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NOTE.

THIS work, as originally published, was well fitted to fill a vacant space in English technical rudimentary literature; and the present edition has been carefully revised, and some omissions supplied. The chapters on the theory of "Natural Colours," and on "Oils, Dryers, Varnishes, &c.," have been wholly, and those on the "Colours of Material Objects" and on "Pigments" have been in great part, written by me; and the text elsewhere revised, and many corrections or additions made. As an introductory work, I may express my belief that it will prove useful to the student either of Fine Art, or of its applications to decorative purposes.

It may also give the student of Architecture, or of Engineering, some preliminary notions as to the principles upon which paints and varnishes act as mere protective coverings.

ROBERT MALLET.

February, 1870.

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COLOURS,

THEORETICALLY AND PRACTICALLY CONSIDERED.

PART I.

CHAPTER I.

THEORY OF COLOURS—ILLUSTRATIONS OF COLOURING.

THE eye, that exquisite work of creative wisdom, is designed as the organ to convey to the brain and to the thinking faculty, the impressions of external and distant objects by means of the sensations conveyed to the retina.

The external force which acts upon this organ is that of light.

Whether light be, as in the earlier days of optical science, viewed as something, whether a fluid or a force, emanating in rays, or in right lines in all directions from bodies luminous either directly or secondarily, *i.e.*, reflected, or as con-

sisting in the rapid vibration of an elastic medium or ether pervading all space, the effects which alone need engage us here are the same.

The great source of light to our world is the sun ; but light is also shed down upon us by the stars, the suns of other systems than our own. These are probably the *only* self-luminous bodies of which we have any cognizance.

Our world also receives light by reflection from the moon and planets, and from the light emitted from burning substances, whether in quick or in slow combustion, such as gas lights, candles, &c., in the former, phosphori of various sorts in the latter.

Light is also elicited by the electric discharge, by sudden change of chemical or of molecular state, as in explosions, certain crystallizations, &c., and by violent mechanical action, as when iron is hammered until it becomes red hot, or air suddenly compressed so as to flash and ignite tinder. All these are very commonly considered as direct sources of light ; but the high probability is, that in the case of the light capable of being elicited by any known process from any terrestrial substances, it is given forth merely from where it had been before stored up, and like heat, was

primarily derived from the sun. So that in a philosophic classification artificial light is in so far only secondarily returned to us, and is in the same range with reflected light.

Light, as emitted by the sun or stars, is, with a few exceptions in the case of stars, colourless; it stimulates the eye, and had material substances no special powers of their own in acting upon light, the latter would indeed enable us to discern objects, but these would be alike *colourless*, and be only perceivable by differences of illumination and of shadow. The light emitted from heated or burning bodies on our globe, is rarely colourless. In some cases, as for example in the red, blue, and green fireworks of our theatres, &c., this colouration is striking.

Whether viewed as matter or as motion, light is transmitted to us from the sun, at a speed across intervening space of 200,000 miles per second in round numbers, as first determined by observation upon the occultations of the satellites of Jupiter. Although apparently to the eye directed to the unobscured sun, its light is both colourless and homogeneous, its rays or undulations consist of at least three sorts:—those which affect the eye with the sensa-

tion of light, those which are recognisable as heat, and others which, though invisible and incapable of being felt, yet exist and are active in producing chemical change.

The first of these, light colourless to the eye, may be made to convey to us the additional sensation of *colour* by either *refraction* or by *reflection*. When a ray or beam of light impinges *obliquely* upon the bounding surface of a denser medium passing out of a rarer one, or *vice versa*, it is bent or refracted from its right-lined course.

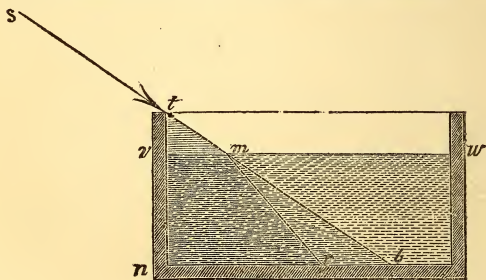


Fig. 1.

Thus in the vertical section of an empty rectangular box, Fig. 1, upon which the light of the sun st shines obliquely over the top edge at t , leaving all that portion to the left of tb , or tbn in shadow, st and b being in one straight line, marking the boundary of the cut-off sunshine. Now if the

box be filled up with water to vm , the boundary of the shadow will retreat from b to r , and the portion $rm b$ will no longer be in shadow. That is to say, the marginal beam stb will have been bent at the surface of the water into the line mr , or *refracted*. The angle through which it is bent is always the same for the same medium.

But it was the glorious discovery of NEWTON, that when a ray of colourless light is so refracted, all its parts are not refracted alike, *i.e.*, through the same angle; the beam, for example, if passed through the oblique surfaces of the glass prism, Fig. 2, is not only *refracted*, *i.e.*, all bent

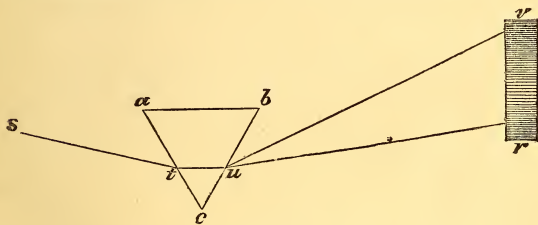


Fig. 2.

more or less by the prism, but also dispersed. That is to say, the beam becomes split up into others having different refractive angles, and on emerging from the prism the before colourless beam, if received directly into the eye, or upon a

white surface, communicates now the sense of colour to that organ.

The beam $s t$, transmitted through the glass prism, $a c b$, is refracted at the first surface, $a c$, into the direction $t u$, and, emerging from the second surface, $c b$, is again refracted, and dispersed through the angle of dispersion, $v u r$, and the beam of light upon the white receiving surface presents a variously and gloriously *coloured* stripe. The different colours are always in the same order from v to r , and in the same relative proportions; and if we adopt the division of the colours given by Newton, these are, in the order from v to r —*i.e.*, from those most refracted to those least so—as follows :

Violet, indigo, blue, green, yellow, orange, red.

This is a real and, so far as refraction and colour are concerned, an ultimate *decomposition* of colourless light. For, if any one of those coloured beams be transmitted again through a second prism, it is refracted indeed—*i.e.*, bent from its course—but it emerges the same colour as before, and is all refracted through the same angle; but each coloured beam through a *different* angle, for the same medium or prism. Blue, yellow, or red are proved to exist in all parts of the coloured stripe,

v r, called the spectrum ; and it has been inferred that, in fact, there are but these three primary colours—the other four, of Newton, resulting from the various superpositions of these.

We need not here enter upon this question ; and, for our present purpose, it will be most instructive to abide by Newton's nomenclature and division.

If the dispersed and differently-coloured rays, thus separated by the prism, be received upon a line of suitably-disposed mirrors, so that each is reflected back and all thrown again upon a single point, their superpositions there will be found to result once more in colourless light—another proof that the decomposition is real.

Upon examining narrowly a large, well-defined spectrum, Fraunhofer discovered in it numerous dark lines, of variable widths, whose positions (parallel to the bands of colour) are constant for the same sort of light, whatever be the nature of the refracting medium (*i.e.*, of the prism), but whose number and positions, &c., differ for light from different sources—such as solar and artificial light. These lines have become as landmarks, enabling the widths of the respective bands of colour to be fixed with a precision impossible in Newton's time, as

well as other highly important points to be discovered. The fixing of the positions of these dark lines has, in fact, been the basis of one of the most extraordinary advances in the means of human knowledge ever made—namely, *Spectrum Analysis*—by which the material substances constituting the masses of the sun, stars, comets, and planets have become in part revealed to us.

