in the generally accepted sense of the term, nor is it printing: it is, in fact, neither more nor less than painting letters; and, therefore, the proper name should be "letter painting." Finally, the letter painter does not always paint "signs;" but is called upon to paint the inscriptions on omnibuses, the names on ships, the numbers on doors, &c.

We throw out these hints in the hope that some one, wise in his generation, may be induced to make an innovation on the generally adopted name of "sign writer;" and we shall be happy, in future editions, to adopt a name other than sign writer, which is merely used for want of a better.

The work of the letter painter is easily defined. He is to paint the names, trades, or other inscriptions, on the architraves of shops, on show-boards (commonly called sign-boards), on walls, and in various other situations, on vehicles, &c.

Now the object of such inscriptions is clearly to make known the name of the occupier of the shop, his business, and the number of the house, the various points in the route of an omnibus or other conveyance, or to give some information to the public in a brief and rapid manner; and it is therefore obvious that the inscription should be as visible as possible.

Let us, in the first place, inquire into the conditions of the inscription on the architrave of a shop-front. The letters are, as a rule, to be looked at from below, or perhaps, if the shop be rather low, they may be on a level with the eye of a passenger sitting on the knife-board of an omnibus; but they are seldom *below* the eye of the spectator. Now the simplest way of making known the name of the inhabitant is, of course, to paint it up, just as one can imagine an emigrant doing over the entrance to his tent or over the door of his cabin. But the colouring matter with which the surface and letters are painted is to a certain degree evanescent, and this knowledge has led to the adoption of methods by which men of the earliest epochs of the world have made known their history to us, and by which our modern school-boys endeavour to inform posterity of the fact of their having learnt their lessons on a particular form, or practised their pot-hooks and hangers at certain desks, viz., by incising or cutting the letters into the surface; and this is, unquestionably, the most permanent method, as the inscription is only removed when the thickness of the whole surface is reduced to a level with the lowest depths of the incised characters.

Incising the letter in a wooden architrave, however, is soon found to be impracticable for general use, because the wood requires to be much thicker than is usually employed, in order to allow of the letters being cut to a depth proportionate to their size; secondly, the work would be difficult of execution, considering that the inscription is seldom executed before the architrave is fixed in its place, and thus cannot be turned about during work; and, thirdly, the whole plank would have to be removed in case of change of name. In spite of these obstacles, incised names may be seen over some few shops, where they show to very great advantage.

The next most obvious plan is to cut the separate letters out of wood of a certain thickness, or to form them of earthenware, or other suitable material, and to attach them to the architrave by means of nails: a plan which is very largely adopted, and which, if the letters are made of well-seasoned wood, and are properly secured, is found very efficient. The wooden letters, however, owing to no fault on the part of the maker, but to the alternations of wet and dry to which they are subjected, often crack and part, or even the whole of the letter drops off. The earthenware letters too are liable to accident, though perhaps not so much so as the wooden ones.

The letter painter, then, either practises the first of these systems in its entirety, or imitates the effects produced by the other two. We shall treat of the methods of proceeding in the order in which we have mentioned them.

First, then, of painted letters, imitating neither sunk nor raised forms, but merely giving the inscription in a plain and simple manner. It will be clear that, as the letters will be on the same level as the surface on which they are painted, they should be made as distinct from it as possible, and their forms should be well defined. Although the letter painter is seldom, if ever, consulted as to the painting of the architrave or sign-board (we are compelled to retain the name for want of a better), still, in order that his own work may show to advantage, it may be well that he should intimate to his fellow-workers in the other branch of the business, through whom the information may reach the customer, that the surface on which the name, or other inscription, is to be painted should be as retiring as possible.

We are aware that persons having their houses and shops painted have a perfect right—of which they avail themselves to the fullest extent—of exercising their taste in any way they think proper, but they are by far too sensible to wish the object they have in view in this matter—the publishing of their names and trades—to be defeated, and hence are mostly open to advice of practical men. It behoves these, then, not to be mere machines, but to suggest to the employer how his wishes may be better carried out by the exercise of good taste than without it.

It must be pointed out, then, that the object is not to show the architrave, but the inscription upon it, and that its colour should be such as will bear out or, as workmen say, " show up " the lettering: a quiet retiring tone should therefore be used, with the mouldings or other architectural details relieved, or "picked out," with brighter colours in small quantities.

Graining and marbling are wholly objectionable on surfaces on which the inscription is to be painted in the flat, as the veining destroys the unity of form in the letters from which the irregular lines seem to proceed like so many cords by which they are drawn in different directions, and the outlines are thus as it were merged down into the veins of the marble or the curl of the wood. Where the surface has already been marbled or grained, a portion of it should be painted to indicate another stone or wood of a different and uniform character—as a fine granite or a wood of a straight unobtrusive grain—which may be represented as inlaid, or as a tablet superadded; but, in either case, the letters should have a firm outline of a colour different from that of the ground.

Referring to the colours with which letters, under these circumstances, should be edged, we may repeat here the rules propounded by M. Chevreul, and quoted by Mr. Owen Jones, in regard to ornament, but which apply with equal force to lettering, viz.:—(1.) That when ornaments (or letters) are on a ground of a contrasting colour, the ornaments should be separated from the ground by an edging of a lighter colour, as a red flower on a green ground should have an edging of lighter red. (2.) When ornaments in a colour are on a gold ground, the ornaments should be separated from the ground by an edging of a darker colour. (3.) Gold ornaments on any coloured ground should be outlined with black. (4.) Ornaments of any colour may be separated from grounds of any other colour by edgings of white, gold, or black. (5.) Ornaments in any colour, or in gold, may be used on white or black grounds without outline or edging. The ground here is supposed to be of a uniform colour; but, as already stated, an edging is required where the ground is marbled or grained. (6.) In self-tints, tones or shades of the same colour, a light tint on a dark ground may be used without outline; but a dark ornament on a light ground requires to be outlined with a still darker tint.

Although we have given the whole series of Principles of Decorative Art in another section of this volume, we repeat the above propositions, knowing the tendency of readers to look first at the sections of a book in which they may themselves be specially interested; and we desire to furnish such with information of immediate service to them, but we urge the student to consider his branch as only a part of a great whole; for it is only when those engaged in the various departments are conscious of the conditions and requirements of the others, that a proper harmony pervades the result of their united labours: and as we attach sufficient importance to letter painting to elevate it to the rank of one of the decorative arts, we trust the student will make himself well acquainted with the whole of the principles laid down, as well as with the other departments described in this volume, whilst the higher branches are to be studied from "The Grammar of Colouring and Ornamental Art" (No. 186 of this series).

As our instructions in regard to the formation and spacing of letters will refer to sign or rather show boards, as well as to shop-fronts, &c., we will, in the first place, offer a few hints as to the construction of the boards (which the painter is often called in to supply), which will be found of service. The wood chosen should be old and well seasoned. Oak and mahogany are the best, but are, of course, more expensive than pine, of which very good boards may be made. The constant alternations from wet to dry, however, severely test the resisting powers of the boards, and every precaution must be taken to prevent their warping, twisting, or splitting. The separate lengths of which the board is composed should be carefully united by the plough-and-tongue joint, the tongue and groove being cut in the dovetail fashion, and the one driven into the other from the end; the parts should not, however, fit tightly, in order to allow of a certain amount of expansion and contraction; and this provision must also be made in regard to the rabbets or cross-pieces at the back. It is owing to neglect in this particular that we often see sign-boards, of a large and expensive character, spoiled by fissures extending over their whole length. The component boards are often ploughed and tongued together, broad flat pieces are placed at the back, a screw or two passing into each of the boards, and a framing is then nailed round the whole. When the boards are acted upon by damp, they swell, and then bulge up at the parts not immediately held down by the screws, thus producing a wavy or corrugated surface; the ledges left by the ploughed groove are often thus forced off, leaving the unpainted tongue exposed: nor is this all, the same expansion forces outward the framing nailed to the edges, separating them from the pieces nailed to the ends of the boards—which, of course, have not expanded lengthwise—the wood again contracts by warmth, and then cracks and splits, as already described.

The best plan therefore is not to screw the boards to the rabbets, but to cut grooves across the back, to about half the thickness of the wood, and making the edges of these grooves to slant inward; the rabbets being cut to fit, but not too tightly, are then to be run into the grooves; the rabbets, however, should not be placed on their broadsides, but should be used edgewise, by which the resistance to warping is much increased; and they should be cut rather shorter than the width of the board: in this way a certain amount of expansion and contraction is allowed for, and splitting is avoided. The frame should not be nailed to the board, but should be made like a picture-frame, with a rabbet in front, a free space being allowed on each side, the board being kept in its place by slips, or blocks of wood, nailed to the frame at the back.

It may, perhaps, be worth mentioning that it is better for a large sign-board to rest upon brackets, or holdfasts, than to be suspended from them, there being less strain on individual parts by the former than by the latter method.

The following method of painting sign-boards is quoted from "Workshop Receipts" (E. Spon):—

"Brush the board over, back and front, with equal quantities of linseed oil, japanner's gold size, and turpentine, to which add a little ground white lead, driving or rubbing out the colour well. For the second coat, take equal quantities of white lead, common spruce ochre, and whiting, all well dried and ground fine and stiff separately with raw oil; mix the whole together, add sufficient of gold size to cause it to dry quickly, firm, and hard; dilute with turpentine to a proper consistency, and apply two or three coats of the above colour.

"When dry and hard, rub the surface smooth with either sand-paper or pumice stone and water, then grind equal portions of spruce ochre, whiting, bath brick, and white lead, with two parts oil and one part turpentine, adding a little gold size diluted with turpentine, and apply one, two, or three coats, if necessary, taking care to rub down and wash off the panel between each coat, repeating rubbing and colouring until the surface is as smooth and level as plate-glass. It is then fit to receive the required last coat, to write, marble, or grain upon. The finishing application, whether it be a plain ground, landscape, figure, or letters, ought to stand until thoroughly dry and hard; it should finally be varnished twice over with best body copal or amber varnish, as the delicacy of the painting will admit."

We shall presently proceed to the consideration of the forms of letters of different characters, and the proportions of the various parts to each other; but we desire that this should be essentially an instruction-book, one which the apprentice can have on his book-shelf, and take down from time to time and consult as a friend. We live in an age when, happily, the education of artisans is no longer neglected; but it is necessary that all who engage in this great work should bear in mind that we have not simply to deal with boys at school, and to whom it is desirable to impart the elements of technical education, but that we have to spread the blessings of practical instruction over youths and men already engaged in trade, who, almost entirely ignorant of the principles of the work they are engaged in, pick up a few practical hints from each other, under difficulties and obstacles such as only Englishmen would have the courage and perseverance to overcome: (and foreign artisans are unacquainted with such difficulties, having the benefit of technical instruction in early years).

The men and youths, then, with whom we have to deal return from their work jaded and tired. They seek places of amusement (often of an objectionable character), for they feel the necessity for recreation. They have had no interest in their day's work. They require no exercise of mental power on the morrow, and they are thus deterred from studying or practising in the evening. To such we say, "Come, let us reason together." We do not take our place on an eminence, and, glancing around at the fine prospect presented, advise our brethren below to come up to us—as if the path were a smooth one. We take our stand with them, and we say to them, "each step has its difficulties," we will show you how to surmount them; obstacles will present themselves at each turn, we will assist you to remove them; and we assure them that at every step gained they will receive additional courage to proceed, and will become strengthened in their pursuit of knowledge.

CHAPTER XXV.

THE ELEMENTARY FORMS OF STRAIGHT-LINED LETTERS.

Considering the views expressed in the foregoing chapter, it will not be necessary to apologize for beginning at the beginning, and we therefore refer our student, in the first instance, to our course of elementary drawing, and, assuming that he has passed through this, we advise him to study carefully the forms of the different kinds of letters, the proportions of the various parts, the relation of the letters to each other, the height of the small (or, as printers call them, the "lower case") letters as compared with the capitals, the suitability of each kind of letter to the sentence to be written in it, to the surface on which it is to be painted, and the position from which it is to be viewed.

The letters should, in the first instance, be drawn on paper, and at that stage should not be less than two inches high; and as each one has been sketched, it should be held at some distance from the eye, in a vertical position, so that its general form may be judged of when placed as it would be in actual practice.

Letters of a much larger size should then be drawn, and these should be filled in with black: the colour used may be either Indian ink or the moist water-colour sold in collapsible tubes; but the most economical material is simple lamp-black, ground up in water, with the addition of a few drops of gum arabic.

It must, of course, be understood that, excepting the top and bottom lines, no other parts of the letters are to be ruled, or done by any other mechanical process. We shall not however insist on this point when the question is one of business, and shall show how far means may be employed to improve the quality of the work and to give rapidity in execution.

We advise the student to paint a set of letters of the block or, as type-cutters call them, the "sans-seriff" character, taking care that they shall not be clumsy, and bearing in mind that letters seen from below will naturally look rather shorter than they really are, and that this effect must be provided against by making them of a rather elongated form. The paper should then be squared as near the letters as possible, and two long parallel lines having been ruled as high up as convenient on a wall, they should be placed so as to form names, &c., being temporarily fastened by means of tacks.

When the letters have been so placed, it will at once become evident that they must not be drawn at equal distances apart. The power of properly spacing is only to be acquired by great practice, and is much wanted by some of our writers who have made the forms of the letters only their study, and who, unfortunately, have had no systematic education in their special branch, but who, with a zeal most creditable to them, have picked up (or, in plain words, have learnt from troublesome experience) the way of placing letters: thus, we see men get up on the plank placed in front of the surface on which they are to "write," and at once commence sketching in their letters, and reaching the end of the space at their disposal just at the last stroke of the final letter, all the letters being correctly spaced. We will not make the unfair remark, which we once heard made by a spectator on witnessing such a feat, that it was "more hit than wit," for we have already said that the power has been attained by long practice and experience, and would have been acquired long ago had the same man been taught how to form and set out his letters instead of having had to grope his way, and try and try again, until success crowned his labours. But, in quoting such examples as the above, we are taking cases which are not numerous, and we more often see writers make several attempts both in forming the letters and spacing them, rubbing out their chalk lines and putting them in again, to the injury of the surface, and to the waste of time—which to them means money; and we have never been able to find out how letter painters *do* learn their business, or if they are ever taught it at all.

We will, in the first place, give some instructions as to the study of the letters themselves, and then proceed to show how they should be spaced.

The alphabet must, for our purpose, be divided in a manner quite different from that adopted in schools. We can think of neither vowels nor consonants. We must classify them according to the lines of which they are formed. Thus we have, in the first place, letters consisting of parallel lines at right angles to each other, and with these the student should begin. In this elementary stage the sans-seriff character will be found the best for practice. The full height of the letters having been decided on, horizontal lines should be ruled, and within these too should be placed the lines which are to guide the thickness of the horizontal parts

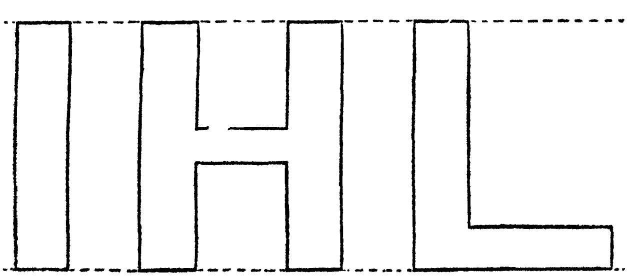


Fig. 6.

of the letters. The distance of these from the outer horizontals must be determined by the thickness of the intended letters: in some cases, where a very solid or heavy letter is required, the horizontals at top and bottom may be of the same thickness as the uprights; but as a rule they should be rather thinner, the upper one being slightly narrower than the lower, in order to avoid a "top-heavy" appearance, but this difference should be so very little, as not to be really apparent to the casual observer. The simplest of these letters is I, the outline of which consists of two perpendicular lines, united at top and bottom by horizontals. Although, as far as form is concerned, this is a very easy letter, it still demands great care so that it may be kept perfectly upright, and that it may not be irregular in form. It must, however, be pointed out that when the letter is very large, and is placed in a very high situation, its sides should bulge out in a very trifling degree, and it

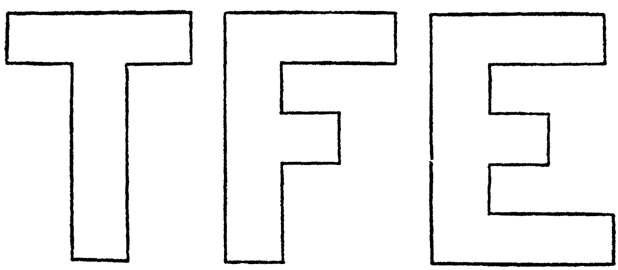


Fig. 7.

should be slightly wider at the top. Where these deviations are not made, the sides will seem to bend inwards, and the lines will seem to converge towards a point above; but great care must be taken that neither the bulging of the sides nor the increase at the top are exaggerated. The effect, viz., the apparently uniform thickness of the letter, should be visible, but not the means by which it is obtained; and in letters of a small size placed at a medium height the plan suggested for large letters need not be adopted. The letter H is simply made up of two uprights, like the letter I, united in the middle by a horizontal bar which should be rather thinner than the horizontal parts of the other letters. The distance between the two uprights is, of course, regulated by the character intended to be given to the letter—from the elongated, in which the space is less than the thickness of the uprights, to the square and compressed or broad, in which it is twice or even three times that proportion. A fair average width is shown in the example. The letter L is of equal simplicity, consisting as it does of an upright and horizontal only. The general breadth of the letter should be the same as T, F and E, but the lowest horizontal member of the last-named letter should be a trifle longer than the upper one, a difference which must not however be exaggerated. The horizontal in the middle of F and E should never be less than half the length of the other horizontals; it may be more. In some characters, such as the "elongated," it may be lengthened until it is almost equal to the others. When this member is too short, it gives an exceedingly mean appearance to the letters.

We now proceed to forms of letters composed entirely of oblique lines, and of these the simplest is V.

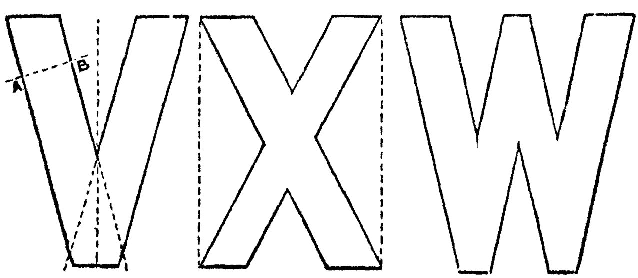


Fig. 8.

The width at top having been decided upon, the external lines are to be drawn, at equal distances, on each side of a perpendicular. The point is cut off at the bottom, where the width should not be as great as that of each of the members at the top. A certain amount of care is necessary in fixing the thickness of the sides.

In the case of an upright letter, as I, the thickness is set off on the horizontals at top and bottom; but if this were done in regard to the V, or other slanting letters, the parts when drawn would be narrower than the others. It is therefore necessary to set off the real width required on a line at right angles to the sides, as at A, then the lines drawn at B parallel to the outer line will give the width at the top of the letter. The letter X should be sketched in a rectangle, formed by the two horizontal lines at top and bottom, and two perpendiculars giving the extreme width of the letter. To the angles of this rectangle the lines of the letter are to be drawn, but it will be observed that the line which starts from the angle at the top, or bottom, does not proceed to the opposite angle at top, since the same line, which is the outer line in the upper, is the inner one of the lower part. The first sketch must, in the case of the learner, be probationary, as the exact positions of the two members must be obtained in the same manner as those of the two parts of the letter V. In some specimens, by both type-cutters and painters, we find the upper part of the X smaller than the lower; but this is not by any means general, owing to the difficulty of avoiding the high-waisted appearance which is the result. No absolute rule can, however, be laid down.

The formation of letters is very much a matter of taste and judgment, and each letter painter of experience will be found to have formed a style of his own, although he may not be able to give any rules on which he has based his practice. The W consists of a repetition of the letter V, but, excepting in the elongated or narrower forms of letter, the V which is doubled must be narrower than the one used as a single letter. The points at bottom and top are to be cut off by the horizontal lines which give the height, and the three flattened points—viz., the one at top and two at bottom—are to be of the same width, which, as already explained in relation to the letter V, will be narrower than the ends of the other members. The method by which the proper diminution of these points, by completing the members as if crossed, is shown in the letter V. A W which is too wide, whether it be placed at the beginning, end, or middle of a word, or whether it be used as a separate initial letter, has a very ugly, disconnected, and straggling appearance, and much judgment is required in regulating the width. As a general rule it will be found that it should never exceed the width of letters such as E by more than one-half: that is to say, if the bottom member of the E be 4 in. the extreme width of the W should not exceed 6 in.; but we repeat that this proportion is not by any means arbitrary.

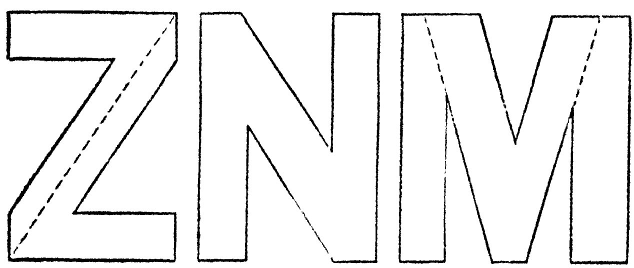


Fig. 9.

We shall next consider letters formed of horizontal and vertical, combined with oblique lines.

The letter Z is contained in a rectangle. Having marked the extremities of the upper and lower horizontals, draw a diagonal; the sides of the slanting member will then be parallel to this, half of the thickness being set off on each side of it. We sometimes see the oblique member painted rather thinner than the other two, and the upper horizontal rendered rather shorter than the lower one. We do not think there is any gain in either of these modifications, for the middle portion of the Z is, of course, a down stroke, and would naturally therefore be thick; and further, when the upper horizontal is made shorter than the lower one, a pyramidical appearance is given to the letter which is not natural to it.

The N is a letter of a similar character, resembling a

Z turned on its side, and is to be drawn in the same manner.

The letter M may be formed in the same way, but it is necessary to remark that the width must not be exaggerated. The M should never be broader than it is high, unless the characters be of the kind called "extended," but should in most cases be narrower. It may also be drawn in the manner shown in the figure, viz., by considering it as a V supported by two perpendiculars—the upper points of the V starting from the middle of the top of each perpendicular. In order to obtain the proper thickness for the two oblique lines, however, the breadth of the top of the letter must be extended, and this in a rather wide letter gives a clumsy and top-heavy appearance; but there is this advantage that the blank space at the top is diminished, whilst those at the bottom are increased.

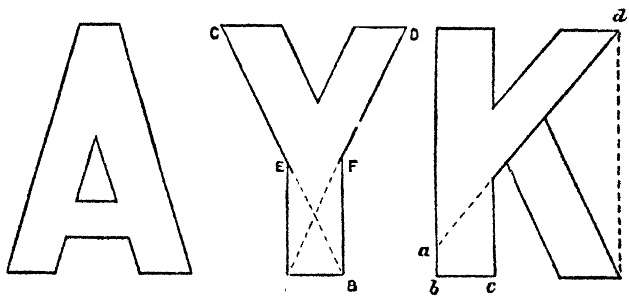


Fig. 10.

The A is precisely similar to the V inverted, and with the addition of a horizontal member, which should be rather thinner than the other two.

The Y is as it were a V supported on a single stem. In forming this letter, the difficulty is the proportion which the open part holds in relation to the stem: for if the stem be too long, the fork will look too insignificant; whilst, if the arms spread too widely and start from too low a point in the stem, a vulgar look is the result. The plan which the author has constantly adopted in designing lettering for painters, carvers, and engravers, and which he has found applicable to letters of various widths, is to draw the stem of indefinite height, and to draw lines from the extreme points of the width C and D, to A and B. These lines cutting those of the stem in E and F determine the proportions. The inner lines of the fork are, of course, parallel to the outer ones. The left one must, under all circumstances, be of the same thickness as the stem. The other may be so, if such be the character of the letter, but the thickness of the slanting side must be increased or diminished on the inner, not on the outer side, so that the exact balance may not be interfered with.

The letter K is often subjected to malformation, and is sometimes erroneously painted, as in Fig. 11, whereas the history of the growth and formation of

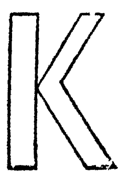


Fig. 11.

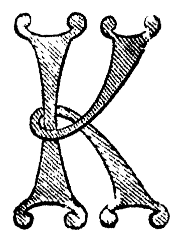


Fig. 12.

letters shows us that the front part is the result of the crossing of the two parts of which it is made up, forming a loop which gathers in the upright. Thus in manuscripts of the twelfth century,* we find the K drawn as shown in Fig. 12, and in this the origin of the present method of forming the letter is apparent.

It may, of course, be said this is a "written character," not a printed one; but it must be borne in mind that the great object of the early printers was to make their characters resemble manuscript as nearly as possible.

* See "The Book of Ornamental Alphabets, Ancient and Modern." By F. Delamotte. (Lockwood and Co.)

Much of the difficulty, in fact (as stated by the author in a course of lectures on engraving and printing, given at the request of the worshipful Stationers' Company, in their hall, in March, April, and May, 1873), which surrounds the research into the history of printing, has been owing to the circumstance, that the first types were cut so as to imitate as nearly as possible the characters used by the scriveners of the period. The discovery of the mechanical means of multiplying a book would, of course, have the tendency to depreciate the price, and thus printing seems, in its earliest days, to have been not so much a substitute for, as a counterfeit of, writing done by hand; and thus we have a story that Fust was found selling printed bibles in Paris, pretending that they were written by hand, and was charged with being aided by powers we had better not mention, in producing the copies with such rapidity.

The similarity of the printed to the manuscript books of the time was much favoured by the circumstance that all the capital letters were omitted in printing, and were afterwards put in by hand, by means of the pen and brush. Some of these illuminated capitals are most exquisite works of art.

It must, however, be borne in mind that Fust was not (though he has been sometimes classed as) one of the inventors of printing. Had he invented the art, or had he even possessed an honest enthusiasm in its introduction, he would not have stooped to consider the light of the intellectual sun thus raised in the world, spreading the effulgence of its rays over land and sea, over poor as well as rich, as a mere pecuniary speculation. But the fact is Fust was a well-to-do goldsmith, and goldsmiths in those days were the leading merchants and money-lenders, and having supplied the capital for establishing the printing-office in which Guttenberg's great invention was being carried out, was thus anxious that the profits realised should be as great as possible. The open conduct of Caxton is characteristic of our great countryman, for at the end of his translation of the history of Troy (begun in Bruges on 1st March, 1468), he says :—" Thus end I this book which I have translated after mine author as nigh as God hath given me cunning, to whom be given the laud and praise; and forasmuch as in the writing of the same my pen is worn, mine hand weary and not steadfast, and mine eyes dimmed with overmuch looking at the white paper, and my courage not so prone and ready to labour as it hath been, and that age creepeth over me daily and feebleth all the body, and also because I have promised to divers gentlemen and to my friends to address them as speedily as I might this book, therefore I have practised and learnt at my great charge and dispense (expense), to ordain this said book in print, after the manner and form as you may see here, and it is not written with pen and ink as other books are, to the end that every man may have them at once."

The knowledge then of how the letter was at first written is of some assistance in shaping it. Having drawn the upright, and having marked the width of the whole letter by the dotted perpendicular, mark on the upright stem the height *a*, equal to half the width *b c*, then from *d* draw a line to *a*, and another parallel to it. The lower member is then to abut against the upper, leaving a small space between it and the perpendicular at *c*. The student will not work the letter in the above fashion after he has acquired the proper judgment as to the relation of the parts to each other, and their proper proportions; but the method shown in Fig. 10 and the hints here given will, we think, materially aid him in his early studies.

CHAPTER XXVI.

OF LETTERS CONTAINING CURVED LINES.

Following up our subject by gradual steps, we come next to letters in which straight lines and curves are combined, and of these the simplest is the J. In this letter the first part to be drawn is the upright, which may be brought down to about the level of the line which regulates the thickness of the horizontals at bottom. At this point the curve is to begin. We must guard the student against an error into which many letter painters fall, viz., beginning the curve too soon, or bending it off too gradually. When this is done the letter has, as it were, an unsafe appearance, as if it were likely to turn over on the one side; besides which, it is by far more difficult to balance the curves than when they start from a given point. In very large letters it is, in fact, advisable to let a portion of the bottom of the J, and that of the U, be quite flat, the angles at which it meets the upright and end being rounded off.

The question whether the end of the J and other letters of this character should be cut off by a horizontal or an oblique line has been much discussed. We cannot admit that the reasons given for either one or the other are in any way satisfactory; but consider it a point which must be settled by the taste of the painter according to the character of the letter.

The U is simply a J with the addition of a second upright, and the same remarks as to the curve will apply to it.

The D consists of an upright united to a curve on its right side, the general width of the letter corresponding with that of the E, or similar ones. In large letters it is advisable that the curve should be somewhat fuller towards its lower part than above the middle; and, in very large letters of the sans-serif character, the back may be

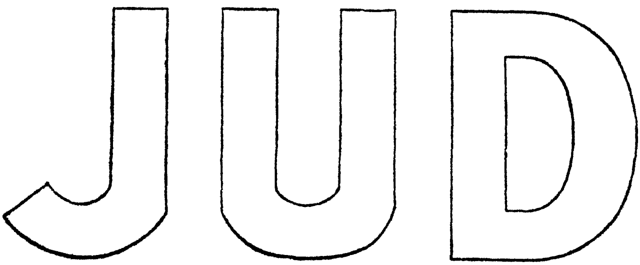


Fig. 13.

upright, the angles at top and bottom being rounded off: this gives a broad and bold appearance to the letter, but is not admissible in any other character, or in any but letters of a very large size.

Fig. 14.

Similar in character is the P, in which, however, the curve meets the upright at a point rather below the middle of its height, and at this part the curve should be slightly thinner than at any other. Great care in fixing the point of junction is necessary, as if it be placed too high, the appearance called "high-waisted" is given to the letter, whilst if placed too low, it looks clumsy and vulgar. The B and R are, as it were, amplifications of the P, one curve being added to each. In the B this curve turns inward, being simply of the same character as the upper one, whilst in the R it turns outward. In both these letters, however, the upper curve must be rather smaller than that of the P, in order that the lower portion may be slightly more full than the upper ones: an effect which must not be exaggerated.

Although a small part of the G is made up of straight lines, the general form is so nearly allied to those next to be treated of, that its consideration is deferred for the

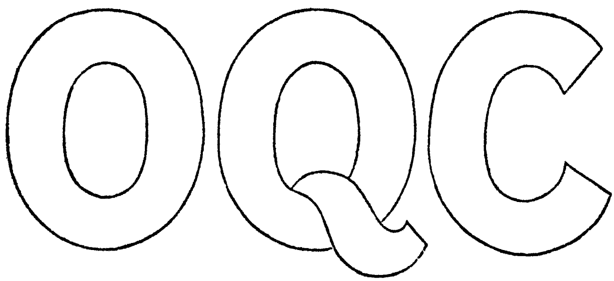


Fig. 15.

present. The next set of letters consists entirely, or almost so, of curved lines, and includes C, O, Q, and S.

The O is the basis of the C, the Q, and the G. It consists of two ellipses, either parallel or otherwise, according to the character of the letter. In the present stage of study the learner should draw these by hand, in order to acquire the necessary practice; but mechanical means for striking the forms will be alluded to further on. Two diameters at right angles to each other should in the first case be traced, and the left hand upper quarter having been sketched, should be followed by the opposite one, the lower portion being sketched in the same manner.

In very large letters of the square or block character, the O may be rendered as a simple parallelogram, that is, having its top and bottom horizontal, and its sides vertical, the angles being rounded off. The Q is merely an O to which the extra appendage, called the tail, is added. This should not be brought too far below the line, so as to interfere with the proper balancing of the letter, by appearing to draw the ellipse on one side or downward.

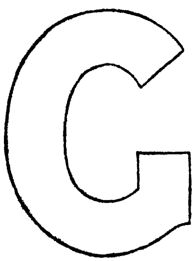


Fig. 16.

The C again, is the O, out of which a portion contained between two radii is taken. The beauty of the form thus produced, as compared with that resulting from cutting off the ends by horizontal lines, would seem to settle all doubts on this head; but, as we have already said, the matter is one of taste, not of principle.

The upper termination of the G is formed in the same way, whilst at the lower part, the curve of the ellipse is made to bend outward, meeting a straight line: the inner curve merges gradually into a straight line, and the letter is completed by a horizontal.

The S now alone remains, and this is indeed a most difficult letter. Many rules for its construction have been laid down; but we do not think any of them are of general application. We urge the student to attain facility in free-hand drawing, and to study the curved forms we have given in our elementary lessons. He will then find that he will be able to draw the letter to suit the character of the others in an infinitely shorter space of time, and with much less trouble, than would be required in carrying out any rules which might be laid down. whilst by far greater grace can be imparted to the form thus traced by hand than could be given to one resulting from geometrical construction. A parallelogram

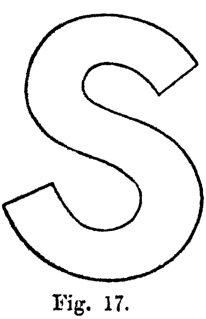


Fig. 17.

to contain the letter should be sketched, and this should, for reasons which will presently be explained, pass above and below the horizontals which regulate the heights of the other letters. The curve must then reach the top and bottom of this rectangle, but must touch the sides only at the lower part of the letter, the upper portion being smaller than the other: the difference must however be very slight, so as not to be too obvious.

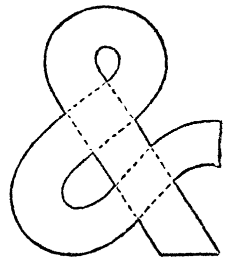


Fig. 18.

The & is a very troublesome form—for we cannot call it a letter—which, either when standing alone or in combination with c in &c., is gradually falling into desuetude: the word "and" or "etc." being far preferable, and occupy little, if, indeed, any more space. To establish a rule for the construction of this figure is even more difficult than for that of the s, and the painter must therefore depend on the accuracy of his eye and his power of hand, both of which will be improved by practice.

CHAPTER XXVII.

METHOD OF STUDY.

Having thus given a few hints as to the proportions and general formation of letters, we next proceed to advise the student as to a more extended system of practice, and for this purpose a black board must be provided. This may be bought ready made at the houses which supply school furniture, where the purchaser has the advantage of selecting from a number which have been some time in stock, and are thus seasoned, and not very likely to twist, warp, or split; but of course it is not the cheapest plan. We therefore suggest that a board may be made by a working carpenter, who purchases his wood first-hand, at a very reasonable rate. A single 11-inch board cut in halves, and the two parts joined and clamped at the ends, will make a board which will be found to answer every purpose.

This may be supported by screwing two legs against the back, and a third attached by a hinge—the whole forming, as it were, a board and easel in one; or if a wall in a room, outhouse, or shed, be available, the board may be fixed up by means of holdfasts, and will always be ready for use.

The board should be well covered with several coats of paint, of the usual kind, the last coat being mixed with turpentine, so as to dry without gloss, and this will occasionally require repetition; but that, to our young painter, will be a matter of but small difficulty. So long as the practice is confined to the use of chalk or pipe-clay, the board may be kept in very good order by rubbing it, once a week or so, with a rag dipped in common writing ink, which should be allowed to dry on the board. When the practice is in oil colour, the work must be washed off with turpentine before it dries, and for such practice the coat of flat paint will not be required. It is advisable, too, to change the colour of the board occasionally as the power of forming letters is obtained, so that their effect when differently painted, and on various grounds, may be studied.

The horizontal lines, which are to regulate the heights, &c., of the letters, are to be "snapped." This is done in the following manner:—Obtain some twine or whipcord—which may be kept for the purpose wound round a piece of stick—make a knot or loop at the end, and having marked at each end of the board the heights required, fasten the cord at the one on the right-hand side by a bradawl passing through the knot or loop; then rub white chalk along the entire length, so that it may be well charged with it; then hold the loose end of the cord against the required point at the left-hand edge of the board, draw it tightly, at the same time holding the end down with the thumb; take hold of the string at about the middle, and, drawing it away from the board as far as its elasticity will allow, let go suddenly, when a clear straight line will be "snapped" on the board. This plan will, however, only apply in relation to a board of limited size; but in other cases, as on the architrave of a shop, or on a wall, a bradawl must be driven in at the left side also, and the cord must be wound tightly around this, so that the operator may be at liberty to walk to the middle of the cord to snap it. The horizontal lines to regulate the height of the letters, and the thickness of the horizontal members, are all the mechanical aids of which the student should at this stage avail himself: a restriction which we shall remove when the question is one of absolute business.

We shall, for the present, confine the practice to single letters only, reserving our instruction as to general arrangmeent, spacing, &c., for the next stage.

The beginner is urged to sketch generally, rather than specifically—that is, to mark out the letter by a few general elementary lines, not finishing any particular part until he is sure that it is in its right place. As he progresses, he will acquire the habit of making his outline more and more correct, but less and less complete; so that after a while he may be able to paint his letters with the brush, whilst their general forms only have been indicated, by which plan he will not only save much time, but he will impart greater grace and spirit to his lettering than if every line were done in a more formal manner.

The outlines having been settled, they are to be gone over with paint: the brushes or "pencils" used being made of sable, and the hairs of greater length than in those used for other branches of art—they are called, in fact, "writers'" pencils. They will at first be found rather difficult to work, as owing to their length they will sag at the point, especially when charged with the heavier colours; but a little practice will enable the student to overcome this difficulty, and he will be able to use them with ease. The outlines are not to be executed in short or separate touches, but the pencil is to be drawn along in the required form, by which a continuous and graceful line will be obtained: the outlines of the broad parts of the letter are then to be filled up with pencils having greater body and shorter hair. The pencils used by letter painters are made in various sizes, amongst which are the following:—miniature, crow, duck, goose, full-goose, extra full goose, small, middle, and large swan; but others are employed, according to the taste or requirements of the painter.

Assuming now that the student has acquired a certain amount of power in free-hand and geometrical drawing, and that he is able to form the letters of a simple alphabet, such as that explained in the preceding chapter, we shall follow up the study in such a manner as to apply his knowledge to the actual practice of his occupation, and in this it is just possible that we shall run counter to the generally accepted ideas on the subject. We write from our practical knowledge of the difficulties by which letter painters are surrounded, and with the avowed object of ameliorating them.

It is laid down, then, as a rule, by some writers on this subject, that no mechanical aids of any kind are to be allowed to the letter painter, either in drawing circles, arcs, or other curves; and that, even in sketching italics, or writing characters, no means are to be taken to assist the eye and hand in giving to all the letters a uniform and proper slant.

Now this is manifestly an absurd theory, and one which, if carried into practice, would place the letter painter at a great disadvantage as compared with others who have to accomplish similar results, but who are allowed every mechanical appliance that can aid them in accomplishing their work with success and expedition.

Both these terms must receive their proper attention at our hands. The work must be done successfully, for unless it be so, the customer will be dissatisfied and future employment will be lost; and it must be done expeditiously too, for it is important that, whether it is a question of week or piece-work, it is to the interest of both the employer and the workman that every moment should be economized.

Now, however well our letter painter may be able to draw his letters by hand, however accurately he can, after repeated trials, sketch letters such as the C or G, and however well he may be able to draw straight lines, it must be clear, that his work must, to say the least, be expedited by mechanical aids. It must be borne in mind that he stands on a plank placed across two step-ladders, or similar contrivances, quite close to his work, and that he cannot see the exact effect of his lines; so that he is, in reality, working by guess, or rather, he depends on his experience, which is often at fault: whilst the fact proves our argument, for very much of the lettering seen above shops will, on examination, be found to be out of the perpendicular.

Again, to deprive the letter painter of all mechanical aids, is to treat him with great injustice, when compared with other workmen. An engraver is allowed to rule all his lines, to draw guides, and to use squares and compasses, or any other implements he may desire; cabinet makers and joiners scribe all their forms either by compasses or templates; the turner uses compasses and callipers; the machinist uses both of these with accurate gauges; the stonemason uses rules and squares; so does the mason, who cuts inscriptions in stone: yet, to the man who is to *paint* the same inscription, it is forbidden to use "rules, compasses, or any other mechanical aid." It is even said to him, "In forming any kind of slanting letters, as italic, care should be taken that all the letters slope to the same degree, but no mechanical means for effecting this object should be had recourse to." Fancy saying to a bricklayer, "You must be careful to keep your 'perpends,' and to see that your work is thoroughly 'plumb,' but you must use neither square, rule, nor plumb line." Or to a joiner, "You are to make the baluster-rails for three flights of stairs, you must be careful that they are all the same size, but you must use neither measure nor rule." Such instructions would be deemed manifest absurdities, and the work would deteriorate accordingly.

Let us deliberately consider what the letter painter is called upon to do, so that we may appreciate his difficulties, and that we may be able to show that the work will be better and more quickly done by the use of proper mechanical aids than without them, and that in the end the customer and the workman will be all the better pleased, for the one will get his work done in a superior manner, and the other will be enabled to work more rapidly, and consequently to earn more money, than he would otherwise have done.

In all we say on this point, however, we desire not to be misunderstood. We do not propose to allow mechanical aids to the student in his elementary practice, for the eye must be educated to act as a check on work done by means of instruments, which will always be found necessary ; and the hand must be trained so that the general forms may be sketched, and such parts as cannot be done mechanically, may be drawn by free-hand ; but as soon as a certain amount of power has been acquired, and the work done becomes a matter of actual business, we would allow, in fact encourage, the use of all such appliances as can improve the quality and expedite its progress.