If the whole length of the spectrum from v to r (Fig. 2) be divided into 360 equal parts, then the following is the distribution of colour :

Violet	.	.	.	.	109
Indigo	.	.	.	.	47
Blue .	.	.	.	.	48
Green	.	.	.	.	46
Yellow	.	.	.	.	27
Orange	.	.	.	.	27
Red .	.	.	.	.	56

The spectrum, when examined by special methods along its length, is proved to consist not only of light, so divided as to affect the eye with the sense of colours, but that, in connection with these colours, it differs, in different places, in *luminosity*—*i.e.*, in the mere power of exciting the optic nerve.

These *visible rays* are also found to be accompa-

nied by two distinct sets of *invisible rays*, possessing respectively the properties of exciting the sensations and producing the other physical effects of heat, and of exciting or increasing chemical action.

These rays, the discovery of which was due to the elder Herschel and to Berard, are called the *calorific rays* and the *chemical rays*; and the extraordinary fact with respect to them both is, that they are found in greatest abundance and power outside the visible spectrum altogether, so that the maximum amount of the calorific rays are beyond the visible extremity of the red end of the spectrum, and that of the chemical rays beyond the visible extremity of the violet end.

Thus in the following diagram the rectangular

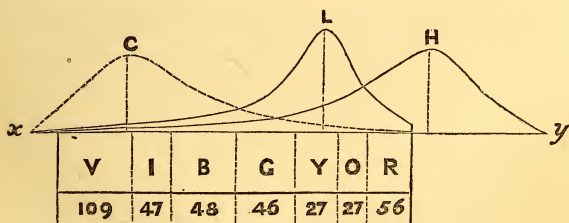


Fig. 3.

band below the line $x y$, represents in length and width the *coloured spectrum*, the colouring being indicated by the letters, and their respective widths by the figures beneath.

The curve marked L indicates the variation of luminosity, which, it will be seen, culminates about the centre of the yellow, and is least in the violet and the red. Thus it is that yellow, orange, and green, are said by colourists to give light in a picture, and are sometimes designated as “advancing” or prominent colours; and that black print, upon a yellow or straw coloured ground, can be read in a feebler light than even if on pure white paper. The curve H is that of the *calorific rays*—the highest point of which shows the maximum heating power to be beyond the red end, and more or less of these invisible rays of heat to extend far away beyond the visible spectrum. One of the most striking facts in relation to these invisible heat rays, is that ascertained by Sir John Herschel, namely, that when concentrated, they can be rendered visible, and that their colorific effect upon the eye is that of a dull lavender grey.

It is foreign to our immediate object to refer here to the remarkable discoveries of Tyndall as to the properties of these “obscure heat rays.”

The curve C is that which follows the march of the *chemical rays*,—which are found to have their maximum power near the passing of the

deepest blue or indigo rays into the violet. These rays, as has been said, extend beyond the violet end, and are not found beyond the red, and of very little power in the red. With the calorific rays, we have little further concern here; but the chemical rays are operative and important in all that relates to artificial colouring or painting, in dyeing, &c. To the properties of these chemical rays, photography, in all its varied branches, owes its existence.

Artificial colours are subject to many chemical changes—dependent upon the atmospheric or other agencies to which they are submitted—even in the dark; but changes either deepening, lightening, or otherwise altering the tint to the eye may occur in certain cases, or with certain artificial colours or dyes, without any other agency than that of the chemical action of light itself,—and all chemical action due to external material chemical agents is exalted by the exposure of the colour or dye, &c., to such agency, and to that of light also.

By special methods it has been shown that the three colours—red, yellow, and blue—are found diffused in all parts of the spectrum, and that their relative proportions, or intensities of respec-

tive colour along the length of the spectrum $R\ v$, Fig. 4, are given by the three overlapping curves, R being that of the red, Y that of the yellow, and B that of the blue colour.

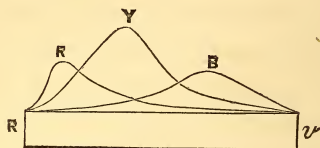


Fig. 4.

Red, yellow, and blue, are thus the fundamental base of all colour ; and in the preparation and use of artificial colours or paints, all colours, tints, and tones, may be produced by suitable mixtures of *white*, red, yellow, blue, and *black*. Why white and black must be added to the list we shall presently explain.

Besides the decomposition of colourless light into coloured light, by refraction and by reflection, as has been explained, its decomposition may be effected by absorption, or the extinction or stifling within the mass of material bodies, of certain of the rays of the colourless light, leaving the others only to be reflected back to the eye from the surfaces of those bodies.

This is the nature of all colour in natural objects. Colour is not a property inherent in any substance,

except in so far as it is elicited by their varied powers of thus absorbing some, and reflecting the remainder of the colourless light incident upon them. That colour is only thus produced, may be made manifest by the facts that any colourless body—as white paper, silk fibre, &c.—assumes for the time the colour of whatever part of the spectrum it is placed in ; and that coloured bodies assume a deeper tint when placed in the part of the spectrum of like colour with themselves, whilst, if placed in a ray of a colour different to their own, they appear of a colour made by the mixture of both. Always, however, with more or less of apparent blackness, because no earthly colour is pure, and nearly all are compound. The sunbeam alone affords perfect purity of colour.

If the body be *homogeneous* and *transparent*, like a thick slab of colourless glass, all the light nearly may pass through, or part be reflected, but still colourless. If the body be transparent, but made up of a great number of thin superposed plates, the light is broken in its transmission by repeated refractions ; and if the plates be sufficiently numerous and thin, the transparent substance seems opaque, and approaches whiteness in colour.

Thus a large number of thin watch glasses superposed, though each quite transparent, appear opaque, and present the aspect and lustre of a great pearl. The white foam lashed from the breakers upon "some wild and rocky shore," driven in from the pure transparent ocean swell, is produced in the same way. This also is the cause of the *nacre* of mother-of-pearl, or other shells made up of thin superposed plates of transparent carbonate of lime, crystallized in the form of *arragonite*. The *play of colour*, however, in such shells, and also in minerals, such as precious opal, or Labrador spar, arises from other causes, which do not come within the scope of this treatise.

To absorption, and to the phenomena of *Dispersion*, *Diffraction*, and *Polarization* of light, also are due all the glorious colours and play of these, which make the plumage of birds, and the coats and scales of insects and of fishes, more magnificent than anything that human art can approach.

Bodies which appear white are those (as in the instances given) which reflect *all* the rays of colourless light. Black bodies are those which absorb the whole, or nearly the whole.

Texture, i.e., the nature of the surface of bodies, has an important influence upon their apparent colours. A polished surface of silver reflects almost colourless light, which stimulates the eye, and enables the form to be discerned, but conveys no sense of colour ; but if the surface be rough, or “matted,” it appears white.

All rough surfaces appear deeper in colour than smooth ones of the same actual tint. A piece of rough cloth appears much deeper in colour than a piece of satin, though both have been dipped in the same dye.

Paper is whiter as its surface is rougher and its texture of transparent fibres looser ; hence card-board made by compression is darker in tint than the paper pulp fibre from which it was made.

Surfaces that consist of finely divided and closely packed filaments, or particles, extinguish much light, especially when the filaments are themselves more or less completely opaque. Thus, black velvet of silk is one of the most intense of blacks, yet it may be shown experimentally, by looking at a surface of black velvet through a telescope, the object glass of which has been obscured to light, except a narrow concentric ring round the edge, by gumming centrally upon it a

round disk of tin foil, that its blackness is not the blackness of darkness; in which case we could not see it thus at all. We see it and other black bodies by *sheen*, *i.e.*, by some colourless light which they all reflect more or less, and by the contrast of their outlines against surrounding objects.

Mere subdivision of transparent substances may produce blackness: thus Brewster found that a perfectly black and opaque surface upon a pure and transparent crystal of quartz, was only due to a film of equally transparent quartz in a state of excessively fine division, *i.e.*, a crystalline powder.

Such is probably the cause of the black colour of charcoal, which differs little chemically from the transparent and crystallized diamond.

The velocity of propagation (whether by transmission or undulation) of colourless light as a whole, we have already stated. When this light is separated as in the spectrum, it has been proved that the light producing the sensation of each colour is propagated with a different velocity of undulation

The rate of vibration, or undulation of the elastic ether, is such, that the red ray makes in the

same time about half as many vibrations as the violet one. The other coloured rays being intermediate, but as all the rays are propagated through space with equal velocity (about 200,000 miles per second), so the wave of vibration of the red ray must be about double the length of the violet one.

Fraunhofer has found that red light while passing through a distance of one metre, or 39·37 English inches, makes 1,351,351 such vibrations, while violet light in passing through the same, makes 2,564,102 vibrations. Red light, therefore, affects the eye with 421 billions of vibratory impulses in one second of time, while violet light strikes the eye with 799 billions such impulses in the same second of time.

To their differences in the rapidity of vibration of the rays of light of different refrangibilities, and to their mutual relations, are owing their powers of producing on the eye not alone the mere perception of colours, but those of their harmonies or discords, or as they are sometimes popularly called, of their matches and contrasts, good or bad. As the differences in the rates of vibrations of musical strings communicate to the ear the sense of sounds, high or low in pitch,

and as concords, discords, and even *silence* may be produced by the reaching the ear together of such vibrations, in respect of whether the vibrations are in unison, or in multiple or sub-multiple proportion to each others time of vibration, or in no commensurable proportion, or as one vibration is opposed to another, so that these extinguish each other, and make silence out of two sounds; so do the conjoint actions of these rays of light vibrating at different rates give the sense of colour, of its harmonies, discords, and even of darkness or extinction. Two or more notes forming a concord, or a discord—two or more rays of differently coloured light entering the eye together, either produce harmony or the contrary.

When all the rays in the proportions found in the natural solar beam enter the eye together, the extinction of their respective differences in the lengths or times of wave vibration by mutual action results in *colourless* light. To this very commonly (even in works of exact science) the name of *white* light is applied, but with less propriety. Whiteness and blackness are in reality matters due to the texture of the surfaces, and to the physical constitution of material bodies.

Blackness and darkness, as has been already shown, are not identical.

These analogies between vision and hearing, light and sound, may be placed more clearly before the eye, thus—the spectrum colours being arranged in the upper line, and the notes of an octave in the second.

RED.	ORANGE.	YELLOW.	GREEN.	BLUE.	INDIGO.	VIOLET.
<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>a</i>	<i>b</i>
1	2	3	4	5	6	7

But the immeasurably greater delicacy of the impressions which the eye has been prepared to receive as compared with those of the ear—exquisitely delicate as is even that—may be judged of when we consider that, while the red ray which moves the most *slowly*, impresses the eye by 421 *billions* of vibrations in a second of time, the lowest audible note, the slowest vibration of sound, strikes upon the ear only thirty-two times during the same time, and the fastest vibration we can hear moves not twenty times faster. The shrill note of the cricket is almost the acutest that can be heard by a human being, and even this is inaudible to some ears.

On the other hand, were our eyes, which discern all colours, within as it were a single octave,

more exquisitely delicate than even they are, we might be conscious of colours of which at present we can have no notion ; and it may be that other animals, insects in particular, may enjoy colours denied to man.

What has been said as to the colours of opaque natural bodies being due to the absorption of some, and the reflection of the remaining rays of the colourless light, is also true of coloured diaphanous substances, such as stained glass, coloured varnishes, coloured transparent jelly, &c.

Here some of the rays of certain refrangibilities, *i.e.*, of certain colours, are stopped in the medium, and the remainder pass through and give it its own colour as it addresses our eyes. The colour stopped, and that which passes through, are necessarily such as together make colourless light.

In certain substances which are imperfectly diaphanous, the colour which passes through or is transmitted may be observed, and also that which is stopped, and which can be seen (not by looking *through* but by looking *at* the object) by reflected light.

Thus certain varieties of glass which are deep green by transmitted light, appear deep red when thus looked at, by the light reflected back from

the surface. An interesting and historical instance of this exists in the celebrated glass vessel which held some fabulous relics in Italy, and which was formerly alleged to have been excavated out of a solid block of emerald. The French *savants*, however, at the end of the last century, dispelled so much of the fable, by proving that the vessel was of green but very peculiar glass, and which appeared red by reflected light. Thus also, it may be frequently remarked that the pieces of rich ancient crimson glass in the windows of Cathedrals, which appear of that colour from the interior, or by transmitted light, when looked up at from the exterior, and therefore seen by reflected light, appear as patches of a dirty whitish green and nearly opaque colour. Certain crystals also from like causes appear of one colour by transmitted, and of another by reflected light.

From what has been already stated as to the separation of the colour rays, and of the combinations and interferences possible between the vibrations producing them, it will be understood that not only may any colour or tint be produced by combination of the three fundamental spectrum colours, but that if any two colours or tints be

produced, which we may call c and c' —the former by any given combination of spectral tints, and the latter, c' , by the like combination of all the remaining tints in the entire spectrum—then these two colours, being such as if mixed together would produce again colourless light, are called *complementary colours*, *i.e.*, c is complementary to c' , and *vice versa*. Such colours, when pure and of equal intensity, are perfect and harmonious contrasts. But if c or c' contain more or less of any one tint (no matter how complex may be the mixture of tints in either) than is just sufficient to make up, with the other, colourless light, then the contrast *may* be not harmonious. It will not necessarily be a discord in colour, but whether it be a harmony or a discord, more or less marked (in *pure* colours such as those of the spectrum), depends upon what is the tint in excess or in deficiency, and what is its proportion in excess or in deficiency present, in relation to the others that go to the complete spectrum.

The general nature of these complementary colours is rendered pretty clear by the diagram, Fig. 5, in which the three fundamental pure colours are found combined two and two (passing round circumferentially) as in the spectrum, into

binary tints, purple, orange, and green, and those taken diametrically opposite are complementaries.



Fig. 5.

So also the overlapping circumferentially of those in pairs produce the *ternaries*, red-purple, red-orange, &c., &c., and these taken diametrically show their respective complementaries; and these again overlapping, produce *quaternary* compound tints, and their diametrically opposite complementaries. The centre point, here marked as neutral, would in reality in the case of any arti-

ficial colours be so, because none such are pure, but in the solar beam it would be a point of colourless light.

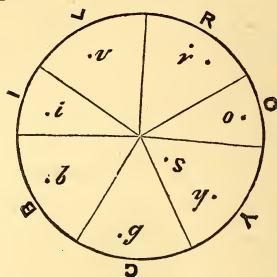


Fig. 6.

Newton described a method by which the colour or tint, exactly complementary to any given colour or tint, may be found graphically or mechanically, as in Fig. 6. A circle whose radius is unity, is divided round the 360° of its circumference into segments proportional to the numbers we have given in a preceding paragraph as being those proportionate to the respective coloured rays of the spectrum, so that commencing at the top of the figure, and going round from right to left thence, *i.e.*, reverse to the motion of the hands of a watch, we have the seven sectors representing the seven rays of colour marked v, i, b, &c. Let the points marked

in small letters v, i, b , &c., be the centres of gravity of the respective arcs v, i, b , &c., of the circumference, assumed equal in weight for the unit in length or for 1° of the circumference, then the common centre of gravity of all these must pass through the centre of the circle. That will be therefore the centre of gravity for colourless light, as for all the arcs or colours combined. A diameter, no matter how or where taken across this circle, shall cut it into two semicircles, each of which shall have a common centre of gravity for all the arcs or parts of arcs within it, which shall equilibrate the common centre of gravity of all those of the other or opposite semicircle. And the combined colours of all such semicircles respectively shall be to each other complementary.