We have said that, placed as he is, the letter painter cannot well judge whether his letters are upright ; but this is not his greatest difficulty. He has to move along in front of his work, and, as he does so, he loses sight of the first part of the inscription : how then can he judge of the uniformity of the thickness of the uprights, or of the widths of the letters themselves? He should therefore have in his left hand a pair of wooden compasses, one end of which holds a piece of chalk, and this should be set to the thickness of all the letters, so that he can mark them off in the snapped line. When this is done, a strip of wood is to be fastened by two or three thin nails against the line last mentioned, and on this a set square is to be moved along, and by the aid of this the uprights are to be drawn.

But we have yet another difficulty to deal with, and this relates to the curved letters, singly, and when doubled, or repeated at different parts of the inscription. Take for instance the letter O, on which are based C, G, and Q. The O should be a perfect ellipse, the proportion of the diameters to each other varying according to the character of the letters : a perfectly circular O is seldom used, and is always ugly. Is it not too much to expect that the letter painter should, in the most off-hand way, draw this most difficult figure, and in its most difficult position too, namely, standing on its narrow end? The first-rate painter succeeds, but the numerous failures observable in a half-mile walk attest the absurdity of the attempt ; for we see the letter bulging out on one side or the other, generally towards the upper part of the right side; sometimes too small when the painter has hit on a good form and thinks it "better to leave the well alone," lest by enlarging he may run the risk of spoiling it; or sometimes too large, owing to additions made in the hope of getting a satisfactory form.

The same applies to the s, but all the difficulties are increased when these, or any other letters, have to be repeated in the line. All good engravers, letter carvers, lithographers, and of course printers, look upon it as a matter of the greatest importance that the same letters occurring, no matter how often in a line or inscription, should be perfect transcripts of each other: a rule which it is next to impossible to carry out in the present system of letter painting; for how can a man moving along on a board, not able to step back to see the effect, judge whether a letter he is sketching corresponds in every respect with a similar letter some fifteen feet away? and yet the pedestrians who look at his work from below, or from the other side of the road, see the inscription as a whole, and criticize it (as we do every thing) from their own point of view.

We watched the efforts, some few months ago, of a letter painter in a large manufacturing provincial town. He was engaged on the following inscription:—

S. SOORNS AND SONS, WOOL STAPLERS.

Now here, without mentioning the simple letters, the painter had to accomplish seven copies of the letter s, five of the o, and two of the r. It is almost needless to say there was not much likeness between the numerous letters placed thus apart, and yet the painter was most assiduous in his attempts, whilst his failure was evident to the observer at a proper distance; and we thought the letter painter must agree with the old adage—

"O wad some power the giftie gi'e us
To see oursels as ithers see us."

We would therefore suggest the following remedy, of which the letter painter need not be ashamed, considering that the system is constantly adopted, not only by decorative painters, but by the greatest painters in the execution of fresco painting, viz., to draw one letter which is to appear several times in the inscription on a piece of cartridge paper, contructing the o in the proper geometrical manner, as shown in Fig. 120. This outline is then to be pricked with a large pin or darning-needle, and a line having been drawn down the middle, and a diamond-like opening being cut at top and bottom, the pattern thus made is to be held against the architrave or board, the diamond-like openings being placed against a central perpendicular previously drawn, and the outline is then to be pounced—that is, dusted over with some fine chalk, placed in a loose little bag of thin muslin, or brushed over with a stiff brush rubbed on chalk—the outline will be thus transferred, and as the pattern may be used many times, the letters, however often repeated, will be of precisely the same form.

But this system may be further extended with benefit to all concerned; for the whole inscription may be sketched on a broad strip of paper, which may be temporarily fixed in its place, and the appearance may be in some degree judged of before the work is executed, thus avoiding much disappointment and annoyance.

We have pointed out how a set square is to be used in drawing the perpendiculars of the letters: this set square may be made of a piece of ¼ in. deal, and should be about 9 in. at the narrow end. A very good average slant for writing is that of 60°, that is, the same as the side of an equilateral triangle. Some persons think that a greater degree of elegance is given to writing by increasing the slant, and there can be no doubt that the letters at a fair slant are much more graceful than when nearly upright; but this knowledge must be acted upon within proper limits, for when the writing slants too much, it has a straggling appearance which is very unpleasant.

The set square above alluded to may be used for both the upright and slanting lines; but we do not mean that the precise lines of the letters are to be ruled, but merely that lines are to be lightly drawn at six or seven inches apart in order to act as guides for the inclination of the writing, and to assist the painter in keeping a uniform slant throughout the whole line.

Set squares may of course be purchased, but they are not generally sold of the size named above: we therefore recommend the painter to make one for himself. A piece of board about 9 in. broad and 15 in. long may be easily obtained: it should be well planed, and one of the short and one of the long sides should be made accurately at right angles to each other; an equilateral triangle should then be constructed on the narrow end, and the one side carried on until it meets the long side of the board; the set square will thus be outlined, and the superfluous piece may be taken off by cutting through the line drawn with a penknife, taking care to guide the point against a rule, and that the knife is held upright; the edge of the wood may then be smoothened on a sheet of glass paper. A hole should be cut in the set square, so that it may be hung up when not in use, and this will also assist in moving it along whilst drawing the lines.

We now approach the important question of spacing; first words, and then the letters themselves. We have alluded to the haphazard style of working, of the time wasted by repeated trials, and there is no doubt that the result is in only a very few cases satisfactory; for it will be natural to suppose that when a man has several times failed in getting all his words nicely in, and at length finds himself approaching the end of his line, but with about one letter too much, or too little, to fill the given space, he will not alter the whole, but will "squeeze" or "stretch" the last few letters so as to accommodate matters, and any one walking through the streets will be able in a few minutes to find cases in which this has been done.

The first thing to be done then is to sketch out roughly on a piece of paper the whole of the inscription, in order to form some judgment as to the space to be occupied by each word, and corresponding divisions should then be marked on the surface on which the lettering is to be done, allowing at the outset for a certain space to be left between each word—a point frequently overlooked; and hence we so often see inscriptions in an almost continuous line, or some words crowded together, whilst others are far apart.

We may just cursorily point out that where a shop-door is in the middle of the front, and it is desired to have the name over the door, and the trade inscription divided and placed on each side of it, the name should always be in a character different from that in which the trade is painted. We say always, because, although this is advisable even when the whole inscription is to read in a continuous line—it is not so important in the latter as in the former case—in which the trade and the name of the shopkeeper when thus mixed up, often form most ridiculous sentences when read as if in one line: thus, we have seen at different times—

CHINA	BIRD	DEPOT

CABINET	LOCK	MAKER

HOUSE	FLOOR	AGENT

and similar other inscriptions; in each case the middle word being the name of the occupier of the shop. Where uniformity in the letters is requested, a perpendicular line or ornament should in every case be inserted so that a separation may be made between the words.

The space for each word having been decided upon, the number of letters the word contains is next to be counted, and the first, last, and middle letters are then to be sketched; or if the number of letters in the word is even, one on each side of a middle line should be sketched; or, again, if the word be a long one, it may be divided into three or four parts, and guide letters placed at the various points, to form as it were landmarks.

These divisions must not, however, be considered as absolutely fixed points; for although a word may be divided numerically into a given number of equal parts, it does not follow that each of those parts would necessarily occupy the same place, since one may contain an I the narrowest, and the other a W the broadest letter; but the division will generally be approximately right, and the differences above alluded to can be easily adjusted during sketching.

Nor can the letters themselves be placed absolutely according to measurement, for not only do they vary in width, but from their very conformation they require more or less space to be left around them in order to look well: thus, in the word **INDOOR**, greater space must be allowed between the I, the N, and the D, than between the D, the O, the second O, and the R, for it will be seen that in the first letters the space is equal all the way down, whilst between the other letters the space is gradually growing wider from the central horizontal. It is in circumstances such as these that the accuracy of the eye, obtained by the study of geometry and free-hand drawing, is found of infinite assistance: the eye must after all be the great guide, and all ruling or other manipulative operations are merely the means by which the work is accomplished so as to satisfy the eye.

The first sketch of the inscription need only be done in single lines, the centres as it were of the thickness. This operation need not occupy many minutes, but it will save many hours in the work, and avoid many days of vexation to those who have had an inscription painted, which is an eyesore to them every time they enter their place of business.

The circumstance that the letters O, C, G, O, Q, and S, only touch the top and bottom lines at one point, from which the curved line travels onward, causes them to look rather smaller than the rest of the letters, and in order to correct this appearance it is necessary that they should be painted slightly larger, passing in fact beyond the two horizontal lines which regulate the height of the other letters. As we have however pointed out, this is done so that the letters may look the same size as the others, but not that they may appear larger. The means in fact by which apparent equality of size is effected should not be evident. It is necessary to point this out, for whilst on the one hand we see the letters referred to look as if they were smaller, owing to the ignorance of the painter of the usual effect alluded to, we observe in others the curved letters made so exaggeratedly large as to look almost like a capital in the middle of a word.

Certain characters require to be spaced differently from others, and in this matter much judgment is necessary: thus the small or lower-case italics, called by engravers "stump," require to be packed, that is, placed close together; whilst the script, or writing characters, should be free and not by any means cramped. "Old English" letters look best when moderately close: in fact, when they were really in vogue, it was a common practice to join two letters together, or to make part of the one common to both; whilst "German text," so much less severe in form than the other, may be spread.

CHAPTER XXVIII.

OF VARIOUS KINDS OF LETTERS.

Before giving some specimens of letters specially adapted for sign writing, we would impress on the letter painter that all eccentricity in the forms of his letters is for his purpose quite out of place on inscriptions over a shop or on a wall, and in the situations where his work is called into requisition, however much the purposes of posters and placards are supposed to be assisted thereby: in the latter case the object is to catch the eye of the passer-by, in spite of the numerous other announcements by which each may be surrounded. The question in that case, becomes how to make one more striking than the other, and in this some of the placards succeed admirably. It is in fact impossible, to speak too highly of the progress made in this respect by our wood-letter cutters, some of whose works may truly be taken as models by the letter painter. We must not, however, disguise from ourselves the fact that the test of beauty is fitness, and that as the inscription of the name and trade of a shop-keeper is not likely to be eclipsed by another inscription close to it, that the very architectural members serve as a separation, or as it were a framing, and that therefore no expedient is necessary to protect the words from being confused by the proximity or brilliancy of another inscription; but that simplicity, boldness, and clearness are the great conditions to be fulfilled by the letter-painter.

We have already given the general rules for the formation of sans-serif letters, which may be said to be the simplest and boldest letters in use. The character has been called Sans-serif, Celtic, Grotesque, etc., and is well adapted for situations when, owing to distance or other circumstances, fine lines and minute details would be out of place, or would diminish the boldness of the inscription. We give in Fig. 19 the character in its heaviest form, such as would be used high

Fig. 19.

up on a wall, and where there is plenty of space at the disposal of the painter. This character does not admit of shadows or thickness, as it is in itself so solid that any addition to its form renders it clumsy.

For situations nearer the eye we give Fig. 20, in which the letters are thinner and the general form more open.

Fig. 20.

The form is thus rendered altogether more elegant, and may be either used plain, or with thickness and shading. The letters require great care in outlining, so that all the lines may be kept of the same thickness, and that the same character may be preserved throughout.

trouble to look, will observe that wherever the capitals tower above the other letters in an undue proportion, the general forms and workmanship will indicate that the inscription is the handiwork of a second-rate artist. In types, the above character is called Canon, and in Fig. 25 we give examples of the character called Aldine, a very refined letter of a narrower character than the other: these are both adapted for situations where a

MERCER

Fig. 25.

rather long inscription has to be got in; but, although the last looks well in print, it is not adapted for letter painting, in which characters narrower than those in Fig. 23 should not be used.

Fig. 26 is an example of a letter now very much used, under the name of Runic, but it would be difficult to defend the appellation, considering that it differs in every particular from the truly Runic characters; but

DRAPER

Fig. 26.

in the multiplicity of letters it had become necessary to give some designation to this style, and on the principle that "a rose by any other name would smell as sweet," the title by which this character is known has been bestowed upon it.

In spite, however, of our taking exception to the name, we cannot withhold our admiration of the so-called Runic letters. They possess much of the lightness and elegance of the Roman, whilst, at the same time, owing to the greater equalisation of the thickness of the lines, they are bolder, and may be used with both thickness and shading, whilst the thickening of the fine lines is gradually lost in a pointed termination of the "seriffs."

Following up the system of thickening the fine lines of the Roman characters, a beautiful letter called the Clarendon has been recently introduced. It is an exceedingly handsome and dignified letter, and is, as far as general proportions are concerned, similar in every respect to the Roman. It is outlined by ruling

Fig. 27

two horizontal lines at bottom and two at top, to regulate the thickness of the serifs or feet, and these may be made to project more or less, according to the space at disposal—our example, however, presenting the maximum in this respect.

We must call attention to the fact that in this, as in the Roman character, the vertical are merged into the horizontal lines by curves at the angles, and we must urge the letter painter to beware of exaggeration in this particular. The perpendicularity of the one line, and the horizontality of the other, must not in any way be interfered with: in the sketch they should, in fact, meet and form a right angle, which should just be rounded off. Even in this particular, the work of a first-rate letter painter is evident, for in inferior work the curve is often begun from the very beginning of the seriff of the letter to hide the failure in the horizontality of the line. The workman may in this, as in other departments of work, be assured that it is in the refinement of points such as these where the skilled artisan —possibly only another name for the "artist"—is distinguished from the common handicraftsman.

Fig. 28 is another specimen of Clarendon in a condensed form, and narrower than this: the letter should

CASE

never be used, as the beauty of the character is lost, when the space forbids the proper extension of the feet of the letters.

We would suggest to the letter painter the use of the

Fig. 29.

This Desirable
RESIDENCE
to be Let.

For particulars
apply to

Clarendon character in notice-boards, Fig. 29, where it is bolder than the Roman, and is perhaps more rapidly executed, as the thin lines do not require so much care as do the fine lines in the Roman.

Next in solidity to the Clarendon is the Egyptian, or, as it is by some painters and printers called, the Antique. It is scarcely worth while asking which is the more correct name, as neither of them is in the slightest degree justifiable. The names seem to have arisen from the letters appearing as if made up of blocks, having thus some similitude to the massive Egyptian buildings. The letter E may seem to remind one of the labyrinth of Lake Mœris, or it may be supposed to bear some resemblance to the Greek fret or key border; * but these reasons are very doubtful, nor

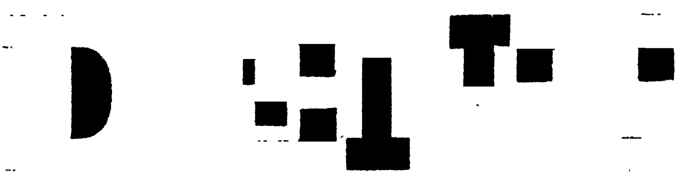


Fig. 30.

is the matter of the slightest consequence. The letter is a most useful one, the boldest we have, and is specially adapted for being rendered with thickness and shading. It differs from Clarendon in being heavier, and in its angles being accurately rendered, without being rounded off as in the Clarendon. When Egyptian letters are painted on a very large scale all the lines may be made of the same thickness; the letters then have a very striking effect. When of a medium or small size, the down strokes should be rather thicker than the others.

Fig. 31 is an example of condensed Egyptian, and nar-

* See "Grammar of Colouring." Part V. "The Characteristics of the different Styles of Ornament." Page 183.

rower than this the letter should not be used; for if the space be so limited that such a narrow letter is required

Fig. 31.

a sans-serif may be used; and as that character has no projecting feet it will allow of a wider letter being employed.

We have thus given the characteristic features of what may be called the three great orders of plain letters, and we again urge on all who would excel in letter painting, to study and practise these until they become quite proficient in them, since all the ornamental letters should be based upon them, the general forms being the same, the difference consisting only in the lines being curved or in the addition of ornamentation. Of some of these letters we now give specimens.

Fig. 32 is called Classic. We have already said it is not our business to defend the names. It is a very useful

Fig. 32.

character, elegant in its simplicity. The letters should be sketched and spaced as for Clarendon, the difference consisting merely in the serifs turning round into scrolls. The effect of this letter, when painted in black on glass with a diapered gold background, is very good. The addition of thickness and shading to this character, owing to the amount of drawing required, is a work of some difficulty and time, whilst the appearance is not thereby improved.

The character shown in Fig. 33 goes by the name of Tuscan; but it is, as it were, an ornamental rendering of the Egyptian, within the outline of which it may very well be sketched. We give the letter as usually

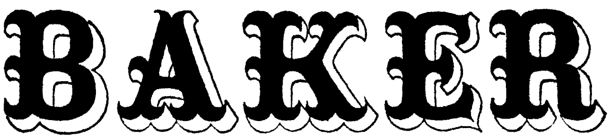


Fig. 33.

drawn; but we cannot say we admit the beauty of the excrescence on the left side of the uprights, and think the general appearance would be improved by its omission.

This letter may be shaded, or rendered with thickness, but we prefer it in its simple form.

Fig. 34 shows another letter called open Tuscan. An inscription in this character in a light colour on a dark ground with a darker line on the right and under side, and the pattern on the letter in a bright colour, "comes out," to use a technical phrase, very well. The main beauty of the letter, however, consists in the

Fig. 34.

correctness of its form, and its rather angular character; and if these points are not observed, the painter may depend that all his colours however brilliant, and all his gilding however well done, will be thrown away or will serve to show only the more plainly the defects in the form.

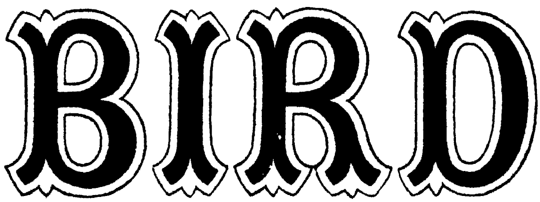


Fig. 35.

We scarcely know which to admire the most, the beauty of the letter shown in Fig. 35, or the plain sense of its designer, who, discarding the terms Classic, Runic, Tuscan, or other names absolutely inappropriate to the character, has called it simply "Ornamented:" a name which it really deserves, being one of the handsomest characters in use. The colouring must be left to the taste of the painter; but it must be pointed out, that the space between the surrounding line and the letter itself is not to be filled in, in which case it would form a heavy broad border: but it is intended to be a single outline only, thus lightening the effect of the letter, and increasing at the same time its distinctness.

Fig. 36 is an example of Rustic character, well adapted for the name or inscription of a horticulturist or somewhat similar trade. We have purposely avoided making suggestions as to the appropriateness of certain letters to special trades, knowing that this matter is for the most part decided by the employer; but we recommend the letter painter to think over the matter, and wherever opportunity occurs, to make such suggestions as may lead to an appropriate and handsome inscription being executed. In order to elevate his art, the letter painter should be prepared to submit sketches of the inscription as a whole, and of individual letters drawn full size; and a well-selected set of patterns in a book will afford the customer an opportunity of examining

Fig. 36.

the different characters before giving his order, and the letter painter may be assured that this plan will be by far the most satisfactory one that could be adopted in the interests of all parties concerned.

Under the head of Old English we have numerous families of characters—Black letter, Church text, Elizabethan, &c., &c., into the various styles of which our limits forbid us to enter, so advise the letter painter to consult some of the books named below,* in which he will find full instructions as to the formation, character, and date of each class of letter. As a type of the class

Fig. 37.

we give a word in the Elizabethan character, which is perhaps the best adapted for business purposes. Church text is not well fitted for general inscriptions, as it is, of course, more or less associated with sacred things, and as it has varied from time to time a great amount of study is necessary in order to render it correctly. This

* "Mediæval Alphabets and Initials," by F. G. Delamotte. (Lockwood & Co.) "Examples of Modern Alphabets," by F. G. Delamotte. (Lockwood & Co.) "The Book of Ornamental Alphabets," by F. G. Delamotte. (Lockwood & Co.)

study we strongly recommend to our letter painters in order that they may see how very absurd it is to mix up the characters of the different periods, and that they may when called upon be able to undertake the higher branches.

In contrasting the "Old English" character with the German text, Fig. 38, it will be observed that, whilst the former is essentially angular and severe, the latter is rounded and free. Thus, flourishes seem almost necessary to German text, whilst they are utterly out

Fig. 38.

of place in Old English or Church text. We must, however, warn the letter painter against the inordinate use or misapplication of flourishes. They should always have some apparent connection with the letters themselves, and should not be used just to fill up a vacant space. We frequently see a word or sentence too crowded at one part of the surface on which it is painted, leaving a blank space at the other, and this is usually filled up with a meaningless flourish. By the method already pointed out for spacing the letters, this ugly expedient is rendered unnecessary.

The Old English and German text do not look well when rendered with thickness. They are so essentially writing characters that fine lines are indispensable to them, and the beauty of these and the contrast of them with the thick lines are diminished when both are viewed from the side, and are seen to be equal in solidity; both characters, however, look well when outlined with a darker colour than that in which they are painted, but in that case, more than ever, the absolute correctness of form must be insisted upon.

Italics, Fig. 39, are not by any means the easiest characters

Fig. 39.

racters with which the letter painter has to deal, the main difficulty being the uniformity of slope. In the letter M, the right-hand down stroke, which in the Roman character would be upright, must take the slant of the general mass of letters.

The A and V afford subjects for some study and trial. They may either be drawn so that their down strokes slant like the other letters, or they may be outlined in

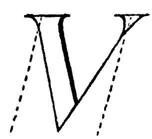


Fig. 40.

a parallelogram, their point being in the middle of one of the sides. This method is shown in Fig. 40. The X is necessarily drawn according to the latter method. Fig. 41 shows the small letters, or "lower case," of the Italic character. It is as it were a substitute for plain writing, but no flourishes of any kind are admissible.

The words written in Italic small, must not be spread: in fact, the character looks much better when "packed," or placed close together, the down strokes not being too thick. It is very important that a uniform slant should be preserved throughout, and this slant should

Fig 41.

not be quite as oblique as that of writing characters: a set square of a different degree to the one already alluded to should therefore be provided for this purpose.

We thus reach what is called the Script or writing

Fig. 42.

character, the most elegant of all. We give merely one specimen, Fig. 42, knowing that this character has been more studied than any other, since it is the hand taught in schools. Yet, writing with a pen is very different from drawing the letters which are to be painted: the first is done in an off-hand manner, the latter should be drawn deliberately and carefully. The writing done with a pen is as a rule temporary in character, and the exact form of each letter and the spacing of the words are matters of but small consequence, unless the work be a piece of ornamental caligraphy or illumination. But, as already stated, the work of the letter painter is to have a permanent object, and must therefore be carefully outlined and spaced. We recommend the student to take as models the engraved head-lines of some of the copy-books now used in our national schools: these may be obtained at one penny each, and we advise him, in the first place, to return for a while to the years of his boyhood, and in order to "get his hand in," to write a few pages in the usual formal school-hand, for in the rough off-hand way of writing to which after leaving school we naturally fall, the careful way of forming the letters will have been neglected; we then recommend him to proceed to *draw* the letters on a much larger scale, outlining them in pencil, and subsequently in colour, as described in the early part of this section, and finally practising them on an upright board.

As already stated, a fair but not exaggerated slant, and much taste, are required in the arrangement of the capitals and their heights, and of the heights and lengths of the long letters. If the capitals are too small, a degree of meanness is given to the writing, and the effect of the tails, &c., of the letters being too short is extremely unpleasant. Various teachers of writing and engraving have different rules as to the lengths of the letters which are to project above and below the lines, and these rules, which will be apparent from the examples above referred to, must be taken as standards—to be adapted to the circumstances of the case—for the height of the surface on which the work is to be executed being limited, and a certain inscription being required, the heights of the letters must in some cases be modified: the letters should then be kept rather thinner than otherwise, or they will look clumsy; the thickness in fact of the script character should always be kept within, rather than up to, the maximum, as the work never looks well when the down strokes are too thick.

As a rule, the capitals should be at least double the height of the line of the other letters, and the long letters such as *l*, *d*, etc., should be nearly up to the same level, whilst the tails or loops of letters such as *g* or *p* should extend the same distance below the line, the letter *t* being just half the height of the general letters above the line. Thus if the body of a line of writing on an architrave were to be 6 in., the capitals and long letters should be 12 in. high, whilst the latter should descend 6 in. below the line, and the letter *t* should be 9 in. high. It adds however to the dignity of the writing to give the capitals still greater height, but the long letters should never exceed the proportions laid down; whilst they may, if required, be rather shortened.

Great care is necessary in forming the turns in writing characters, so that the junctions of the up and down strokes may be gracefully accomplished; the down strokes must be drawn to their exact slant until near the turning, they must not be kept as it were bending in their whole length, nor on the other hand must the bend take place too suddenly. We must again warn the letter painter against unnecessary flourishes, which give to the script character an ugly and straggling appearance.

It is not advisable either to give the appearance of thickness, or to shade writing characters, for the lightness and elegance of the work is much diminished by either process.

A very elegant style of writing, called the Italian, is well adapted for inscriptions where the business is one of a refined character, such as a milliner's, perfumer's, embroiderer's, &c.

It is in fact to such inscriptions that the script character seems specially adapted, the heavier or more solid characters being better suited to trades with which they harmonize.

This idea cannot of course be carried out to its full extent, as the letter painter is greatly in the hands of his employer; but it seems clear that there should be a certain consonance between the trade and the inscription: for instance, an inscription in church text must evidently be better adapted to the shop of a bookseller, a clerical robe-maker, a bible warehouse, &c., than over a bootmaker's, a butcher's, or a toy shop; whilst the character of the writing should as far as possible accord with the style of architecture of the shop-front or building on which it is executed.

CHAPTER XXIX.

OF THE REPRESENTATION OF RAISED AND INCISED LETTERS.

HAVING thus given suggestions as to rendering letters in their simple or "flat" form, we now proceed to speak of the method of painting them in imitation of relief; that is, with the addition of thickness, so that they may appear as if cut out of wood and affixed to a background.

Now it is clear, that if the letters were really raised, their sides—that is, the thickness of the material of which they were made—would be visible; and, further, that a shadow of the whole letter would be cast on the surface to which they are attached: but it must be borne in mind that, under these circumstances, the appearance of the letters would alter with every change in the position of the spectator, and that the shades and shadows would be altered as the sun rises or sets.

Again, it will be evident from our lessons in perspective, that if the spectator is supposed to view the inscription from any one fixed point, the apparent thickness of each letter will vary according to its situation in relation to the spectator. Thus applying the principles of perspective and supposing the spectator situated at s, Fig. 43, that is, immediately opposite the middle of the inscription (in this case a single word, but the effect would be worse in proportion to the length of the line), the right sides of the **P** and **L** and the left sides of the **T** and **E** are visible, whilst the left and right sides of the letter **A** and the underneath surfaces of all are seen; and there is thus an utter absence of uniformity. It will of course be understood that if the spectator were on the right side instead of in the middle, the right side of all the letters would be seen, and the reverse effect would be the result of his position being on the left side; but still there would be an absence of uniformity, for the thickness of each letter would be increased according to its distance from the point of sight, and conse-

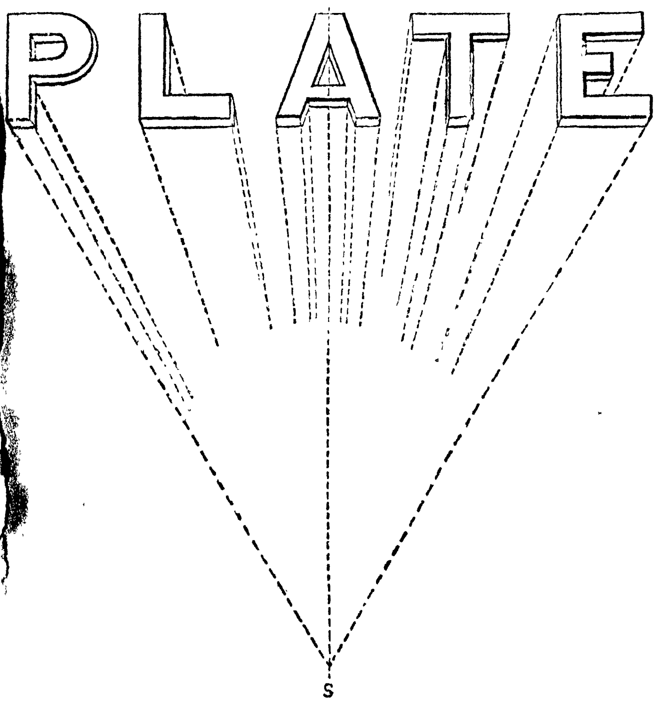


Fig. 43.

quently those letters would appear much broader than others.

In special cases, on ornamental tablets, show-boards, &c., where the width is such that the whole of the letters could be taken in from one point of view, without the forms of the letters being injured or distorted thereby, radial perspective may be used with good effect; and the principles laid down in our elementary course will be found most useful under such circumstances, since all the letters can be put into perspective by the application of the rules worked out in the various figures. The letter painter is advised, however, not to depart from the plain and bold rendering in order to show his own knowledge of perspective, or to produce striking effects.

Thus, if the thickness of the letter is to be shown perspectively, it should be considered as secondary to the correct formation of the letter itself. If, for instance, the letter L is to be painted, it should be rendered like the left-hand upright and the lower horizontal of the square shown in Fig. 137: that is, the letter itself being perfectly drawn. It is not good taste to represent the letters as if their surfaces were at right angles to that against which they are placed, their edge or thickness facing the spectator, thus implying that they are attached by one of their edges, as the square frame in Fig. 139. The form of the letters would thus be distorted, and each would be wider as it became further removed from the point of sight.

Another general condition must also be considered namely, that as a rule the inscriptions on shop fronts and similar situations are above the eye, and therefore the underneath surfaces of the thickness should be shown, as in the square, Fig. 137; or if the whole letter is to be placed in perspective, in opposition to the advice above given, the sides should bend downwards as in Fig. 140, not upwards as in Fig. 138.

We have already referred to the objection to eccentricity in letter painting, and it is equally to be avoided in perspective rendering as in the general outline. Thus it is obviously wrong to paint a whole line in perspective as if running into the distance, *i.e.* at right angles to the wall on which the inscription is painted, the letters becoming smaller and smaller as they appear to recede.

This is not however the worst. We have seen an inscription over a shop in which the letter painter, desiring to show his skill, had painted the whole of the letters as if they were lying horizontally, their underneath edges being vertical: the letters thus appear as if attached by their upper edges only, the surfaces themselves not resting on anything. Now it is evident that if letters cut out of wood were so placed, the spectator could only read them if he came very close to the window and looked directly upward. An inscription or two may be seen in London, in which the letters, supposed to be made of wood, are represented as warping and twisting, thus forcing themselves away from the wall against which they hang in the most ıwkward positions. In both these cases the work is

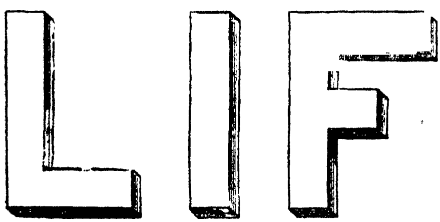


Fig. 44.

ɑirably done; but, whilst an artist may admire drawing, the general public fail to read the ription, since in some of the instances adduced it is ɑost unreadable, and thus it cannot be denied that he skill and labour are misplaced.

We have therefore come to the conclusion, in regard the methods of rendering the thickness of letters, ɔle orthographic projection is the best system to adopted; the slanting lines being all drawn at 45°, by ıns of the set square, and the thickness being uniform oughout. It is, as a general rule, advisable to show thickness on the right side of the letter, as the ickness of the ends of the horizontals of letters such L and F are then visible; but this is of course a of taste.

Now as to shading letters which are rendered in imitation of relief. It will of course be understood that the shades on, and the shadows of, the letters in relief would alter with every variation of the light, and thus neither their form nor position is arbitrary; but the situation of the light having been decided upon, the effect must be uniform throughout. The shades and shadows, however, should have the effect of raising the letters from the surface without altering or injuring their true form.

It is suggested that letters look the best when the thickness is shaded, and the cast shadow is thrown on the background on the same side. In that case, the fac of the letter is painted in its full local colour, the thick ness either in the same colour shaded or in a darke colour, and the shadow in a darker colour still. Bu where the shadow is painted on the side opposite to t on which the thickness is shown the thickness must in bright light, and the shadow of the uprights must narrower than that of the horizontals; because, as the eye is supposed to be on the side on which the thickness is shown, the projection of the letter will serve to hide some of the shadow, and there is a further want c unity in the circumstance that the shadow would b opposite the thickness in the uprights, but on the sam side with it in the horizontals; for, of course, th shadow could not be represented of striking *upwards* and, as already pointed out, it is not good taste to show the upper side of the thickness of letters in situations where they are above the level of the eye of the spectator. It should be specially pointed out that the cast shadows must not be in a bright colour: they should be merely of such colour as the ground would be at any part on which the light was prevented falling; but, as already pointed out, they must be darker than the shaded side of the letters, and the outer edge of them should be softened off, not so that the outline should be lost, but merely divested of its hardness.

It improves the effect of the inscription to paint shadows of the horizontal members of the letters rathe darker than the upright ones, as the junction of the angles is thus rendered more visible.

In this as in other branches, we would most earnestly urge the young painter to study for himself; not to take it for granted that, because he sees certain letters or their shadows constantly painted in the same way, that the rendering is therefore right, or that at least it could not be improved upon or varied. We have given some instructions as to drawing from solids, and have also laid down some of the principles of shading, and we now advise the student to apply these. He should obtain pieces of wood, of various shapes, and about 1 in. thick, squares, oblongs, triangles, circles, and nail them against a wall or other upright surface, and closing

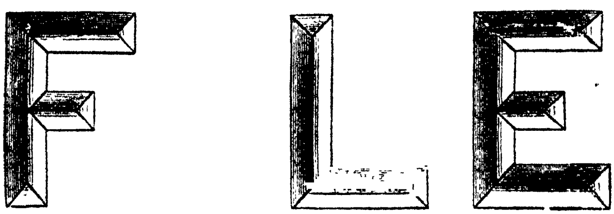


Fig. 45.

all but one window, and covering up the lower portion of that, or using one gas-light, he should study the shadows cast from each according to every change in the relative position of the object or light. We assure him that he will discover effects which will convince him of the absurdity of merely imitating the works of others.

The imitation of incised or engraved letters next claims our attention, and here the whole question of cast shadows must be dispensed with, as sunken letters can cast no shadows beyond their own boundary. If, however, the sunken surfaces of the letters is supposed to be flat and the edges vertical—as if the word "LIFT" Fig. 44, were incised instead of raised—the edges which are visible from any particular point of view, and which are not opposite to the light, would not only be themselves in shade, but would cast shadows on the lower surface. This style of representation is not, however, pleasing, and is not by any means generally adopted, the mode of rendering the letters shown in Fig. 45 being preferable. In this style the sides slant directly inward until they meet at a line at the bottom which corresponds precisely with the general outline of the letter; being, in fact, the letter drawn in single lines. In painting these letters, therefore, the external outline must be, in the first place, most carefully formed, and this is to be followed by the internal or bottom line: the letters, it must be remembered, are to be represented as if cut with a square graver. This style of letter-cutting is used on tombstones and other memorial tablets, and is more permanent than the kind previously alluded to; for as the angle at which the sides of the letters meet, the surface in which they are cut is more obtuse than in the former case, the edge is not so liable to be chipped off, and offers a greater resistance to the abrading effect of time and atmospheric action.

This will be understood from the annexed diagrams.

Fig. 46 represents the section or cutting through a letter having a flat sunken surface. The perpendicular edge B is seen to be at right angles (90°) to the surface A in which it is cut; whilst in the section of a letter, Fig. 47, incised with oblique sides, B is at an angle of 135° to A, or 45° more than a right angle.

The light being supposed on one side (in this case the left) and above the inscription, one of the oblique surfaces of the uprights, and the upper one of the horizontals, will be shaded, whilst the others will be in full light. The lines joining the outer to the inner outline have, in the present example, been shown in their simplest form; but they are subjects for much study in some of the letters. The best method for obtaining the necessary practice is to flatten out a piece of softened clay, and cut out the letters with a flat chisel-like tool or two, which may be purchased under the name of modelling tools, at 3*d.* or 4*d.* each, or they may be easily made out of pieces of fire-wood,—one being flattened and sharpened off like a broad chisel, and the other similarly formed, but cut slantingly on each side so as to give the exact shape of the recess to be cut at the ends of the letters, where it will be seen the surface slants inward in the form of a triangle.

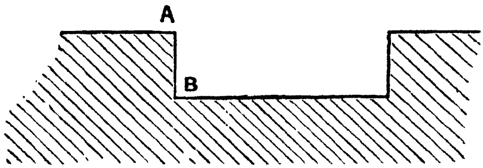


Fig. 46.

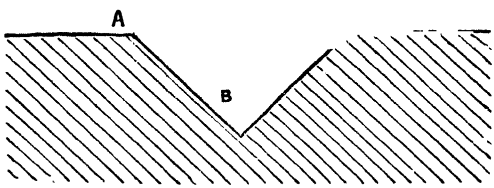


Fig. 47.

An inscription in letters in the last described characters, when executed in gold on a highly polished black surface, has a very fine effect, the gold being shaded with burnt sienna.

CHAPTER XXX.

METHOD OF GILDING LETTERS.

In order to overcome the "tackiness" of a newly painted surface, which would cause the gold-leaf to adhere to it, it is necessary that it should be "pounced." This process consists in dabbing it all over with powdered whiting, placed in a little thin muslin bag. The lines traced by the sable pencil dipped in the proper mordant will then be visible, as, of course, the action of the brush will remove the whiting, thus restoring the ground to its original colour. If the surface be light coloured, however, some colour should be mixed with the size, in order that it may be seen whether the ground is entirely covered on the parts to be gilded; for not only is patching afterwards very difficult, but the marks or joints are always perceptible.

Gilders generally use what is termed gilders' size, which consists of fat oil ground up with yellow ochre. This is, however, too thick for the general purposes of the letter painter, unless the weather be very hot, when it becomes limpid. The gold-leaf must not, however, be applied until the next day, the size remaining sufficiently tacky in fact for several days.

The young painter must be specially reminded that the size must be very equally spread: there must be no marks or streaks of the brush left, nor any parts on which the material, or mordant as it is called, is thicker than at others; for if the mordant be one which dries quickly, a hard line will be left at each of the streaks, and from these raised lines the gold will soon be worn off; whilst, if the mordant be a slowly drying one, the gold spread over the surface will crack and leave breaks in the gold, technically called "spider legs." If, therefore, the body of the letter to be gilded is wide, the size should be spread with a tolerably large and flat brush, and the strokes should be crossed so that all brush lines may be erased, and that the outlines executed with the sable pencil may be smoothened off into the body of the letter.

If the gilding has to be rapidly executed, japanners' gold size is generally used, and as this dries very quickly the gold may be laid on within an hour after its application. The letter painter is often compelled to finish his work at once, in which case gold size alone is used. But if an interval of a few hours is no object, oil varnish may be added to the gold size, regulating the quantity according to circumstances. Linseed oil should not be added to the gold size to retard its drying properties, because it is apt to destroy not only the adhesion of the size, but to sweat through and destroy the colour of the metallic leaf. A few drops of boiled oil may be added to the size occasionally; but, as a general rule, varnish will be found preferable to oils.

The old fashion, and we may say as yet the general way of gilding, consists in the gilder taking the leaves from the book of gold and placing them on the "cushion." The gilder's cushion corresponds with the painter's palette. It is a small board covered first with baize or cloth, and afterwards with wash-leather, which is tightly stretched over it. This cushion is supplied with a loop underneath into which the thumb passes, the cushion resting on the hand in much the same way as a palette does. There is also an edging or wall made of parchment on three sides of the cushion, and this in some degree prevents the gold-leaf blowing away. The gold-leaf, having been deposited in the cushion, is "puffed" flat, that is, it is generally blown upon until it is perfectly smooth; but this is more easily said than done, for if the puff be in the slightest degree too forcible the whole leaf will, in the most vexatious manner, huddle itself up in the corner of the cushion, defying all attempts of the beginner, at least, to flatten it out, and as this is likely to take place when a fair amount of wind is blowing—certainly in the open air—the difficulty of the operation can well be imagined.

Some gilders surround themselves with a kind of awning, in order to be protected from the currents of wind, and this has led to the absurd idea that they desired to keep the process by which they worked secret; whereas, when the gilding is being done by either of the old-fashioned methods, such a screen is absolutely necessary.

The leaf of gold, having then been successfully flattened out, is next cut into pieces of the desired size by means of a long thin knife, the edge of which is very smooth. Each piece is then taken up with the "tip." This is a very light and thin brush, made of soft hair, held together between two pieces of pasteboard. The hair of the tip is drawn across the face or hair, by which it becomes slightly moistened, and thus the gold adheres to it sufficiently to allow of its being raised and placed on the required spot. Practised gilders shake about a dozen leaves of gold on to their cushion, and it is astonishing to see the manner in which they flatten each, and cut it into pieces with the utmost accuracy, and with such economy that they can tell precisely how many books of gold will be required for each job. The size of each leaf is 3¼ inches square, and there are twenty-five such in a book. It is customary, in estimating gilding, to speak of the quantity of gold required, not in "books," but in hundreds: thus, if a particular work would take "eight books," it would be spoken of as requiring "two hundred."

Some letter painters use neither cushion, knife, nor tip; but opening the book of gold, bend it backward and apply the gold directly to the part of the letter prepared to receive it. This is, however, a very wasteful method, and one which renders the operation almost impossible in windy weather, unless the workman is surrounded by an awning.

The following is by far the best and most economical method of gilding, and may be pursued out of doors even during a moderate wind. Rub a sheet of tissue paper well over with a piece of white wax, a piece of wax candle, or even common bees' wax. During this operation the tissue paper should be spread over a very smooth surface, another sheet of paper, such as cartridge, being placed under it, and it should be secured at different points in the margin by pins or tacks. The piece of wax should be smooth, and the rubbing at first gentle, so that the wax may be equally distributed, and that the paper may not be torn; and it must be understood that the object is not to spread a thick coating of wax over the sheet, but merely to impart a sufficient degree of tackiness to it to hold the gold temporarily.