But let it be supposed that we add or diminish the quantity of any one or more colours in one such semicircle, *i.e.*, that we add to or diminish the weight of any one or more of the arcs, v, r, g , &c., of colour, then the common centre of gravity of the whole circle will no longer be in the centre, but will pass somewhere to one side of that, and *the sector of colour within which it is now found will indicate the colour that must be*

added on the opposite side of the diameter so as to restore equilibrium (*i.e.*, to make the other or opposite semicircle to the disturbed one complementary); and *the distance from the centre at which the centre of gravity of the whole circle after disturbance is found, will indicate the quantity of that colour that must be added to restore such equilibrium or complementary condition, while the direction of the line joining these centres points to the colour that must be added.*

For example, if there be added as much more yellow, or yellow combined with orange and green, or even with a portion of blue and red, as shall bring the centre of gravity of the whole circle from the centre to a point *s*, Fig. 6, we can at once decide how much we must add to the weight of each of the arcs of colour at the opposite side of the diameter which is normal to the line joining *s* with the centre, *i.e.*, how much violet and indigo light, and in proportion respectively to its own length to each such arc, in order that we shall restore equilibrium, that is, restore the complementary condition of the colours of the opposite halves of the whole circle of colours, *i.e.*, of the whole spectrum.

If a *scale of intensity* of colour be once arbitrarily

fixed upon for each of the tints of the spectrum, the artist can, by means of such a diagram and method, determine with perfect precision every possible problem as to harmony or contrast, &c., of colour, and having once obtained this in regard to mixture for a given tint, or intensity of tint, can recover the same at any future time in an unerring manner.

Were we to place a circle such as is here referred to upon an axis at its centre and spin it round rapidly, the sectors having been coloured artificially, it would, when viewed through a narrow slit, appear, if the artificial colours were as pure as spectral ones, perfectly *colourless*—if the colours were on an absolutely diaphanous and colourless circle of glass,—and perfectly *white*, if on white paper or porcelain, &c.; on principles which we have already explained.

Upon the principles which have been just explained, it is not difficult to see that an instrument might be constructed, of a simple character, by which all questions of harmonies and contrasts, &c., of *pure* colours and of *equal* intensities, might be mechanically solved with perfect exactness and facility. And there can be no question but that such an instrument would prove of con-

siderable practical value in the hands of any fine art painter or decorative painter, even in dealing with the comparatively impure compound and muddy colours, such as are even the very best that science and skill can produce for their use as paints or colouring agents.

But to be even of this limited use, the *principles* of the instrument, such as we have here sketched them, must be from the beginning *thoroughly* understood. The limitations to the use of any such instrumental means of educating or of assisting the eye of the colourist, require some remarks. No artificially made colours, *i.e.*, dyes, stains, or paints, are pure. The finest and clearest yellow, for example, such as chrome yellow, the most glorious scarlet lake, the blue of natural or of artificial ultramarine, each contains other colours than the dominant one. And this is equally true of the colours of all natural objects. That is to say, the yellow, or the red, or the blue, respectively reflect, each more or less, also of the rays of colour of the others.

This may be proved to the eye of the artist by the use of the glass prism, an instrument that he will find of great value in giving hints, of service to his combinations of paints, in order to match any

given tint or to imitate the colour of any natural object. Let a surface painted over with the purest yellow chromate of lead, for example, be looked at when placed in good clear daylight through a



Fig. 7.

prism, and it will be at once seen that the beam transmitted to the eye from it is not all yellow light—a partial spectrum will be formed at the eye as in Fig. 7—and it will be seen that the coloured surface reflects back, not only yellow mainly, but also some red, and probably some green light.

In such experiments, if the prism be held as in the Fig. with one edge uppermost, reverse to that in Fig. 2, the order of the spectral colours will appear, when *directly* received by the eye as in Fig. 7, the same as when viewed upon the screen in Fig. 2; namely, the violet end at the top, and the red at the lower end of the spectrum.

Similar trials will prove to the artist that the like conditions are true of all his other paints or colours. And should he require to match the colour of a natural object by the mixture of arti-

ficial ones, *i.e.*, paints, he may derive useful hints by examining with the prism both the object itself in nature and each of the separate paints that he proposes to mix in order to match its tint. Thus should the precise tint needed to be matched be that exquisitely beautiful pale sulphur yellow of the flower of the common primrose, on looking at it through the prism the yellow ray will be found mingled with a good deal of green, and perhaps with a very little red. The yellows to be employed as paints being examined in the same way, those can be at once found and chosen which give most nearly the similar partial spectrum, or the mixed paint obtained which shall do so.

While these purely theoretic laws, and these few deductive principles of a practical character, are worthy of careful consideration by the artist, whether he be an historical or fresco painter, or a house or ship painter, it must be equally placed clearly before him that optical theory, and its most skilfully-made applications, can go but a short way in actual practice in ruling his work as an artist as regards harmony in colouring or the complex effect of colouring upon the eye, and through it upon the imagination and the mind at

large. For this there are many reasons, into which to enter at the length they demand would be to fill a large volume.

One or two points we may just glance at ; and for a further and more exhaustive treatment of the subject, we must refer the reader to many of the great works that have been written upon the principles and practice of colouring, such as Chevreul's "*Le Contraste des Couleurs*" and "*Le Moyen de définir et de nommer les Couleurs*," &c., as well as others of a more purely artistic character.

Many other conditions as well as mere *complementarism* come into play in the cases of the colours of natural objects or of paints, &c., producing pleasure or pain to the eye, whether seen alone or together, in harmony or in discord, and this, assuming the eye to be that of one educated somewhat in colour. Into the vast question of how much mental culture and imagination have to do with these matters we must not attempt to enter here. Helmholtz, the great German physicist, has recently discovered that there is a special reticulation of nerves in the ear, by which the *timbre* in sounds is judged of—that is, the quality of the sound independently of acuteness or graveness of note: that which,

for example, in running through the same notes of an octave, distinguishes the tones of a flute from those of a trumpet or an organ, or these from the tones of the human voice.

Now there is a precise analogy to this in colour, though the means provided in the eye by which we are, after it has become educated, enabled to judge of it, are as yet but very imperfectly known ; what *timbre* is to musical sounds, *pitch* or *key*, as it is sometimes called, is to colours.

All artificial or natural-object colours are, as we have said, more or less mixed, and more or less muddy and impure.

But they also all inhere, of necessity, in material substances ; the molecular properties of these constantly differ, and with these their surfaces differ ; and, as a consequence, we have in all paints, and in all objects, and in all coloured surfaces, differences of *texture*, as it is called by artists.

The effect of these differences of texture—apart from their effects suggestively upon the mind in imitative painting—is, materially and in endless variety, to further alter the character of colours in objects or surfaces, as these address the eye. Some textures—such as those of flowers, silk, satin,

paper, certain minerals and metals—mix the colour with more or less of white, or apparent white; *i.e.*, colourless but dispersed light. Others, such as all rough and villous substances, mix the colour with more or less of black; *i.e.*, with colourless but extinguished light.

All terrestrial colours, therefore, are modified by mixture with others, from which they cannot be separated; by intensity of tint; by the light by which they are seen, whether that be clear or sombre, and itself colourless, as sun-light, or coloured, as gas-light and all artificial lights are; by texture and the sort of surface which exhibits the colour; and by balance, or proportion in mere quantity of two or more entering the eye at the same time: which last depends upon all the others, but mainly upon intensity, and upon the relative surface of each of the colours exposed to the eye simultaneously.

With such varied conditions, all productive in skilled hands and to the cultivated eye, of harmony or of discord, it should be obvious to the reader that years of careful observation, training, and culture of eye and mind together, can alone give him that power which at length, more or less with nearly all, but in a high degree with but a

very few men gifted by nature, enables the artist *intuitively* to arrive at colours, tints, and their combinations that shall be harmonious and beautiful.

The basis and pedestal, it is still true, of all the colourist's success in art rest upon abstract science; upon chromatics, whose optical principles we have sketched, in determining chromo-harmonics and their opposites; and upon the observation of *pitch* or *key*, in the same combination of colour.

The purest and brightest colours, all other things being the same, must always be the most delightful to the eye, though they may not be the best to express a determinate conception on the mind (in design). But colours in themselves dull or impure, or even muddy, may not only most suitably affect the imagination for a given subject (in design), but are not necessarily unpleasing, provided they be all so—that there be no violation of *rhythm*—*i.e.*, that the whole of the coloured surface be painted with colours in the same key or pitch; or that, if at some one point (in design) a brilliant departure be made, it should address the eye, in expressing the design, by the brilliancy of pitch given to this part of the picture.

The student of colouring who has got first principles clear in his head, will best further educate himself in the colourist's art by carefully studying the means by which some of the greater masters of colour, in fine art, have produced their final effects.

Let him, for example, stand before such a picture as Mulready's well-known one, "Choosing the Wedding-Dress," exhibited a few years ago, and, observing the vast variety of colours introduced, and yet the perfect harmony of the whole—the pleasure that, as a coloured surface (even irrespective of the subject of the picture), it conveys to the eye—then mentally take it to pieces, compare each patch of colour with those next it, mark their difference in colour intensity, the relation of these to the actual and the intended positions of the objects in the picture so coloured, the effects upon the mind of the relation between the materials—the silk, the cloth, the wood, the glass, &c., in texture—and the colours applied to represent them, the balance of the actual surfaces bearing each colour and tint, to the whole surface of the picture, and to each part of it in relation to distance in the design. Mulready was a master of harmony; but his

pitch of colour, though bright and clear, was not very high.

Let the student turn from him to some of Meissonier's charming pictures, or to some of the exquisite interiors of the *genre* class of the present Belgian school. He will find a brilliancy and pitch of colour greatly higher, but he will find often equal harmony. Place the two, Mulready's and Meissonier's pictures side by side, and they will not spoil each other—each style is fitted and intended, in pitch, to affect the mind in its own special way; but both are natural—the difference seems to be as that between a bright, grey day, and a sunshiny one.

The few remarks here added, as illustrations of colouring in decorative art—a subject fully and ably treated in more elaborate publications which address themselves specially to those who make that branch of it a separate study—are those of the author of the first edition of this work, then one of the volumes of the “Weale Series of Rudimentary Treatises.”

“The exercise of taste, and the demands of novelty and style, in decoration, and beautifying with colours, have a boundless field of exertion and production in the application of the foregoing principles, wherein the genius and taste of the colourist have scope as ample for delighting the eye as those of the musician in harmon-

izing sounds ; and to do justice by examples to these powers in either art would be a vast undertaking, if not a vain attempt. The following illustrations are therefore given, merely as suggestive instances of the effects of the three primary accordances of colours.

“The first example (see *fig. 10*) is that of *Blue with Orange*, or of cold and warm colours, which are general equal powers or equivalents, and as such are instanced in nature by the warm sunshine and azure sky. It is in the same relation that Blue is employed effectively with Gold.

“The second example (*fig. 9*) is of the accordance of *Red with Green*; the first of which is the extreme of colour, as the latter is the mean or middle colour, and they harmonize as one to two in power or equivalence, and are remarkable in the roseate blossom with the green foliage throughout vegetal nature.

“The third example (*fig. 8*) is of the remaining general accordance of *Yellow with Purple*, which are complementary nearly as one to four ; the first as an advancing or light, the second as a retiring or shade colour ; and they are reciprocally employed by nature in giving effect to Purple and Yellow flowers. The above are leading examples only ; but it would be easy, were it expedient, to multiply them to any amount.

“It is a matter of necessary knowledge to the Artist and of useful information to the Decorator of taste, that *the colours of shadows and shadings are always true contrasts to their lights*, in nature, and affords a rule to harmonious art, the neglect of which is a common cause of failure, and dulness of effect. Hence it may merit attention that rooms, &c., lighted from a cold or northern aspect would be of best effect when having their ornamental designs shaded with warm colours ; and that, on the contrary, cool shadows are required in rooms of a southern and sunny aspect. The artist, however, who is acquainted with the true relations of light and colours, will be at no loss in adapting his practice to the peculiarity of the case or situation.

“Not only are there the foregoing harmonies of Succession and Contrast among positive colours, there also is a like contrast of Colour with Neutrality, or of positive Hues with negative Shades. It is hence that coloured back-grounds relieve sculptures, which

are white or neutral, agreeably ; and that *Blue** does so more effectively than other colours, because sculptures having their own relief, and being powerfully reflective of light, are best contrasted and advanced by that colour which is of nearest affinity with shade, and such is Blue. We find accordingly that the Greeks relieved the sculptures of their temples, &c., by Blue back-grounds, which at once harmonized with the sculpture and the sky.

“ So again, in contrasting Black objects with coloured grounds, such as engravings, neutral drawings or designs, &c. ; the colour nearest in relation to light being a warm Yellow, is for the above reason theoretically and practically of best effect. And these will be sufficient to suggest the proper practice in the conduct of Colours and Neutrality in other cases.

“ Fashion, it is true, governs Operatives and Decorators in their works or designs, but when these artists are well-instructed and masters of principles, they will guide and influence fashion by nature and good taste,—advancing art by purifying it from those barbarous and gaudy obtrusions on chaste design which ever denote art in its infancy or decline. As to the aids of literature, it can do little more for the artist and artisan than present them with these principles and precepts, the application of which is an affair of their own skill and faculties, in which they have liberty of action but not equality of powers, for these are divine gifts from nature, or the rewards of acquired skill and industry.

“ In the choice, admiration, and display of colours, we find crude, natural, and uncultivated taste, as in children and savages, delighting in, and employing, entire and primary colours, and unbroken or whole notes in their music ; but as taste and sober judgment advance, sense becomes more conciliated by broken colours and

* A light reddish-brown, with very little yellow in its composition, is admitted nearly universally as the best tint for the walls of sculpture galleries. One of the most cultivated of *connoisseurs* of the last generation, however, was of opinion that a deep crimson, in a rather low key, was the best of all possible colours for display of white sculpture, and the practice of the ancients seems to support his opinion. The walls of the chamber in which the Laocoon was found, are stated to have been crimson.—R. M.

half-tones, till, in the end, they refine into the more broken and enharmonic. The same laws still govern them in practice, and the contrasts of which we have given the first crude examples, may still be as strictly employed with colours extremely subdued, and with the utmost refinement of broken tints and delicacy of expression.

“Thus colours are no less a science than musical sounds, to which they are every way analogous ; and as the musician may be thoroughly acquainted with harmonic science, and able to detect all the errors of the composer and performer of music without himself being able either to compose or perform,—so also it is with the informed and critical colourist, whether decorative artist or man of taste ; for the excellent works of both arts are the product of genius or natural taste, conducted by science and a practised eye and hand.”

PART II.

CHAPTER II.