The waxed sheet is to be cut into squares rather larger than the leaves of gold, and the book having been carefully opened, one of these sheets is to be laid with the waxed side downwards on the leaf of gold, and the finger gently passed over the back so as to press it down. On raising it, the gold will be found adhering, and thus sheets for gilding are formed, which are of course infinitely more manageable than gold-leaf itself.

The letters having been painted in the proper mordant, the gold-leaf thus attached to the tissue paper is taken up and applied where required, gently pressing the paper at the back with the hand. The mordant, being more adhesive than the wax, will retain the gold, and the paper can then be lifted off, and may be used several times. The gold should then, in this and indeed in all other methods, be gently dabbed over with a small pad made of cotton wool, which will smooth the surface of the gold, press down any little inequality, and remove superfluous pieces. The tissue paper being transparent, the gilder can see where the gold has been taken off by the mordant, and can thus use the remaining portion for other parts of the work.

This method cannot be applied with advantage in carved or otherwise curved surfaces. It is therefore necessary that the method of gilding by means of the cushion and tip should be acquired. The work of the letter painter is, however, as a rule, restricted to flat surfaces, and gilding any of the ornamental portions of the sign-board, or architrave, would be the work of a regular gilder. In London and other large places, this accurate division and subdivision of labour is all very well: it is economical in a pecuniary point of view, and there is no doubt that a man whose whole time is devoted to one branch attains greater proficiency in it than if he were to work at one thing one day and another the next. But in country towns it is different, and thus we find the same man a house painter, grainer, letter painter and gilder: and to the credit and zeal of our working men be it said, we often find the work well performed in each branch. At all events there is no reason why a young man should not, as far as he can, make himself acquainted with the principles and practice of several branches of his trade, any one of which may some day or other be found of service; and certainly the more a man knows of the general working of the different branches, the better able will he be to work into the hands of his mates, and the result of harmonious action will be evident in the superiority of the work turned out.

We advise the young letter painter to seek practical instruction in the first place—of course from good workmen in his own trade—and not to fall into the error, so general amongst students, of believing that the work is easy because an expert works rapidly, and without any apparent difficulty: for in no other branch of industry will this idea be more erroneous than in gilding. We see experienced gilders, both of picture-frames and of book-covers, "puff" on a thin leaf of gold, and, in obedience to their breath, it spreads itself out and lies perfectly flat, awaiting, as it were, their further orders. We just approach it, and behold our breath seems to terrify it, and give it wings, for it starts up, and, after twisting about in all directions, huddles itself up in a corner of the cushion. We try the effect of the tip, but to no purpose: it seems in an incurable state of crumpling. The gilder takes it again in hand, he raises it with his knife, he draws his tip first over his forehead and then over the apparently quivering leaf; it is as it were calmed, and lies once more as smooth as the cushion. The gilder takes his knife and cuts it into several strips, all as straight and as smooth edged as if cut with a sharp pair of scissors. "Surely," we say, "that is easy enough." So we take the knife and try our power; but the edge which seemed so smooth in the hands of the gilder seems notched and jagged in ours, for when we draw it across the gold the metal adheres to it, and the leaf is roughly torn into two pieces, both of which follow the knife as we draw it along.

Practice alone can give manipulative skill, and this the young workman must obtain; but much practical information must be received by watching others, and we advise him to seek opportunities of spending a few hours in the workshops of picture-frame gilders, book-cover gilders, etc., in both of which he will see the methods of cutting the gold-leaf into small pieces, and manipulating it, carried out in the most surprising manner.

It is desirable that the artisan should possess some information in regard to the materials which he employs in his work. We therefore extract the following particulars in relation to leaf-gold from "Chambers's Encyclopædia:"—"The gold used for this purpose is usually alloyed with silver or copper according to the colour required. For *deep* gold an alloy containing about one part of copper to twenty of pure gold is used. As gold-leaf is not sold by weight but by superficial measure, and as increasing the quantity of alloy diminishes the malleability, there is but little temptation to use the baser metals as an adulteration."

The gold is first cast into oblong ingots about three-fourths of an inch wide, and weighing two ounces. The ingot is flattened out into a ribbon of about $\frac{1}{800}$th of an inch in thickness, by passing it between polished steel rollers. This is annealed or softened by heat, and then cut into pieces of one inch square.

One hundred and fifty of these are placed between leaves of vellum, each piece of gold in the centre of a square vellum leaf, another placed above, and so on till the pile of one hundred and fifty is formed. This pile is enclosed in a double parchment case and beaten with a 16 lb. hammer. The elasticity of the packet considerably lightens the labour of beating by causing the hammer to rebound with each blow.

The beating is continued until the inch-pieces are spread out to four-inch squares. They are then taken out and cut into four pieces, and squares thus produced are now placed between goldbeater's skin, instead of vellum, made into piles, and enclosed in a parchment case and beaten as before, but with a lighter hammer. Another quartering and beating produces 2,400 leaves, having an area of about one hundred and ninety times that of the ribbon; or a thickness of about $\frac{1}{200000}$th of an inch. An ounce of gold is thus extended to a surface of about 100 square feet. A still greater degree of thinness may be obtained, but not profitably.

After the last beating the leaves are taken up with wooden pincers, placed on a cushion, blown out flat, and their ragged edges cut away, by which they are reduced to squares of three and a quarter inches. Twenty-five of these are placed between the leaves of a paper book, previously rubbed with red chalk to prevent the adhesion of the gold, and are sold in this form.

There are many different shades of gold-leaf, from the deep orange red down to the white approximating to silver, which is known as "pure virgin." The kind generally used in letter painting is that termed "medium," which does not readily become discoloured by varnish, and is not as much acted upon by the atmosphere as the others are. It will be readily understood that only clear varnishes should be used over gilding, as the dark ones become darker with time and exposure, and the brightness of the gold will thus be obscured.

PART VI.

THE PRINCIPLES OF DECORATIVE ART.

CHAPTER XXXI.

OF THE ORIGIN, SCOPE, AND PRACTICE OF DECORATIVE ART.

ALTHOUGH the house painter is, as a rule, only expected to cover the walls or wood-work of a house, according to given instructions, he is constantly consulted as to the decorative features, the colouring and "picking out" of cornices, the harmony and contrast of the tints proposed, and other points in which his experience may serve as a guide, and on which his knowledge may enable him to give sound advice.

This experience is, however, frequently at fault, not being based on any definite principles, but being merely the memory of what has been done by other men, equally uninformed; the knowledge is therefore only assumed, being empirical, and not the result of education or study.

It is not in these remarks intended to imply any censure on working men who have, considering the scanty means of acquiring knowledge which have been at their disposal in bygone years, done wonders; but things are now different from what they have been, and the rising generation are urged to move out of the track in which their predecessors were—for want of another—compelled to travel; and, by availing themselves of the numerous opportunities for improvement now offered to them, qualify themselves to become worthy members of that profession which so gradually merges into the realms of Art, and which affords so many opportunities for the exercise of taste and refinement.

With the view of giving the student some sound information on the principles on which the decorative Arts are based the following "propositions," which were discussed in a course of lectures by the late Mr. Owen Jones, are here quoted, together with such remarks as are suggested by them.

Relation of the Decorative Arts to Architecture.

1. The Decorative Arts arise from and should properly be attendant upon Architecture.

It seems evident from the earliest period of the world's history that the moment the absolute want of a dwelling has been supplied, the desire to ornament it has followed, thus proving that a craving after beauty is inherent in the human mind. Often as Keat's sentence, "A thing of beauty is a joy for ever," has been quoted, we still repeat it; for it is true, not only in the present, but has evidently had its influence in bygone ages. For a long period ornamental art was neglected in this country, until the idea that the English were a nation without taste was universally accepted; the fact being, however, that they were a nation without art-education. This omission is now in a great measure supplied, and we have schools of art, and art-teaching generally spread throughout the country. In these schools of art, the student is provided with examples of the highest character and with the best teaching; whilst, even in our National, Parochial, and "Board" schools drawing is taught, so that a boy when he leaves one of these is by far more fit to become an apprentice to a trade in which the principles of form and colour are necessary, than our children were formerly. It is to be hoped that our working men, of every trade, will avail themselves of these opportunities of instruction which will in time effect so much improvement in the work in which they are engaged.

2. ARCHITECTURE IS THE MATERIAL EXPRESSION OF THE WANTS, THE FACULTIES, AND THE SENTIMENTS OF THE AGE IN WHICH IT IS CREATED. STYLE IN ARCHITECTURE IS THE PECULIAR FORM WHICH THAT EXPRESSION TAKES UNDER THE INFLUENCE OF CLIMATE AND MATERIALS AT COMMAND.

"The history of architecture is the history of the world."—(A. W. Pugin.)

"The influence of the causes which act most powerfully on the genius of the arts, after the climate, are the manners, religion, and the changes to which a nation is subject in its political state during the course of ages." —(Seroux d'Agincourt.)

"Unless art is the expression of the system it should illustrate, it loses at once its greatest claim on admiration, and fails to awaken any feelings of sympathy in the heart of the spectator."—(A. W. Pugin.)

"Architecture is the art which so disposes and adorns the edifices raised by man, for whatsoever uses, that the sight of them contributes to his mental health, power, and pleasure. Architecture concerns itself only with those characters of an edifice which are above and beyond common use."—(Ruskin.)

"In what are generally understood as styles in the history of art, such as the Grecian, the Roman, the Gothic, the Renaissance, &c., may be recognised deeply interesting accumulations of experience concerning the nature of man's intuitive affections for certain concatenations of form. Styles are usually complete in themselves, and, although not of uniform excellence, are still generally concordant amongst all the various members that compose them."—(M. D. Wyatt.)

Fitness, Proportion, and Harmony.

3. AS ARCHITECTURE, SO ALL THE WORKS OF THE DECORATIVE ARTS SHOULD POSSESS FITNESS, PROPORTION, HARMONY; THE RESULT OF ALL WHICH IS REPOSE.

"Architecture depends on fitness, arrangement, and on proportion, uniformity, consistency, and economy.

"The perfection of all works depends on their fitness to answer the end proposed, and on principles resulting from a consideration of nature herself; and the ancients approved only those which by strict analogy were borne out by the appearance of utility."—(Vitruvius.)

"The essence of the fine arts begins where utility in its narrower acceptation ends. The abstract character of ornament is in that sense to be useless. That this principle exists in nature we immediately feel in calling to mind the merely beautiful appearances of the visible world, and particularly the colours of flowers. In every case in nature where fitness or utility can be traced, the characteristic quality or *relative* beauty is found to be identified by that of fitness; but where no utility is found to exist, save that of conveying rational delight, or of exalting the mind by ideas of perfection, we recognise a more essential or absolute principle of beauty."—(Sir Charles Eastlake.)

"Infinite variety and unerring fitness govern all forms in nature."—(M. D. Wyatt.)

Decoration.

4. CONSTRUCTION SHOULD BE DECORATED. DECORATION SHOULD NEVER BE PURPOSELY CONSTRUCTED. THAT WHICH IS BEAUTIFUL IS TRUE; THAT WHICH IS TRUE MUST BE BEAUTIFUL.

"The useful is the vehicle for the beautiful.

"There should be no features about a building which are not necessary for convenience, construction, or propriety.

"All ornaments should consist of enrichment of the essential construction of the building.

"Pointed architecture does not conceal her construction, but beautifies it.

"How many objects of ordinary use are rendered monstrous and ridiculous, simply because the artist instead of seeking the most convenient form, and then decorating it, has embodied some extravagance to conceal the real purpose for which the article has been made."—(A. W. Pugin.)

"The primary consideration of construction is so necessary to pure design, that it almost follows that whenever style and ornament are debased, construction will be found to be disregarded; and that those styles which are considered the purest, and the best periods of those styles, are just those wherein constructive utility has been rightly understood and most thoroughly attended to."—(Redgrave.)

"By means of design we inscribe, or ought to inscribe, upon every object of which we determine the form, all essential particulars concerning the material, its method of construction, and its uses."—(M. D. Wyatt.)

"All common and useful things may be refined into objects of beauty, and, though common, all that is beautiful or high in art is merely an elaboration and refinement of what is fundamentally a useful and necessary art."—(Fergusson.)

General Form.

5. Beauty of form is produced by lines growing out one from another, in gradual undulations. There are no excrescences; nothing could be removed and leave the design equally good or better.

"Beauty is produced by the pleasing appearance and good taste of the whole, and by the dimensions of all parts being proportioned to each other."—(Vitruvius.)

Decoration of the Surface.

6. The general forms being first cared for, these should be subdivided and ornamented by general lines; the interstices may then be filled in with ornament, which may again be subdivided and enriched for closer inspection.

7. As in every perfect work of Architecture a true proportion will be found to reign between all the members which compose it, so throughout the Decorative Arts every assemblage of forms should be arranged on certain definite proportions: the whole and each particular member should be a multiple of some simple unit.

Those proportions will be most beautiful which it will be most difficult for the eye to detect.

Thus the proportion of a double square, or 4 to 8, will be less beautiful than the more subtle ratio of 5 to 8; 3 to 7 than 3 to 6; 3 to 8 than 3 to 9; 3 to 5 than 3 to 4.

"If nature has made the human body so that the different members of it are measures of the whole—so that the ancients have with great propriety determined that in all perfect works each part should be some aliquot part of the whole, Proportion is that agreeable harmony between the several parts of a building which is the result of a just and regular agreement of them with each other—the height to the width, and this to the length, and each to the whole."—(Vitruvius.)

"Those Arts are generally considered the most worthy in which the mental labour employed and the mental pleasure produced are greatest, and in which manual labour, or labour of whatsoever kind, is the least apparent."—(Sir Chas. Eastlake.)

Harmony and Contrast.

8. Harmony of form consists in the proper balancing and contrast of the straight, the angular, and the curved.

"There are three primary figures, the right line, the angle, and the curve. There can be no perfect harmony in the composition of figures in which either of the three genera is wanting, and the varieties of harmony in composition and design depend on the various predominance and subordination of the three."—(Field.)

Distribution, Radiation, Continuity.

9. IN SURFACE DECORATION ALL LINES SHOULD FLOW OUT OF A PARENT STEM. EVERY ORNAMENT, HOWEVER DISTANT, SHOULD BE TRACED TO ITS BRANCH AND ROOT. —(Oriental practice.)

10. ALL JUNCTIONS OF CURVED LINES WITH CURVED, OR OF CURVED WITH STRAIGHT, SHOULD BE TANGENTIAL TO EACH OTHER.—(Natural law. Oriental practice in accordance with it.)

"In the surface decoration of the Moors all lines flow out of a parent stem. Every ornament, however distant, can be traced to its branch and root. They have the happy art of adapting the ornament to the surface decorated, so that the ornament as often appears to have suggested the general form as to have been suggested by it. In all cases we find the foliage flowing out of a parent stem, and we are never offended, as in modern practice, by the random introduction of an ornament just dotted down without a reason for its existence. However irregular the space they have to fill, they always commence by dividing it into equal areas, and round these trunk lines they fill in detail, but invariably return to their parent stem."—(Owen Jones.)

(For illustrations of these principles see "The characteristic features of the various styles of Ornamental Art," given in "The Grammar of Colouring," No. 186 of this series.)

The Conventionality of Natural Forms.

11. FLOWERS OR OTHER NATURAL OBJECTS SHOULD NOT BE USED AS ORNAMENT, BUT CONVENTIONAL REPRESENTATIONS FOUNDED UPON THEM SUFFICIENTLY SUGGESTIVE TO CONVEY THE INTENDED IMAGE TO THE MIND, WITHOUT DESTROYING THE UNITY OF THE OBJECT THEY ARE EMPLOYED TO DECORATE.—(Universally obeyed in the best periods of Art, equally violated when Art declines.)

12. THE PRINCIPLES DISCOVERABLE IN THE WORKS OF THE PAST BELONG TO US; NOT SO THE RESULTS. IT IS TAKING THE END FOR THE MEANS.

13. NO IMPROVEMENT CAN TAKE PLACE IN THE ART OF THE PRESENT GENERATION UNTIL ALL CLASSES, ARTISTS, MANUFACTURERS, AND THE PUBLIC, ARE BETTER EDUCATED IN ART, AND THE EXISTENCE OF GENERAL PRINCIPLES IS MORE FULLY RECOGNISED.

OF THE LAWS WHICH GOVERN THE EMPLOYMENT OF COLOUR.

Colour generally.

14. COLOUR IS USED TO ASSIST IN THE DEVELOPMENT OF FORM, AND TO DISTINGUISH OBJECTS, OR PARTS OF OBJECTS, ONE FROM ANOTHER.

15. COLOUR IS USED TO ASSIST LIGHT AND SHADE, HELPING THE UNDULATIONS OF FORM BY THE PROPER DISTRIBUTION OF THE SEVERAL COLOURS.

The Places of Primary, Secondary, and Tertiary Colours.

16. THESE OBJECTS ARE BEST ATTAINED BY THE USE OF THE PRIMARY COLOURS ON SMALL SURFACES, AND IN SMALL QUANTITIES, BALANCED AND SUPPORTED BY THE SECONDARY AND TERTIARY COLOURS ON THE LARGER MASSES.

OF THE PROPORTIONS BY WHICH HARMONY OF COLOURING IS PRODUCED.

(For further explanation and coloured illustrations see "The Grammar of Colouring," No. 186 of this series.)

17. THE PRIMARIES OF EQUAL INTENSITIES WILL HARMONIZE OR NEUTRALISE EACH OTHER IN THE PROPORTIONS OF 3 YELLOW, 5 RED, AND 8 BLUE—INTEGRALLY AS 32.

THE SECONDARIES IN THE PROPORTIONS OF 8 ORANGE, 13 PURPLE, 11 GREEN—INTEGRALLY AS 32.

THE TERTIARIES, CITRINE (COMPOUND OF ORANGE AND GREEN), 19; RUSSET, ORANGE, AND PURPLE, 21; OLIVE, GREEN, AND PURPLE, 24;—INTEGRALLY AS 64.

It follows that each secondary being a compound of two primaries is neutralised by the remaining primary in the same proportions, thus:—8 of orange by 8 of blue, 11 of green by 5 of red, 13 of purple by 3 of yellow.

Each tertiary being a binary compound of two secondaries is neutralised by the remaining secondary, as 24 olive by 8 of orange, 21 of russet by 11 of green, 19 of citrine by 13 of purple.

The contrast and harmonious Equivalents of Tones, Shades, and Hues.

18. THE ABOVE SUPPOSES THE COLOURS TO BE MIXED IN THEIR PRISMATIC INTENSITIES, BUT EACH COLOUR HAS A VARIETY OF TONES WHEN MIXED WITH WHITE, OR OF SHADES WHEN MIXED WITH BLACK.

When a full colour is contrasted with another of a lower tone, the volume of the latter must be proportionately increased.

Variety of Hues, &c.

19. EACH COLOUR HAS A VARIETY OF HUES BY ADMIXTURE WITH OTHER COLOURS IN ADDITION TO WHITE, GREY, OR BLACK: THUS WE HAVE OF YELLOW, ORANGE-YELLOW ON THE ONE SIDE, AND LEMON-YELLOW ON THE OTHER; SO OF RED, SCARLET-RED AND CRIMSON-RED; AND OF EACH, EVERY VARIETY OF TONE AND SHADE.

When a primary tinged with another primary is contrasted with a secondary, the secondary must have a hue of the third primary (*i.e.* when a blue tinged with red is contrasted with orange, the orange must possess a greater than usual proportion of yellow).

The Positions the Colours should occupy.

20. IN USING THE PRIMARY COLOURS IN MOULDED SURFACES WE SHOULD PLACE BLUE, WHICH RETIRES, ON THE CONCAVE SURFACES, YELLOW, WHICH ADVANCES, ON THE CONVEX, AND RED, THE INTERMEDIATE COLOUR, ON THE UNDER SIDES, SEPARATING THE COLOURS BY WHITE ON THE VERTICAL PLANES.

When the proportions required by Proposition 17 cannot be obtained we must procure the balance by a change in the colours themselves : thus, if the surfaces to be coloured should give too much yellow, we should make the red more crimson, and the blue more purple, *i.e.*, we should take the yellow out of them ; so, if the surfaces should give too much blue, we should make the yellow more orange, and the red more scarlet.

21. THE VARIOUS COLOURS SHOULD BE SO BLENDED THAT THE OBJECTS COLOURED WHEN VIEWED AT A DISTANCE SHOULD PRESENT A NEUTRALISED BLOOM.

22. NO COMPOSITION CAN EVER BE PERFECT IN WHICH ANY ONE OF THE THREE PRIMARY COLOURS IS WANTING, EITHER IN ITS NATURAL STATE OR IN COMBINATION.

Simultaneous Contrasts.

23. WHEN TWO TONES OF THE SAME COLOUR ARE JUXTAPOSED, THE LIGHT COLOUR WILL APPEAR LIGHTER, AND THE DARK COLOUR DARKER.

24. WHEN TWO DIFFERENT COLOURS ARE JUXTAPOSED THEY RECEIVE A DOUBLE MODIFICATION: FIRST, AS TO THEIR TONE (THE LIGHT COLOUR APPEARING LIGHTER, AND THE DARK COLOUR APPEARING DARKER) ; SECONDLY, AS TO THEIR HUE, EACH WILL BECOME TINGED WITH THE COMPLEMENTARY COLOUR OF THE OTHER.

25. COLOURS ON WHITE GROUNDS APPEAR DARKER, AND ON BLACK GROUNDS LIGHTER.

26. BLACK GROUNDS SUFFER WHEN OPPOSED TO COLOURS WHICH GIVE A LUMINOUS COMPLEMENTARY.

To increase the harmonious Effects of juxtaposed Colours.

27. When ornaments in a colour are on a ground of a contrasting colour the ornament should be separated from the ground by an edging of lighter colour, as a red flower on a green ground should have an edging of lighter red.

28. When ornaments in a colour are on a gold ground the ornaments should be separated from the ground by an edging of a darker colour.

29. Gold ornaments on any coloured ground should be outlined with black.

30. Ornaments of any colour may be separated from grounds of any other colour by edgings of white, gold, or black.

31. Ornaments in any colour, or in gold, may be used on white or black grounds without outline or edging.

32. In "self-tints," tones, or shades of the same colour, a light tint on a dark ground may be used without outline, but a dark ornament on a light ground requires to be outlined with a still darker tint.

33. Imitations, such as graining of woods and of the various coloured marbles, are allowable only when the employment of the thing imitated would not have been inconsistent.

PART VII.

ELEMENTARY DRAWING FOR HOUSE PAINTERS, DECORATORS, AND SIGN WRITERS.

CHAPTER XXXII.

FREE-HAND DRAWING.

1. STRAIGHT-LINED FORMS.

THE principles of Decorative Art having been set forth, it is now intended to give a brief course of elementary drawing, in order to afford the student an opportunity of carrying into practice the theories propounded.

The house painter may perhaps think that, as his business consists merely in painting flat surfaces, he has no necessity for drawing; but in this he would be mistaken, for drawing improves the perceptive faculties and gives appreciation for that which is accurate and refined, thus materially assisting him in improving his work, and consequently his position. To the decorator, a knowledge of drawing is indispensable, and the few lessons here given will be an introduction only; they will serve to take off as it were the rough edges of the subject, to clear away some of the obstacles, and to place just a few lamps on the path which might otherwise appear difficult to traverse. It is to be hoped, however, that the student will follow up the course, and, having acquired a certain amount of manual power, will take nature as his guide, and draw from foliage and flowers—first singly and then grouped—by which means he will acquire the elements of original design.

The materials required in the first instance are merely a drawing-board, two or three pencils, a piece of indian-rubber, and of course some drawing-paper.

The drawing-board should be made of deal, clamped at the ends, or otherwise secured from twisting, the first condition, however, being that it must be made of well-seasoned wood. Drawing-boards may be obtained at artists' colour shops, and it is perhaps the safest plan to purchase them thus, as there is always a certain amount of risk in having them made, whilst by selecting from a stock this is obviated.

For all the studies given in this course, the paper called "Drawing Cartridge" will be sufficient, the size being that termed "Imperial," or 30×21 inches. This should be cut into halves or quarters, and attached to the drawing-board by means of drawing-pins, which are small steel points with broad flat heads.

The drawing-boards should be of regular sizes to agree with those of the paper, an inch or so of margin being allowed. By this means the paper is economized, and no useless remnants are left.

All the studies here given should be copied twice or three times the size of the examples, but measuring should not in any case be resorted to.

The pencils required for present purposes are those marked B and HB, and, when finer details are to be drawn, those marked H or F may be used; but it will soon be found that for freedom in sketching a very soft pencil is to be preferred, the harder ones being only used to clear up the lines in the manner which will be presently described.

The best indian-rubber for drawing purposes is that called "VULCANIZED," which removes the pencil-marks more rapidly and effectually than the patent indian-rubber, *i.e.* that sold in small flat black squares. Good "bottle" indian-rubber (that is the article in its original condition) is however very useful, and was, until the recent introduction of the vulcanized, generally employed. It may be passed over a large surface after the vulcanized has been used, when it removes the grit and gives additional smoothness to the paper. Ink-eraser should only be used in very exceptional cases, or where a line has been so heavily drawn that it cannot be removed by other means. The paper should afterwards be smoothened with the other indian-rubber, or the lines drawn on it will be ragged and coarse.

Of Straight Lines and their Combinations.

We often hear persons say, "I shall never be able to draw, I cannot even draw a straight line," unconscious that they are naming a difficulty which it will take them some little time to surmount, and that if they think they must defer learning to draw until they can draw straight lines with correctness and ease, their idea will be about as absurd as that of a lady who said she would never allow her son to go into the water until he could swim.

To draw straight lines is a matter which will require some practice to accomplish, but this practice need not be wholly gone through at starting. Every good teacher of music and singing will tell the inquirer that the pupil must start with exercises and scales, and that although it is all-important that perfection in these elementary branches shall be attained it is not advisable that the lessons should for a long time be confined to these; first, because the learner becomes tired of the monotony, and secondly, because it is only when the necessity for and the application of the single notes in "pieces" or "songs" is understood, that the importance of every one of them is appreciated, and the pupil then returns to the practice of the scales and exercises with pleasure and interest.

The same holds good in relation to drawing, for no doubt drawing single straight lines is an irksome and uninteresting branch of the study, and, after a while, the eye of the student becomes so tired of the isolated elements, that he fails to see their incorrectness, and hurries over them, mistaking the advantages of quality over quantity.

Experience of nearly a quarter of a century has proved to us that, the ground having been roughly broken up, the result desired must be attained gradually, and that, be the pupil child or man, the moment the smallest power of drawing lines has been acquired, the elements should be applied in studies composed of the very lines which are to be practised, returning to the original elements from time to time, and on each of these occasions an improvement will be evident.

Straight lines are spoken of according to their direction as Vertical, Horizontal, and Oblique.

VERTICAL LINES ARE SUCH AS ARE PERFECTLY UPRIGHT.

If a weight be attached to the one end of a string whilst the other is fixed, the position of the line, when still, will be vertical. The term "*perpendicular*," though often used to describe an upright, is not always correct when thus applied. A vertical line is absolutely upright, and has no relation to any other lines. The term perpendicular is a relative one, and is used to describe the position of one line to another; thus the sides of a square are perpendicular *to each other*, even though the square may be a board or sheet of paper lying horizontally on the table, neither one of the lines being upright. Again, a vertical line will be perfectly upright, although not perpendicular to other lines. Thus the lines by which a chimney-stack is bounded will be vertical, but not perpendicular to the tiles, whilst the walls of the house will be perpendicular (*i.e.* at right angles) to the pavement.

We will now proceed to show the method of drawing vertical lines, and must, in the first place, point out that the position of the arm and hand during drawing is different from that in which they are placed when writing. The elbow should be at a distance from the side, and the hand should be brought round so that the line may be drawn immediately in front of the chest; whilst in writing, and in drawing lines which slant from right to left, the elbow is placed close to the side.

The pencil should be cut evenly, the slant commencing at about three-quarters of an inch from the end, the wood being removed equally all round so that the point may clear from wood for about the length of an eighth of an inch. A properly cut point may be made to last some time by merely drawing it along with a slightly twisting motion on a piece of fine glass-paper.

In commencing to draw a line place a few slight

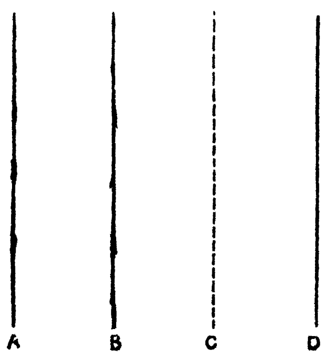


Fig. 48.

marks to indicate the general direction. These marks must not, however, be round dots, which when afterwards united may give the line the appearance of a knotted string, as shown at A, nor should they be a careless series of scratches as indicated at B. They should be absolutely straight pieces, which only require to be united to form the line required, C. The paper should then be held up at a short distance from the eye so that the correctness of the line may be the better judged, and, when it is deemed satisfactory, it is to undergo the process called "lining in." This consists simply in partly erasing the rough sketch and repeating the lines with a harder pencil, and completing the line as shown at D. The more correct, therefore, the sketch is in its position and form, the better, so that the whole attention may in the second stage be devoted to the manipulation only.

When a certain amount of power in drawing single vertical lines has been acquired they should be drawn in pairs, observing to keep them perfectly parallel, and increasing the length of the lines and the distance between them in each pair. This practice is very important to the sign writer who is continually required to draw pairs of parallel lines in the bodies of letters.

HORIZONTAL LINES, Fig. 49, are now to be practised, and in commencing these the elbow is to be placed near

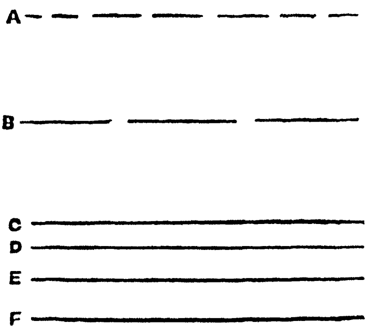


Fig. 49.

the side, but to be gradually moved from it, for these lines are not to be drawn by the motion of the fingers only or even of the whole hand, in either of which methods the lines, unless exceedingly small, will be curved, as the fingers will describe an arc of which the wrist or elbow will be the centre. The horizontal lines are therefore to be drawn by moving the arm along, the line being in the first studies drawn in small pieces as at A, which are to be increased (B) as greater power is attained; and, as already explained, the whole is subsequently to be carefully lined in. Lines parallel to each other should next be practised, the distance between them being gradually increased as at C D E F.

OBLIQUE LINES, Fig. 50, are now to be practised, and these, when slanting from right to left, will be found comparatively easy, reminding us of our first efforts at caligraphy. If, however, our memory can be carried

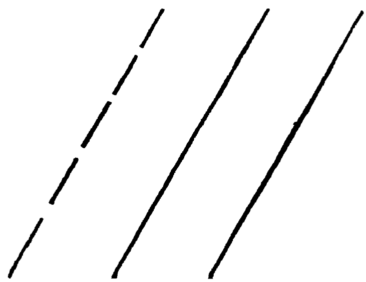


Fig. 50.

back thus far (and what pleasant reminiscences of those early days will at the same time arise), the picture of the first line in our copy book will present itself to our mind's eye in something like the annexed form, and this

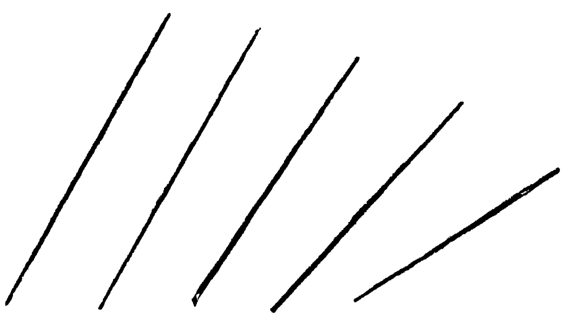


Fig. 51.

result we must now in maturer years avoid, and must be careful that a given number of lines may slant in precisely the same direction, be at exactly the same distance apart, and of the same length.

OBLIQUE LINES slanting from left to right, Fig. 52, will form the next subject for practice, and will, perhaps, from our "strokes" in early days not having taken this direction, be found more difficult, and therefore more of them should be drawn than of the previous ones; the elbow being removed from the side, and the hand brought round so as to be higher than the line which is being drawn.

As already stated, these lines are of the utmost importance to the letter painter, and the student of that branch should, as soon as he can draw them with any degree of correctness upon paper, proceed to practise

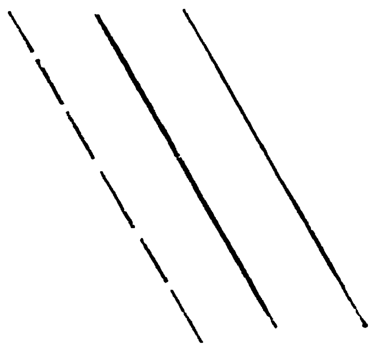
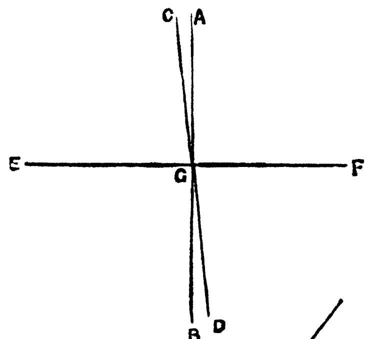


Fig. 52.

them on a black board, which should be fixed against a wall so as to be perfectly upright, and therefore corresponding in position with the surfaces on which writing is usually done. The black board should be well prepared with several coats of good black paint, and should be *flatted*. The chalk employed may be either that sold in sticks, or pieces roughly cut from common unprepared chalk, or, better than either, pipe-clay. Broken pieces of the stems of unburnt pipes may be obtained from pipe-makers; or white clay, called modelling clay, may be obtained at any of the plaster figure shops. Pieces of this rolled out to a convenient thickness and dried will answer very well: and, further, sticks of such clay may be purchased of most colourmen.

In drawing on the black board the hand must be perfectly free, the arm being held out straight from the body. We have spoken of *sticks* of chalk, but practically we mean *pieces* of sticks; for much greater freedom may be attained with pieces than with sticks.

Fig. 53.



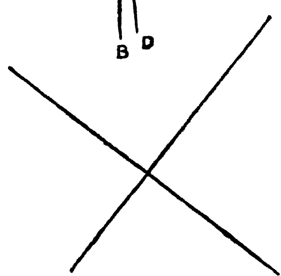


Fig. 54.

The pieces should be held by the points only of the fingers, and the whole arm should be moved in the course of work, depending only on the chalk; but not, as a rule, allowing the hand to touch the board, excepting, perhaps, in some ornamental detail to be subsequently spoken of, when some little ease may be obtained by allowing the little finger to touch or trail along the board: but it must be remarked that the friction would soon cause soreness of the extremity of the finger.

The lines should at first be sketched lightly in the manner already indicated, but after practice the student will acquire the power of delineating the required form without this preparatory stage, and to draw on the black board in a bold and free manner.

The further use of the black board is explained in rela-

Fig. 55.

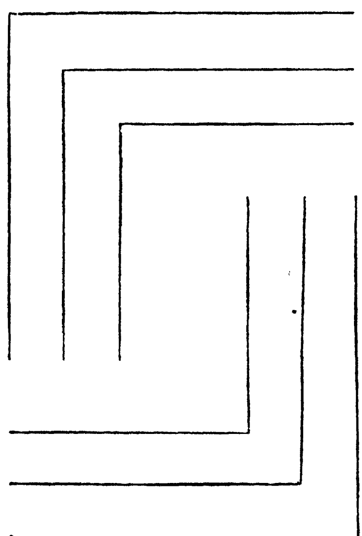


Fig. 56.

tion to letter-painting. The power of drawing single lines with some amount of ease and correctness having now been attained, their combination should be attempted, in order that they may be placed in any required position to each other, at the same time obtaining further practice in drawing the lines themselves.

The elementary studies here given are of such a character that the student will himself be able to judge of their correctness, as any inaccuracy will at once be obvious.

Fig. 53 is composed of a vertical and horizontal line crossing each other. The lines thus disposed will form FOUR RIGHT ANGLES, and this will be a test as to the correct position of each line. Thus it will be seen, that if the line A B were placed as C D, the angle E G C and the opposite angle D G F would be equal; and this would also be the case with the angles C G F and E G B;

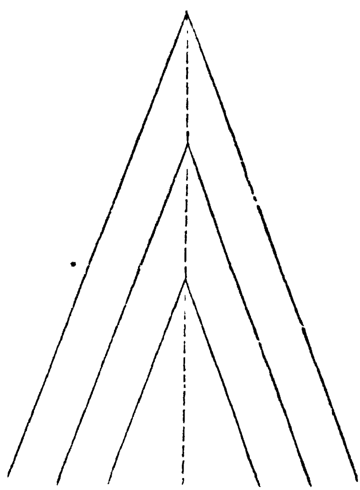


Fig. 57.

the angles thus corresponding in pairs, whereas the whole four should be equal. But it has already been pointed out that lines may be perpendicular to each other without either of them being vertical or horizontal, and this is exemplified in Fig. 54 which will afford useful practice in drawing oblique lines in both directions.

In Figs. 55 and 56 lines are placed perpendicularly to each other, without crossing, each pair thus forming a right angle. These should be practised in various directions, and then correctness may be tested by carrying on each line beyond the point of meeting, when four right angles will be formed as shown in Fig. 53.

The next exercise, Fig. 57, consists of two lines meeting at a point so as to form an ACUTE ANGLE. It is important that the power of placing such lines at any required slant should be acquired, and that they should incline equally in relation to a perpendicular, a result which is constantly required in letter-painting, as in the A M V W and Y. In commencing this exercise it is a good plan to draw a horizontal line and a perpendicular rising from

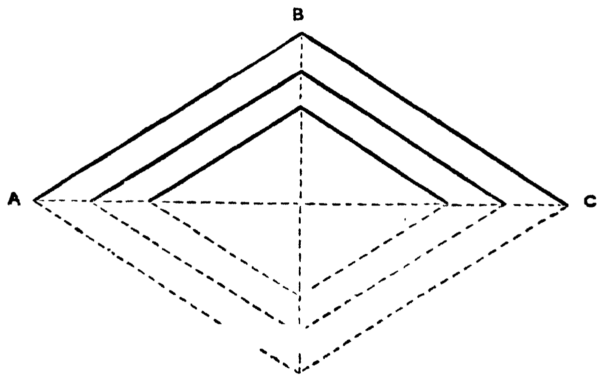


Fig. 58.

it. The position of the angle having been fixed, a point is to be marked on the horizontal on each side of the base of the perpendicular, and to these the lines are to be drawn. After a while such leading-strings must however be discarded.

This study is to be varied by drawing the lines so as to form an obtuse angle, A B C, Fig. 58, and in this and the last exercise the horizontal and perpendicular lines are afterwards to be produced (*made longer in the same direction*), and the lines repeated below the horizontal, by which means a series of lozenges (or diamond-like forms) will be produced.

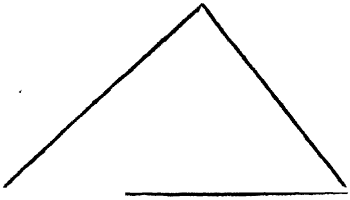


Fig. 59.

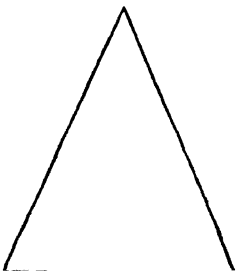


Fig. 60.

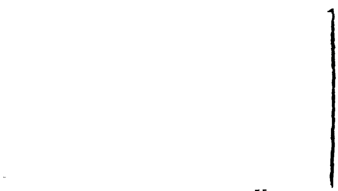


Fig. 61.

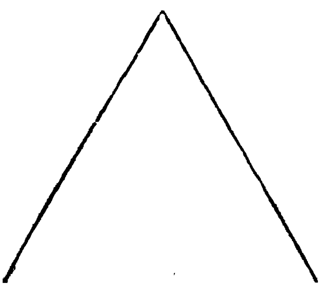


Fig. 62.

The various kinds of triangles now follow in natural sequence, and we advise the young painter to study Practical Geometry contemporaneously with free-hand drawing — which he can do by alternating the lessons—the former will thus materially assist the latter; for the student will understand the precise conditions on which the figures are based, and will duly estimate minute differences in form which he might otherwise have overlooked.

The figures therefore which have been drawn by means of instruments as studies in Practical Geometry will form excellent copies for Free-hand drawing; but the result only is to be copied, not the lines by which the form was constructed.

It is only necessary in this place to mention that Fig. 59, in which the three lines are of different lengths, is a SCALENE TRIANGLE; that Fig. 60, in which the two sides are equal, is an ISOSCELES TRIANGLE;

that Fig. 61 is a RIGHT-ANGLED TRIANGLE, and that Fig. 62 is an EQUILATERAL (or equal-sided) TRIANGLE.

In commencing figures such as these the lines should not be drawn in a hap-hazard manner, roughing in and rubbing out alternately until an approximation to the form is obtained. The student may depend that a correct geometrical figure or ornamental form will not be done by mere random lines, but that the points to which the lines are to be drawn must first be carefully indicated.

Returning now to the practice of right angles it will at once be seen that the lines in Fig. 55 and Fig. 56 if made of equal lengths will, when united, form a SQUARE,

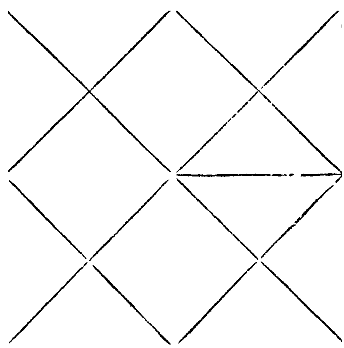


Fig. 63.

Fig. 63, and this figure should be repeatedly practised, so many others being based upon it. When the square is deemed correct lines parallel to the sides are to be drawn across it so as to divide the whole into four equal squares. When this has been accomplished DIAGONALS (or lines crossing from angle to angle) are to be drawn. The figure will now be found to consist of four squares with one diagonal in each, and is to be completed by adding the second diagonal, by which another square placed angularly will be formed within the outer square.

The exercise may be made still further useful by placing the original square in an angular position. This is best done by drawing two lines (which become the diagonals of the square) so that they may intersect each other at right angles, and from this intersection marking on each of the lines the length from the centre to the angles of the square. These points are then to be united.

The student must keep his future avocation constantly before his mind's eye, and must beware of accomplishing his present result by means of which he will not be able to avail himself in actual practice; it is therefore necessary that he should learn to draw lines and figures in every direction *without turning* his

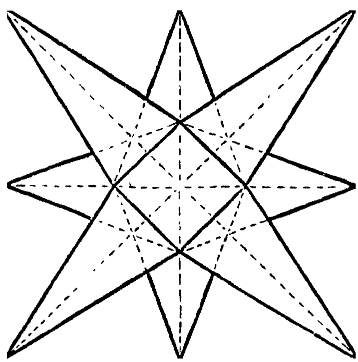


Fig. 64.

drawing-board or paper. He might, perhaps, by so doing accomplish his present purpose with a little more ease than otherwise, but it will be at the expense of his future success; for he must remember that he cannot turn a wall or architrave on which he is to paint a name or inscription, and he would then have to encounter the difficulty which early practice might have enabled him to overcome.

Fig. 64 is another study of the same character. The square and the lines across it having been drawn, the central square is to follow. The sides of this form the bases of four isosceles triangles; the extreme points (called the apices, plural of apex) are in the angles of the outer square. Other triangles are then drawn from the extremities of the diagonals of the central square.

CHAPTER XXXIII.

FREE-HAND DRAWING.

2. CURVED-LINE FORMS.

Having thus devoted some little attention to straight lines drawn by free-hand we now proceed to give a few hints on the elements of ornamental forms, and the method of drawing them.

As in the early stage of the previous section, we avail ourselves of guide lines, which, however, the student is advised to use as little as possible.

Having drawn the central perpendicular and the horizontals crossing it, which are to regulate the heights of the curves, on each side of the perpendicular mark on the horizontals, the points for the commencement of the curves, and on the perpendicular itself, mark the point where the curves are to meet, and then the oblique lines which give the general direction of the curve are to be drawn. Now in relation to these and similar curves which are to be balanced it must be pointed out that the left-hand curve should be first sketched, and made tolerably correct, before the right-hand one is attempted; for if the latter one were to be first done the hand would cover it whilst sketching the other, and the balancing would be much more difficult and troublesome than otherwise. There are, however, two other points on which it is necessary that special instructions should be given :—

1. The curves must not proceed from the straight line in a stiff or formal manner, but must merge gradually into

it. This will give the interpretation of Proposition 10, page 231, that "all junctions of curved lines with curved, or curved with straight, should be tangential to each other." Now, a tangent in geometry is a line which touches a circle without cutting off any portion of it. The curve A B, Fig. 66 (in this case an arc of a circle), will thus be seen to touch the perpendicular, but not to pass over it; whilst a part of the curve in Fig. 67 is

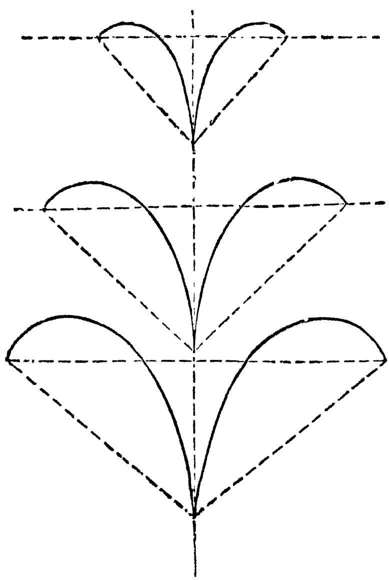


Fig. 65.

cut off by the straight line, and thus it proceeds from the line in a sudden and abrupt manner, instead of merging gradually and imperceptibly into it. So gradual should this meeting take place, that it should be scarcely possible to discover the exact point of junction. Figures 66 and 67 will exemplify this, and from these it will be seen that the curve in the first merges gradually into the straight line, and would, if continued, form an ellipse wholly on the one side of the

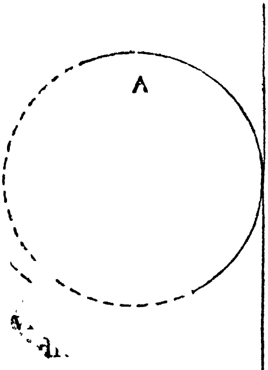


Fig. 66.

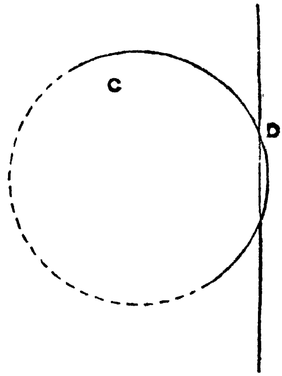


Fig. 67.

perpendicular; whilst the other would cross the line, thus giving the idea of a hole having been bored in an

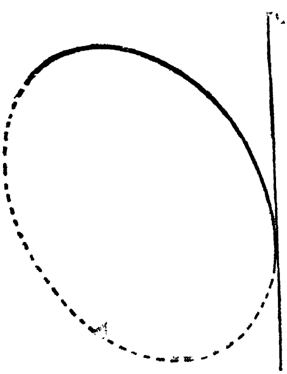


Fig. 68.

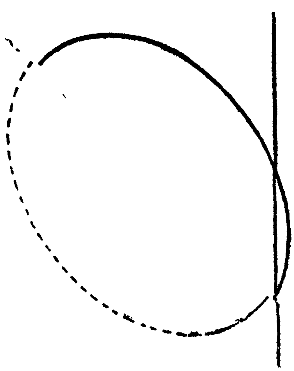
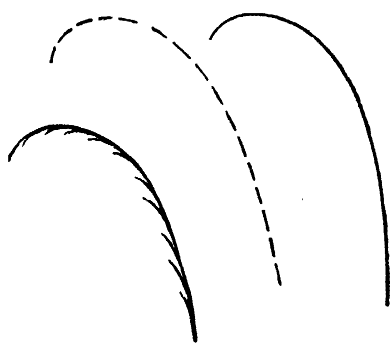


Fig. 69.

upright through which a branch had been made to pass.

2. The second point to which the attention of the student must be called is the method of sketching these curves. It has already been pointed out in relation to straight lines that they must not be sketched in odd pieces, and this is still more necessary to be observed in relation to curves; for it will be seen that, if sketched after the fashion shown in Fig. 70 *a*, there would be a difficulty in knowing where to draw the curve when "lining in." The curve should therefore be sketched as in *b*, that is, in pieces of line of uniform thickness and following the same general direction, so that the exact form may be judged of before it is partially erased



a *b* *c*

Fig. 70.

preparatory to "lining in." Fig. 70 *c* is the finished line.

Fig. 71.—This exercise is a continuation of the last, a curve tending in an opposite direction being added.

The same rule holds good in this as in the other study, viz., that the curves must not grow abruptly out of a straight line, or out of each other, but must be tangential. Thus it will be seen at *a* that the curve if continued would just touch and then proceed to form an elliptical or oval figure; whilst at *b* the one would pass through the other. It follows, therefore, that the part of the curve from which the branches spring must be regarded as the parent stem, and must be "common" (that is belong equally) to all curves springing from it. Thus, if the curve *c* were removed, the curve *d e* should be left perfect; and again, if the curve *f* were taken away, *e g* should remain unbroken.

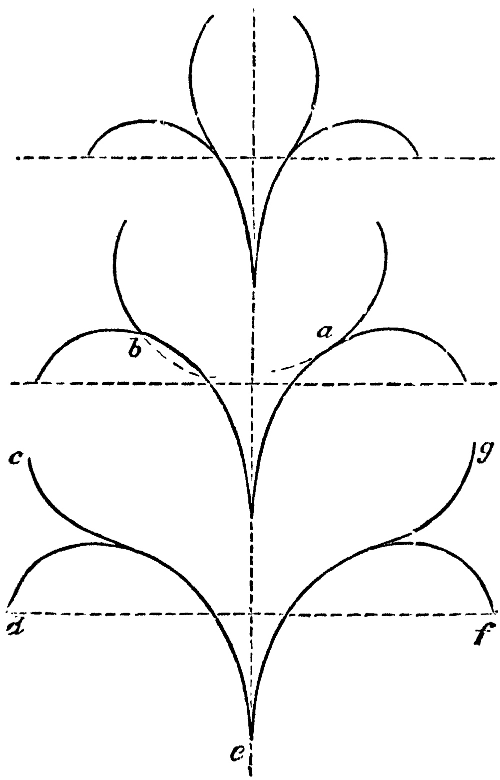


Fig. 71.

It will of course be understood that in the concise course of instruction necessitated by the limits of this work the examples chosen must be indicative only, each one becoming, as it were, a representation of a class; and therefore the student is urged to vary the last two examples, so as to reach by several intermediate steps the example presented in Fig. 72, in

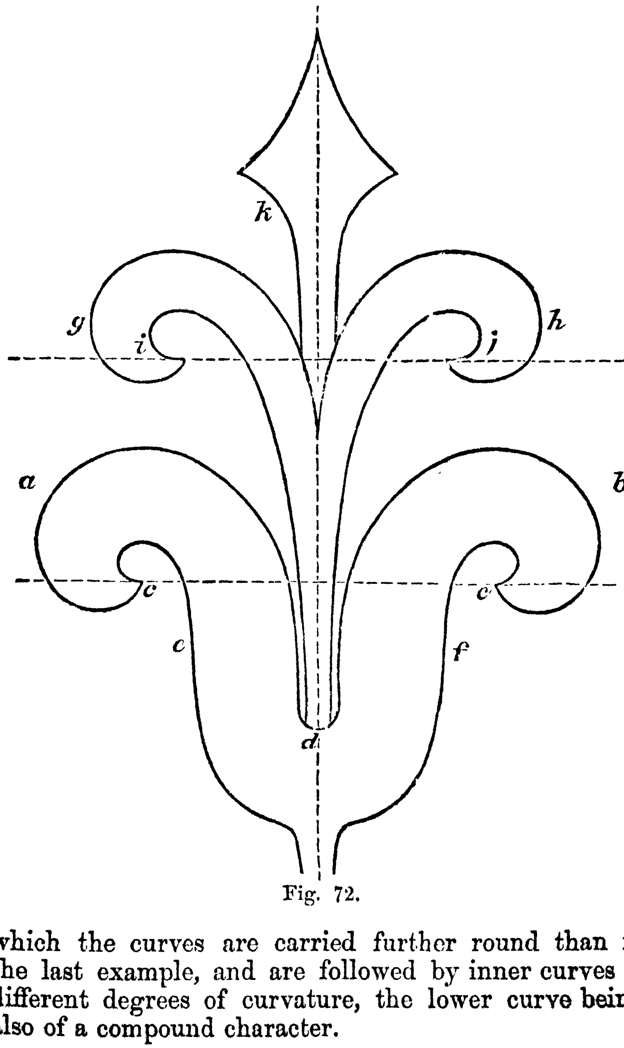


Fig. 72.

which the curves are carried further round than in the last example, and are followed by inner curves of different degrees of curvature, the lower curve being also of a compound character.

In drawing this example, which should be copied at least twice the size of the original, the two largest curves *a* and *b* are to be the first drawn. This plan is advisable in copying examples where one part is much larger than the others; for if the work is commenced at the smaller part, and this be drawn too large, the other being increased in proportion, the whole will often become larger than was originally intended, or than the space admits, and thus cause waste of time and trouble.

The curves *a b* are to be commenced at *c c'*, and are to be carried round until they merge into each other at *d;* the curves *e f* are then to be drawn, thus completing the lower part of the subject. The outer curves *g* and *h* are then to be drawn; these are to be followed by the inner ones *i* and *j*, after which the central lobe *k* is to be added, thus completing the general sketch.

Great care will be necessary in sketching this example, the different parts of which must be very accurately balanced. The student must now be supposed to have attained a certain power in the delineation of form, and must aim at refinement of manipulation. The curves must flow in a smooth and graceful manner, there must not be any excrescences nor flatnesses, nor must the form appear stiff or laboured.

These results may seem impossible to accomplish, but the student is assured they are not so. That they are difficult of attainment there is no doubt; persevering practice, inspired by the desire to excel, will, however, enable the learner to overcome the obstacles which at first appeared insurmountable, but which vanish before energy and determination.

Fig. 73 is intended to afford practice in drawing a spiral curve known as a scroll. In sketching this the curve should be commenced at about *a* and carried on towards *b*, the pencil is then to be brought back to *a* and carried round to *c*, in pieces of line of about a quarter of an inch in length; there must however be no joint visible at *a*. In repeating this exercise the sketch may be commenced at *c* and be carried round to *b*; and in another copy a curve may start from *b* and be worked quite round to *c*: each of which methods may be found useful under different circumstances.

The next practice should consist in drawing a central perpendicular and sketching Fig. 73 on the left,

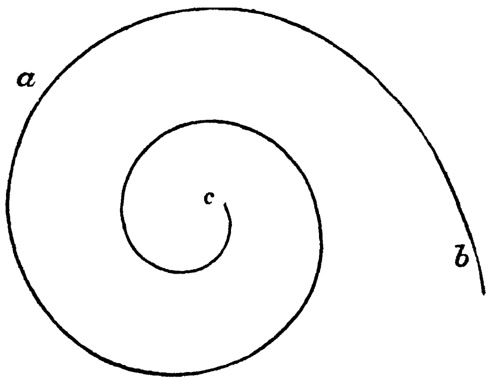


Fig. 73.

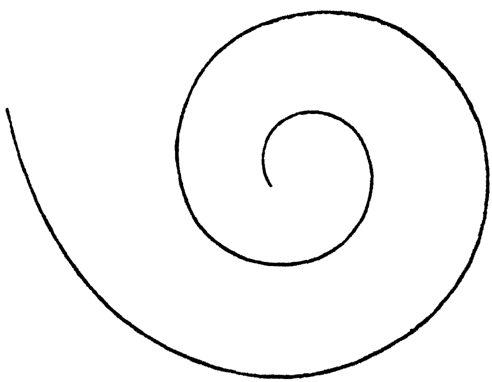


Fig. 74.

and reversing it on the right side, so as to meet the previous curve at *b*. This should be done at various heights on the perpendicular, the sizes of the pairs of scrolls diminishing towards the top of the line.

Fig. 74.—This exercise consists of the same scroll inverted, and is to be sketched in the same manner.

In drawing scrolls care must be taken to avoid their slanting in either direction, or projecting at any one part more than another. In order to judge of their form the student may be allowed in the earlier stage of practice to turn his board upside down or sideways, to *look at his sketch*, but not to draw any portion of the figure; he will then no doubt see faults which will sur-

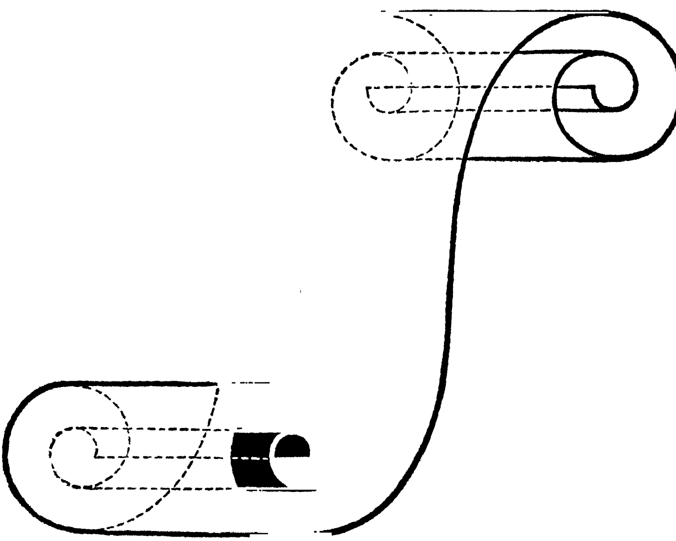


Fig. 75.

prise him, and he will thus be put on his guard in drawing on fixed surfaces, such as sign-boards, shop fronts, &c.

Fig. 75.—This example represents a scroll of paper or parchment, and is one frequently used by writing painters. It will be seen that the elements of which this figure are composed have already been studied, and no difficulty in drawing it is therefore anticipated.

The double curve is to be the first part attempted, and this having been satisfactorily sketched, horizontals are to be lightly drawn from the top and bottom of each of the scrolls; but in order that the correct curvature may be given to the left side, it is necessary to imagine the whole object to be transparent, and to sketch the outline as if it could be seen: this will enable the student to delineate the parts which are visible, with correctness and certainty.

In Fig. 76 we give a series of scrolls running in a vertical direction. This study may be begun either at the lower or upper portion, care being taken to keep the central wave, or parent stem, equally distant from a central line which may subsequently be erased, and that it forms a portion of each of the scrolls which grow out of it. The place which the scroll holds in ornamental art is fully described in a special chapter in "The Grammar of Colouring," and to this the student is referred. This figure, which is the basis of by far the greatest portion of the ornaments likely to be used by the decorative painter, should be most assiduously practised in horizontal, vertical, and oblique directions.

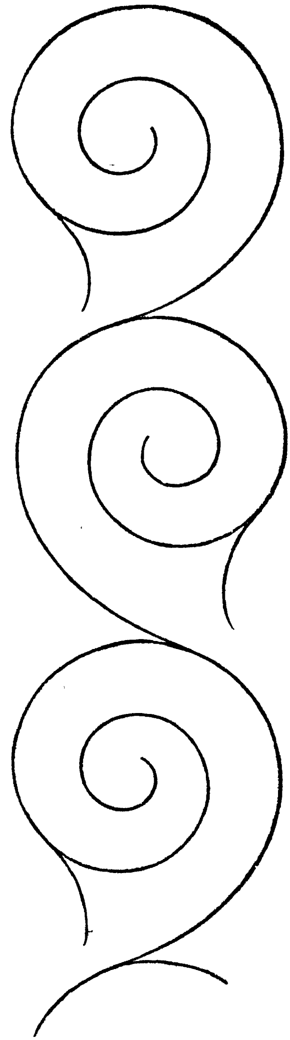


Fig. 76.

Fig. 77.—In this example two compound scrolls are balanced, and at this stage it is not advisable for the student to use any guide lines beyond the central

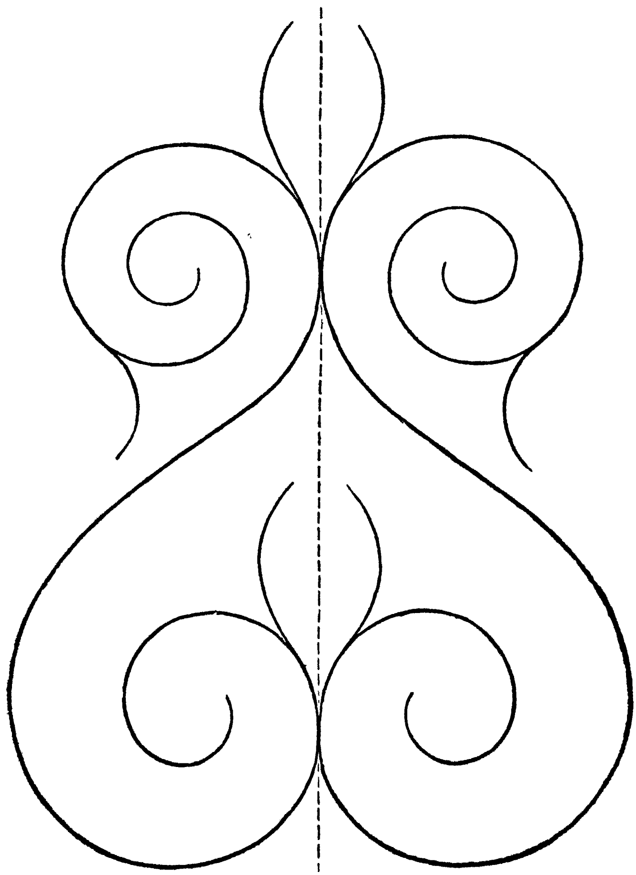


Fig. 77.

perpendicular. As already pointed out, the left side must be sketched first, and made as nearly as possible correct before the right side is attempted.

The whole subject may now, for additional practice, be inverted; the perpendicular and a horizontal at the bottom of the present figure being common to both portions of the design.

Fig. 78 is based on the natural growth of three leaves, the form being, however, rendered in a conventional manner, so as to adapt it for an ornamental purpose.

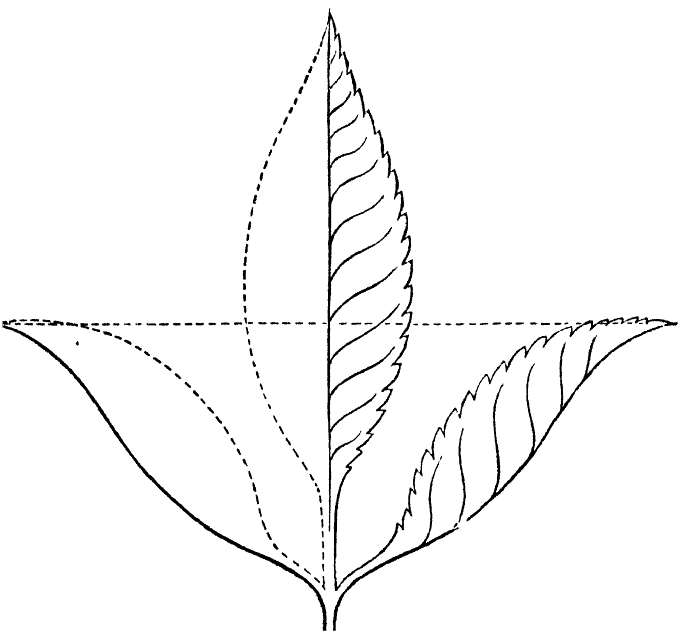


Fig. 78.

By this we mean that although the *idea* is taken from nature, still the leaves do not grow in a manner so accurately balanced or so precisely disposed. This principle has already been laid down in Proposition 11, page 231, and should be borne in mind by every decorative painter; but it must not be misunderstood to mean that nature, or correct drawing, are to be neglected. On the contrary, the flower or plant may be rendered conventionally, but its natural details and growth must be carefully indicated; the student is advised therefore to take nature as his universal standard, and to make sketches and notes of the thousands of beautiful forms and peculiarities of growth with which the ever-open book of nature is filled; he must follow the manner of growth, the symmetry, and the natural details, whilst adapting them to the special purposes of his design.

"The designer, like the poet, has his license with regard to possibilities or probabilities. A mere natural improbability, where natural imitation is in no degree essential, is the privilege of the fancy; but mechanical disproportion and impossibilities, violations of the most palpable laws of gravity, cannot be otherwise than offensive. Nothing can bring them within the range of good taste, as they are essentially obnoxious to æsthetic sensibility, which is the truest test of propriety in art; the effect being analogous to discord in music. We may be extremely grotesque or fanciful, without being ridiculous. There need be no limit to our chimeras, for nature is not their test; but if we combine monsters in our scrolls, or place animals upon the tendrils of plants, we should at least proportion them in size to the strength of the stem or tendril upon which they are placed."—*Wornum's Analysis.*

In sketching Fig. 78 it will of course be evident that after the central perpendicular, the outer curves on the left and right side must be drawn, their height being regulated by a horizontal.

The general form of the leaves is then to be sketched, and it must, once for all, be understood, that the jagged or indented edges of leaves is not, in the first place, to be thought of, but they are to be accurately drawn as if surrounded by one continuous outline, which must, however, be done lightly, so that it may subsequently be erased. Within this outline the serrations are to be drawn. This method of working is shown on the left side of the example.

A very useful set of studies (the best possible in fact) may be formed in the following manner:—Collect, during the summer season, leaves of various plants; place them between pieces of blotting paper, either in some large book or on each other, covering them with a small board: on this place a weight, and leave them for a week or two.

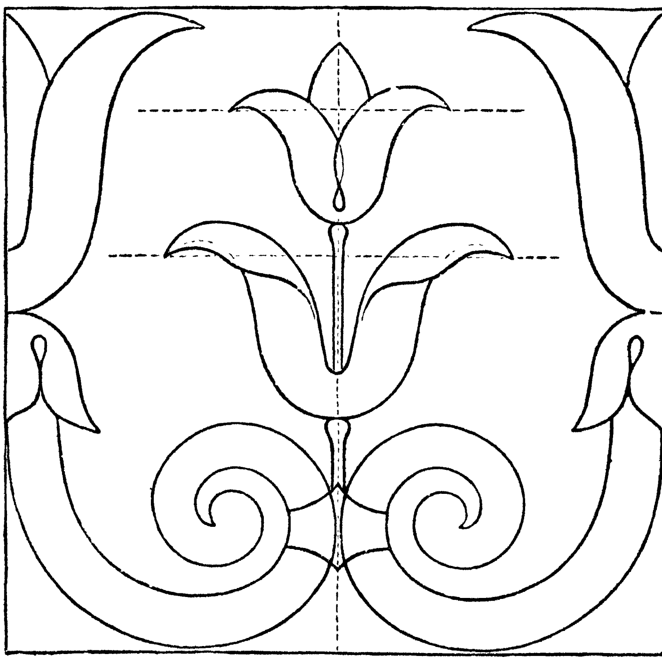


Fig. 79.

Next, cut pieces of pasteboard to the required sizes, and gum the leaves down upon them, so that they may lie quite flat. The set will then be very useful, not only as elementary drawing copies, but for reference as to the correct form of each leaf.

As already stated, it is not possible, within the limits of the present section, to give a complete course of free-hand drawing, and therefore the student will do well to seek from the source indicated several intermediate studies between the last and the present example (Fig. 79), varying, combining, and re-arranging the different elements of each; for he may depend that his practice in drawing, if confined to mere copying, will not be of material assistance to him, unless it be accompanied by the study of principles, and attempts at original composition. To think otherwise, is to mistake the means for the end.

Fig. 79 is a portion of a border designed in "repeats;" that is to say, any length of it may be formed by joining the one side to the other.

Having drawn the boundary line of the space in which the design is to be contained, draw the perpendicular and the conventional flower in the middle; next the half flowers at the sides are to be done, remembering that they must be in every respect equal, so that they may be joined and form one flower. The scrolls are then to be added, thus completing the sketch, which is subsequently to be "lined in." The practice is to be extended by drawing one of the side flowers complete, in the centre, and dividing that which is now the central flower.

CHAPTER XXXIV.

GEOMETRICAL DRAWING.

OF THE COMPASS AND OTHER MATHEMATICAL INSTRUMENTS.

IN the preceding section we have given the elementary principles of Free-hand drawing, in which all mechanical aids are forbidden, the eye and taste being the sole guides.

The accurate division of spaces, and the correct construction of the various forms in design, are dependent on geometrical principles; and a knowledge of some few of these will materially aid the decorator and letter painter, besides forming the basis of Perspective—a study which is of the utmost importance to both. We purpose therefore giving a brief course of lessons in Practical Geometry, to which we call the student's special attention.

A "case of mathematical instruments" is the object of ambition of every youth who is in any way connected with a business or profession in which drawing is applied, and even in our school days we have been accustomed to look at the rosewood case, brass bound and lined with blue velvet, and with its lock and key, with deep veneration, which was increased into amazement when we saw the complex many-sided figures, the exquisitely accurate forms, and the geometrical tracery, which were executed by means of the compasses only; and we have felt ourselves much humiliated when we have seen a beautiful, fine, but firm line drawn by the aid of the ivory-handled draw-pen, and have compared it with one we have attempted to draw by hand, made up of odd pieces, varying in thickness, and not by any means following the direction we had intended. Time was, when a case of such instruments was considered as a piece of family property, and we have seen a set which had been willed as a heirloom through two generations.

"Time works wonders," and thanks to the promulgation of practical drawing by the Government Department of Science and Art, and thanks, too, to the Society of Arts, which in the year 1851 offered a prize for the best set of instruments, to be sold at *2s. 6d.*, the result of which was a most useful, strong, and cheap set; various manufacturers have applied themselves to the production of cases of instruments, at prices to suit the means of all classes of society, and to these firms working men especially are under the deepest obligation, since by their means these important adjuncts have been popularised.

Nor must we forget the benefits we have in this respect received from our Continental manufacturers, through whose means even our national school boys troop out of school with their shilling or eighteen-penny box of instruments strapped up with their books, and without which the study of Geometry in such schools would have been impossible.

The first and by far the most important instrument in the case, is the COMPASS, the general form of which is too well known to need description. A complete pair of compasses consists of the body of the instrument, and three movable parts, viz., the steel point, the pencil, and the inking legs; all of which are kept in their places either by a screw or by the end of the leg fitting into the compass, kept in its place by a projecting ledge which runs in a slit in the upper side of the socket.

The latter is the most modern and most generally approved method. Its advantages, as compared with the screw, are (1) that the movable leg is liable in time to become shaky, owing to the wearing away of the thread of the screw—a result which must eventually occur, as the very force exerted in tightening up the leg wears away the thread of the screw, which then becomes unable to exert its full force; (2) that the screw being but small is very liable to be lost.

In drawing out the movable leg, care should be taken that it is not wrenched from side to side, with the view of getting it out easily, by which means the slit would be enlarged, and the leg would not work steadily; the consequence of this can be very well imagined, when it is remembered that the leading purpose of the compass is to draw circles, and unless the legs of the compasses be absolutely firm, the circle will not be true, and the point of the pencil or inking leg will not meet the starting point, an ugly break being thus formed. The proper way, therefore, is to draw the movable leg out in a straight line, in a direction *from* the chest.

The steel point is used when distances are to be accurately measured or divided, and therefore the smaller pairs of compasses which have both points of steel are called "DIVIDERS," a pair of which is to be found in all complete sets of instruments.

The pencil leg is used in drawing arcs (or parts of circles). It should be kept exactly the same length as the fixed leg; but as the piece of pencil inserted in it becomes shorter by being sharpened, it must from time to time be drawn out so that the two points may always be kept equal. In very old-fashioned instruments the piece of pencil is held in a split tube, which is tightened around it by means of a sliding ring; but in those of modern make a short split tube is placed at the end of a solid leg, and the cheeks of this "cannon leg," as it is called, are tightened by a screw.

Not only is the pencil by this method more firmly held than in the previously mentioned form, but the two points can (owing to the slanting direction of the pencil) be brought much more closely together than in the older kind.

The purpose of the INKING LEG is told by its name. The ink used should be *Indian* ink, with which a small quantity of Indigo should be mixed to correct the brown tendency.

Indian ink should be carefully rubbed with water in a small saucer or slab; as little force as possible should be exerted, so that the edges may not be chipped off, for the particles thus set free are apt to get between the nibs of the inking pen, and cause irregularity in the lines, sometimes in fact wholly preventing the proper working of the instrument.

A joint will be perceived in the inking leg, and the purpose of this is to allow of the leg being bent, so that the nibs may be kept upright, both of them being called into action; for it will be easily understood that, if the inking leg be kept straight when the compass is widely opened, only the inner nib would touch the paper, and the outer edge of the arc or circle drawn would be rough and irregular.

In drawing circles care should be taken to press as lightly as possible on the steel point of the compass, so that the paper may not be pierced; for should it be required to draw several circles from the same centre, the hole will become larger and larger, and all chance of correctness will be lost.

"HORN CENTRES" are sometimes used. These are small circular pieces of horn with three needle points fixed in them. One of these little transparent plates is pressed down over a point in the paper from which several circles are to be drawn. The central point will be visible. The steel point of the compass may then be placed over it, and the circles drawn with perfect safety.

This is all very well where the circles are large, but the plan fails in drawing small ones, for the plate of the horn centre would perhaps cover the place where the circle is to be drawn; and, further, the thickness of the plate causes the one point of the compass to be higher than the other; and although this may not be of consequence in large circles, it is a great disadvantage in drawing small ones.

"Prevention is better than cure," and the student is therefore advised from the outset to lean as lightly as he can on the point of his compass, and he will find that a very little practice will soon place him beyond the necessity for using the horn centres.

The steel point of the compass should be kept round, not triangular, which latter form assists in widening the hole at the centre, which may at first have been very small. The point should not however be too thin, but only just sharp enough to prevent it slipping away from the centre. It may be kept in proper order by occasionally drawing it along with a twirling motion on an oil-stone.

The compass should be held loosely between the thumb and forefinger, allowing it to rest with equal weight on both points, and merely using the forefinger to guide it.

When a circle of larger radius than can be contained between the two points of the compass is required, a "LENGTHENING BAR" is used. This is a brass rod, which fits into the socket of the compass, and which is itself provided with a similar socket into which the pencil or inking leg will fit. A pair of compasses having one leg very much longer than the other is thus formed, and a very awkward instrument it is, requiring much care in management. The student is reminded of the use of the joint in the movable legs, which he will now find very important.

For drawing very large circles, a "BEAM COMPASS" is used. This consists of a long bar of wood, at the end of which a "beam head," or socket, is fixed; and in this the pencil or inking leg is fixed. A similar socket holds the point which is to rest on the central point. This is made to slide along the bar, and may be fixed at any desired point by means of a thumb-screw, and thus the distance between the two points may be regulated according to necessity.

A beam compass of a large size, for the use of sign writers, may be made in the following manner:—Obtain a strip of well-seasoned wood (mahogany is generally found the best), about 2 in. wide and ½ in. thick. At about 1 in. from the end cut a hole, through which insert a piece of brass tubing about 3 in. long, in one end of which a piece of chalk can be fixed.

A fine bradawl is to be inserted at the distance of the centre of the circle to be drawn, and the point of this being pressed a small way into the board on which the writing is to be done, the end of the rod may be moved along, the chalk thus describing the required arc. Of course a piece of string with a loop for the reception of the chalk, and a knot through which the bradawl or a small nail may be passed, will answer the same purpose, but is not so accurate as the beam compass. For circles of about 18 in. in diameter, wooden compasses having a chalk holder at one end may be purchased, and will be found very useful.

Returning now to the instruments found in the usual cases, we must explain that the full-sized compass is not well adapted for drawing small circles, and therefore a pair of instruments called the "BOW-PENCIL" and "BOW-PEN" are used. These are simply smaller-sized compasses, the legs of which however are not removable, and therefore the one is adapted for pencil, and the other for ink. For still smaller purposes, "SPRING-BOWS" are used. These are sold in sets, consisting of dividers, pencil and inking bows; but may be purchased separately. In these instruments the legs, instead of being united by a hinge-joint, are made in one piece, so that a spring is formed, which by its action tends to force the points apart; they are then acted upon by a nut, which, screwing upon a bar fixed in one leg and passing through the other, closes the legs in the most minute degree possible. These instruments are of the utmost service in the higher order of geometrical drawing, but will not be required in any of the studies given in the present course.

The "DRAW-PEN" is used for inking lines, and is in form precisely like the inking leg of the compass; but it is fixed in a handle, and has generally smaller nibs. The Indian ink is dropped between the nibs by means of a camel's hair brush, after which the outer sides of the point are to be wiped against a piece of waste paper.

In using the draw-pen it should be held nearly upright, the flatter side being guided by the rule. The thickness of the line to be drawn is regulated by the opening allowed between the nibs, which may be altered by the screw. If a very broad line is required, the best plan is to draw a line on each side of the thickness, and fill in the space between them by means of a brush. A piece of smooth paper should occasionally be drawn between the nibs of the draw-pen to remove any minute atoms of grit, or to clear off the colour which may have dried in the pen, by which the flow of ink is prevented, and the lines become irregular and unequal in thickness. The better class of draw-pens are specially constructed for the accomplishment of this purpose. In these one of the nibs is made to work on a hinge joint, and may be opened to a distance from the other, thus allowing of both being cleaned. The draw-pen, inking leg, and ink bows should be carefully wiped before they are put away.

The RULE, or STRAIGHT EDGE, must be bevelled on one side. When it is used in drawing pencil lines the slanting edge is to be on the upper surface; but for inking the bevel must be directed downwards, so that the edge which guides the pen may be raised above the paper, and thus any ink which may drag along the outside of the pen will touch the rule only, and not smear the drawing.

SCALES of various kinds will be found in the cases of mathematical instruments, but those used by the student of the present group of subjects will be of the most simple character; and a rule divided into inches, eighths, tenths, and perhaps twelfths, will be all that will be necessary, and even these he can make for himself, if provided only with a simple 12 in. rule. The method of dividing lines into a given number of equal parts will be shown in the course of lessons in Geometry.

The uses of the different scales above mentioned are to measure the various parts of a drawing, so that each may have its proper proportion to the other; and to render a design on paper in such a manner that it may be an absolute copy, however much reduced, of the original.

Thus, let it be supposed that a decorative painter is required to make a design to show the customer how he proposes to decorate the different parts, and in order generally to try the effect. Of course he cannot draw the whole front of its full size, and yet, unless the whole be drawn, the effect cannot be appreciated. It becomes necessary, therefore, to make a drawing of some convenient size, and each part should have the same proportion to the whole that the portion it represents has to the original. This is called working "to scale."

To construct a plain scale:—

Let it be required to construct a scale of 1 in. to the foot, that is to say, a scale to be used in making a drawing which is to be one-twelfth the size of the original.

Now it will be clear that if one inch represents one foot, then one-twelfth of an inch will represent an inch, which is one-twelfth of a foot; therefore, having set off on a strip of cardboard, or on the edge of the drawing, any number of inches, divide one of them into twelve equal parts, numbering them 1, 2, 3, &c. Any part of the original which is six inches wide will in the drawing be represented by six of these divisions.

The brass or horn semicircle usually found in instrument boxes is called the PROTRACTOR; it is used in measuring and constructing angles. Thus, if the straight edge is placed against the line of the angle so that the mark in the middle of it touches the extreme point of the angle, the other line will be found to be at or near to some one of the figures in the semicircle, and this will indicate the number of degrees contained between the two lines; and the angle is then said to be of so many degrees.

"FRENCH CURVES" are rules cut into an almost endless number of shapes. They are used for inking curves which have been previously sketched by hand. To accomplish this, the curve must be turned about until some part of it corresponds exactly with the form already drawn, which may then be repeated by the draw-pen, guided by the French curve. These curves may be purchased for a few pence each; but the student is warned against making too frequent use of them, under the idea that the study of free-hand drawing is thus rendered unnecessary. On the contrary, there is such variety of form in drawing, that no mechanical means can possibly supersede the necessity for refined and accurate education of the eye which is obtained by that study; and, further, a little practice will enable the student to draw many curves by hand in less time than it would take to find their places in the French curve.

We do not in any way wish to recommend the instruments of any particular maker. The names of our best English makers are too well known to need mention here; nor can we pretend to suggest the prices which should be given, as this must of course depend on the means at the command of the purchaser. The *cheapest* sets are the *French* or Swiss, which for the price (from 1*s*. 6*d*. upwards) are quite as good as can be expected; but smallness of price is not always the test of cheapness, and a good article manufactured by, and bearing the name of, a respectable English house will be found to be by far the most economical in the end.

The T square, which is a most important adjunct in linear drawing, consists simply of two pieces of wood at right angles to each other. The best form is that in which the blade is screwed *across* the stock, not mortised into it. The advantage of this arrangement will be explained presently.

In using the T square, it should be placed so that the stock presses closely against the left edge of the drawing board, the blade stretching across the board in a direction parallel to the chest. The T square should not be used for lines at right angle to those thus drawn, for they would be thrown out by the smallest inaccuracies in the board, which, owing to the shrinking of the wood, are so likely to occur; and the perpendiculars should therefore be drawn by means of set squares placed against and moved along the edge of the blade of the T square.

SET SQUARES are pieces of thin wood, in the form of right-angled triangles. Two of these (they cost about 6*d*. each) will be useful to the student. The one is called "a set square of 45 degrees (45°)," because the two angles are 45° each, the third being a right angle, the form being in fact a half square, and the other is termed a "set square of 60°;" and it may just in this place be wise to mention, that as the one angle of this set square is a right angle 90° and the other 60°, the third will be 30°, for the angles of any triangle are together equal to 180°.

There is, however, another important use which may be made of a pair of set squares, namely, in drawing parallel lines. There is in most cases of instruments one called a PARALLEL RULE, made of two flat pieces of ebony or ivory, connected by two bars of brass. The student is not advised to use this in obtaining parallel lines, as unless the instrument be in very good order, and very carefully used, the lines drawn will not be parallel. The preferable way is to place a set square against the line to which it is required to draw parallels, and to place another square against the opposite edge of the first, which may then be moved along, care being taken to hold the lower square very tightly, in order to prevent it from slipping.

The HB pencil will be found the best for linear drawing, but the H may be used for very minute parts. The pencil work should be done as lightly as possible, and the lead on the surface should be removed by means of india-rubber, in order to prevent the grit getting between the nibs of the draw-pen.

All the pencil lines should be drawn past each other at the angles and intersections; for as the edge of the rule partially obstructs the view of the line during inking, the student is liable to pass over the point at which the lines should properly end. This annoyance is prevented by the pencil lines crossing at the exact point at which the pen is to stop.

The DRAWING BOARD consists of a simple board, clamped or otherwise protected against warping. The different kinds of boards are described in "The Grammar of Colour;" in which volume is also given the method of stretching paper for work which will occupy a long time, or which is to be executed in water-colours. This process will not however be required for the studies given in the present volume.