ARTIFICIAL AND MATERIAL COLOURS.

THE methods whereby colours are more commonly given to or changed in or upon the surfaces of solid bodies, may be classed into *dyes*, or stains, and *pigments*, or applied surface colours. A dye *may* be a mere surface stain or paint, as in the processes by which fine muslins are printed with the blue in impalpable powder of artificial ultramarine, but a *dye*, properly speaking, is a true chemical combination between the material of the dye and that of the cloth, wood, or other object dyed, whereby colour in the latter becomes developed. Thus woollen *white* cloth dipped into a *colourless* solution of deoxidized indigo, and exposed then to the air to reoxidize the latter, assumes a deep blue; so silk or other animal sub-

stance dipped in magenta solution is at once dyed a permanent and undischageable crimson. These are examples of *substantive dyes*, i.e., those in which there is a direct chemical affinity between the dye stuff and the material of the thing dyed.

When there is not such, that affinity may be produced by the intervention of a third substance which has an affinity for both the dye and the thing to be dyed. The dye in such case is called an *adjective dye*, and the third go-between is called a *mordant*. Thus cotton cloth or linen, which could only receive a temporary stain from being dipped into infusion of cochineal, become permanently dyed if first dipped into a solution containing peroxide of tin. The mordant, too, may be employed greatly to modify the colour of the dye itself. Thus, calico dyed with garancine, the bright red of madder, is red if the mordant be alum, but purple if that be a salt of iron.

Stains, such as are employed for colouring the surfaces of wood naturally white or light in colour, are only surface dyes, transparent enough to show the wood grain through or not.

Thus *oak stain*, for deal, may be but a salt of iron. Ebony black stain, a dye produced by pouring over the surface alternately infusion of

logwood or of gallnuts, and solution of a salt of iron, usually sulphate.

To the class of dyeing properly belongs the colouration of glass for stained glass windows, the dyeing material here being usually some oxide or other *haloid** compound of a metal which combines with the colourless glass when the latter has been liquefied by fusion. In this case the dyed or stained glass is called pot glass, as having been coloured in the melting pot; but glass in sheets stained by coating one or both surfaces with the staining material and then heating the whole in an oven, whose temperature is nearly equal to the melting point of the glass, is but the same thing in disguise. Enamelling and porcelain painting present examples both of the employment of surface pigments and of dyes or stains, often in combination, and both being fixed by fusion or by baking only.

The colours themselves are, in both these arts, derived from very much the same elements, and rest upon the same principles as those employed by the glass-stainer. They are either haloid or other compounds of metals chiefly, or they are

* Haloid, from 'αλς—ειδος—having the form from whence salts, or saline combinations, are produced.

frits, i.e., opaque or transparent stained glasses nearly completed as to fusion, which when levigated can be applied to the surface of the enamel base, or to the porcelain, by the help of a suitable liquid vehicle.

With none of these processes for giving colour, however, are we concerned here. This volume refers merely to pigments, or surface-applied colours spread on as paint.

Such colours or paints are mainly of mineral origin; that is to say, they are either haloid compounds of the various metals, or they are certain insoluble (in water) salts of these. Most commonly oxides constitute paints—such are the whole tribe of ochres,* from yellow through red to deep purple—and many chemical combinations of oxides with oxides; but chlorides, as of lead, oxychlorides, as of copper, and, in Pattinson's patent white lead, iodides, as of mercury, and sulphides, as of arsenic, are employed.

Amongst the insoluble salts we find carbonates, as of lime (whiting), of copper (malachite), chromates, as of lead (chrome yellow), arsenites, as of

* Ochre, *ωχροα*, in Greek, originally applied no doubt to yellow ochre only, as its composition indicates, *ωσ*, an egg (yolk), and *χροα*, colour.

copper (Scheeles green), acetates, as of copper (verdigris), phosphates, as in phosphate of iron (blue), ferro cyanides, as in Prussian blue.

In addition we have some natural or artificial compounds of a highly complex character, as in ultramarine, verditer, &c., as to chemical constitution.

Besides these, many pigments are derived not from inorganic compounds like the preceding, but from organic compounds derived from the vegetable or animal world. Thus the whole tribe of lakes consist of vegetable colouring matters, or of animal ones combined with pure clay, hydrous oxide of aluminium, by precipitation. The lakes most commonly known are pinks and crimsons in colour, derived from the colouring matter chiefly of the cochineal or lac insects, or from that of madder: but lakes may be of any colour. Thus, Dutch pink, so called, is a green lake; yellow lakes are made from Persian berries; and blue lakes may be made from the colouring matter of blue flowers.

All lakes are more or less *fugitive*, *i.e.*, liable to lose colour or become bleached by even the mere action of light; but much remains yet to be done by the chemist to make them as permanent as

the conditions of their production will admit; a point which has not been reached, nor any sustained effort made with competent knowledge to attain it.

Some colours are derived direct from the vegetable world in the form of coloured resins, such as gamboge, annotta, dragon's blood, and indigo; and several indirectly, *i.e.*, from vegetable matter which has undergone more or less chemical change, as in the many browns derived from peat or ulmine (Vandyke brown), &c., and asphalt, and several yellows and reds. A few are derived from the animal kingdom direct, such as sepia from the cuttle fish (*Sepia octopus*), and the celebrated murex purple, the colour of which has been proved in modern days to be a real animal indigo, and from which there seems reason to believe a sort of lake was made anciently, and employed as a pigment, as well as the animal juices of the shell fish as a dye for woollen and silk.

In addition to all these, many pigments result from the partial or complete decomposition by heat of animal or vegetable substances. These are chiefly brown or black pigments, such as bistre, Indian ink, lampblack, &c.

Such is a very brief and general view of the

sources and classification of the pigments usually employed.

Pigments *may* be employed in a dry state, and their powder caused to adhere to a suitable surface by mere friction—such is the nature of chalks or *crayon drawing*, or coloured drawing in Conté or in Italian crayons upon *carton dur*, paper, or the like ; that powder may be afterwards *fixed* to the surface by thin glue washes or by varnishes. But, in general, pigments are applied and are caused to adhere, in a film of greater or less thickness, to the surface to be coloured, by the help of some liquid, more or less compound. These are called *vehicles* by painters, and from these come the distinctions of all painting into two great classes, *water colour* and *oil colour*.

Water colour comprises three distinct sub-classes, one of which may be said to be no longer practised ; *viz.*, *water colour proper*, in which the pigments are ground with water, and some gluey body, soluble in or miscible with water, by which they adhere to the surface coloured. *Tempera*, or *distemper* painting, being that by which theatrical scenery is produced, differs from the last, chiefly in that the colours are all made opaque by being mixed with white, in the shape of whiting or

white clays, and then called *body colours*, and is still water colour.

Fresco painting upon prepared mural surfaces, in which the colours *may* be merely ground with water alone, though generally with some stiffening material added, form the second sub-class. The colours here are *fixed* in various ways. The most modern, and probably the most perfect, being that of Kuhlmann, as employed largely by the celebrated Kaulbach, at Berlin and Munich, by means of soluble glass (silicate of soda).

Lastly, there is *encaustic painting*, as practised to some extent by the ancient Greek painters, in which water colours applied upon a suitable mineral surface (often of *gesso* or plaster of Paris, or of white marble), were fixed by diffusing over them a thin coating of melted wax, which was absorbed by the porous surface.

Oil colour, commonly reputed, though on very debatable grounds, to have been invented by Van Eyck, a Flemish artist, about 1410-20, comprises properly every application of paint by any liquid vehicle, not miscible with or soluble in water. There are many such besides fat oils, of which we shall speak further on.

CHAPTER III.

QUALITIES OF PIGMENTS.

PRECISENESS in the use of terms is essential in all matters pertaining to science, and it may here be as well, before treating of the qualities of *pigments*, technically called *colours*, to mark precisely the distinction of the terms *shade*, *hue*, and *tint*, as applied to colours, because these words, even in our best dictionaries, are considered all but synonyms. The variety of lightness and darkness in colours is expressed by the word *shade*; the varieties of gradations in the mixtures of colours are designated *hues*; and *tints* are produced by the admixture of hues and colours with white and dark hues.

Beauty of colour, including pureness, brightness, and depth of body—essential to a pigment working well—and durability, are the chief qualities. Dependent upon that are transparency and opacity: keeping place and drying well. In

opaque and white pigments, body is the quality which colours and hides the ground, and in transparent pigments body signifies the degree of richness of colour or tinting power. Fineness of texture, essential to working well, depends much upon sufficient grinding, as keeping place and drying well depend no less chiefly on the vehicle, mostly oil, used in the admixture. These will all be found treated of in their proper place in the following pages, to which the index will furnish a ready reference.

The same physical qualities that cause a pigment generally to *work well*, in the operation of applying with the brush, are those which determine the goodness of its *body*.

These are, the molecular form of the particles of the pigment, however prepared, and the perfection of its subsequent levigation. Almost all pigments (not found in nature) are produced either by fusion, torrefaction, sublimation, or by precipitation; in any case, but more especially in the last, it is essential to good *body* that the pigment should be precipitated in what is called and appears to the naked eye, the amorphous state. It is probable that *all* precipitates are in form crystalline, but when the crystals are extremely

minute so that to the eye their form is indiscernible, it is then said to be an amorphous precipitate. Such is the case when sulphuretted hydrogen is passed through a solution of arsenious acid or water, to form orpiment.

In this state of minute division, crystals, although of compounds which in a larger size produce translucent crystals, are *opaque*, and this opacity, due to minute subdivision, must be produced, either by the conditions of production of the pigment, or subsequently by fine and careful levigation.

Cinnabar, the sulphide of mercury as it exists in nature, as an ore of quicksilver, or as obtained artificially, is in crystals which, when perfect and large, are translucent, and in this state its colour is not nearly as bright as a good red brick; in fact, it is a dirty red purple brown. But by fine grinding, it assumes its well-known magnificent scarlet colour in vermillion.

In former times the Dutch had almost a monopoly of vermillion, and theirs was deemed the best in Europe. Since then the Chinese vermillion has had a high but more problematical reputation.

Inquiries instituted in the last century by

French men of science to ascertain upon what the superiority of the Dutch vermilion rested, resulted in the conclusion that it was merely the perfection with which it was levigated or ground.

Natural opacity in the chemical compound, or acquired opacity by subdivision, are the conditions of good body. The effect of subdivision in producing opacity, may be illustrated by remarking that if a pure transparent piece of plate glass be ground into fine powder, even in a common mortar, the powder is an opaque white, and even green glass thus treated becomes nearly a white powder.

Durability in pigments depends mainly upon two conditions.

1. That the pigment itself shall be of such a nature as not to originate molecular or chemical changes within the range of its own constituents after it has once been formed.

2. That its nature shall be such as to be to the least possible extent acted upon by the chief natural agents, molecular or chemical, that are constantly at work everywhere to produce decomposition, &c.

Besides the power which the chemical rays of light have, as already explained in the first part,

to originate or exalt chemical action, and therefore change the main natural agents of chemical change to which pigments are exposed, are the combined action of air and water, or moisture. These tend to produce oxidation when both are even pure, but in most places, and especially in our crowded and coal-burning cities, foreign matters are always present in the air, and in much of the moisture it contains, or precipitates as rain, which possess energetic chemical action, destructive to many pigments. Thus in our cities, nitric acid, sulphuric acid, carbonic acid, are present in the air, as well as various other products of combustion of coal or of gas making, and soot and grit, as a mechanical agent, are constantly falling or being blown about.

Besides these, one of the most destructive of all agents to some of our most important pigments is sulphuretted hydrogen, ever present in the air where putrid matter, drainage, &c., is near.

Natural waters contain this gas dissolved, as well as carbonic acid, and, along with a large number of saline compounds, contain bases combined with chlorine and with phosphoric acid.

These and other like agencies, to go into which fully cannot be attempted here, and the under-

standing of which must pre-suppose a large acquaintance with chemistry and physics on the part of the reader, are those most inimical to the durability of any given pigment. Under these conditions, colours derived from inorganic sources are always the most durable, such as the iron ochres, &c., and the most fleeting are those obtained from vegetable or animal compounds, such as the red lakes. Amongst the former class of colours, those derived from the metals, which are highly positive bases, those of the mercuric series, of lead, mercury, copper, &c., are much more readily acted upon *generally*, than are those of less positive bases, iron, tin, antimony, zinc, &c.

Peroxides are always more durable than oxides lower in the scale of saturation with oxygen; hydrates, or hydrated carbonates (as orange ochre), more liable to change than anhydrous ones.

Some colours (iodide of mercury, for example) will not bear to touch some metals, such as iron, zinc, &c., without decomposition. Some react upon the canvas, or the wood, or paper, or even ivory or parchment, upon which they may be laid, as verdigris, &c.

The special chemical relations of each pigment, however, must be studied distinctly; and for the

production of a sound decision as to the durability of any given colour, an exact and full chemical knowledge is indispensable.

The nature of the vehicle affects the durability of the colour. All pigments are more durable in oil than in water colour. The old chemical maxim,—*corpora non agunt nisi soluta*, comes here into play; the colour ground in oil, and coated with varnish, is to a certain extent sealed up from the effects of external chemical agency of air and water. But here again, the case tends to destroy the instrument left within it. Not only the canvas, the board, the paper, but also, and much more, the fat and volatile oils of the oil colour tend slowly to oxidate and decay by *eremacausis*,* but in their decay thus, they transfer oxidation and decay occasionally to the colours themselves. We shall return to this in describing the respective pigments.

Before proceeding to describe in detail the various pigments, and modes of manipulation best adapted for painting in oil, distemper, fresco, &c, it should be stated that on no account should

* *ερημος* and *καιο*. To slowly burn when left to time, which is the nature of all decay; a very slow oxidation, of which actual combustion is a very quick one. "Time is as a lambent flame," said Bacon with rare insight.

a greater number of pigments be used in mixing colours than is necessary to produce the tint required, because such mixtures, as a rule, are fouler than the colours employed, the drying and other qualities are liable to deterioration in consequence. For this reason ready-made composition and tints should be avoided if possible; and the artist will always find it safer and better to rely upon his own judgment and skill. Experience also has proved, as another fact to be kept in view, that old pigments are preferable to new, as regards these two essential qualities, drying well and durability.

CHAPTER IV.

OF WHITE AND ITS PIGMENTS.

WHITE is the basis of nearly all opaque painting designed for the laying and covering of grounds, whether they be of woodwork, metal, stone, plaster, or other substances, and should be pure, for the better mixing and compounding with other colours without changing their hues; while it renders them of lighter shades, and of the tints required, it should have as little chemical action on them as possible. It also gives solid body to all colours.

It is a very advancing colour; that is, it comes forward and catches the eye before other colours, and it assists in giving this quality to other colours with which it may be mixed, by rendering their tints lighter and more vivid. Hence it appears to throw other colours back which are placed near it, and it powerfully contrasts dark colours, and black most so of all. The term *colour* is, however, equi-

vocal when attributed to the *neutrals*, white, black, and greys; yet the artist is bound to regard them as colours.