It cannot be too strongly impressed on the student that the instruments are merely tools, the mechanical agents through which the mind works; but the mere possession of instruments, however good they may be, will not constitute a draughtsman.

It has however already been pointed out, that the more the mind comprehends of the subject to be drawn, the more intelligent servants will the hands become, and the more accurately will they guide the instruments, which without such guidance will be useless. Geometrical drawing then should be looked on as a mental exercise as well as a merely manual occupation, giving us not only subject for thought and earnest reflection, but enabling us to communicate our designs and plans to others in such a manner that they can understand us, and work out our designs better than they could have done from the most eloquent verbal description.

Sir Joshua Reynolds has said, "A love of art, and a desire to excel, will often supply the place of genius;" and having a firm belief in this, we beg of the student not to say, "I have no talent, and therefore cannot learn to draw." All the genius in the world, if unaccompanied by application, would be of but little value to one who really wishes to excel in a definite course; whereas industry, perseverance, and patient study must unfailingly carry the true worker to a certain point in those departments of art, which depend not so much on imagination, as upon sound theoretical knowledge and practical skill.

We now proceed to show the methods of constructing geometrical figures, selecting such as may be of the greatest service to the Decorator and Letter-painter.

This course must however be considered as elementary only, and it is hoped that the student will pursue the subject with the aid of other works.*

* For a complete course of Practical Plane Geometry, see "Linear Drawing," by Ellis A. Davidson.

CHAPTER XXXV.

THE CONSTRUCTION OF GEOMETRICAL FIGURES.

Fig. 80. To bisect the line A B (viz. to cut it into two equal parts).

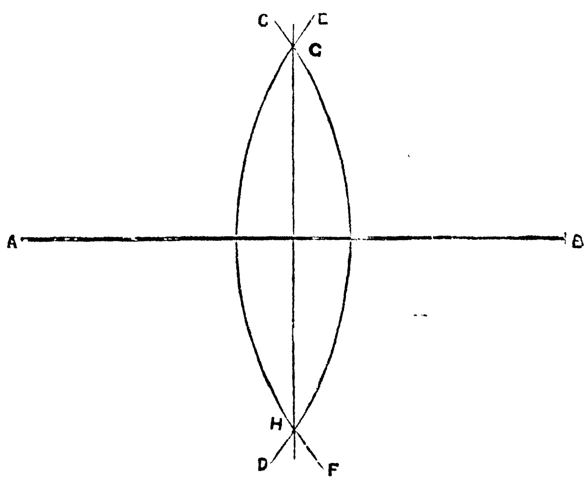


Fig. 80.

Use the compass having a pencil leg.

Place the steel point in A.

Open the compass until the distance between the points is much more than half the line (say to *a*).

Keep the steel point in A, and with the pencil point draw a part of a circle, C D.*

* A part of a circle is called an *arc.*

Place the steel point in B, and with the same length * in the compass draw E F, which will cut through C D in the points G and H.

Draw a line from G to H, which will cut the line A B into two equal parts.

Fig. 81. TO ERECT A PERPENDICULAR AT THE END OF THE LINE A B.

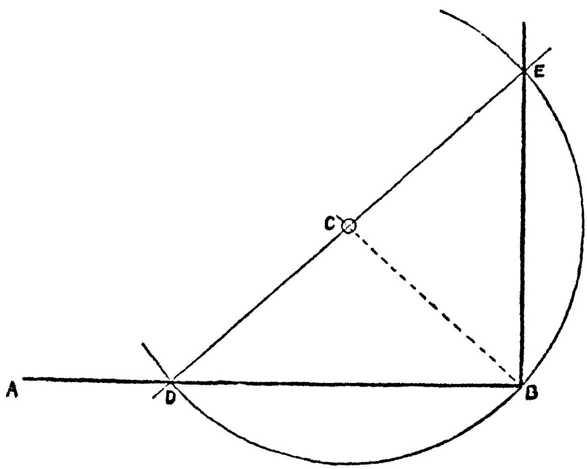


Fig. 81.

Place the steel point of the compass in any point above the line, as C.

Extend the pencil point until it reaches B. With the radius from C to B, draw a part of a circle cutting the line A B in the point D.

From D draw a line passing through C and cutting the arc in E.

Draw a line through E to B, which will be perpendicular to A B.

* The length with which a circle or part of a circle is struck, is called the *radius;* it is the length from the centre of a circle to its outer line or circumference.

Fig. 82. To ERECT A PERPENDICULAR FROM THE POINT C, which may be at the end, or at any other part, of a line, A B.

From C, with any radius, draw an arc, D *d*.

From D, with radius C D, draw an arc, cutting the arc D *d* in E.

From E, with the same radius, describe the arc C G, which will cut arc D *d* in F.

From F, with the same radius, describe the arc E H, cutting F G in I.

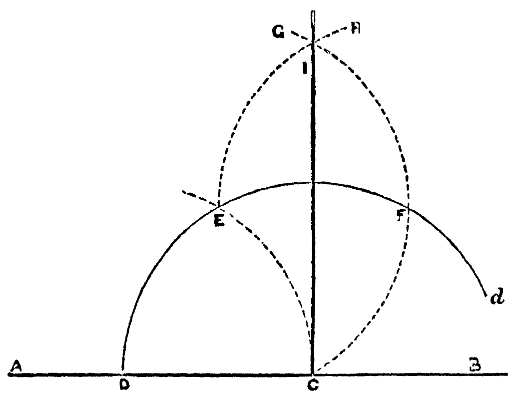


Fig. 82.

Draw a line through the point I to meet the point C, and this line will be the perpendicular required.

Fig. 83. To CONSTRUCT A SQUARE ON THE GIVEN LINE A B.

Make the perpendicular A C equal in length to A B. This is best done by using A as a centre, and A B as radius, then describing the arc (in this case a *quadrant*, or quarter of a circle) A C, which will cut off the perpendicular at the required length.

From B, with radius A B, describe an arc; and from C, with same radius, describe another arc, cutting the former one in D.

Draw the lines C D and D B.

Then A B C D will be a square on the given line A B.*

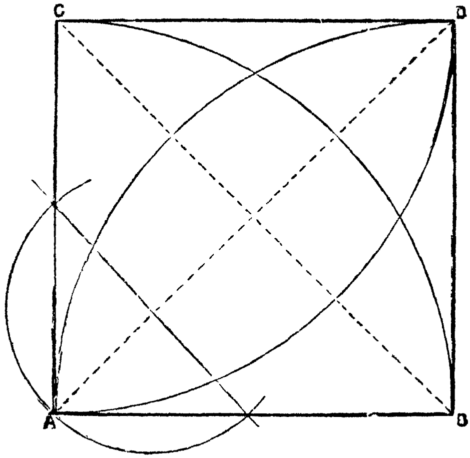


Fig. 83.

Fig. 84. To CONSTRUCT AN OBLONG OF A GIVEN SIZE (in this case $2\frac{1}{2}$ in. long, and $1\frac{1}{2}$ in. wide.)

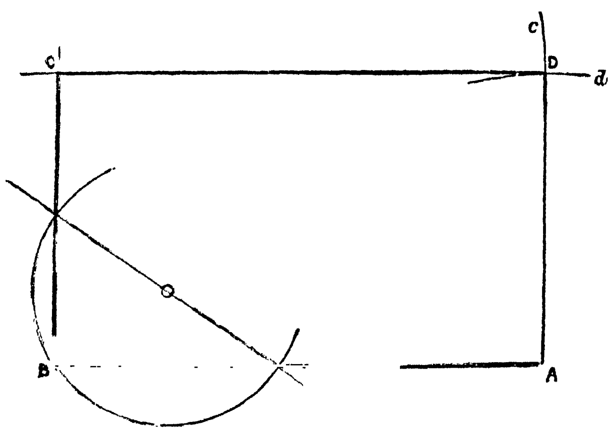


Fig. 84.

* In a square, all the four sides must be *equal*, and all the angles must be *right angles*. If both these conditions be fulfilled, both the

Draw the line A B $2\frac{1}{2}$ in. long.

At B erect the perpendicular B C $1\frac{1}{2}$ in. high.

From C, with radius A B, describe an arc (*c*).

From A, with radius B C, describe an arc (*d*) cutting the former arc (*c*) in D.

The lines C D and D A will complete the oblong (or rectangle) of the required dimensions.*

Fig. 85. TO DRAW A LINE PERPENDICULAR TO A B, FROM A POINT LYING AWAY FROM THE LINE, AS C.

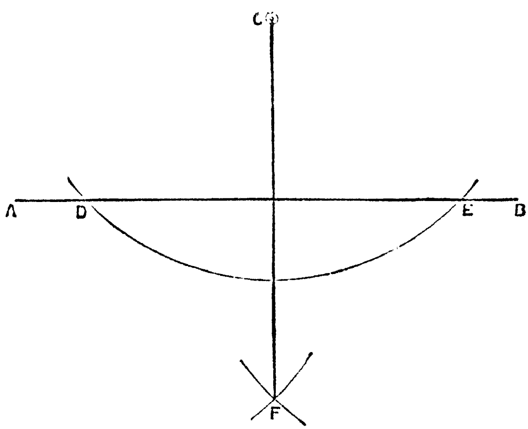


Fig. 85.

From C, with a radius rather shorter than from C to B, draw an arc, cutting A B in the two points D and E.

diagonals will be equal. *Diagonals* are lines crossing to opposite angles, as A D and B C.

* The greatest pains should be taken to acquire, from the first, the power of measuring with perfect accuracy, which is of the utmost importance in geometrical drawing when applied to trade purposes. In drawing, it is best to take the measurements with compasses from the rule. This is more likely to result in exact measurement, than laying down the rule on the paper and marking from it. The proper way to "put down" this measurement is $2\frac{1}{2}'' \times 1\frac{1}{2}''$. One dash (′) over a figure means *feet*, two dashes (″) mean inches: thus $2'\ 6'' \times 1'\ 8''$ signifies that the surface is 2 ft. 6 in. long, by 1 ft. 8 in. broad.

From D and E, with any radius, draw arcs cutting each other in F.

Draw C F, which will be perpendicular to A B.

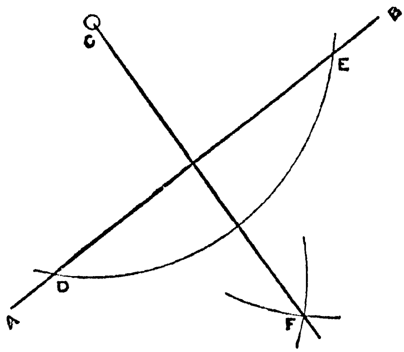


Fig. 86.

This mode would apply if the point C were *under* the line, or if A B were placed obliquely, etc. (as in Fig. 86).

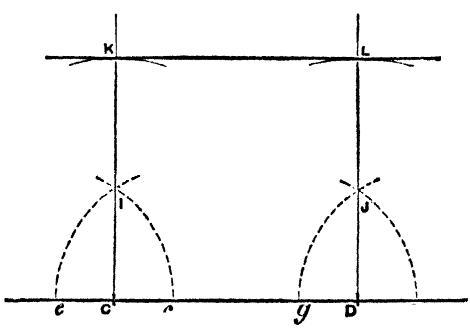


Fig. 87.

Fig. 87. TO DRAW A LINE PARALLEL* TO A B, AND AT A GIVEN DISTANCE FROM IT.

* *Parallel* means running in the same direction, and keeping the same distance apart from each other. For instance, the "ruts" or

Mark any two points on the line, viz. C and D.

Set off equal distances, *e f* and *g h*, on each side of C and D.

From *e f*, *g h*, with any radius, describe arcs cutting each other in I and J.

Draw lines from C and D through I and J.

On these perpendiculars set off from C and D the required distance between the parallels, viz. C K and D L.

Draw the line K L, which will be the required parallel.

Fig. 88. TO DIVIDE THE LINE A B INTO ANY NUMBER OF EQUAL PARTS (in this case seven).

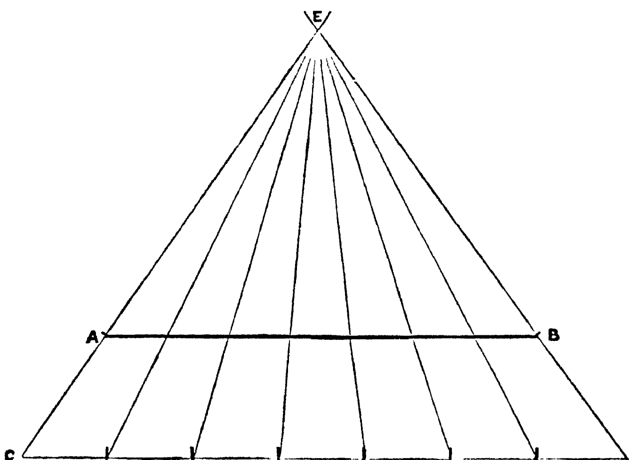


Fig. 88.

Draw a line C parallel to A B.

The line C may, for the present, be drawn of any length.

From C set off along this line the number of parts into which the line A B is to be divided, viz. 1 to 7.

marks on a road made by the wheels of a cart which has passed over it, are parallel, as are also the sides of a rectangular table.

These parts may be *any* convenient size, but must be all equal.

Draw C A and 7 B, and produce* both lines until they meet in E.

From each of the points, 1, 2, 3, etc., draw lines to the point E, which passing through A B will divide it into seven equal parts.

Fig. 89. To construct an EQUILATERAL TRIANGLE on the given line A B.

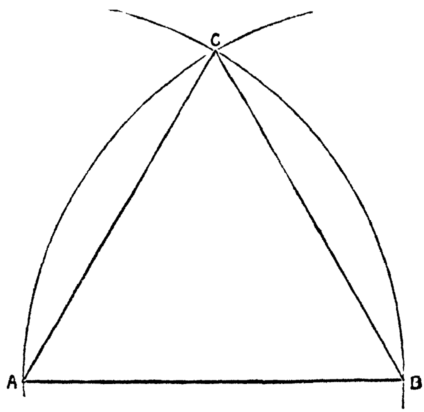


Fig. 89.

From A, with radius A B, describe an arc.

From B, with the same radius, describe a corresponding arc, cutting the former one in C.

Lines joining A C and B C will complete the triangle, which will be equilateral—that is, all its sides will be equal.

Fig. 90. To construct a TRIANGLE of given dimensions (in this case $2\frac{1}{2}''$, $2\frac{1}{4}''$, and $2''$).

Make A B $2\frac{1}{2}''$ long.

* To "produce" a line, signifies to prolong it in the same direction.

From B, with a radius of $2\frac{1}{4}''$, describe an arc.

From A, with a radius of $2''$, describe an arc, cutting the former one in C.

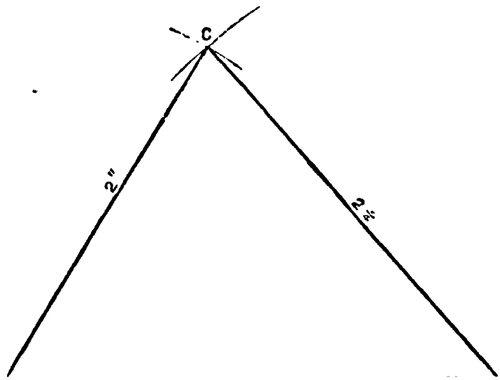


Fig. 90.

Draw A C and B C, which will complete the triangle of the required dimensions.

Fig. 91. TO BISECT AN ANGLE, A B C.

From B, with any radius, describe an arc, cutting the

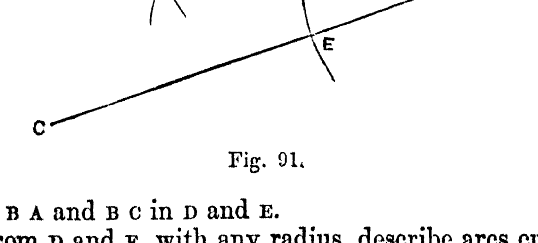


Fig. 91.

lines B A and B C in D and E.

From D and E, with any radius, describe arcs cutting each other in F.

Draw B F, which will bisect the angle.

Fig. 92. To INSCRIBE A CIRCLE IN THE TRIANGLE A B C.

Bisect any two of the angles.

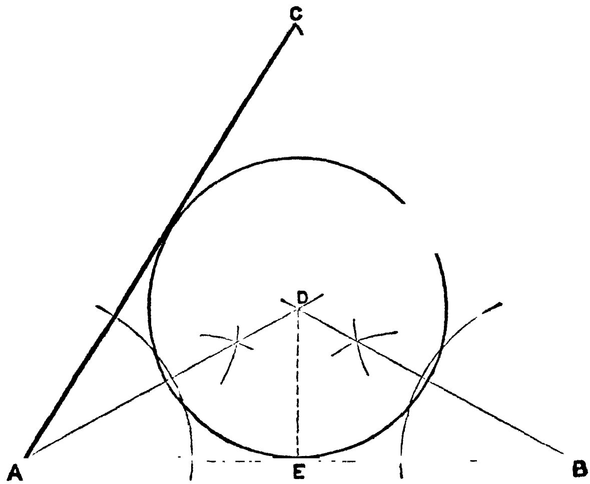


Fig. 92.

Produce the bisecting lines until they meet in D.

From D, with radius D E, a circle may be described, which will touch all three *sides* of the triangle.

Fig. 93. To DRAW A CIRCLE THROUGH THREE POINTS, HOWEVER PLACED (provided they be not in a straight line).

Let A B and C be the three given points.

Join A B and B C.

Bisect A B and B C, producing the bisecting until they meet at D.

D will then be equally distant from each of the three points.

Therefore, a circle may be drawn from D, with radius D A, D B, or D C, which will pass through A B and C.

This problem serves also for describing a circle to touch the three *angles* of a triangle, it being evident

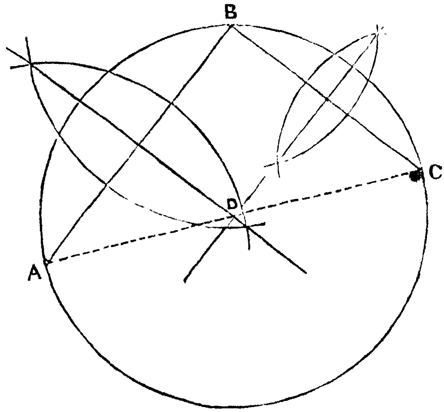


Fig. 93.

that a line connecting A with C, in addition to those at A B, B C, would convert the figure into a triangle.

Fig. 94. To construct on the given line D E, an ANGLE similar to the angle A B C.

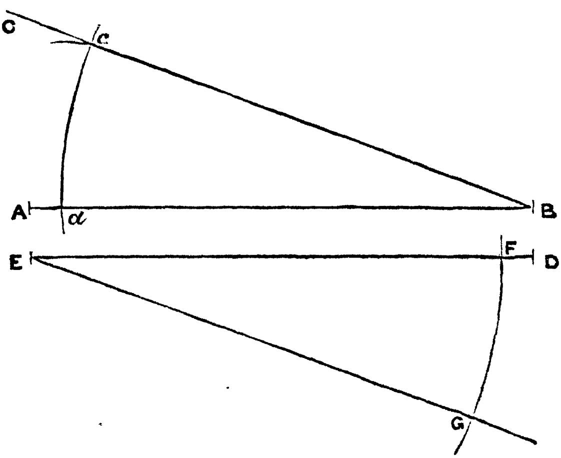


Fig. 94.

From B, with any radius, describe an arc cutting the sides of the angle in *c* and *d*.

From E, with the same radius, describe an arc cutting E D in F.

Measure the length from point *c* to *d*.

Mark off the same on the arc from F, viz., to point G.

Draw a line from E through G.

The angle F E G will be equal to A B C.

Fig. 95. ON THE GIVEN LINE A B, TO CONSTRUCT A TRIANGLE SIMILAR* TO C D E.

At A, construct an angle similar to the angle H C G, viz., J A I.

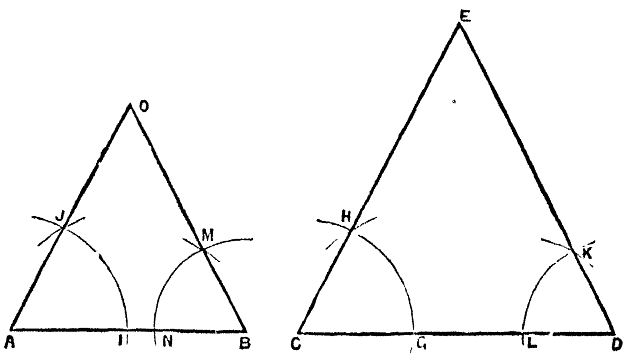


Fig. 95.

At B construct an angle similar to the angle K D L, viz., M B N.

Produce the lines A J and B M until they meet in O, which will complete the triangle required.

* The terms similar and equal, when applied in geometrical drawing, signify, the former, that the figure is of the same shape as another; the latter, that it contains precisely the same space or area. When employed together, the figure in question is understood to be of both the same size and shape as the one with which it is compared.

Fig. 96. To CONSTRUCT A SQUARE ON A GIVEN DIAGONAL A B.

Bisect the diagonal A B in the point C.

From C, with radius C A, describe a circle cutting the bisecting line in D and E.

Draw A D, D B, B E, E A, which will complete the square on the given diagonal A B.

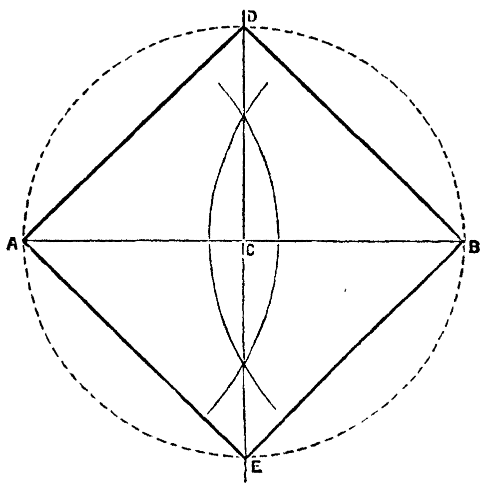


Fig. 96.

Fig. 97. To DESCRIBE A SQUARE ABOUT A CIRCLE.

Draw two diameters, A B and C D, at right angles to each other.

From A and C, with radius equal to the radius of the circle (O A), describe arcs cutting each other in E.

From B C D and D A, with same radius, describe arcs cutting each other in F, G, and H.

Draw E F, F G, G H, and H E, which will complete the square about the circle.

Fig. 98. To describe a CIRCLE about the square A B C D.

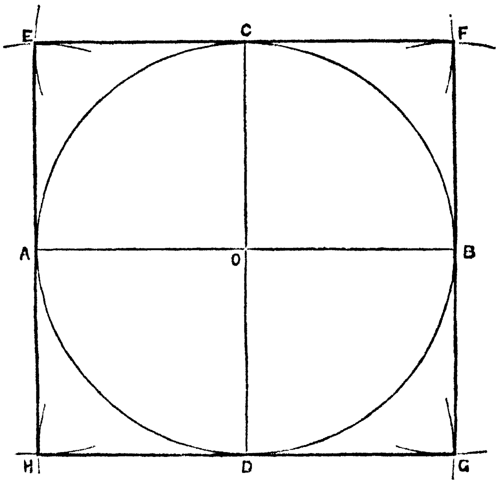


Fig. 97.

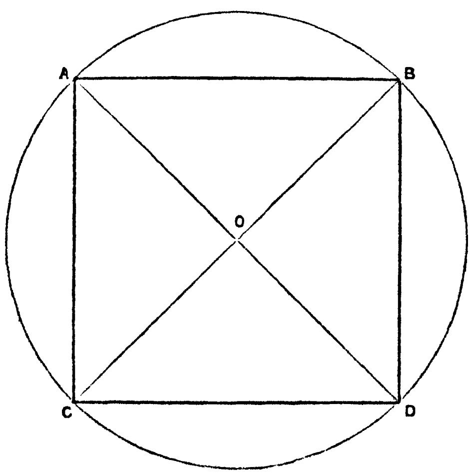
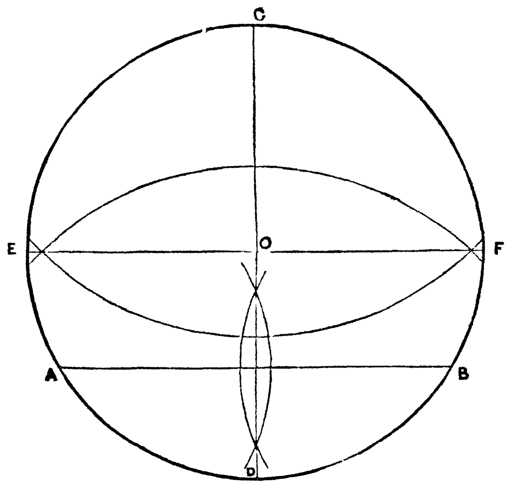


Fig. 98.

Draw the diagonals A D and B C.

From their intersection (O), with radius O A, O B, O C or O D, describe the circle touching the four angles of the square.

Fig. 99. TO FIND THE CENTRE OF A CIRCLE.



Draw a chord,* as A B, and bisect it by a line cutting the circle in C and D.

Bisect C D by the line E F.

The intersection O is the centre of the circle.

Fig. 100. TO INSCRIBE A SQUARE IN A CIRCLE.

Find the centre of the circle, and draw two diameters at right angles to each other.

* The term *Chord* is applied to a line cutting off any part of a circle; this part is called a *Segment*, and that contained between two radii (as D O E in Figure 98) is distinguished by the name of *Sector*.

From their extremities draw lines A B C D, which will form the required square in the circle.

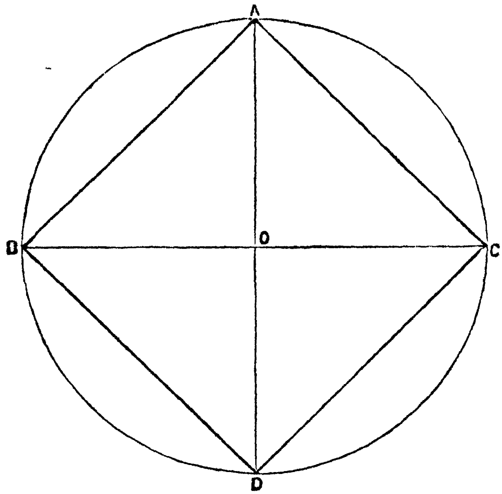


Fig. 100.

Fig. 101. TO INSCRIBE A SQUARE IN ANY TRIANGLE, AS A B C.

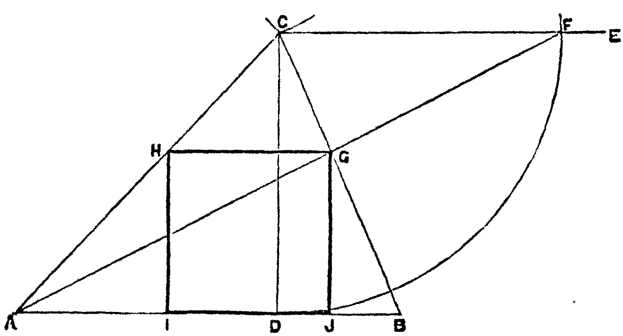


Fig. 101.

From C drop the perpendicular, C D.
From C draw a line parallel to A B, viz., C E.

From C, with radius C D, describe a quadrant cutting C E in F.

Draw F A, cutting C B in G.

From G draw G H parallel to A B.

From G and H, draw lines (H I and G J) which will complete the square in the triangle.

Fig. 102. TO INSCRIBE A SQUARE IN A GIVEN TRAPEZIUM, A B C D.

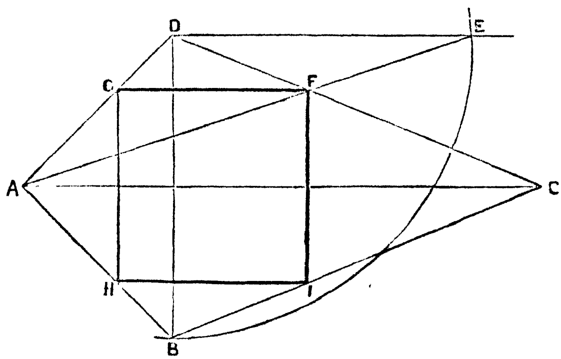


Fig. 102.

Draw the diagonals A C and B D.

Draw D E at right angles and equal to D B.

Draw E A, cutting C D in F.

Draw F G parallel to A C.

Draw G H and F I parallel to D B.

Join H I, which will complete the square in the trapezium.

Fig. 103. TO INSCRIBE A CIRCLE IN A GIVEN TRAPEZIUM (A B C D) OF WHICH THE ADJACENT SIDES ARE EQUAL.

Draw the diagonal A B, which will bisect the angles C B D or C A D.

Bisect the angle A D B.

Produce the bisecting line until it cuts A B in O.

Then O is the centre from which a circle may be described, touching all four sides of the trapezium.

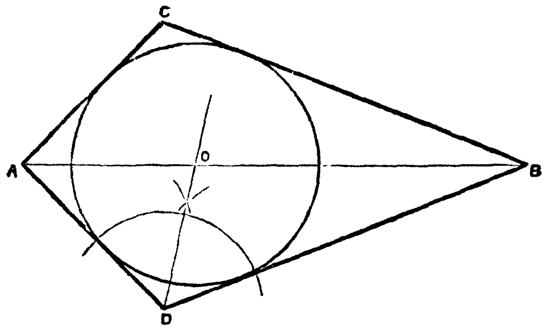


Fig. 103.

Fig. 104. TO TRISECT A RIGHT ANGLE, A B C.

From B, with any radius, describe the quadrant D E.

From D, with radius D B, describe an arc cutting E D in F.

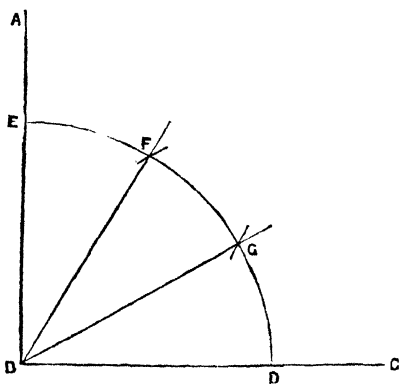


Fig. 104.

From E, with the same radius, describe an arc cutting E D in G.

Draw lines B F and B G, which will trisect the right angle.

Fig. 105. THE MEASUREMENT OF ANGLES.

Angles are estimated according to the position which the two lines of which they are formed occupy as radii of a circle.

The circle being divided into 360 equal parts, called "degrees," it will be evident that the lines A O C contain 90 degrees (written 90°), or a right angle.

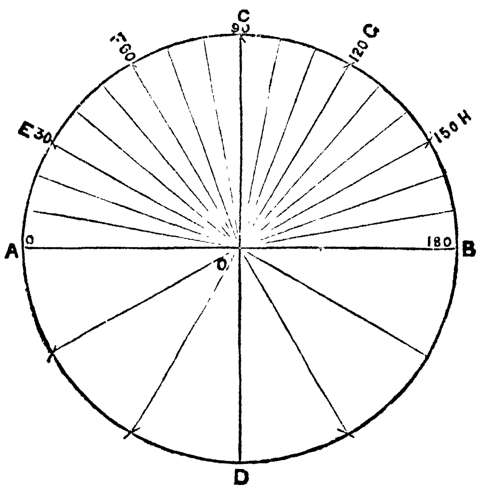


Fig. 105.

Similarly B O C, D O B, and D O A are right angles.

Now, if these right angles be trisected (as per last problem), each of the divisions will contain 30°, thus—

A O E	is an angle of	30°
A O F	,,	60°
A O C	,,	90°
A O G	,,	120°
A O H	,,	150°

A O B is, in reality, not any angle at at all, being a perfectly straight line; but the slightest divergence from it would cause it to become an angle, as 179°, etc.

Each of these angles being again divided into three parts will give tens, which may again be divided into units; and thus angles may be constructed or measured with the greatest accuracy.

Fig. 106. WITHIN THE GIVEN SQUARE A B C D, TO INSCRIBE THE LARGEST EQUILATERAL TRIANGLE IT WILL CONTAIN.

Trisect the right angle D A B.

Bisect the angles E A F and G A H by the lines A I and A J.

Join I J. Then A I J is the largest Equilateral Triangle that can be contained in the square A B C D.

The principle on which this construction is based, is, that as the angle of the square is 90°, and that of the

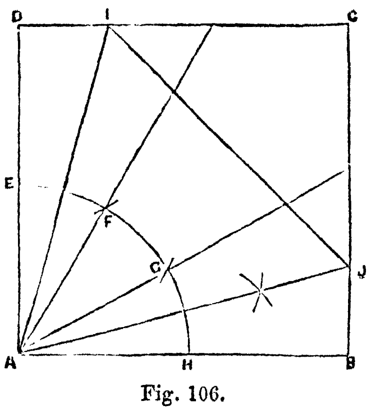


Fig. 106.

Equilateral Triangle is 60°, there is an overplus of 30°. If then the two outer angles (E A F and G A H) which are each 30° are bisected, and half of each (15°) added to the angle F A G (30°), an angle of 60° is obtained centrally placed, leaving 15° on each side. It will be seen that the sides of the Equilateral Triangle are larger than those of the containing square.

Fig. 107. To construct an EQUILATERAL TRIANGLE of the given altitude A B.

At A and B draw lines C D and E F at right angles to A B.

From A, with any radius, describe the semicircle G H.

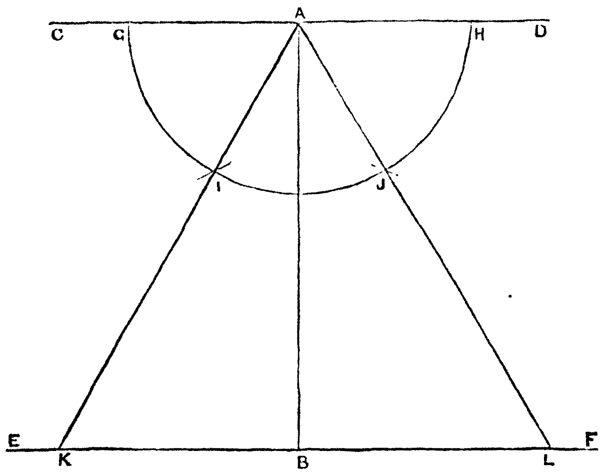


Fig. 107.

From G and H, with radius A G, cut the semicircle in I and J.

From A, draw lines through I and J, cutting E F in K and L.

A K L will be the equilateral triangle of the required altitude.

Fig. 108. To draw a TANGENT* to a circle at the given point C.

(1.) Draw a radius from the centre O to the point C.

At C construct a right angle, O C D.

* A *Tangent* is a straight line which touches a circle at one point, but does not cut off any portion of the circumference. *A tangent is always at right angles to the radius drawn from the point at which it touches.*

Then D C is the required tangent.

Or (2.) let E be the given point.

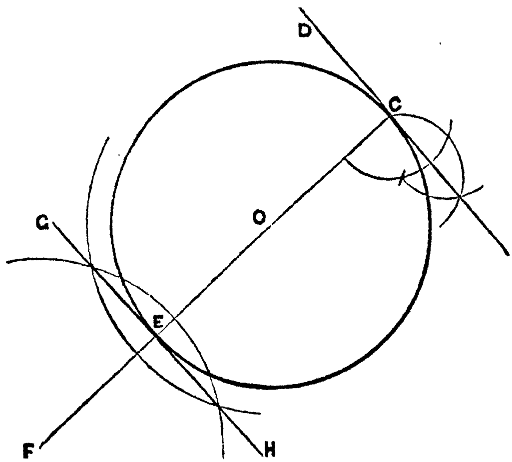


Fig. 108.

Draw radius O E, and produce until E F equals E O. Bisect F O by the line G H, which will be the tangent required.

Fig. 109. TO CONSTRUCT AN EQUILATERAL TRIANGLE ABOUT A GIVEN CIRCLE.

From any point in the circle, as A, with a radius equal to the radius of the circle, describe an arc cutting the periphery* in B and C.

From B and C, with radius B C, cut the periphery in D.

(It will be seen that if B C, B D, and D C, are joined, an Equilateral Triangle will be *inscribed* in the circle.)

From B and C, with radius B C, describe arcs cutting each other in E.

* The *Periphery* is the circumference or boundary line of a circle, ellipse, or any other curvilineal figure.

From B and D, with the same radius, describe arcs cutting each other in G.

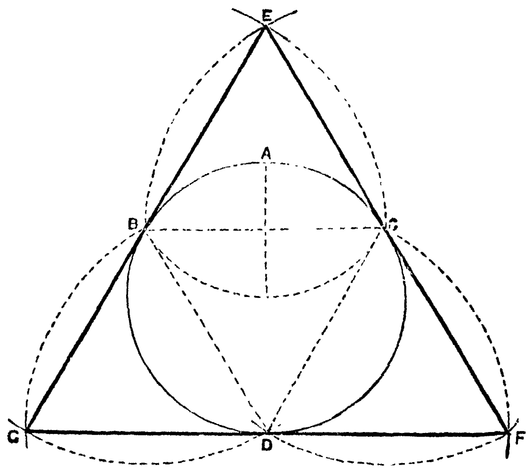


Fig. 109.

From D and C, with same radius, describe arcs cutting each other in F.

Join F G, F E, and G E, which will complete the triangle about the circle.

CHAPTER XXXVI.

THE CONSTRUCTION OF GEOMETRICAL FIGURES.—
(Continued.)

Fig. 110. TO CONSTRUCT A REGULAR POLYGON*—IN THIS CASE A PENTAGON—ON THE GIVEN LINE A B.

Produce A B on each side.

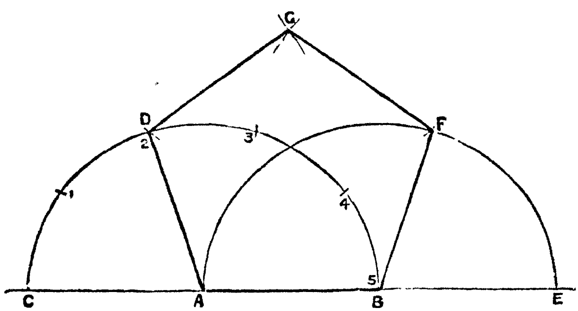


Fig. 110.

From A, with radius A B, describe a semicircle cutting A B, produced in C.

* A figure having more than four sides.

A polygon	having	5	sides is	called a	Pentagon.
"	"	6	"	"	Hexagon.
"	"	7	"	"	Heptagon.
"	"	8	"	"	Octagon.
"	"	9	"	"	Nonagon.
"	"	10	"	"	Decagon.

When all the sides are equal the figure is said to be *regular*.

Divide the semicircle into five equal parts.

From A, draw A D, to the *second* division.

From B, with radius B A, describe a semicircle cutting A B, produced in E.

From E, mark on this semicircle the length of the arc C D, viz., to F.

From D and F, with radius A B, describe arcs cutting each other in G.

Draw D G and F G, which will complete the Pentagon on A B.

The above mode being a *general* one, any other polygon may be similarly constructed: thus, by dividing the semicircle into seven equal parts, a heptagon will be obtained; into eight, an octagon, and so on. It must, however, be remembered, that whatever the number of parts, the line A D must *always* be drawn to the *second* division.

Fig. 111. TO INSCRIBE A REGULAR POLYGON—IN THIS CASE A PENTAGON—IN A GIVEN CIRCLE.

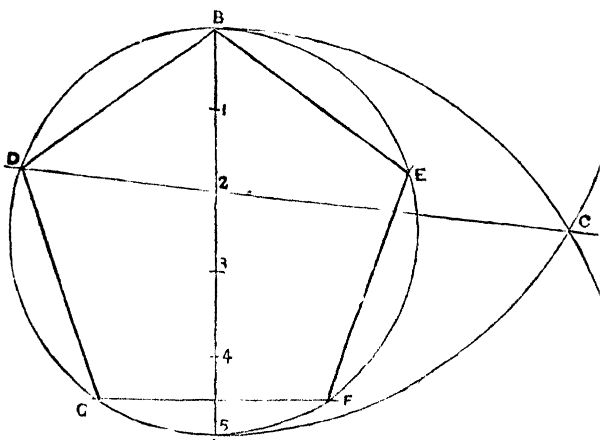


Fig. 111.

Draw the diameter A B, and divide it into five equal parts.

From A and B, with radius A B, describe arcs cutting each other in C.

From C, draw a line passing through the *second* division, and cutting the circle in D.

Draw D B, which will be one side of the polygon.

Set off the length D B round the circle, viz., E F G. Join these points, and thus complete the figure.

As in the preceding problem any polygon may be thus formed, the diameter in this case being divided into the number of parts corresponding with the sides of the required polygon. It is, however, indispensable that the line C D be drawn through the *second* division.

Fig. 112. TO INSCRIBE A REGULAR PENTAGON IN A CIRCLE, BY A SPECIAL METHOD.

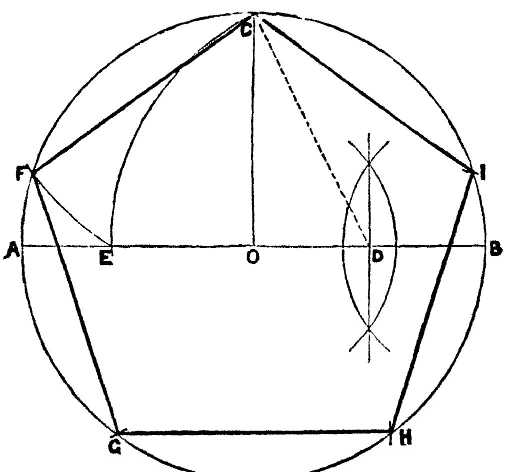


Fig. 112.

Draw the diameter A B.

At O, erect a perpendicular, O C.

Bisect O B, in the point D.

From D, with radius D C, describe an arc cutting A B in E.

From C, with radius C E, describe an arc cutting the circle in F.

Draw C F, which will be one side of the Pentagon.

Set off the length C F, round the circle, viz., G, H, I.

Draw lines F G, G H, H I, and I C, which will complete the figure.

Fig. 113. TO CONSTRUCT A REGULAR HEXAGON ON THE GIVEN LINE A B.

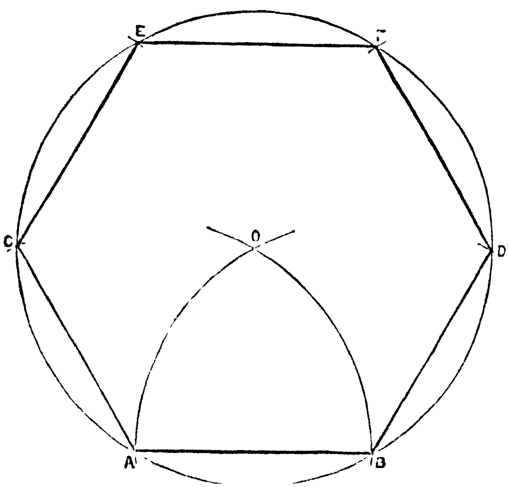


Fig. 113.

From A and B describe arcs cutting each other in O.

From O, with radius O A or O B, describe a circle.

The radius with which a circle is struck will divide it into six equal parts, therefore set off the length O A, which is equal to A B, round the circle, viz., C E F D.

Join A C, C E, E F, F D, and D B, when a regular Hexagon will be formed.

Fig. 114. To construct a regular OCTAGON on the given line A B.

Produce A B, on each side.

Erect perpendiculars at A and B.

From A and B, with radius A B, describe the quadrants C D and E F.

Bisect these quadrants, then A G and B H, will be two more sides of the Octagon.

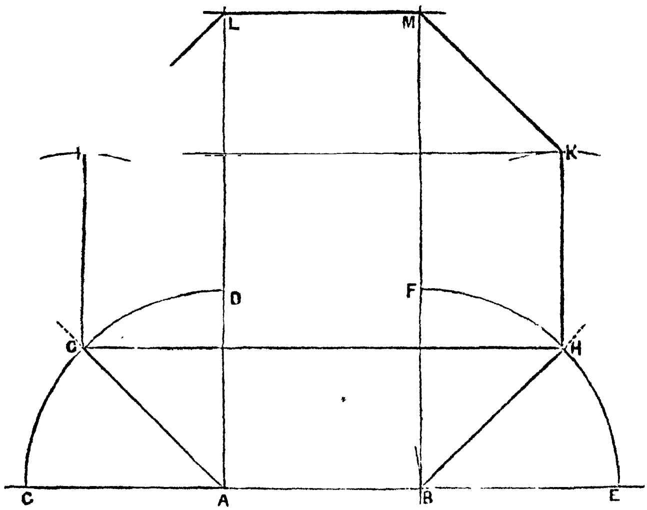


Fig. 114.

At H and G draw perpendiculars, G I and H K, equal to A B.

Draw G H, and I K.

Make the perpendiculars A and B equal to G H or I K, viz., A L and B M.

Draw I L, L M, and M K, which will complete the Octagon.

Fig. 115. To inscribe an OCTAGON in the square A B C D.

Draw diagonals, A D, and C B, intersecting each other in O.

From A, B, C, and D, with radius equal to A O, describe quadrants cutting the sides of the square in E, F, G, H, I, J, K, L.

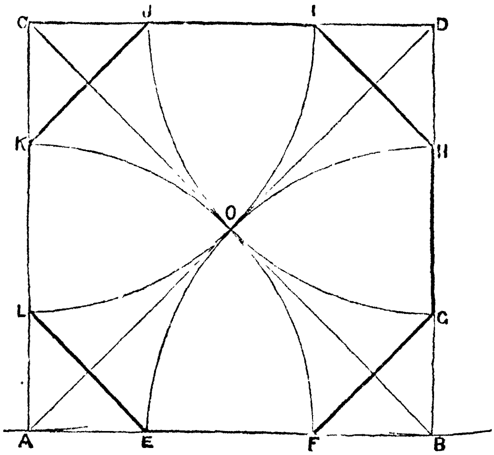


Fig. 115.

Join these points, and an Octagon will be inscribed in the square.

Fig. 116. To INSCRIBE AN OCTAGON IN A GIVEN CIRCLE.

Draw the diameter A B, and bisect it by C D.
Bisect the quadrants A C, C B, A D, and B D, in the points E F G H.
Draw lines connecting all the eight points, which will complete the required Octagon.

Fig. 117. To INSCRIBE THREE EQUAL CIRCLES IN A GIVEN CIRCLE.

At any point, as A, draw a tangent, and A G, at right angles to it.
From A, with radius O A, cut the circle in B and C.

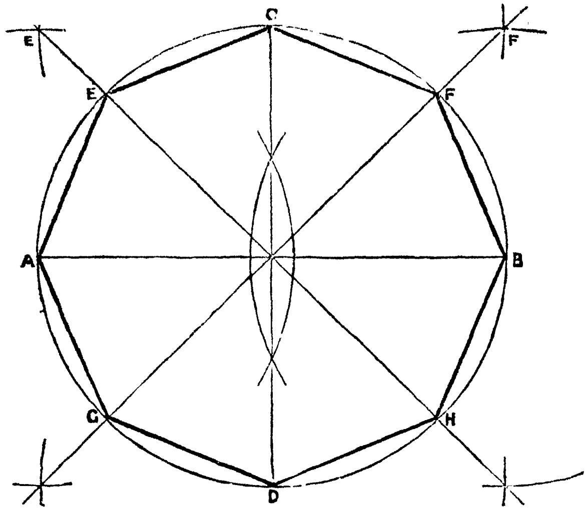


Fig. 116.

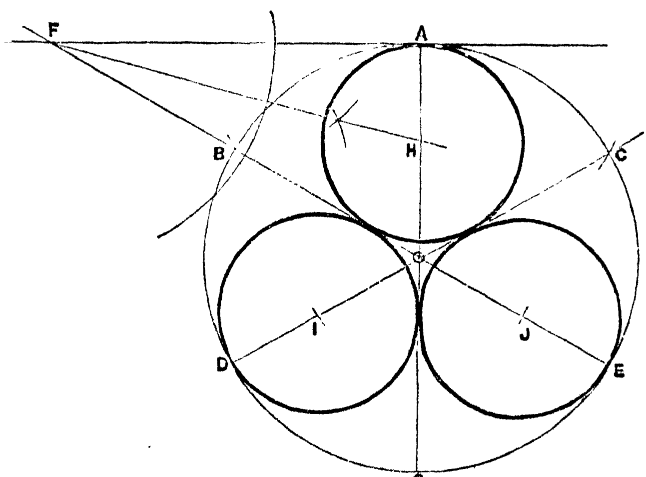


Fig. 117.

From B and C, draw lines through O, cutting the circle in D and E, and the tangent in the point F.

Bisect the angle at F, and produce the bisecting line until it cuts A G in H.

From O, with radius O H, cut the lines D C and E B in I and J.

From H, I, and J, with radius H A, draw the three required circles, each of which should touch the other two and the outer circle.

Fig. 118. To INSCRIBE FOUR EQUAL CIRCLES IN A GIVEN CIRCLE, EACH TOUCHING TWO OTHERS AND THE CONTAINING CIRCLE.

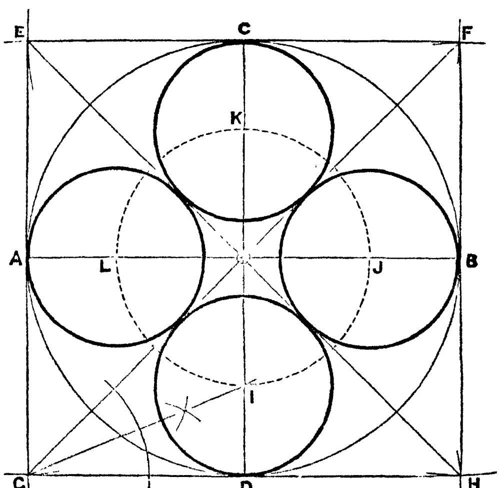


Fig. 118.

Draw the diameters A B and C D, at right angles to each other.

From A B C D, with radius of the circle, describe arcs cutting each other in E, F, G, and H.

Join these points, and a square will be described about the circle.

Draw the diagonals E H and G F.

Bisect the angle O G D, or either of the others, and produce the bisecting line until it cuts C D in I.

From O, with radius O I, describe a circle cutting the lines A B and C D in J K and L.

From these centres, with radius I D, describe the four required circles.

Fig. 119. TO INSCRIBE SEVEN EQUAL CIRCLES IN A GIVEN CIRCLE.

Round the circumference of the circle set off the radius, thus dividing it into six equal parts, A, B, C, D, E, F, and draw the radii.

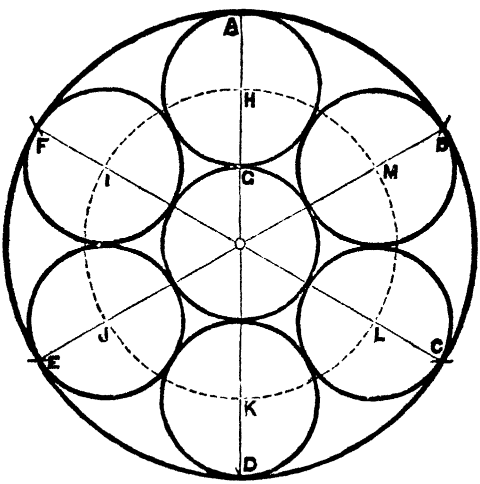


Fig. 119.

Divide one of the radii, as O A, into three equal parts, viz., O G, G H, and H A.

From O, with radius O G, describe the central circle.

From O, with radius O H, describe a circle which, cutting the radii, will give the points I, J, K, L, and M.

From these points, with radius O G, describe the six circles, each of which will touch the central circle, two others, and the containing circle.

Fig. 120. To DRAW A PERFECT ELLIPSE BY MEANS OF A PIECE OF STRING AND PINS; a method of great service to painters, and to artisans generally.

Place the given diameters A B and C D, at right angles to each other at their centres E.

From C, with radius E A, cut the long diameter in F F.

These two points F F, are called the "foci" of the ellipse.

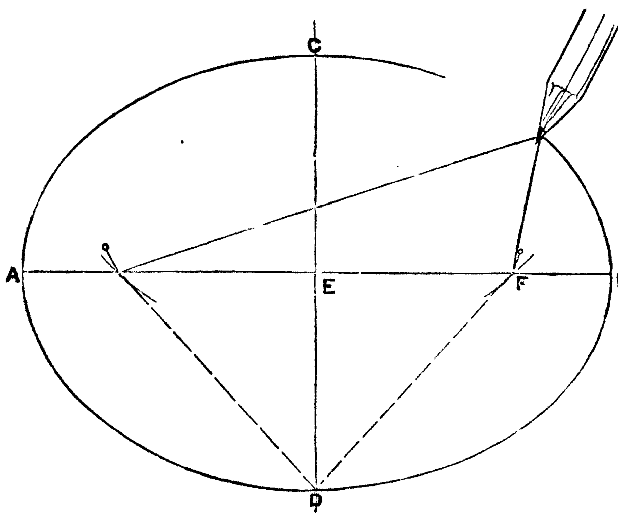


Fig. 120.

Place a pin in each of these, and another in D. Pass a string round the three pins, and tie it securely, thus forming a triangle of string, F, F, D.

Take out the pin at D, and substitute a pencil, which may be drawn along, moving within the loop, and the point will thus trace a perfect ellipse.

Fig. 121. To DRAW AN ELLIPSE; THE DIAMETERS A B AND C D BEING GIVEN.

Place the diameters A B and C D, at right angles to each other, intersecting in E.

Find the foci F, F, as in the last figure.

Between E and F, mark off any number of points, as 1, 2, 3, 4, 5.

It is advisable that these points should be nearer together as they approach F.

From F, F, with radius 1 A, describe the arcs G, G; G, G.

From F, F, with radius 1 B, describe the arcs H, H; H, H.

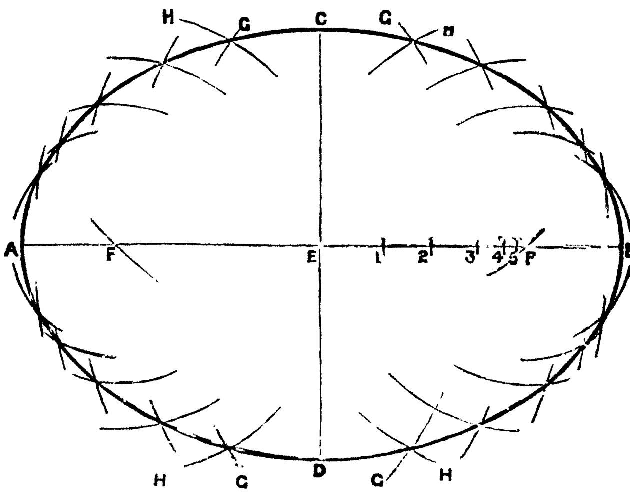


Fig. 121.

The arcs H, H; H, H, will intersect the arcs G, G; G, G in I, I; I, I, and these will be four points in the curve.

Proceed to strike arcs from F F, first with 2 B, and then with 2 A, and these intersecting will give four more points.

When arcs have been struck with the lengths from all the points to A and B, the curve of the Ellipse must be traced by hand through the intersections.

Fig. 122. TO CONSTRUCT A SEMI-ELLIPTICAL ARCH, OF WHICH A B IS THE SPAN, AND C D THE HEIGHT.

At A and B erect perpendiculars, and at D draw a horizontal, thus constructing the rectangle A B F E.

Divide C A, and C B, into any number of equal parts.

Divide A E, and B F, into a corresponding number of equal parts.

Number the parts as in the figure.

Produce D C, and make C G, equal to C D.

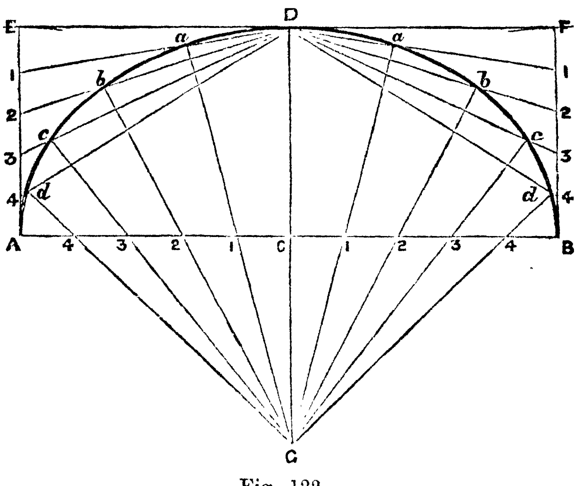


Fig. 122.

From D, draw lines to the points, 1, 2, 3, 4, 5, in the lines E A and F B.

From G, draw lines through the points 1, 2, &c., in the line A B, and produce these lines until they cut those of corresponding numbers drawn from D, to the points in the lines E A and F B.

Thus :—	G 1	will	cut	D 1	in	*a*.
,,	G 2	,,	,,	D 2	,,	*b*.
,,	G 3	,,	,,	D 3	,,	*c*.
,,	G 4	,,	,,	D 4	,,	*d*.

The curve is to be drawn through these intersections.

Strictly speaking, no portion of an ellipse is a part of a circle, and the curve cannot therefore be drawn with compasses so as to be mathematically correct; there are, however, many ways in which figures nearly approximating to ellipses may be drawn by arcs of circles; and as these are very useful for general practical purposes, the following three methods are given.

Fig. 123. To DESCRIBE AN ELLIPTICAL FIGURE WHEN ONE DIAMETER, A B, IS GIVEN.

Divide A B into four equal parts.

From C and D, with radius C A or D B, describe circles touching each other in E.

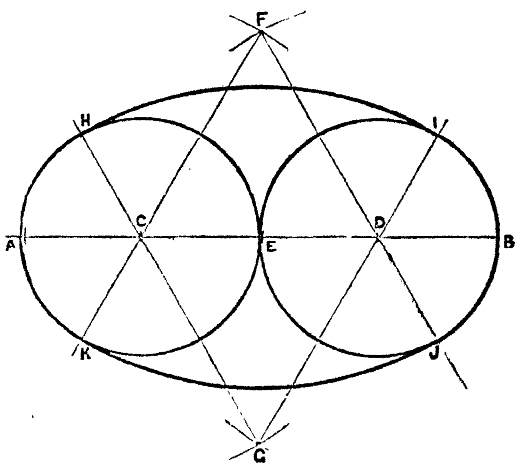


Fig. 123.

From C and
each other in F D, with radius C D, describe arcs cutting
Draw lines G and G.
until they cut the G D, F C, and F D, and produce them
From F and circles in H, I, J, and K.
uniting H with G, with radius F K or G I, draw arcs
the figure. I, and J with K, which will complete

Fig. 124. To construct an ELLIPTICAL FIGURE by means of arcs of circles.

Place the two given diameters, A B and C D, at right angles to each other, at their centres E.

From A, set off A F, equal to C D.

Divide F B into three equal parts (1, 2, 3)

Set off two of these parts on each side of E, viz., E G and E G.

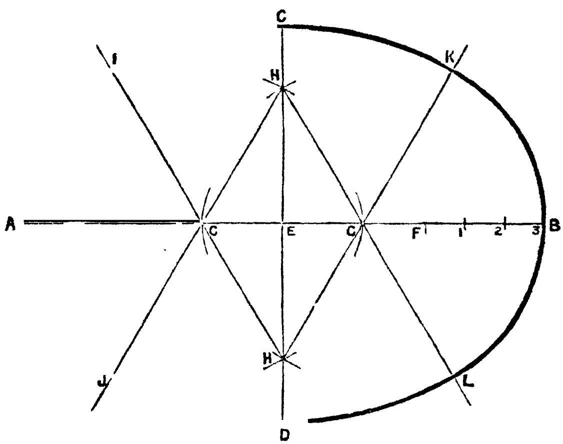


Fig. 124.

From G, G, with radius G, G, describe arcs cutting each other in H, H.

From H, H, draw lines through G, G, and produce them.

From H, H, with radius H C, or H D, describe arcs meeting the lines drawn from H, H, in I, J, K, and L.

From G and G, with radius G B, describe arcs meeting the points I, J, K, L, which will complete the figure.

Fig. 125. To construct an ELLIPTICAL FIGURE by means of two squares, A B C D, and B D E F.

Draw diagonals in each of the squares, intersecting each other in G and H.

From B, with radius B C, describe the arc C E.

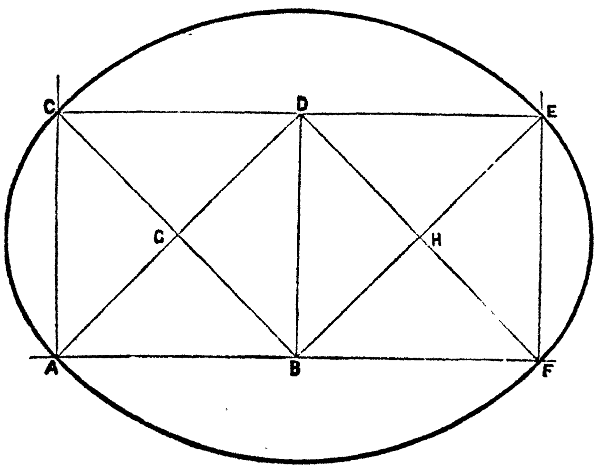


Fig. 125.

From D, with the same radius, describe the arc A F.

From G, with radius G C, describe the arc C A.

From H, with the same radius, describe the arc E F, which will complete the figure.

Fig. 126. To construct an OVAL, the width, A B, being given.

Bisect A B by the line C D, cutting A B in E, and from E, with radius E A, draw a circle cutting C D in F.

From A and B, draw lines through F, and produce them indefinitely.

From A and B, with radius A B, draw arcs cutting the last two lines in G and H.

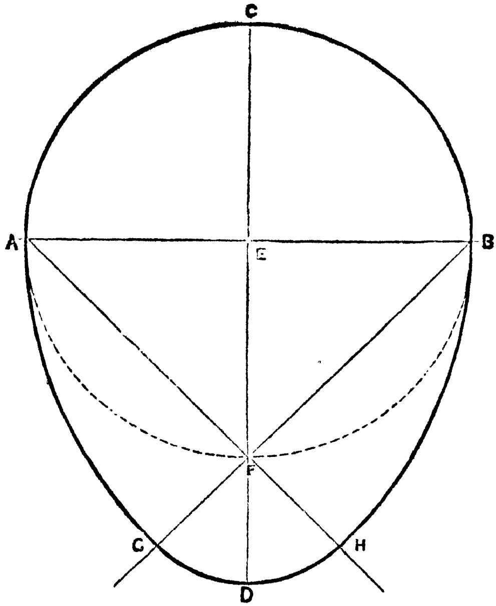


Fig. 126.

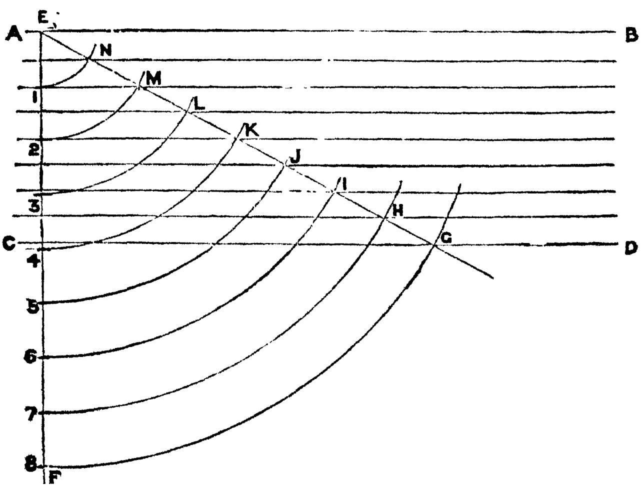


Fig. 127.

From F, with radius F G, describe the arc G H, to meet the arcs A G and B H, which will complete the figure.

Fig. 127. To DIVIDE THE SPACE CONTAINED BETWEEN THE LINES A B AND C D, INTO EQUAL PARTS, BY MEANS OF LINES PARALLEL TO A B.

Draw the line E F, perpendicular to A B, and set off on it equal lengths corresponding to the number of spaces with which A, B, C, D, is to be divided, viz., 1 to 8. These spaces may be *any* size, but must be *equal.*

From E, with radius E 8, describe an arc cutting C D in G.

Draw E G.

From E, with radius E 7, E 6, E 5, etc., describe arcs cutting E G in H, I, J, K, L, M and N.

Draw lines parallel to A B through these points, and the space will be divided as required.

Fig. 128. To DRAW A CIRCLE OF A GIVEN RADIUS, WHICH SHALL TOUCH ANOTHER GIVEN CIRCLE AND A STRAIGHT LINE.

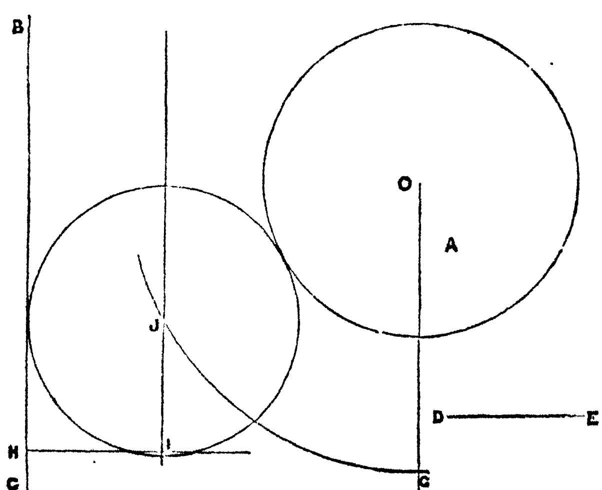


Fig. 128.

Let A be the given circle, B C the straight line, and D E the radius of the required circle.

From O, the centre of the given circle, draw a radius, and produce it.

From the periphery * of the circle, and on this radius, set off F G, equal D E.

From O, with radius O G, describe an arc.

At any point, as H, draw a line at right angles to B C, and equal to D E, viz., H I.

From I, draw a line parallel to B C, cutting the arc drawn from O in J.

From J, with the required radius, describe a circle, which will touch the given circle and straight line.

Fig. 129. TO DRAW A CIRCLE OF A GIVEN RADIUS D E, WHICH SHALL TOUCH BOTH LINES OF AN ANGLE A B C.

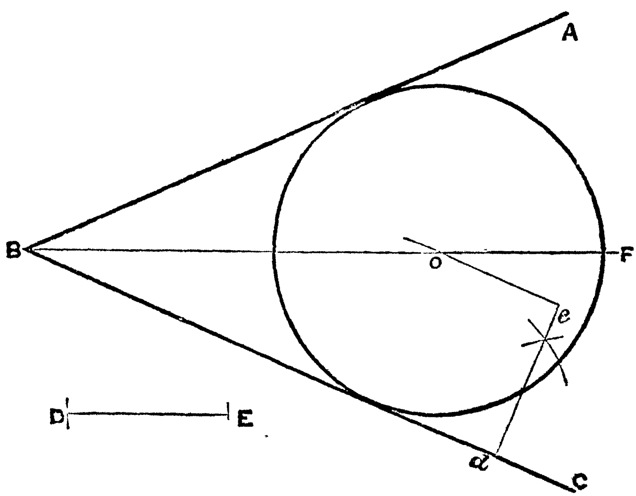


Fig. 129.

Bisect the angle by the line B F.

On either of the lines of the angle erect a perpendicular equal to the given radius D E, viz., *d e*.

* Periphery, the circumference or bounding-line of a circle.

From *e*, draw a line parallel to B C, cutting the bisecting line in O.

From O, with the given radius, draw the circle, which will touch both the lines of the angle.

Fig. 130. To DRAW A CIRCLE WHICH SHALL TOUCH BOTH LINES OF AN ANGLE, AND SHALL PASS THROUGH A GIVEN POINT P.

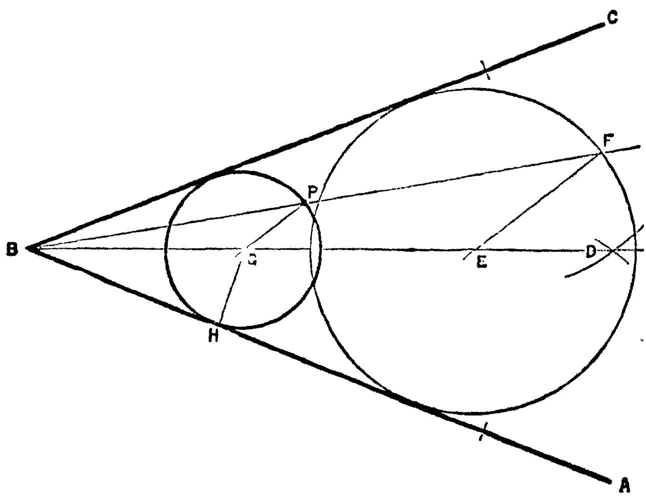


Fig. 130.

Let A B C be the given angle, and P the given point, through which the required circle is to pass.

Bisect the angle A B C, by the line B D.

From any point in B D, as E, draw a circle, touching both lines forming the angle.

From B, draw a line through P, cutting this circle in F.

Join F to E, the centre of the circle.

From P, draw a line parallel to F E, cutting B D in G.

From G, draw a line perpendicular to A B, viz., G H.

Then, with radius G H, which will be found equal to G P, describe a circle which will touch both lines forming the angle.

CHAPTER XXXVII.

ELEMENTARY PERSPECTIVE, SPECIALLY ADAPTED FOR LETTER AND SIGN PAINTERS.

In our lessons in Practical Geometry we have shown the construction of plane figures, namely, such as are supposed to consist of length and breadth only, or at least to have so little thickness that it cannot be taken into consideration in a representation; and we have further assumed that the figures are placed immediately in front of and parallel to the spectator, so that the forms are rendered according to their exact geometrical proportions.

Perspective enables us to show the solidity of objects, and to represent them under the various changes in appearance caused by any alteration in their position or that of the spectator, thus—

A Geometrical drawing renders the form as it is; Perspective, represents it as it appears.

This study is the basis of all object-drawing. It is the Grammar of Art as a universal language, and, thus considered, its importance cannot be overrated. The sign painter (properly so called) is frequently asked to paint some illustration bearing on the trade carried on in the establishment; the letter painter is constantly required to give the appearance of solidity to the letters so that they may seem to be raised above the architrave, or surface on which they are painted; and the necessity for a knowledge of the principles of Perspective in these branches will thus be obvious.

It is not intended to enter here upon the theory of

Perspective further than is required to enable the student to comprehend the elementary studies in this brief course. For further instruction we must refer him to works specially devoted to the subject.

When we open our eyes, a flood of light enters; and the rays which pass from every part of the surfaces of the objects by which we are surrounded, proceed in straight lines to the eye of the spectator.

We know (1.) That it is because of the *rays of light* that we see an object, because if the room were darkened, although the object might remain unchanged, we could not see it. (2.) That the rays are reflected from *every part* of the object, because, though we cannot see some portions, they will be visible to persons differently placed in the apartment. (3.) That the rays converge to the eye in *straight* lines, because we can only see such parts of the object as could be connected by straight lines with our eye.

To test this last statement, let a thread be pinned to each corner of a block of wood or book, then, if all these be gathered to the eye, it will be found that those sides only will be visible from which the threads proceed, without being turned round any one of the edges.

The view of the object is thus altered with every change in the position of the spectator.

THE SURFACE ON WHICH THE DRAWING IS TO BE MADE IS CALLED THE PICTURE PLANE.

It is supposed to be transparent, and (as a rule) to be placed vertically between the spectator and the object to be delineated, the rays passing through it to the eye.

Thus, let it be supposed that a sheet of glass is placed on its edge on the table, the spectator taking his position on one side of it, and a cube standing on the other, then, if threads attached to the angles of the cube were made to pass through small holes in the glass, the lines uniting such holes would give the perspective form visible to the spectator.

THE BOTTOM LINE OF THE PICTURE IS CALLED THE PICTURE LINE.

The view of the object is in the first place affected by the circumstance of its being situated above or below the eye of the spectator, and a line called the horizontal line is therefore drawn across the picture.

THE HORIZONTAL LINE REPRESENTS THE LEVEL OF THE EYE OF THE SPECTATOR IN RELATION TO THE OBJECT.

If the object be lower than the eye of the spectator, as a stool or box placed on the ground, the top will be seen; if above the eye, as a bird-cage suspended, the underneath surface will be visible. When therefore it is required to represent an object below the level of the eye, it must be placed under the horizontal line; if above the spectator, it must be placed in the upper part of the picture, higher than the horizontal line.

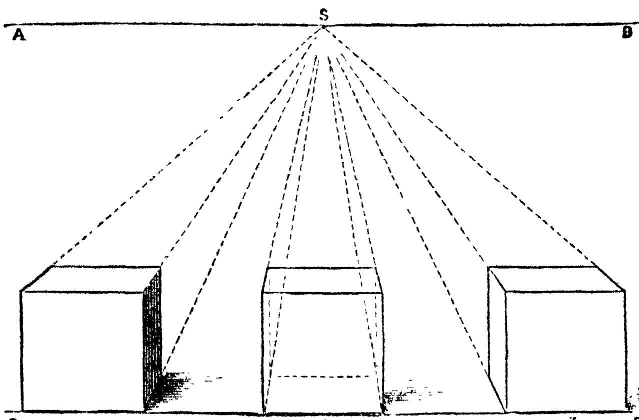


Fig. 131.

The knowledge of the height of the object will not however be sufficient, for the view would of course be altered according as it might be placed on the left or right side of the spectator. The representation is in this respect governed by the situation of the Point of Sight.

THE POINT OF SIGHT, IS THE POINT IN THE HORIZONTAL LINE WHICH IS DIRECTLY OPPOSITE THE EYE OF THE SPECTATOR.

ALL LINES WHICH IN THE OBJECT ARE AT RIGHT ANGLES TO THE PICTURE, VIZ., SUCH AS RUN DIRECTLY FROM THE SPECTATOR INTO THE DISTANCE, MUST IN THE REPRESENTATION BE DRAWN TO THE POINT OF SIGHT.

The above principles are exemplified in Fig. 131, in which A B is the Horizontal Line, C D the Picture Line, and S the Point of Sight.

The three cubes or blocks are supposed to be about 2 ft. high, whilst the eye of the spectator is about 6 ft. from the ground, the spectator being placed immediately opposite to the point of sight S.

It will be clear that, under these circumstances, since all the cubes are below the eye of the spectator, the tops of all of them will be seen. As No. 1 is on the left of the spectator, its right side will be visible, the opposite view being obtained of No. 3, which is on the right side, whilst neither side of No. 2 is visible, as it is immediately in front of the spectator.

But the student should inquire, "Where are the sides of the cube No. 2?" and he will ascertain this by imagining it to be transparent, when all the hidden lines will appear in their places.

The whole of the conditions would be similarly worked out if the objects were placed above the horizontal line, in which case their under sides would be visible.

The difficulty which the student will now feel is in deciding on the positions of the distant lines of the cubes; for it will be clear, that if they were placed near the fronts of the objects, they would give the appearance of thin slabs of wood or stone; and if they were placed very far back, the drawing would represent a long back of timber, the end of which was presented to view.

The necessary dimensions are represented by means of the points of distance.

THE POINTS OF DISTANCE REPRESENT THE DISTANCE OF EYE FROM THE PICTURE.

We now proceed to illustrate the uses of the Point of Sight and Points of Distance.

We have, in our course of Practical Geometry, explained the uses of the scale, and we shall, in the following studies, put into practice the instructions previously given. The present study is worked to the scale of $\frac{1}{4}$ in. to the foot. The student will, however, in every case adopt a much larger scale than is possible within the limits of these diagrams, in order that all the minute details which occur may be clearly worked out.

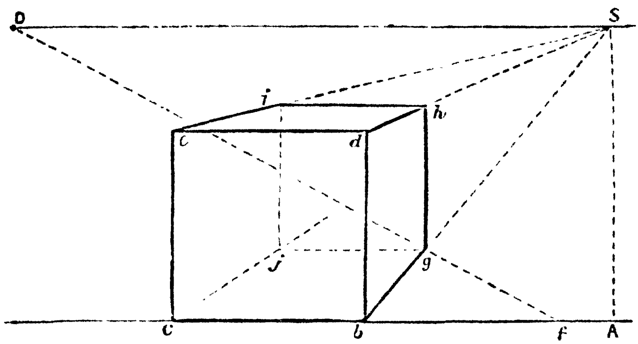


Fig. 132.

It must further be impressed on the mind of the student, that he will not, by merely copying diagrams, however numerous, learn principles. The drawings are mere illustrations, to aid the explanation given in words, and will only be thoroughly comprehended when the principles are applied. It is absolutely necessary that the sizes, proportions, and positions of the objects should be varied, and the views worked out under numerous changes of conditions; unless this be done, the time spent in copying the diagrams will be wasted. The height of the spectator is in the present study supposed to be 6 ft. The Horizontal line must therefore be ruled at that distance above the picture line. The Point of Sight may be fixed at s, and the point of distance at D, viz., 12 ft. from s. The object—a cube, the faces of which are 4 ft. square—is to be placed at 5 ft. on the left of the spectator. From the Point of Sight draw the perpendicular S A, and from A mark A *b*, at 5 ft. along the picture line. At *b* draw the square *b c e d*, representing the front of the cube.

Now it has already been explained that all lines at right angles to the picture plane are to be drawn to the Point of Sight, and the direction of the edges of the cube is thus indicated. From *b*, *d*, and *e* draw lines to the Point of Sight, viz., *b s*, *d s*, and *e s*. It is now required to cut off a portion of each of these which shall represent the perspective thickness of the object.

Now, in this instance, the real width of the distant side is equal to that of the front, or any other of the sides. Therefore, from *b* set off on the picture line, between *b* and A, the length *b f* equal to *b c*. From *f* draw a line to the one Point of Distance D, cutting the line *b s* in *g*. At *g* erect a perpendicular, cutting the line *d s* in *h*. At *h* draw the horizontal *h i*. Strengthen the lines between the points *b g*, *d h*, *e i*, thus completing the view.

In order, however, to account for the lines which are not visible in the present view, draw a line from *c* to the Point of Sight. Draw also a horizontal from *g*, and a perpendicular from *i*, both meeting *c s* at *j*. Then *c j*, *i j*, and *g j* will be the distant edges of the cube, which would, in an opaque object, be invisible from the present position of the spectator.

After this figure, the student should practise putting into perspective rectangular objects of different dimensions, applying the principle here illustrated.

The real length of the distant side, whatever that may be, being set off on the picture line from the nearest angle of the object, and a line being drawn from the point so fixed to the Point of Distance, the point at which the line drawn to the Point of Distance cuts that previously drawn to the Point of Sight will be the position of the distant end of the object.

The cubes shown in the last illustration are, however, all in the immediate foreground, and it is intended in the present lesson to show the method of putting objects into Perspective when standing at certain distances back, or, as it is termed, "within the picture." Fig. 133. (I.) This is merely a further working out of the method by which the positions of the distant edges of the cube in the last study were ascertained. Let the height of the spectator be 4 ft. (scale $\frac{1}{4}$ in. to the foot), and his distance 5 ft.

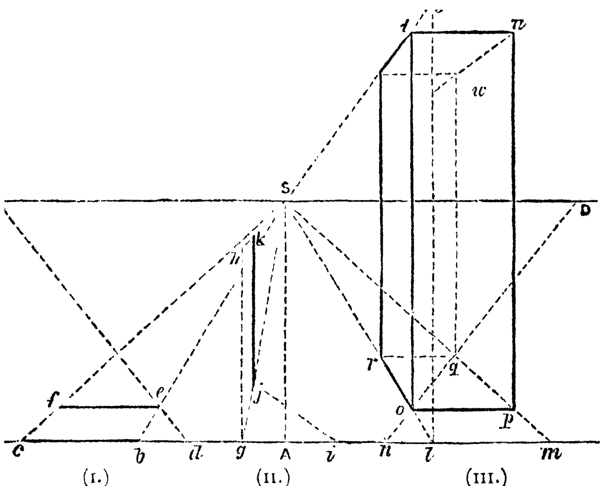


Fig. 133.

It is required to put into Perspective a single line 2 ft. long, lying parallel to the plane of the picture at 3 ft. on the left of the spectator, and 1 ft. within the picture. Draw the perpendicular S A. From A set off *b*, at 3 ft. (the distance which the line is to be) on the left of the spectator. From *b* set off *b c*, representing the real length of the line (viz., 2 ft.) as it would be if in the immediate foreground, and from *c* and *b* draw lines to the Point of Sight.

Now it will be clear that as the whole length of the line is contained between the two lines drawn to the point of sight from *c* and *b*, and as these two are the respective representatives of two lines equally apart throughout their whole length, any horizontal drawn between them would represent the line *b c* at some undefined distance within the picture, and it only remains to remind the student of the method of fixing definitely any required point.

From *b* set off *b d*, 1 ft., the distance at which it is required that the line shall lie within the picture, and from *d* draw a line to the Point of Distance, cutting *b s* in *e*. Draw *e f* parallel to the picture line, and it will be the perspective representation of the line *c b*, when lying at 1 ft. within the picture.

It is now required (II.) to put into Perspective a perpendicular, 3 ft. high, ($\frac{1}{4}$ in. to the foot), standing at 1 ft. on the left of the spectator, and 2 ft. within the picture.

Set off the point *g* at 1 ft. on the left, draw the perpendicular *g h* 3 ft. high and from *g* and *h* draw lines to the Point of Sight.

It will be evident, that as the perpendicular recedes into the distance, its' extremities will move between these two lines, which are, as it were, the upper and lower boundaries of a wall extending from the spectator into space, and of this plane the required line would form a part. The question for solution is, where to draw the perpendicular.

From *g* set off *g i*, equal to the required distance of the perpendicular within the picture, and from *i* draw a line to the Point of Distance, cutting *g s* in *j*. At *j* draw the perpendicular *j k*, which will be the perspective representation required.

To apply this system in putting into Perspective a cubical block (III.), the base of which is 2 ft. square, and the height of which is 7 ft., when standing at 3 ft. on the right of the spectator, and 1 ft. within the picture.

From A set off 3 ft. to *l*, and from *l* set off *l m*, representing the real width of the base, then from *l* and *m* draw lines to the Point of Sight. From *l* set off *l n*, the distance (1 ft.) which the object is to stand within the picture, and draw a line to the Point of Distance, cutting *l s* in *o*, then *o p* will be the front edge of the base of the object. The line drawn from *n* to D will cut *m s* in *q*. Draw the horizontal *q r*, which will give the perspective representation of the base of the object. At *o* and *p* draw perpendiculars of indefinite height. Then at *l* erect a perpendicular of the true height (7 ft.), viz., *l s*. From *s* draw a line to the Point of Sight, cutting the perpendicular *o* in *t*. At *t* draw a horizontal, and at *p* a perpendicular meeting the horizontal in *u*. Then *o t u p* will be the perspective front of the figure. At *r* erect a perpendicular meeting *t* s in *v*, draw *u* s and *v w*, which will complete the representation.

The lines appertaining to the object may be strengthened, in order that they may be distinguished from those used in construction.

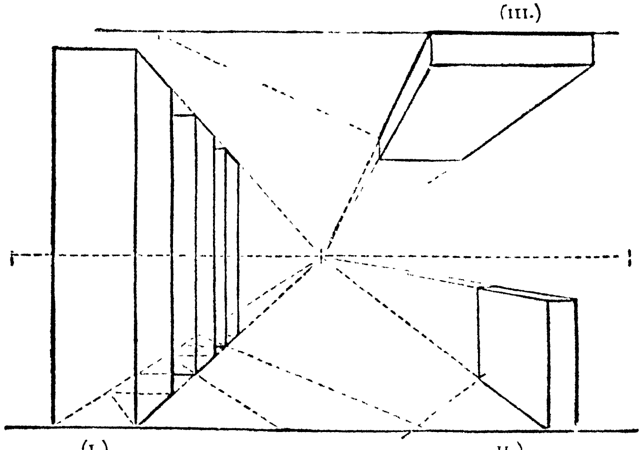


Fig. 134.

The methods shown apply, of course, to objects placed either partially or entirely above the level of the eye of the spectator, as well as those below it. This is exemplified in the following studies. In these the lines of construction are shown; but beyond the mere description it is not intended to give the student an details as to measurements, as it is hoped he wi be able to apply the principles taught, and to work out the subjects without any further aid.

The subjects represented are—(I.) Three square columns of equal height, standing in a line at right angles to the plane of the picture, and at equal distances from each other. (II.) A square slab placed on its edge, its surface being at right angles to the picture; and (III.) a plank placed above the eye of the spectator, its surface being horizontal, and its length at right angles to the picture plane.

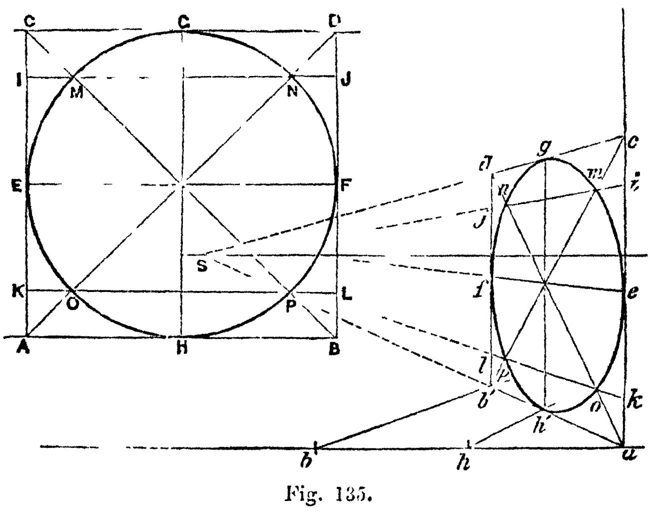


Fig. 135.

Perspective does not deal with curved lines and circles in their separate form. It is necessary that they should be enclosed by straight lines, and that, by causing these to intersect, points should be found through which the curve passes.

It is now required to put the circle in Fig. 135 into Perspective. In order to do this, enclose it in a square A B C D, draw the diagonals A D and B C, and through their intersection draw the lines E F and G H.

In this case the height of the spectator, the Point of Sight, and the Point of Distance have been arbitrarily fixed.

Having prepared the original circle as above, proceed to put the enclosing figure into Perspective. Draw the perpendicular *a c*, equal to A D, and from *a* and *c* draw lines to the Point of Sight. From *a* set off *a b*, equal to *a c* (or A C). From *b* draw a line to the Point of Distance, cutting *a* S, in *b′*. At *b′* erect a perpendicular, cutting *c s*, in *d*. Then the figure *a b′ c d* will be the perspective representation of the square A B C D.

In this figure draw the diagonals *a d* and *b′ c*. From *e* draw a line (*e* s) to the Point of Sight.

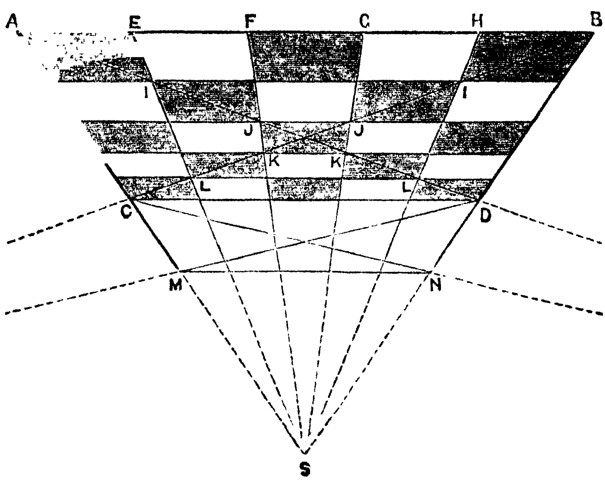


Fig. 136.

From *a* set off *a h*, equal to A H, or half of the side of the square; and from *h* draw a line to the Point of Distance, cutting *a* s, in *h′*. At *h′* erect a perpendicular *h g*, passing through the intersection of the diagonals.

Returning now to the original figure, draw the lines I J and K L, through the points in which the diagonals cut the circle, viz., M N O P.

In the perspective view mark from *a* and *c* the distances *a k* and *c i*, equal to A K and C I in the original figure; and from these points draw lines (*i j* and *k l*) to the Point of Sight, cutting the diagonals in *m n o p*.

It will thus be seen that the whole rectilinear figure, with the eight points through which the circle passes, has been put into perspective; and now the elliptical figure, which will be the representation of the circle, is to be drawn through these points. It should at first be lightly sketched, and great care should be taken to obtain a smooth curve which shall pass through the given points without appearing, as it were, bent out of its proper form in doing so.

Fig. 136 shows the method of putting into Perspective a square surface divided into a number (in this case twenty-five) of smaller squares.

Draw the line A B, equal to one side of the required square. From A and B draw lines to the Point of Sight, and also from the same points draw lines to the opposite Points of Distance. Then the line from A will cut B S in D, whilst the line from B will cut A S in C. Join C D, then A B C D will be the perspective representation of the containing square, with the two diagonals A D and B C. Divide A B into five equal parts, in the points E F G H, and from these draw lines cutting the diagonals in I I, J J, K K, L L. Through these points draw lines parallel to A B, which will divide the figure into twenty-five portions, representing squares in various positions in relation to the Point of Sight. By drawing lines from D and C, cutting A S and B S in M and N, and joining these points by the line M N, the perspective representation of another square is obtained, and in this manner the study may be continued so as to cover a ceiling of any dimensions; or if the Point of Sight be placed above the figure, a tesselated floor will be delineated.

Fig. 137. In this study a square frame is represented. It is supposed to be made of square wood, and to be placed on the left of the spectator, and above the level of the eye. This figure has an important bearing

on the Perspective of letters, and will therefore be considered in various forms in the following examples.

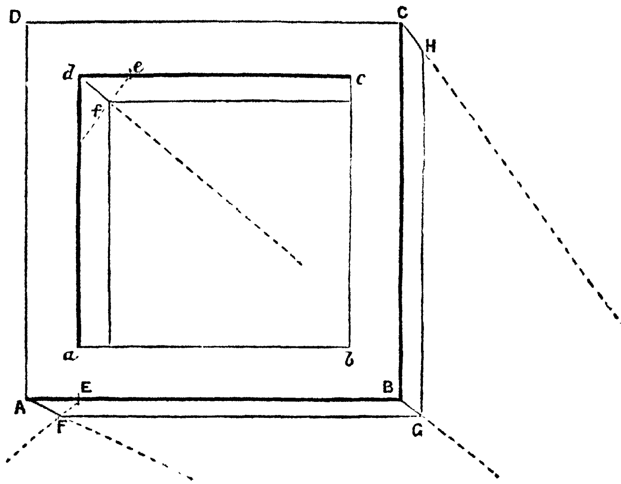


Fig. 137.

Having drawn the square A B C D, and having fixed the Point of Sight and the Point of Distance, draw lines from each of the angles to the point of sight. Now from A set off A E, equal to the real thickness of the wood of which the frame is made. From E draw a line to the Point of Distance, cutting the line drawn from A to the point of sight in F. From F draw a line parallel to A B, and meeting the line drawn from B to the point of sight in G, and draw the perpendicular G H.

The drawing will now represent a square slab; and when it has been ascertained to be thus far correct, it is to be completed in the following manner:—

Draw the inner square *a b c d*, the distance between the sides of which, and those of the outer square, being equal to the real thickness of the wood (viz., A E).

From *d* draw a line to the Point of Sight. From *d* set off *d e*, equal to A E, and draw a line from *e* to the Point of Distance, cutting the last drawn line in *f*. From *f* draw lines parallel to *d c* and *d a*, which will complete the figure.

Fig. 138. In this figure we proceed to show how the object is to be rendered in Perspective, when placed so that the edge, instead of the square surface, is parallel to the plane of the picture; the frame being placed below the level of the eye of the spectator. Draw the perpendicular A B, equal to the side of the square, and from A and B draw lines to the Point of Sight. From A set off on the picture line the distance A C, corresponding with

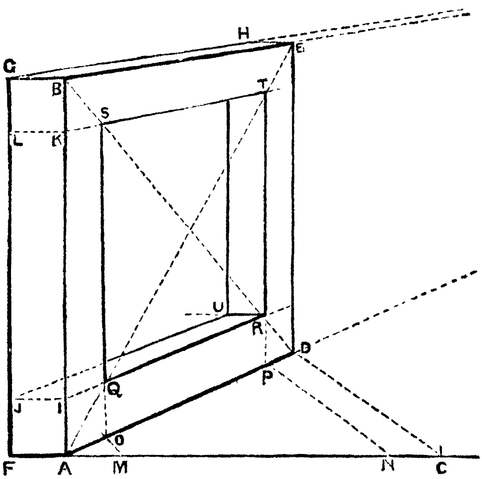


Fig. 138.

A B (or either of the sides of the square), and from C draw a line to the Point of Distance, cutting that drawn from A to the Point of Sight in D. At D draw D E, which will complete the perspective appearance of the plane surface of the square, placed at right angles to the picture. Now from A mark off A F, representing the thickness of the edge (or of the wood, of which the frame is made). From F draw a perpendicular, and from B a horizontal intersecting in G. From G draw a line to the Point of Sight, cutting a horizontal drawn from E in H. From A and B, at distances equal to A F, mark off A I and B K, and draw I J and K L. The small squares F J I A and G B K L, will then represent the ends of the two horizontal sides of the square frame. Within C and A mark off A M and C N, equal to A F, and from M and N draw lines to the Point of Distance, cutting A D in O and P. From O and P draw perpendiculars cutting the lines drawn from I and K in Q R S T. From J draw a line to the Point of Sight, cutting a horizontal

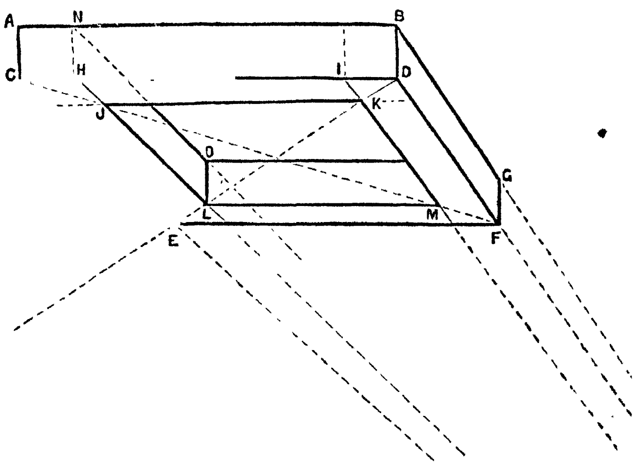


Fig. 139.

drawn from R in U, and at U erect a perpendicular, thus completing the view.

The inner square could have been obtained by drawing diagonals, and intersecting them by the lines drawn from I and K, thus obtaining the points Q R S T, and the trouble of finding the points M N O P might thus be saved; but such method would only apply when the figure is a square and the thickness of its four sides equal: whereas the system shown in the illustration is applicable to rectilineal figures of any proportions. The method referring to a square only is, however, shown in Fig. 139, which represents the same object placed horizontally above the level of the eye, and on the left of the spectator.

Draw the rectangle A B C D, representing the edge of the object, and from C and D draw lines to the Point of Sight. From D draw a line to the Point of Distance, cutting the line drawn from D to the Point of Sight in E. Draw E F parallel to C D, which will complete the underneath surface of the object. The diagonal C F is

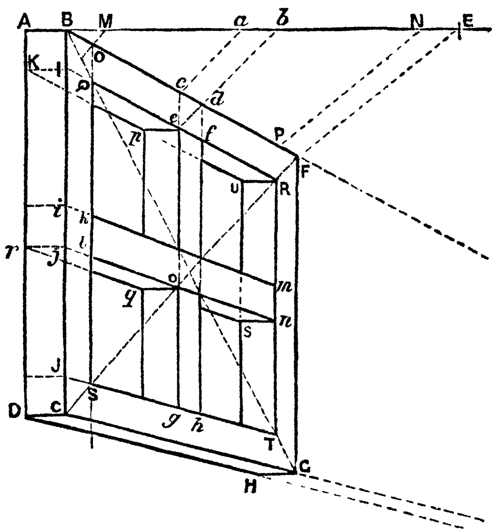


Fig. 140.

then to be drawn. This, if continued, would meet the horizontal in the second Point of Distance. From B draw a line to the Point of Sight, intersecting a perpendicular drawn from F in G. Now within C D set off the distances C H and D I, equal to A C, and draw lines from these points to the Point of Sight, cutting the diagonals in J K L M. At H draw the perpendicular H N, and from N draw a line to the Point of Sight, cutting a perpendicular at L in O. A horizontal from O will complete the representation.

Fig. 140 is a further development of the subject, the frame being now divided by cross pieces at right angles to each other. It will thus be seen to contain the leading principles of the perspective of all the rectangular letters, such as E F H I L T; whilst, by taking certain portions of the figure and rounding the angles, B C G J O P Q R S T U may be formed, and Z will result from joining half of the top to half of the bottom by oblique lines. The angular letters will be treated of presently.

In commencing this study, draw the edge of the object A B C D, and from B and C draw lines to the Point of Sight. Mark on the picture line (the *upper* line of the picture plane being here used) the length B E equal to B C. Draw a line to the Point of Distance, cutting the line drawn from B in F, and draw the perpendicular F G. Next draw a horizontal at G, and intersect it at H by a line drawn from D to the Point of Sight, which will complete the general view of the object. Set off from B and C the distances B I and C J, equal to A B, and draw lines from I and J to the point of sight.

Mark off within B and E the distances B M and E N, equal to A B, and draw lines to the Point of Distance, cutting B F in O P. From O and P draw perpendiculars cutting the lines drawn to the Point of Sight, from I and J in Q R S T. From R draw a horizontal, and from K draw a line to the point of sight, intersecting the last in U. From U draw a perpendicular, which will complete the square frame, which we now proceed to divide. In the middle of the space M N, mark the points *a b*, and from these draw lines to the Point of Distance, cutting B F in *c d*. From *c* and *d* draw perpendiculars cutting Q R in *e f*, and S T in *g h*. Between I and J mark the points *i j*, and from these draw lines to the Point of Sight, cutting Q S in *k* and *l*, and meeting R T in *m* and *n*. Now from O, R, and N draw horizontals, meeting lines drawn from K and *r* in *p* and *q*, U and *s*, and perpendiculars, drawn at these points, will complete the perspective representation.

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The geometrical elevation of the front of the object is given in the right-hand figure, A B C.

At A in this elevation raise a perpendicular, and from the apex of the triangle draw a horizontal, meeting this perpendicular in C′; also from C draw the perpendicular C D.

The Point of Sight and Point of Distance having been fixed, we proceed to put the elevation of the triangle into perspective, assuming that the one angle is to touch the picture line at A′. At A′ erect a perpendicular, the height A′ C agreeing with A C′ in the elevation. From A′ C draw lines to the Point of Sight, and from A′ set off A′ B equal to A B in the elevation. Divide A′ B, on the picture line, into two equal parts, in the point D. From B draw a line to the point of distance, cutting the line drawn from A′ to the Point of Sight in B′. From D draw a line to the Point of Distance, cutting the line drawn from the point of sight in D′. At D draw a perpendicular, cutting the line drawn from C to the point of sight in C′. Strengthen A′ B′, A′ C′ and B′ C′, and the figure thus formed will be the perspective representation of the triangle A B C.

The interior triangle, representing the width of the sides, is now to be delineated; and before this can be done, it is necessary to prepare the original triangle, as in the former case. From E draw a horizontal line cutting A C′ in E′, and from the same point draw perpendicular cutting A B in E″, also from F draw the perpendicular F F′, and from G draw a horizontal, cutting A C′ in G′. Now on each side of D, in the perspective view, set off the distance D E″ and D F″. From E′, on the perpendicular, draw a line to the Point of Sight. From E″ and F′ on the picture line draw lines to the Point of Distance, and from the points where these lines cut A B′ erect perpendiculars cutting the line drawn from E″ to the Point of Sight in E and F. From in the elevation, draw G G′, and set off the same height on the perpendicular A′, in the perspective view, viz., A G. From G draw a line to the Point of Sight, cutting the perpendicular D′ in G′. Strengthen the lines E F G′, which will complete the inner triangle.

The figure here delineated is, however, only a plane, and it remains to give solidity to the representation. We proceed to do this, marking the points on the back in italics, corresponding with the capital letters designating the same points in the front.

From A′, on the picture line, mark off the distance *a*, as representing the real thickness of the object, erect a perpendicular, and transfer to this line the points E″ G′ and C, viz., *e g c*. From C′, the apex of the triangle, draw a horizontal line, and from *c* draw a line to the Point of Sight, cutting the last drawn line in *c*′. Draw *a c*′, which will then give the representation of the thickness of the one bar of the triangular frame. Draw horizontals at G′ and F, and from *g* and *e* draw lines to the Point of Sight, cutting these in *f* and *g*′. Draw *g*′ *f*, strengthening only such part of it as would be visible, and strengthen also the portion of *e f* which is not covered by the front bar of the frame. The view will thus be completed.

Triangles of all kinds are put into perspective in the same manner, the proportions being laid down in the perspective projection from a carefully prepared elevation of the original figure.

Polygons.

Let it now be required to put into perspective a plan Hexagon, of which A B C D E F, Fig. 142, is the elevation the surface to be represented as at right angles to the plane of the picture. As in the case of the circle, it necessary that polygons should be enclosed in a rectangular figure, as *g h i j*.

Having decided on the position at which the figure to be placed, put this enclosing figure into perspective i the following manner :—

At *g*′ (the fixed point) erect a perpendicular, and o it mark the heights *g*′ C′ and C′ *h*′, corresponding wit *g* C and C *h* in the elevation, and from *g*′ C′ and *h*′ dra lines to the Point of Sight. Now from g' set off along the picture line the distances g' B′, B′ A′, and A′ j' corresponding with g B A j in the elevation, and from these points draw lines to the Point of Distance, cutting g' S

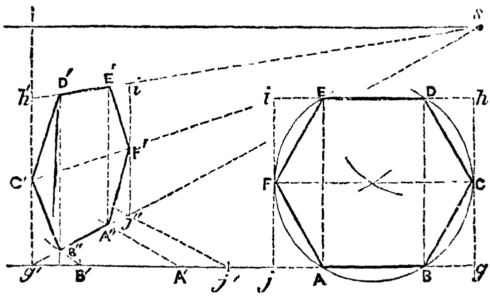

Fig. 142.

in B″ A″ and j''. From j'' A″ and B″ erect perpendiculars, cutting the lines previously drawn from C′ and h' in F′ i E′ and D′. Strengthen B″ A″ and E′ D′, and draw B′ C′, C′ D, E′ F, and F′ A, which will complete the figure.

Fig. 143 shows the method of drawing a polygon, in this case an Octagon, when lying horizontally on the

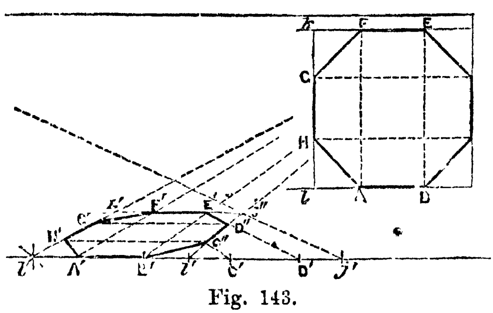

Fig. 143.

lane. Draw the elevation of the Octagon A B C
, and enclose it in the square $i\ j\ k\ l$. Mark
ture line the points l' A′ B′ i' to correspond with

l A B *i* in the elevation, and from these points draw lines to the Point of Sight. From *i*′ set off C′ D′ *j*, ′corresponding with C D *j* in the elevation, and from these points draw lines to the Point of Distance, cutting the line drawn from *i*′ in C″ D″ and *j*″. From these points draw horizontals, cutting the line drawn from *l*′ to the Point of Sight in *k*′ G′ H′, and cutting also the lines drawn from A′ B′ in E′ and F′. Strengthen A′ B, C″ D″, E′ F′, and G′ and H, and draw B′ C″ D″ E′ F′ G′ and H′ A, which will complete the figure.

CHAPTER XXXIX

THE ELEMENTS OF ANGULAR PERSPECTIVE.

Having thus given the student a general insight into the method of putting objects in perspective, when their sides are parallel with, or at right angles to, the plane

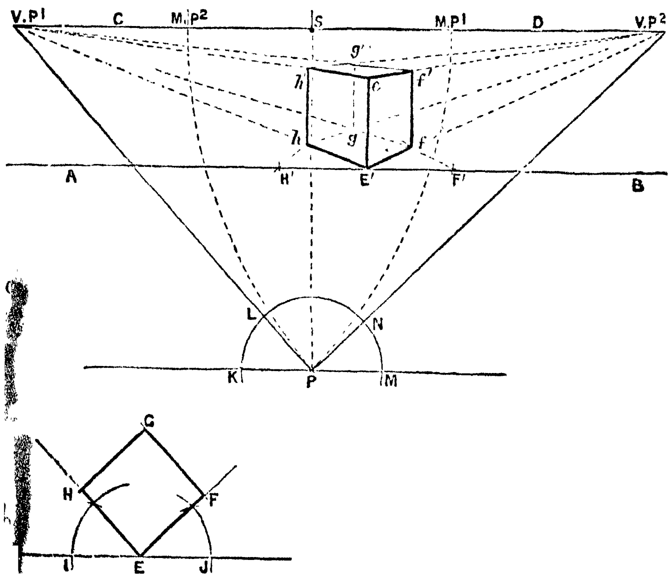

Fig. 144.

of the picture, we now proceed to give a few hints as to the system to be pursued when the object is placed angularly in relation to the picture.

Let A B be the Picture Line, C D the Horizontal Line, and S the Point of Sight. At S draw a perpendicular, and set off on it the distance of the spectator from the picture, thus obtaining the Station Point P. Now let E F G H represent the plan, or base of a cube, placed against a horizontal line I J, in such a manner as to represent the position of the cube in relation to the Picture Plane. In other words, a cube is supposed to stand on E F G H, and the picture plane to stand on its edge, on the line I J. At the Station Point P, draw a horizontal line, and on the one side of P construct the angle K P L, similar to the angle I E H in the plan, and on the other side construct the angle M P N, similar to the angle J E F.* Produce the lines P L and P N, until they intersect the horizontal line. These points of intersection will be the VANISHING POINTS for the respective pairs of sides of the cube, and are called V P 1 and V P 2. From V P 1, with radius extending from the Vanishing Point to the Station Point, describe an arc cutting the horizontal line, and from V P 2, with radius extending to P, describe another arc, also cutting the horizontal line. The points where these arcs intersect the horizontal line are called the MEASURING POINTS, and are marked M P 1 and M P 2, corresponding with the Vanishing Points from which the respective arcs are drawn.

The preliminary conditions having thus been settled, the perspective projection is to be proceeded with.

Place the point E (the angle of the object which is supposed to touch the picture plane) at such a distance on either side of the perpendicular as the object is supposed to be situated either towards the left or right (in the present study, it is placed at E′ on the right side), and from E′ draw a line to each Vanishing Point. Now from E′ set off E′ F′ and E′ H′, equal to the lines E F and E H in the plan. From F′ draw a line to M P 1, cutting E′, V P 1 in *f*, and from H′ draw a line to M P

* For the method of constructing an angle similar to another, see Fig. 94.

cutting E′, V P 2 in *h*. Strengthen E′ *f* and E′ *h*, which will be two edges of the cube.

The following rule must be borne in mind:—

ALL LINES WHICH IN THE OBJECT ARE PARALLEL TO EACH OTHER VANISH TO THE SAME POINT IN THE DRAWING.

On referring to the plan, it will be seen that F G is parallel to E H, and that G H is parallel to E F, and it will be clear, according to the above rule, that F G must meet E H, and G H must meet E F, in the same vanishing points; therefore, from *f* draw a line to V P 1, and from *h* draw a line to V P 2. These two lines intersecting in *g* will complete the perspective view of the plan, on which we now proceed to erect the cube.

At E′ erect a perpendicular E′ *e*, equal to the length of either side of the plan (since all the edges of a cube, whether placed vertically or horizontally, are equal), and from *e* draw a line to each Vanishing Point. At *f* and *h* draw perpendiculars, cutting the last two lines at *f′* and *h′*, and from *f′* and *h′* draw lines to the opposite Vanishing Points. These will intersect in *g′*, which is to be joined to *g* by a perpendicular, thus completing the representation.

It will, of course, be understood that this principle would apply equally to rectilineal objects of any dimensions, the only difference in working consisting in the measurements. Thus, if the object were an oblong 4 ft. long, 3 ft. wide, and 2 ft. high, 4 ft. would be set off from E′ to H′, 3 ft. from E′ to F, and the perpendicular E′ *e* would be made 2 ft. high.

The adaptation of perspective to letter painting is considered in a subsequent section.

CHAPTER XL.

DRAWING AND SHADING FROM OBJECTS.

HAVING thus explained the leading principles of Perspective, it becomes necessary to show how the drawing may be shaded—a branch of the subject which is of exceeding interest and importance to letter, sign, and decorative painters, since a knowledge of it enables them to add materially to the appearance of solidity of the objects or letters they are painting, and to make them appear to "stand out" from the flat surfaces on which they are painted.

Although, however, our reader may have reached this particular page, it does not necessarily follow that he has, from a teacher's point of view, arrived at this stage of study. It cannot be too strongly impressed on the minds of all who would learn to draw with correctness, that on outline, and on outline alone, rests the whole burden of true representation. We have already said (Grammar of Colouring) that colour "assists in distinguishing forms," and that it adds beauty to all around, and in the present chapter we shall show the uses of shades and shadows; but however beautiful the colouring, however effective the shading may be, they cannot make up for incorrect drawing. On the contrary, they would only make the incorrectness of form the more obvious; whilst a clear, bold, and well-drawn outline is, as far as the rendering of form is concerned, independent of colour or shading, the first being regulated by taste, and the other by the position of the light; both of which conditions may be varied, without in any way altering the form of the object.

We often, however, see shading occupying more of the student's attention than the outline has done; and this is one of the baneful results of drawing having been studied from shaded copies. The learner sees how much of the charm of the copy has been given to it by the colouring or shading; he looks upon the outline merely as the introduction to the shading, to be got over as quickly as possible; and he in time acquires the notion, that all the faults in the drawing will be corrected by the shading.

This idea has probably been acquired by the way in which drawing was formerly taught in schools from shaded copies, which were distributed to the pupils according to convenience, without reference to their elementary knowledge: they set to work guided only by the patches of darkness at different parts of the example, until the master came round, and by his magic touches made *something* out of the chaos; it was taken charge of by the teacher (?) only to "mount," the name of the pupil was written under the drawing, it was taken home to delighted parents, by whom it was in due course framed and placed on the wall, amidst the wondering exclamations of friends and relations; and the worst of the matter was, that the poor victim of this deception was under the impression that he had really done the drawing, and that he had been learning to *draw*.

That this is no exaggerated view of the system, happily now almost exploded, may be proved by two instances which occurred in our own experience. We were looking about in a school of some pretensions, where the boys were mainly the sons of tradesmen, painters, builders, etc. We observed several of them rubbing away at the darker parts of the drawings (the copies were landscapes, with ruins, windmills, moss-grown towers, etc., in abundance), and we were bold enough to remark to one young artist, that he was putting in the shading without having finished the outline, which was indeed scarcely indicated; and his reply was, "Master sets all that right when he comes round, *I am just getting on with the shading.*"

In another case, a student, who had been educated in such a school, entered a School of Art. He showed specimens of flower-drawing; and as he was to study flower-painting, a proper example was given him. The master, on subsequently examining his outline, remarked, that it was incorrect in form, and bending towards the left, instead of towards the right side; but the student replied, it would be "all right when the colour had been put on."

The extended action of the Government Department of Science and Art has tended to the demolition of the system described above, and systematic teaching of outline drawing, Geometrical construction, Perspective, and Model drawing has brought about a total change in the state of things; and opportunities now exist for workmen and their children to acquire sound instruction in all the various branches of Science and Art, of which it is to be hoped they will more and more avail themselves.

We do not advise students of this branch to devote much time to practising shading from copies; the principles of shading are not to be learnt by merely copying the effect shown in a print or painting, however good the imitation may be. Copies should be used only as a means to an end; but they must not be mistaken for the end itself. They should be thought of as examples of execution, of method of rendering the various forms, to be discarded as soon as possible for drawing direct from the object; and thus, for purposes of real study, a simple block of wood will be of more service than the most beautifully shaded copy.

The student is therefore advised to provide himself with a few simple objects of the kind mentioned—two or three cubes of wood about four inches square, or larger, a couple of blocks longer than they are wide, a cylinder or roller of any kind, a sphere or large ball. In fact, the models are of the most inexpensive character, since everything around will, when properly viewed, be a subject of study; and when the simple blocks have been drawn from, jars, cups, basins, and culinary utensils generally, tubs, furniture, boxes, books, &c., will afford an endless series of lessons of the most important character.

As already insisted on, the outlines must in the first instance occupy attention; and in this the lessons in Perspective will be applied. Perspective is the grammar of form; but we do not learn it, so that we may draw everything around us by means of rule and compass, any more than we learn the grammar of a language, so that we may carefully construct every sentence we write by its rules. We learn the science, so that we may apply it in Art. And thus, when the mind is thoroughly imbued with the principles, the hand will, rapidly and as it were intuitively, draw the object as it would appear; and the eye will have become so accustomed to correctness of delineation, that it will check the work at every stage. Thus, the student may have carried out a complex perspective study, carefully measuring all the distances and ruling all the lines; but the work, although answering to the exact rules, may not have been quite correct, owing to a single line having been misplaced or inaccurately drawn. Such a study would be most difficult to check by rule, requiring in fact the whole of the steps to be retraced; but the author has known several cases, where the educated eye of the student has at once detected the error, thus preventing its extension.

The plan recommended, therefore, is that the student should place some object in the manner indicated in the previous course, and, having successfully mastered its principles, he should proceed to draw it by hand direct from the model, and to a larger scale, and then shade by careful observation of the effects.

The studies should at first be executed in chalks, in which errors are most readily corrected; this practice should be followed by painting in sepia, and eventually in oils. The two latter processes are fully described in "The Grammar of Colouring," and the following hints on sketching and shading from objects in chalks or crayons are only necessary here.

The paper used may either be white or tinted: if the former, the paper itself will afford the high lights, and will require toning down by work in the middle tints; if the latter, the paper will give a middle tint, and the high lights will be required to be put in with white chalk.

The outline is in the first case to be done with sketching charcoal, of which sticks may be purchased at the colour-shops. These sticks are to be slightly pointed, and, if lightly used, any parts deemed incorrect may be easily dusted off by a cloth or piece of wash-leather; the charcoal should however be dusted, not rubbed off, so that the grit may not be rubbed into the paper, thus injuring the " tooth " or grain, which will render subsequent drawing upon it more difficult.

The student is warned not to acquire the habit of constantly rubbing out. Learners are often heard to say in relation to their first attempt, " It is only the rough sketch;" but the sketch, because it is the first, need not necessarily be made as rough as possible: but general correctness should from the very outset be aimed at. The grand rough sketches of our great artists are the result of their transcendent power, which enables them, by a few broad touches, to indicate their meaning in an unmistakable manner, leaving all detail to be filled up by the imagination of the spectator; but such an attempt on the part of students is mere affectation, leading to incorrect drawing and, as artists call it, " sloppy " painting, intolerable alike in fine art or art applied to trade purposes.

When the outline in charcoal is finished, it is to be dusted off and repeated with crayon or, to use the more homely term, " chalk." There are two kinds—the Italian, and the French or Conté crayons. The Italian chalk is sold by the ounce: it is an indurated black clay, which is sawn into slips for use; it works very smoothly, and may be beautifully softened off, the manipulation in this respect being easier than that of the Conté crayons. Some pieces are harder than others, and these may be reserved for the lighter parts of the drawing.

The Conté crayon is a manufactured article, and is sold in three degrees, Nos. 1, 2, and 3, the first being the hardest. This chalk is in tone much blacker than the Italian chalk, and, though more difficult in manipulation, produces stronger effects.

The "Royal Academy crayons" are also manufactured: they are much approved, uniting, to a great extent, the smoothness of the Italian with the depth of the French chalks. These too are sold in three degrees of hardness.

The method of pointing these chalks differs from that adopted for black lead pencils. The rough edges having been removed, the end is held outward, and the knife is thus worked from the end towards the chest, the point resting on the forefinger, by which it is thus supported.

In repeating the sketch, the student must bear in mind that there is no real outline in nature. One surface adjoins the other, as do the sides of a cube, but the edge at which the sides meet is not a hard line; nor is the edge darker than the surfaces which meet, and therefore the outlines, whilst serving as the necessary boundaries, should give distinctness of form only, but should not be more prominent than the other parts. On this head, the following important remarks are quoted from the works of Mr. Butler Williams:—

"In nature, outlines are in reality but the boundaries of surfaces, and do not exist independently of these surfaces. If we examine an object, the cube for instance, we see the lines which apparently separate one face from the other, only because the different faces of the cube present to the eye different shades or tints. Where the exact boundary of any tint terminates, a line seems to mark that boundary; but it does not exist independently of the surface of which it forms the limit, it merely constitutes a part or a continuation of that shade or tint which belongs to the whole surface. The teacher will illustrate this proposition by laying on the desk, or fixing on the black board, a sheet of tinted drawing paper. The rectangular outline of the sheet of paper is made manifest by the contrast between the colour or shade of the paper and the colour or shade of the lesk or board on which it may be placed; nevertheless, he outline does not exist independently of the remainder of the surface which it terminates, for within the outline the paper is of the same tint or shade as the extreme edge, which differs in no wise from the interior parts, and is only made manifest from its contiguity to another contrasting tint or shade. In order therefore to produce in a drawing as close an imitation as possible of the appearance of actual forms, no line should appear singly and independently as a mere line; but wherever it is desired to mark the boundary between two surfaces, that boundary must be indicated as on the model or in nature, by bringing the tint or shade of one surface to meet at a very precise common boundary the different tint or shade of the adjoining surface: the outline or separation between the two surfaces is thus made apparent, simply by that difference in their tints. This required effect is always to be borne in mind when drawing the outline, which should be made sharp and precise, but never so dark as to prevent its being blended with, or lost sight of, in the shading which is to be applied. And, inasmuch as the distant shades are to be made fainter than the near shades, the distant outlines are to be themselves made fainter in the same proportion, otherwise they could not be properly subdued as required. We have taken an opportunity of explaining this at length, because it is a very prevailing fault with learners to mark the outline too strongly. They should therefore be convinced by the above, or similar explanations, that such a course is faulty. However, this being accomplished, some are liable to fall into the opposite error, of leaving the boundaries of the surfaces indistinct, cloudy, and undefined, imagining that, because their outline is not to appear as consisting of mere lines, it is therefore to be indistinct and ill-defined. The pupils should likewise be cautioned against this error."

Erasures should, as a rule, be unnecessary in chalk drawing; since all corrections should have been made in the charcoal sketch. Correctness is, however, the great object to be attained; and if alterations be indispensable, the lines may be rubbed out with stale bread, either in its usual condition or pinched between the fingers until it is kneaded into a paste. It must, however, be understood that the use of bread always, more or less, unfits the paper to receive the chalk, and thus causes the shading to become spotty, as it gives a kind of greasy surface to the paper. Vulcanised india-rubber will in some degree remove this, but the tooth of the paper is thereby abraded; so that, after all, care is the best preventive of all this trouble.

The general ground for shading in chalk may be laid on with the fine powder, made by rubbing some of the softer chalk on a piece of glass paper, or by filing or scraping the stick of chalk. This is applied by means of a stump or piece of wash-leather.

The "stump" is made of chamois leather, or soft paper tightly rolled into a cylindrical form, and then pointed at each end. The use is, to get a flat tint spread more rapidly over the paper than could be done with the point of the chalk, and this may be darkened and graduated in a beautifully soft manner by a judicious use of the stump.

In commencing to use the stump, one end of it is to be rolled in the powdered chalk, so that it may be equally charged all round. Before the drawing is touched, however, the stump should be drawn along over another piece of paper, so that the chalk on it may be evenly spread, and that, if necessary, some of it may be rubbed off. The stump is then to be passed over the surface to be shaded. The touch should be light and free. The chalk must not be rubbed hard into the paper, for it must be understood that the harder the touch, the darker will the shade become, and thus the work will become streaky; and if frequent rubbing out is required, the paper will become roughened, and a most unsatisfactory appearance will be the result.

The student must exercise the greatest care to avoid passing over the outlines whilst rapidly using the stump. If the space to be shaded be narrow, the point of the stump is to be used; if wide, it may be held almost

›rizontally, so that the side of the point may be used. or very large or broad surfaces, a piece of wash-leather .ay be employed.

Only one end of the stump should be dipped into the ıalk; the other is to be kept clean, so that it may be sed for softening or graduating the work of the other. f any one part be found lighter than the rest, it must ›e retouched with the dark end of the stump, until a olerably level appearance is obtained.

The high lights are produced by white chalk, rubbed ›n with the paper stump; or it may be applied directly to the drawing, being only blended with the stump. It is more difficult to cut than the black chalk; and it is best to cut the point flat, or in the chisel form, drawing lines with the sharp edge.

The work produced by the stump, however, must not be considered as the finished effect, as the appearance, especially on flat surfaces, is not pleasant, being woolly and in many cases unequal; it is, in fact, a preparatory process, and the shading must be finished by means of "hatching," or lines drawn in different directions, by means of which character, force, and brilliancy are given to the shading. Hatching is a term employed to signify the lines, straight, curved, parallel, or crossing, used for producing the shades and tints in engravings and drawings. No universal rule can be given as to the disposition of the lines in hatching, and their proper direction is a matter in which much taste may be displayed, for by their means the texture of materials is indicated: thus, in a well-executed engraving, the various substances—wood, metal, stone, silk, satin, velvet, &c.—are at once seen; the effect being accomplished by lines only. As a rule, the lines should be vertical on the representations of vertical surfaces; horizontal, in horizontal surfaces; and inclined, where the surface represented is slanting. When a curved surface is to be represented, the hatchings should follow the direction of the surface, and force should be given by crossing the lines in the darker parts. It must, however, be observed that the lines must not cross each other at right angles, by which the appearance of coarse canvas or other woven fabric would be given, but must cross obliquely, so that the spaces caused by the intersections may be diamond or lozenge shaped. The lines must not appear separately, but must form part of the general tone, into which they may be further softened by single touches in the interstices, or in parts where the effect is unequal. The process of working in small dots or touches is called "stippling."

Having thus explained the method of shading, we proceed to consider what shades really are. In this we shall not use any illustrations, for the reason already given, that we do not wish the student to think for a moment that he can learn shading from copies; but we shall refer to the perspective studies, advising that blocks be placed in a similar manner, and shaded drawings made from them.

Thus, let three blocks be placed as in Fig. 131, the student sitting opposite to B. Only *one light* must be used; and this should be placed in a position which will best bring out the form of the object, by throwing some portion of it into shade. Let the light then be supposed to be in front of the blocks, at some distance on the left of them. As a rule, the light is assumed to be higher than the object, the sun being the source of natural light; but this cannot, of course, be adopted universally, when artificial light is used: for instance, if the source of light in a room be a candle placed on a table, the shadows of the mantel-piece, picture-frames, &c., will be cast upward. This effect is however unusual, except in some domestic pictures, and would not as a rule be adopted in the branch of Art we have here under consideration. The light then is assumed to be higher than the object.

It will now be clear, that as the rays fall on the tops of the blocks on the front and left faces, the whole of those sides will be in light; whilst the right side and back of each will be in the *shade*.

In Fig. 131, the shaded side of the block I is seen, since the object itself stands on the left of the spectator.

Of the cube II only the top, and of III the top and light side, are visible; and thus three different effects may be seen.

If the light were moved so as to be on a line with the centres of the bases of the cubes, the left side and top of each cube would be in full light, whilst the front and back would be in half light, or middle tint, the right side only being in full shade.

The light is generally considered as coming from the left side; but, as already stated, this is not by any means a rule, as of course the source of artificial light may be placed in any desired position, and the light coming from nature's grand source varies in its direction according to the hour of the day. Besides the opacity of the object preventing the light falling on the sides not opposite to it, the ground adjoining the model at the back, and on the right side, is also obscured; and this darker portion is called the *shadow*. The difference then between the terms shade and shadow is, that any part of the object which does not receive the rays of light is said to be *shaded;* but when this object prevents the light from falling on another surface, the part of that second object, or surface, which is thus obscured, is said to be in *shadow*, and the darkened part is called the *cast shadow*.

When an object is of the same colour as the surface on which it stands, the *shadow will be darker than the shade.*

The rays of light which fall upon any surface are reflected from it according as the surface is more or less polished, and the reflection will be more or less intense as the reflecting surface is of a lighter or darker colour. Any surface, therefore, which is directed towards light, not only becomes itself illumined, but casts a certain amount of light on objects opposite to it. Thus, supposing a cube to be placed so that the light may fall on one side, whilst the other is in shade, if a sheet of drawing paper be held up at a little distance from the shaded side, so that the light may strike directly on it, the rays will be reflected, and the shaded side will be visibly lighter than it was before.

"Although all surfaces that receive light do not reflect back an equal quantity, yet all do so to some extent, and to a greater or less degree, according as they are placed less or more obliquely with respect to the luminous body and to other surrounding objects. Were it not for reflected light, those objects or surfaces which are not directly illumined would be so totally immersed in shade as not to be seen; their exterior figure or outline only would be visible. If an object bounded by flat surfaces be relieved by a wall or other surface, and the light be supposed to proceed from the left, we may notice three prominent varieties of tint. The lightest will be on those surfaces most nearly opposed to or facing the light; the second will be on the side of the object from which the direct rays of the light are interrupted by the substance of the object itself; the third will be the shadow cast by that object on a part of the surface facing the light, but of which part is deprived of the direct rays of light by the interposition of the object in relief.

"Now, the shade on the side of the projecting object appears lighter than the object adjoining, because from the adjacent surface of the wall a certain portion of light is reflected, and the shadow is the darkest, because there is no surface near from which any strong light can be reflected to the place it covers. Shadows appear darker when cast on a surface in bright light, than when cast on a surface in a fainter light, or in shade; and the contrast in the first case between the shade and the adjoining shadow is greater than in the latter case.

"Also in the case of a shadow falling on a flat surface, that part of the shadow which is nearest to the object which causes it, is darker than the parts more distant: the shadow becomes gradually less intense the further it recedes from the object whereby it is produced."—*Butler Williams.*

It must be pointed out, that the largest and darkest shadows should be laid on first; for if the opposite plan were adopted, the learner would have great difficulty in so graduating his tints that the darkest portion of the work should not become too dark and heavy. Still, it

The next subject for study of shading may be the frame with dividing cross, the perspective working of which is shown in Fig. 140. Assuming the light to be on the right side, the edge A B C D, and the whole of the surface B C F G, will be in light. The light will not, however, spread over the whole with equal intensity. The most brilliant lights and deepest shadows are seen in the objects and parts of objects nearest the eye, and these lights and shadows diminish in strength as the surface recedes from the eye. This effect (called Aërial Perspective) is visible in a widely expanded prospect, where, owing to the intervention of the atmosphere, the distant objects appear paler than those near the eye, the lights and shadows become nearly equalised, and seem to blend into each other in a grey or bluish tint. In representing these effects in drawing, therefore, the lights must be most brilliant, and the shadows most intense, where the parts of the object which are nearest the eye are represented; and the outlines of the distant parts too must be faintly drawn, so that they may not give undue prominence to the receding parts.

It will be clear then that the highest and most intense light must be on the edge A B C D, and near the line B C on the side; its strength must then be gradually toned down, until by the time it reaches F G it should be very little removed from a middle tint. If the drawing is executed on white paper, a pale shade must be passed over the distant part, which must be gradually lost towards the front.

The front side of the distant upright U, and also that of the middle one *p*, being parallel to A B C D, will also receive the light; which must, however, be diminished in intensity according as they are removed from the eye.

The underneath surface of the lower side of the frame D C G H is to be shaded, as are also the corresponding parts of the upper side and the horizontal bar across the middle, and there will be small cast shadows at *p q* U and *s*.

If the light be placed on the left side, then the whole of the surface B C F G will be thrown into shade, as will also the under sides of the upper, lower and middle horizontals; whilst the edge A B C D will be in bright light. There will also be cast shadows at *p q* and U and *s*.

The triangular frame, Fig. 141, is to be shaded in the same way, and may be turned in different directions, so that the various parts may in turn receive the light, thus affording a multitude of studies.

The cube (in Fig. 144), or similar object, placed angularly will give good opportunity for carrying into effect the instructions given in relation to the graduation of light and shade. Thus, assuming the light to come from the left side, the highest light will be on the left side of the line E′ *e*, and the strongest shade immediately adjoining it on the right side, both gradually diminishing in intensity as they recede towards *f f′* and *h h′*; and the same effect must be obtained on the upper surface, on which the brightness of the light must be gradually decreased from the nearest angle *e*.

In shading cylindrical objects, it must be observed, that unless the light be placed in a line with that diameter which is parallel to the spectator, which is not advisable, the light will not be at the extreme edge of the object. If the light be placed near the left side of the spectator, and the cylinder standing on one of its ends be placed directly in front of him, the left side of the object will be covered with a pale tint, which will be gradually lost in the high light: this high light will diminish as it recedes from the most projecting part of the cylinder, and will become for a time darker and darker until the deepest shade is attained; but this deep shade will not be at the extreme edge, but will be toned off into what is termed the "reflected light."

When the student has drawn and shaded the cylinder in an upright position, it should be placed horizontally and obliquely, and other objects should be placed near it, so that the forms of cast shadows, when falling on cylindrical surfaces, may be studied.

Spherical objects, such as balls, cups, etc., etc., should now be studied, in order that the method of shading concave as well as convex surfaces may be acquired. The general principles are similar to those already explained in relation to cylinders: the hatching must follow the direction of the surfaces, and be carefully graduated so as to merge into the high lights.

The instructions here given are further developed in relation to letter painting. The student is urged to study and carry them out in their general sense before applying them to any specialty, which will be a comparatively easy matter if the principles laid down are thoroughly understood.

As soon as a certain facility in shading with crayons has been attained, the student should commence sketching in sepia, and from that stage should proceed to work in oils, using in the first instance only black and white, with the numerous shades of gray for middle tints which may be compounded from these two pigments.

PART VIII.

OF STAINING.

CHAPTER XLI.

ITS PURPOSE AND PROCESSES.

STAINING must be considered as a secondary kind of painting, but should be distinguished from graining in every way; for whilst in the latter the original wood is entirely ignored, and a new surface produced on which the colour and veining of another wood is imitated—an operation which requires much skill and taste, and which, from the knowledge of the natural growth of the woods imitated and the artistic treatment required, places graining in the highest branch of house painting—the former must to a certain extent, especially if allowed to trench upon graining, be considered as a sham, for it is clear that the leading difference between woods consists in the system of veining peculiar to each; and thus, although Fir may be stained to match the general colour of Rosewood, the curl or veining will be different; and in our opinion the addition of veining or the use in any way of combs, &c., is an infringement on the true province of graining which should not be encouraged. It must be borne in mind that the graining is itself an imitation, and has indeed been objected to on that ground; but *veined staining* is thus an imitation of an imitation, and as the work of staining is, as a rule, performed by workmen far below the standard of grainers, the result exhibits a corresponding diminution of beauty. The operations of staining are generally considered to be washing, matching, imitating, and improving. We shall, agreeably with the principles above laid down, omit "imitating" as appertaining to other branches of our subject.

The process of staining consists then, in the main, of washing, or laying on the stains in the form of mere washes, so as to change the shade of the wood to a darker or warmer colour; or, at most, to make wood which in its natural grain resembles another, correspond in colour also.

Several excellent stains may be purchased ready for use; and our general directions as to staining refer principally to such: the treatment will be slightly varied in using any of those which may be differently prepared, and a few receipts will be given for making stains in case the ready-made ones cannot be obtained. The wood to be stained should, if possible, be placed horizontally; where this cannot be done, as little of the stain as possible should be used, so that it may not run down and dry in lines, which would subsequently be darker than the general surface. The stain is to be applied with a sponge or large brush, the wood having been previously well rubbed with glass paper, and the dust thus made having been carefully removed. The stain should be sparingly applied, and should be well rubbed in, the desired depth of colour being obtained by several washes rather than by a dark and heavy one; for the wood, if saturated with the watery mixture, is liable to retain some of the moisture, although it may appear dry externally, and warping or twisting may result; and, further, the natural grain of the wood is better brought out by two or three transparent washes than by a single dark and opaque one. In mouldings, or recessed parts, a hog-hair tool will of course be necessary.

When each wash of the stain has dried, the work should be examined, and any of the dust remaining from the glass papering, which may have worked up, should be removed, either by rubbing with a rough cloth or by finer glass paper; in the latter case of course the work must again be well dusted. When the desired colour has been obtained, the wood is to be sized. The size is sold in thin cakes, together with the prepared stains; but of course it is not necessary to purchase it in that condition, as good clear size used for other purposes will do as well.

The operation of sizing requires some care. The size must be applied with a large brush, so that it may be rapidly and evenly spread, and should be quite hot and very thin; the brush, although saturated, should not contain sufficient size to allow it to run down, for if thick streaks are allowed to form, these either crack off at a later period, or as they become dry they cause the varnish with which they are covered to crack or peel off. As already stated in regard to the staining, it is better to obtain the desired effect by repeated coats than to lay on too thick a wash at once. This refers, in fact, with still greater force to size, which, owing to its gelatinous nature, is more liable to clog than the coloured wash.

It has already been said that the size should be hot when used; and it may be added, that if possible the wood to which it is to be applied should be warmed also, in order that the size may be well absorbed into it: the room also should be kept rather warm, so that the size may dry in gradually, instead of being suddenly chilled, in which case it will dry in streaks. Of course these circumstances cannot be commanded in out-of-door work; but staining is not adapted for external situations, and whenever possible a warm and dry day should be chosen for the operation. Experience will soon teach the operator to judge whether the work has been sufficiently sized; it will look uniformly dull, with an even and dry appearance, and should to the touch be devoid of stickiness: if the result is not satisfactory, it had better be washed off with very hot water; but this cannot be done without running the risk of injury to the staining, and wetting the wood more than is desirable. The varnish is finally to be applied by means of either a round or flat varnish brush: the former is mostly used by house painters, the latter by artists; but it has many advantages which recommend it for general use.

MATCHING.—The purpose of this process, is, as its name implies, to make the different pieces of wood of which any piece of furniture is made up, match or correspond, so that they may be of a uniform colour. It will therefore be understood that some parts may require lightening, and others darkening. For the first, make a strong solution of Oxalic Acid in hot water, and add a few drops of Spirits of Nitre, and wash this carefully over the parts which are to be lightened; when quite dry, the surface should have two or three coats of white polish. (2.) Give the parts to be lightened a wash of a clear white stain, and another of white varnish; give the intermediate parts a coat of common varnish, and oil the untouched white parts; bring all up to an equal tint by a darkening stain, if necessary.

Darkening.—The darkeners generally used are Logwood, Lime, Brown Soft-soap, Dyed oil, and various chemicals, such as Aquafortis, Sulphate of Iron, Nitrate of Silver, &c. An intelligent manipulation however of the stains themselves will render special darkeners unnecessary; for in most cases the required depth of colour can be obtained by repeating the stain, or by darkening it for a second wash, and a small quantity of colouring matter may also be mixed up with the varnish.

When it is desired to deepen the natural colour of woods, or to restore such as may have become discoloured by time or other circumstances, the process called "Improving" is adopted; and this differs in no essential particular from staining, excepting that its object is merely to improve the colour and bring out the natural grain of the wood itself, instead of attempting to make it represent another from which its veining may entirely differ. Barberry root boiled in water, Gamboge or Turmeric dissolved in spirit, give good yellow stains adapted for the purpose. A good Red oil for rubbing discoloured Mahogany or Rosewood, or for deepening the colour of Bay-wood, may be made in the following manner:—Tie up some Alkanet-root in a muslin bag, and let it soak over night in some sweet oil. The oil which is then pressed from the bag will impart a beautiful red colour to all the rest. The grain of the wood is well brought out by its being rubbed with Spirits of Hartshorn before the oil is applied. Rectified Naphtha, coloured with Camwood dust, is another good red tint. Discoloured Ebony may be improved by washing over it a strong decoction of Gall-nuts in which a quantity of steel filings has been immersed; this liquid should be allowed to stand a day, and should then be carefully strained, and, as before stated, a little Indigo should be added to the French polish. Raw oil mixed with a small quantity of turpentine serves to improve most woods when well rubbed into them; and this may be greatly enhanced in value by grinding up with it a small quantity of the colour which it is desired to impart to the wood, or by mixing with it oil previously coloured in the manner already described.

The well-known pigment called Gamboge is a gummy and slightly resinous exudation from the young wood of the Gamboge-tree. Though not a dye-stuff, Gamboge is much used in colouring, forming a valuable water-colour; and is also used in colouring lacquer for varnish for brass-work. There is some reason to believe that Gamboge is made from more than one species. It was first introduced into Europe in 1603 by Admiral Van Neck, who brought it from China under its eastern name of *Ghittaiemon*. There are three kinds of Gamboge:—(1.) Pipe Gamboge, which is the best: it comes from Siam in rolls one inch and a half in diameter and about twelve inches long, through which there is a hole about half an inch in diameter. (2.) Lump Gamboge, in masses weighing about one or two pounds, and having the appearance of a hardened yellow paste. (3.) Gamboge in tears or small drops.

Turmeric is the rhizome, or root-stalk, of a plant called the *Curcuma longa*. There are several varieties, of which the China and Bengal are considered the best. The colours produced by Turmeric are various and very beautiful shades of yellow. It is not as a dye-stuff considered permanent; but in the stains, when oiled or varnished, this failing is materially remedied.

Alkanet-root.—The plant from which this root is obtained is of a diffuse character, rarely attaining a height of a foot. It is much cultivated in the south of France, and some portions of Germany. Its chief use is in giving a fine crimson colour to perfumery and woods, for which purposes it is soaked in oil in the manner above described.

Cam-wood.—This tree is a native of Sierra Leone, and has shining leaves and white flowers. It is of considerable size, often attaining the height of fifty feet. The stem is the part used; it is cut into logs about four feet in length, and these, after the removal of the bark and outer wood, are split and trimmed square for exportation; they are of a deep red colour, and yield a brilliant red dye, which is rendered much deeper by sulphate of iron. The red of the English Bandana handkerchiefs is produced by Cam-wood.

CHAPTER XLII.

OF STAINS AND THE INGREDIENTS OF WHICH THEY ARE COMPOSED.

As already stated, a great number of excellent stains with the proper size and varnish may be purchased; but the method of making a few is here appended, for the use of those who desire to compound them for themselves.

Mordants are chemical preparations, the effect of which is to fix and enhance the colours given by stains and dye-stuffs. Spirits of Nitre is used for the Satinwood stain, a strong solution of Oxalic Acid for the Oak, and dilute Nitrous Acid for Mahogany.

MAHOGANY STAINS.—(1.) 2 ozs. Dragon's-blood dissolved in a quart of rectified Spirits of wine; shake frequently during process of dissolution.

(2.) Dark. In 1 gallon of water boil $\frac{1}{2}$ lb. of Madder and 2 ozs. of Logwood chips; brush the decoction, whilst hot, well over; and when dry, paint over the work with a solution of pearlash, composed of 2 drams of pearlash to a quart of water.

(3.) Light. In 1 quart of Oil of Turpentine dissolve 2 oz. of Dragon's-blood, keeping the vessel in a warm place, and frequently shaking it. When completely dissolved, the mixture is to be applied to the work; or if the latter be small, it may be steeped in the stain.

(4.) Grind Raw Sienna on a slab, using beer as a medium; during grinding, add Burnt Sienna until the desired colour is obtained. This mixture is then to be thinned, either with more beer or with water, and is to be applied with a brush, and wiped off with a piece of flannel. It is desirable to avoid "foxey" coloured mahogany; and if this stain should give too brown a colour, a wash made of Madder or Logwood boiled in water may be passed either entirely or partially over it. The work may then be oiled, varnished, or polished, as desired.

Dragon's-blood is a name given to several resins found in commerce, which have a similar appearance, a fine dark red. They are produced by one or two species of Calamus, or cane-palm; and are used for colouring varnishes, and for dyeing horn so as to make it resemble tortoise-shell. The following are the various kinds of Dragon's-blood:—(1.) In sticks, called "Stick Dragon's-blood." (2.) Dragon's-blood in drops or beads, said to be the best. (3.) Dragon's-blood in tears. (4.) Dragon's-blood in lumps.

Madder is one of the most important colouring substances known, and there are several species of it. The plant is extensively cultivated in Southern Europe and in Holland. We receive very large quantities of the root from Smyrna, Trieste, Leghorn, and other Mediterranean ports; much of that which we receive from Holland is in powder, and comes to us in large casks. The Turks formerly understood the manufacture and uses of Madder better than other nations, and the colour thus obtained the name of "Turkey Red." In commerce we have the following varieties of common madder:—Smyrna, French, Syrian, and Italian *roots;* and French, Dutch-crop, Ombros, and Mull *ground* madders.

Logwood.—The tree producing this dye-wood is a native of the province of Yucatan in South America, the principal town of which, Campeachy, situated on the river San Francisco in the Bay of Campeachy, was formerly the mart for Logwood; but it is now extensively cultivated in Jamaica, and the chief trade is removed to Belize, a British settlement in the Bay of Honduras, whence immense quantities are annually exported. Logwood was introduced into this country in the reign of Queen Elizabeth; but, owing to the ignorance of the dyers in fixing the colour, it fell into such disrepute as to occasion the passing of an act of parliament entitled, "An Act for abolishing certain deceitful stuffs employed in dyeing cloths." This law remained in force, and prohibited the use of Logwood until 1661, when it was repealed.

The colouring matter of the Logwood tree depends upon a peculiar principle called *hæmatin* or *hæmatoxylin*, a red crystalline substance which is so abundant in some samples as to exist in distinct blood-red crystals. The stems are cut into large logs, and the bark and alburnum or white wood is chopped off, the dark red inner wood being the only valuable portion. The colour of a decoction of logwood is of a brownish blood-red. Acids change it to the bright colour of red ink (which is often made of an infusion of Logwood chips to which acetic acid is added). The alkalies strike a purple or violet, and the salts of iron a dark violet approaching a black colour.

Rosewood Stain.—(1.) In 3 pints of water boil ½ lb. of Logwood until the decoction is of a dark red colour, then add ½ oz. of salts of tartar. The wood is to receive three or four coats of this liquid, which must be used whilst boiling hot; each coat being allowed to dry thoroughly before another is applied. Veins may be formed in this with the black stain, using grainers' combs or other implements; but, as we have already stated, if this is done, the work is removed from mere staining and becomes an imitation of graining. (2.) (Transparent.) Immerse ¼ lb. Red Saunders-wood and ½ lb. of potash in 1 gallon of hot water. When the colour of the wood is extracted, 2½ lbs. of gum shellac are to be added, and dissolved over a quick fire. The mixture may then be used over the stain above described.

Saunders or Red Sandal-wood.—This dye-wood is the produce of a large tree growing to the height of sixty or seventy feet on the mountains and other parts of India.

It is usually imported in small billets two or three feet in length, of a fine deep red colour, the concentric circles of the transverse section being divided by dark, almost black, lines: with different mordants it yields brownish red, scarlet red, deep crimson, and yellowish red. These colours are not, however, very permanent Another dye-wood, also called Red Sandal-wood, the native name of which is Rutka-chundun, is the production of the largest trees of India. Neither of these must be confounded with the sweet-scented sandalwoods which are furniture woods.

Black Stains.—(1.) To 6 quarts of water add 1 lb. of logwood and two or three handfuls of fresh walnut peelings. Let the whole boil well until reduced to about half the quantity of liquid, then strain and add a pint of best vinegar, boil again, and apply the stain whilst quite hot. Dissolve 1 oz. of Green Copperas in a quart of water, and apply this whilst quite hot over the previous stain, which will be very much improved thereby. (2.) In 3 quarts of water boil ½ lb. of logwood chips, and add 1 oz. of pearlash; strain, and apply whilst hot. Boil ½ lb. of logwood chips in 3 quarts of water, adding ½ oz. of verdigris and ½ oz. of copperas. Strain this decoction and add ½ lb. of rusty steel filings. Wash this stain over the previous one.

Brown Stain.—Make a decoction by boiling 1 part of Catechu, Cutch, or Gambier in 30 parts of water, to which add a little soda. Apply this to the wood which is to be stained, and allow it to dry in the air. Make a solution of 1 part of Bichromate of Potash and 30 parts of water, and apply over the stain, which may be varied in colour according to the strength of the solutions used. Catechu, which is much used in dyeing and staining, is the extract of the wood of the *Acacia Catechu*, the seeds of the *Areca Catechu*, and the leaves of the *Nauclea Gambir*. The Acacia Catechu is a small spiny tree, rarely exceeding twenty feet in height: the wood is hard and heavy; the centre is of a very dark red colour nearly approaching to black; it is from this portion of the wood that the extract is made. In India, it is made by the poorer natives, who move from place to place, selecting jungles where the Acacia is most abundant. They cut down the trees, and chop the heart-wood into chips, which they boil in water: when the water is deeply coloured, it is strained off and submitted to the process of evaporation, fresh supplies of the decoction being added until the whole becomes sufficiently thickened by evaporation. It is then poured into clay moulds and left to dry in the sun. The Catechu made from the Acacia Catechu is also called *Cutch* and *Terra Japonica*. The term *Cutch* is said to be named from the native language, in which the substance is called *Kutt*. The term Terra Japonica was applied by European chemists when the extract was first imported as an astringent from Japan. Commercially, one variety is called Catechu, and another Cutch, although the source is the same. The former has been poured out on to mats when about the consistence of honey and dried in the sun. When sufficiently hardened, it is cut into small square pieces, and, after being thoroughly dried, it is packed into cane baskets for exportation. This variety has a light chocolate-brown colour, and the cubes are about an inch square, having an earthy fracture and external appearance. The other variety, Cutch, is of a darker colour, rich brown, with a shining appearance and fracture: it comes to this country much mixed with broken leaves, in which it has been laid to dry; it is packed in a similar manner to the Catechu, but is most generally run into one mass. *Gambier*, or *Gambir*, is an extract of the leaves of the *Nauclea Gambir:* this plant belongs to the natural order of the Cinchonas, or Jesuits' bark trees. It is made by boiling the leaves and evaporating the decoction to dryness: in appearance it resembles Cutch; but it is not so glossy in its fracture, and rather lighter in colour. It is mostly imported from Singapore, where it is extensively cultivated.

WALNUT STAIN.—Boil 1½ oz. of washing soda, bichromate of potash ¼ oz., in 1 quart of water, and add 2 ½ ozs. Vandyke Brown. This stain may be used either hot or cold.

RED STAINS.—(1.) Boil 1 lb. of Brazil-wood in 1 gallon of water for three hours or more, add 1 oz. of pearlash, and apply it to the wood whilst hot, then brush over it a solution made of 2 ozs. of alum in 1 quart of water. A solution of Dragon's-blood in spirits-of-wine makes a very good stain, as already mentioned. The Brazil-wood is cut from a tree about twenty feet high, with prickly branches and yellow flowers; the decoction yields, in dyeing, rose-colour, red, and yellow, according to the mordant used. It is not used in dyeing now as much as it was formerly, owing to the introduction of superior materials.

(2.) A decoction of Archil forms a very good red stain for common work; two or three washes of it should be given, after which it should be brushed over with a hot solution of pearlash and water. *Archil*, or *Orchil*, is the colouring matter of the Orchella weed in solution. It does not in dyeing produce a fast colour; but it greatly improves other dyes. It soaks, however, into the fibres of wood, and is thus a useful stain for common work.

Oak Stain.—Mix 2 ozs. of American potash and 2 ozs. of pearlash in 1 quart of water, which will make an excellent stain. Should the colour be darker than required, it may be diluted with water. It must be used very carefully, as the American potash will blister the hands if allowed to touch them; the mixture should also be used with a very common brush, as it softens the hair so as to render it of little value afterwards.

Ebonising Stains.—The woods best adapted for ebonising are Sycamore, Plane, and Chesnut; the work should be very well smoothened and rubbed with glass paper before staining, and should be finally rubbed with glass paper or cloth which has been a long time in use, every particle of dust being rubbed off with a smooth cloth.

(1.) Boil ½ lb. of Logwood chips in 3 quarts of water, and add 1 oz. of pearlash. Apply this whilst hot; then boil ½ lb. of Logwood chips in 3 quarts of water, and add ½ oz. Verdigris, ½ oz. Copperas; strain the liquid, and then add ½ lb. rusty steel filings and some powdered nut-galls, and with this go over the wood a second time. When dry, the work is to be well rubbed down; and if the colour should appear uneven, the second stain must be repeated, in which case it must be again rubbed down. French polish, made darker than usual by the addition of finely powdered Stone blue or Indigo, is then to be used. Or,

(2.) The black stain first mentioned to be first applied, then a plate or slate is to be held over a lamp until a quantity of the soot has formed; this, which is fine lamp black, is to be collected and mixed with French polish, which is then to be used in the ordinary manner. This too may be repeated if required, the work having been previously well rubbed down.

(3.) Boil in a glazed pipkin a handful of Logwood chips to 1 pint of rain-water, allowing it to simmer until reduced by about one-fourth, and with this liquid give the wood two or three coats. Now add to the remainder of the liquid two bruised nut-galls, a few very rusty nails, or a piece of sulphate of iron about the size of a pigeon's egg, and add rain-water until the original quantity of liquid is made up. This stain is to be applied hot, and the work is to be French-polished, a little blue having been previously mixed with the polish.

NUT-GALLS.—Gall-nuts, oak-galls, galls, &c., are excrescences formed upon the young twigs of the various species of Oak. Galls are also formed upon other plants; but the nut-galls of commerce are produced on the species of oak called the *Quercus infectorius,* a small shrub about 5 or 6 ft. in height. They originate in the puncture of an insect, *Cynips gallæ-tinctoria.* The puncture is effected by the ovipositor of the insect, and an egg is at the same time deposited. An interruption in the ordinary functions of the tissue of the plant takes place at the spot where the egg is inserted; the consequence is, that an excrescence of vegetable matter, principally tannin, is formed round the egg, and furnishes a *nidus* for the grub or larva when hatched. When this takes place, the grub eats its way out through the side of the gall, after which the vitality of the excrescence either decreases or ceases altogether. Several varieties of galls are distinguished in commerce, the principal of which are the blue and white: the only difference is, that the former are gathered before, and the latter after, the insect has escaped. The colour of the blue galls is a slaty blue, and something of a greyish green; the white gall is of a light drab colour, and much lighter in weight: it is also less valuable than the blue variety. Nut-galls are nearly round, with a few small excrescences over their surface. They yield a fine black colour with any of the salts of iron, and are used in the preparation of writing ink.

APPENDIX.

USEFUL RECEIPTS.

ALABASTER, to clean.—Make a paste with quick-lime and water, spread this well over the discoloured article, and leave it on for about twenty-four hours; then remove with soap and water, applying some friction on parts which are worse than others. Alabaster, if not too much discoloured, may be cleansed with a strong ley of soap and water; or, the superficial dirt and grease having been removed, it may be washed with diluted muriatic acid.

GLASS, to remove Grease from.—Dissolve carbonate of soda in water, in the proportion of 1 of the former to 10 of the latter, and let the liquid boil in a clean untinned iron pot. Slake 8 parts of quick-lime in a covered vessel, and add the hydrate thus formed to the boiling liquid, stirring it meanwhile. Great care must be exercised in using this caustic solution, which must not be allowed to touch the hands; the glass must therefore be dipped in it by the aid of tongs or pliers. When the grease is dissolved the glass is to be well brushed and subsequently rinsed in water.

GOLD SIZE.—Heat ½ lb. linseed oil in a flask, and gradually add 2 ozs. of powdered gum animi, stirring the oil continuously until the whole of the gum is dissolved. Continue boiling until the mixture becomes a little thicker than tar, when it must be strained through a coarse cloth. Previous to use, it is to be ground up with sufficient vermilion to render it opaque; and turpentine must be added in order that it may work freely.

The following method of making gold size is derived from a very old source, and is given in the words of the original:—

To make Gold Size.—Take Gum Animi, Asphaltum, of each 1 oz.; Minium, Litharge of gold and Umber, of each ½ oz.; reduce all into a very fine powder, and add to them, of Linseed oil 4 ozs., of Drying oil 8 ozs.; digest over a gentle fire that does not flame, so that it may only simmer and bubble up, but not boil, for fear it should run over and set the house on fire. Keep constantly stirring with a stick till all the ingredients are dissolved and incorporated, and do not leave off stirring it till it becomes thick and ropy, and is boiled enough; let it stand till it is almost cold, and then strain it through a coarse linen cloth, and keep it for use. To prepare for use, mix with oil of turpentine during heating, and strain again; add Vermilion, and thin as required with turpentine.

Iron-work, Paints for preserving.—(1.) Plumbago and hot coal tar.

(2.) Equal parts of asphaltum and resin dissolved in common turpentine.

(3.) For machinery, dissolve 2 lbs. india-rubber, 4 lbs. resin, 2 lbs. shellac in 5 gallons of benzine. This may be used with any other paint as a vehicle.

(4.) Wrought-iron bridges, &c., are painted with White lead as follows:—The iron-work is first made clean by scrubbing and brushing it with wire brushes; this done, all the cavities and fissures are filled up with a putty of Litharge, Linseed oil, Varnish, and White lead. This filling being dry, brushing is repeated. Afterwards paint is applied consisting of 300 lbs. of white lead, 10 gallons of crude Linseed oil, and 1¼ gallon of Turpentine. This paint is repeated when the previous coat is sufficiently dry, and finally evenly overspread with white sand. Galvanising is also employed to prevent rusting. A galvanising paint consists chiefly of zinc powder and oil varnish. Rusting is further prevented by rubbing the red hot iron with wax, tallow, pitch, or coal tar. Rubbing with heavy petroleum is also well adapted for keeping iron-work clean.

MARBLE, JASPER, PORPHYRY, &c., to clean.—(1.) Mix quick-lime with very strong soap-lees until the liquid is about the consistence of milk, paint it over the substance to be cleaned, and leave it on for twenty-four hours, after which it is to be washed off, and the stone is to be well rubbed with putty-powder and olive oil.

(2.) Marble which has not been tarnished by exposure to the open air may be well washed with potash-water, and subsequently with water with which a small quantity of hydrochloric acid has been mixed.

(3.) Mix soda, pumice stone, and finely powdered chalk, in proportions of two parts of the former to one each of the latter; pass these ingredients through a fine sieve, and mix them with water so as to form a paste of some consistency. This paste on being well rubbed into the marble will remove the stains; the marble is then to be washed with soap and water, when a beautiful polish will be produced.

(4.) Clean with diluted muriatic acid, or soap and warm vinegar. Dissolve $1\frac{1}{2}$ lb. of potash in a gallon of water, add 1 lb. of virgin wax, and let the whole boil for half an hour; then allow it to cool, when a cake of wax will be formed on the surface. This cake is to be ground up in a marble mortar, soft water being added, until a smooth paste is formed, and this laid on the marble, and well rubbed with a piece of flannel when dry, will produce a good polish.

PAINT, ANTI-CORROSIVE.—Take equal parts by weight of whiting and White lead, and half the quantity of fine sand, gravel, or road-dust, and a sufficient quantity of colouring matter. This mixture is made in water, and can be used as a Distemper-colour; but it is more durable to dry it in cakes or powder after mixing, and then use it as an oil-paint by grinding it again in Linseed oil. The proportion of oil recommended for this purpose is 12 parts by weight of Linseed oil, 1 boiled Linseed oil, and 3 Sulphate of Lime, well mixed. One gallon of this prepared oil is used to 7 lbs. of the powder.

PAINT, ECONOMICAL.—Skim milk 2 parts, fresh slaked lime 8 ozs., linseed oil 6 ozs., white Burgundy pitch 2 ozs., Spanish white 3 lbs. The lime to be slaked in water exposed to the air, mixed in one-fourth of the milk. The oil in which the pitch is previously dissolved to be added a little at a time, then the rest of the milk, and afterwards the Spanish white. This quantity is sufficient for twenty-seven square yards—two coats.

PAINT FOR WIRE-WORK.—Boil good Linseed oil with as much litharge as will make it of the consistency to be laid on with the brush; add Lamp Black at the rate of 1 part to every 10 by weight of the litharge; boil three hours over a gentle fire. The first coat should be thinner than the following ones.

PAINT, to remove old.—Wet the place with naphtha, repeating as often as is required; but frequently one application will dissolve the paint. As soon as it is softened, rub the surface clean. Chloroform, mixed with a small quantity of spirit ammonia, has been very successfully employed in removing the stains of dry paint from wood, silk, and other substances.

PAINT, to destroy.—Mix one part by weight of American pearlash with three parts quick stone lime, by slaking the lime in water and then adding the pearlash, making the mixture about the consistency of paint. Lay the above over the whole of the work required to be cleaned with an old brush, let it remain fourteen or sixteen hours, when the paint can be easily scraped off.

PAINT, to remove, Burning, &c.—In those cases where it is requisite to remove painting entirely from its ground, it is usual to resort to mechanical scraping, or to the very dangerous operation of setting fire to the painted surface immediately after washing it over with oil of turpentine, called *turps*, for burning off the paint from the old disfigured work—an operation which may be safely and more easily accomplished by laying on a thick wash or plaster of fresh-slaked quick-lime, mixed with soda, which may be washed off with water the following day, carrying with it the paint, grease, and other foulness; so that, when clean and dry, the painting may be renewed as on fresh work.

Paint, Jay's Metallic.—Break common resin into dust or small pieces, and dissolve in Benzoline or Turpentine until the solution acquires the consistency of syrup or treacle; or, equal parts of each of the above spirits or hydrocarbons, and any other hydrocarbon that will dry and combine with drying oils, can be used instead of Turpentine or Benzoline. When the solution is complete, it is gradually added to Oxide of Zinc, which has previously been made into a paste with boiled Linseed oil, until the whole mixture acquires the consistency of a paint suitable for use. A white paint of a durable and glossy character is thus produced. Other pigments, such as Sulphate of Barytes, Oxide of Iron, Brunswick green, or Red lead, can be added to make any desired colour of paint. "One great advantage of its use," says the inventor, "is its effectual resistance to heat and moisture. It never blisters or cracks even under the hottest sun or in the most inclement weather."

Painted work, to clean.—When painted wainscot or other wood requires cleaning, soft soap and fuller's earth should be applied with a flannel. The work should proceed from the top downwards, and the water should be prevented from running on the clean parts as much as possible, or marks will be made which will appear after the whole is finished. One person should dry with a soft rag as fast as another has scoured off the dirt and washed off the soap. When the paint is soiled in parts only, and does not require a general cleaning, dip a sponge or a piece of flannel into soda and water, wash it off quickly, and dry immediately, or the soda will eat off the paint. When paint simply requires to have the dust removed from it, a cloth should not be used; but, after blowing off the loose particles with a pair of bellows, the operation should be completed with a long-haired brush. With care, paint will look well for a long time if guarded from the influence of the sun.

PAINTING, effect of, on Wood.—It is, of course, generally understood that the main purpose of painting wood is to preserve it from decay, but this effect is only to be expected when the wood is previously quite dry ; if this is not the case, the painting is injurious instead of being beneficial to the timber. On this point Mr. Tredgold ("Elementary Principles of Carpentry," No. 182 of Weale's Rudimentary Series), "There is another cause which affects all wood most materially, which is the application of paint, tar, or pitch before the wood has been thoroughly dried. The nature of these bodies prevents all evaporation, and confines the internal moisture, which is the cause of sudden decay. Both oak and fir posts may be brought into a premature state of decay, by their having been painted prior to a due evaporation of their moisture ; and painting affords no protection to timber against dry rot. On the other hand, the doors, pews, and carved work of many old churches have never been painted, and yet are often found to be perfectly sound, after having existed for centuries. Painted floor-cloths are very injurious to wooden floors, and soon produce rottenness in the floors that are covered with them, as the painted cloth prevents the access of atmospheric air, and retains whatever dampness the boards may absorb, and therefore soon causes decay ; carpets are not so injurious, but still assist in retarding free evaporation."

PUTTY, to make.—Pulverise the required quantity of whiting, which has been specially dried, and pass through a sieve of about forty-five holes to the square inch ; mix the powder with as much raw Linseed oil as will form it into a stiff paste, which should be well kneaded and left for a day or so ; it must then be worked up, a small quantity at a time, so that it may be rendered quite smooth, and that balls of the dry whiting powder may not be imprisoned in different parts of the putty, for these would make their appearance when the putty was being used, and would of course injure the adhesiveness of the composition. Putty should be kept in an earthenware pan covered with a wet cloth. Putty which has become hardened may be made again fit for use by warming and beating it up, and kneading it whilst in that condition. For particular purposes, as for fanlights, iron-framed greenhouses, and other places where the lap or hold is very narrow, a little white lead may with advantage be added. To colour putty, mix Red Ochre, Lamp black, or other colour with the whiting.

PUTTY, to soften.—Slake some quick stone lime in water, and add one-third of the quantity of American pearlash; make the mixture about the thickness of paint. Apply it with a brush to the putty on both sides of the glass, and leave it on for a day or so; the putty will then have become so softened that it may easily be removed with a glazier's knife, and the pane of glass may then be taken out.

SIZE, to make.—Practically, size is merely glue so much diluted with water that it does not (at least for a very long time) harden in the mass, but preserves a jellified condition, and is thus sold in barrels. A better kind is however supplied, made into very thin square cakes like glue, which is principally used for sizing wood which has been stained, or for refined purposes. Parchment size is the best for distemper colours, and is made in the following manner:—Place a quantity of parchment cuttings in an iron kettle, cover them with water, and allow them to soak thoroughly; from twenty-four to thirty-six hours will be required for this purpose, and should the water have been absorbed, more must be added. The whole is then to be boiled for about six hours, during which the scum which rises must be removed. It is afterwards to be strained through a coarse cloth. Size prepared in the following manner will keep good for several weeks: —Dissolve 3 or 4 ozs. of alum in boiling water, and add the solution to every pailful; boil and strain the size a second time, and set in a cool place.

SIZE, GLOVE-LEATHER.—Take ½ lb. of the cuttings of white glove-leather, put them into water and allow them to steep for about twelve hours; add about 6 quarts of water, and allow the mixture to boil down to 1 quart; strain, and allow to cool.

SMELL OF PAINT, to get rid of.—(1.) Place a vessel full of lighted charcoal in the middle of the room, and throw on it two or three handfuls of Juniper berries, shut the windows, the chimney, and the door close: twenty-four hours afterwards the room may be opened, when it will be found that the sickly and unwholesome smell will have left. The smoke of the Juniper berries possesses this advantage, that should anything be left in the room, such as tapestry, &c., it will not be in any way injured.

(2.) Plunge a handful of hay into a pail of water, and let it stand in the newly painted room.

(3.) Fill three or four tubs with about eight gallons of water, and an ounce of vitriolic acid, and place them in the newly painted room near the wainscot. The water will absorb the effluvia from the paint in about three days; but it should be renewed each day during that time.

SOFT PUTTY.—This is made of whiting and boiled Linseed oil, with White lead in the proportion of one-tenth of the whiting; a small quantity of salad oil is then to be added in order to prevent the White lead from hardening and cracking off, as common putty often does in certain situations.

VARNISH, Green transparent.—(1.) Thin some Copal varnish with Turpentine; grind well together equal quantities of Chinese blue and Chromate of Potash, and mix them thoroughly with the diluted varnish.

The precise shade of green may be varied by the different proportions in which the Chinese blue and Chromate of Potash are used.

(2.) For Venetian blinds, &c.—Give the wood a couple of coats of light Lead-colour, and allow it to become perfectly hard. Grind some dry White lead in Spirit of Turpentine, and add to it one-third of its quantity of Verdigris or Navy Green, which has previously been ground in oil; to this mixture add sufficient common oak varnish to bind the colour. Two, or if required, three coats of this varnish are now to be applied, and as it dries very rapidly the whole may be finished in a few hours.

VARNISH, to remove, from Pictures or Fine Work.—By friction, if it be a soft varnish such as that of Mastic, the simple rubbing of the finger ends, with or without water, may be found sufficient: a portion of the resin attaches itself to the fingers, and by continuous rubbing removes the varnish. If it be hard varnish such as that of Copal which is to be removed, friction with sea or river sand, the particles of which have a rotundity that prevents their scratching, will accomplish the purpose. The solvents commonly employed for removing varnish are the several alkalies: alcohol and essential oils used simply or combined. Of the alkalies, the volatile in its mildest state, or carbonate of ammonia, is the only one which can be safely used in removing dust, oil, and varnish from a picture, which it does powerfully; it must, therefore, be much diluted with water, according to the power required, and employed with judgment and caution, stopping its action at the proper time by the use of pure water and a sponge. A thick coat of wet fuller's earth may be employed with safety, and, after remaining on the paint a sufficient time to soften the extraneous surface, may be removed by washing. Both pictures and gilding have been restored to their original beauty by the application of wet clay.

WORM IN WOOD-WORK, prevention of.—The ravages of worms and insects are among the principal causes of the destruction of timber. Some woods are more subject than others to be destroyed by them, such as Alder, Beech, Birch, and in general all soft woods of which the juices are of a saccharine nature. Against the common worm *Oil of Spike* is said to be an excellent remedy; and *Oil of Juniper*, or of *Turpentine*, will prevent them in some degree. A free use of *Linseed oil* is a good preservative, and so is a covering of *Copal varnish*; but these can be applied to small articles only. Another application is *Sulphur* which has been immersed in Nitric Acid and distilled to dryness, which, being exposed to the air, dissolves into an oil; the parts to be secured from the worm are to be anointed with this oil, which does not give an unpleasant odour to the wood. Lime is an excellent prevention against the worm, and sap-wood should always be impregnated with it when used in a dry situation. As worms do not attack bitter woods, soaking wood in an infusion of *Quassia* has been tried, and is said to have the desired effect.

ZINC, to prepare for Painting.—In 64 parts of water, dissolve 1 part of Chloride of Copper, 1 of Nitrate of Copper, and 1 of Sal Ammoniac, and add 1 part of commercial Hydrochloric Acid; brush the zinc over with this mixture, which gives it a deep black; leave it to dry for twenty-four hours, when any oil colour will firmly adhere to it, and withstand both heat and damp.

BIRDS-EYE MAPLE

POLLARD OAK

Plate II

P 107

SATIN WOOD

WALNUT

WAINSCOT OAK

Plate VI

NNA MARRIF

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