White is the nearest among colours in relation to yellow, and is in itself a pleasing and cheerful colour, which takes every hue, tint, and shade, and harmonizes with all other colours, and is the contrast of black; added to which it gives solidity in mixture; and a small quantity of black added to white cools it, and preserves it from its tendency to turn yellow. White mixed with black forms various greys and lead-colours, so called. White, though commonly and properly referred to as the *opposite* of black, is not correctly described as optically the *contrast* of any *colour*—or, if it be so described, the colour must be yellow; and it is a fact that the visual contrast, or distinctiveness, is greater of black and yellow than of black and white. Hence the reason of printing mathematical tables on light-yellow paper.

From the above qualities of white, it is of more extensive use in painting than any other colour, and it is hence of the first importance to the painter to have his pigments of the best quality. These are abundant, of which we shall here notice

those only of practical importance to the painter and decorator.

Notwithstanding white pigments are an exceedingly numerous class, an unexceptionable white is still a desideratum. The white earths are destitute of body in oil and varnish, and metallic whites of the best body are not permanent in water; yet, when properly discriminated, we have eligible whites for most purposes, of which the following are the principal:

WHITE LEAD,

Or ceruse, is a carbonate of lead. Under the various denominations of London and Nottingham whites, &c., &c., flake white, Krems, or Kremnitz white, Roman and Venetian whites, blanc d'argent, or silver white, sulphate of lead, Antwerp white, &c., other compounds of lead also occur for sale. 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 varnish, safe and durable, and dry well without addition; but excess of oil discolours them, and in water-painting they are changeable even to blackness. They have also a destructive effect upon 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, orpiments, &c. ; but ultramarine, red and orange vermillions, yellow and orange chromes, madder colours, sienna earth, Indian red, and all the ochres, compound with these whites with little or no injury. 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 all other pigments. It is also the best local white when neutralized with black, but must not be employed in water-colour painting, distemper, crayon painting, or fresco ; for in all such they occasion change of colour, either by becoming dark or by fading. Cleanliness in using these pigments is necessary for health ; for, though not virulently poisonous, they are pernicious when taken into or imbibed by the skin, or otherwise, as are all other pigments of which lead is the basis. All salts of lead, whether employed in oil or water colour, are readily acted upon by sulphur compounds present in the atmosphere, especially by sulphuretted hydrogen, always present in the air of cities or of inhabited places. Sulphuret of lead in fine division is black.

The following are the true characters of these whites, according to the author's experience :

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 grayer of the two. The inferior white leads are adulterated with whitening (washed chalk) or with 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. 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 duly diluted with linseed oil and more or less turpentine, according to the work; and also for mixing with other colours and producing tints.

KREMS, OR KREMNITZ WHITE,

Is a white carbonate of lead, which derives its names from Krems in Austria, or Kremnitz in

Hungary, and is called also 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 degrees of care or success with which it has been prepared.

FLAKE WHITE

Is an English white lead, in form of scales or plates, sometimes grey on the surface. It takes its name from its figure, is equal or sometimes superior to Krems white, and is an unadulterated oxycarbonate of lead, which is its essential and only advantage. Other white leads seldom equal it in body, and, when levigated, it is called body-white.

BLANC D'ARGENT,

Or silver-white.—These are false appellations of a white lead, called also French white. It is brought from Paris in the form of drops, is exquisitely white, but of less body than flake white, and has all the properties of the best 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. This is not generally found in the shops.

SULPHATE OF LEAD,

As an educt of chemical manufacture, is sold frequently. It is exceedingly white, precipitated from any solution of lead by sulphuric acid, much resembling the blanc d'argent, and is, when well prepared, quite neutral, and, thoroughly edulcorated or washed, has most of the properties of the best white leads, is equally permanent, but is greatly inferior in body.

The above are the principal whites of lead, to which should now be added Pattinson's Patent Carbonate of Lead, manufactured largely at Newcastle-on-Tyne; but there are many other whites used in painting, of which the following are the most worthy of attention:

ZINC WHITE (OXIDE OF ZINC)

Is an oxide of zinc which has been more celebrated as a pigment than used, in England, being per-

fectly durable in water and oil, but wanting the body and brightness of fine white leads in oil ; while in water, constant or barytic white is superior to it in colour, and equal in durability. Nevertheless, zinc white is valuable, as far as its powers extend in painting, on account of its durability both in oil and water, and its innocence with regard to health. And when duly and skilfully prepared, the colour and body of this pigment are sufficient to qualify it for a general use upon the palette, although the pure white of lead must merit a preference in oil. Zinc white is obtainable of the artists' colourmen. Its use for house painting on the Continent is large and steadily increasing.

TIN WHITE (OXIDE OF TIN)

Dries badly, and has almost no body in oil or in water. It is the basis of the best white in enamel painting.

There are various other metallic whites of great body and beauty,—such are those of bismuth, antimony, quicksilver, and arsenic ; but none of them are of any value or reputation in painting, on account of their great disposition to change of colour, both by light and foul air, in water and in oil ; and are procurable only of the chemists.

PEARL WHITE.

There are the two pigments of this denomination: one is an oxide of bismuth, which turns black in air containing sulphuretted hydrogen gas; the other prepared from the waste of mother-of-pearl shell, which is exquisitely white, and of no body in water, oil, or varnish. Both are cosmetics, rather than colours.

CONSTANT WHITE,

Permanent white, or barytic white, is an artificial sulphate of barytes, and, when well prepared and free from acid, is one of our best whites for water-colour, being of a superior body in water, but less so in oil. As it is poisonous, it must be kept from the mouth.

This pigment should be employed with as little gum as possible, as that destroys the body, opacity, or whiteness; and solution of gum ammoniac answers better than gum arabic, which is commonly used: but the best way of preparing this pigment, and other terrene whites, so as to preserve their opacity, is to grind them in simple water, and to add toward the end of the grinding sufficient only of size, or clear cold jelly of gum tragacanth, to attach them to the ground in

painting. Artificial barytic white is seldom well purified from free sulphuric acid, and, therefore, may act injuriously on other pigments.

WHITE CHALK

Is a well-known native carbonate of lime, used by the artist only as a crayon, or for tracing his designs; for which purpose it is sawed into lengths suited to the port crayon. White crayons and tracing-chalks, to be good, must work and cut free from grit. From this material, whitening and lime are prepared; the first of which is the basis of many common pigments and colours used in distemper, paper staining, &c.

There are many earthy whites under equivocal names: among these are Morat or Modana white, Spanish white, Troyes, or Troy white, Rouen white, Bougeval white, Paris white, blanc de roi, China white, satin white; the latter of which is a sulphate of lime and alumina, which dries with a glossy surface, is said to be prepared by mixing equal quantities of cream of lime and solution of alum. The carbonate of lime of the common oyster-shell contains also a soft white in its thick part; and egg-shells have been prepared for the same purpose; as may likewise an endless va-

riety of native earths, as well as those produced by art. From this unlimited variety of terrene whites we have selected above such only as merit the attention of the artist; the rest may be variously useful to the paper-stainer, plasterer, and painter in distemper; but the whole of them are destitute of body in oil.

TINTS.

White is every way of importance in painting, not only as a ground, but as the basis of all tints, as necessary in compounding the endless variety of pale hues which taste and fashion require of the painter and decorator, which every season brings out under new denominations—which are in turn to give way to others and be forgotten. Thus, white tinted with blue, &c., has afforded Paris white, &c., French greys, silver greys, &c.; while reds tint white pink, carnation, coquilocot, and all the blushes of flowers, &c.; and yellow with white has afforded primrose, straw-colour, Isabella, &c. To the more or less compound colours with white we are indebted for the innumerable tints of lilac, lavender, peach-blossom, pea-green, tea-green, &c.; to prescribe formulæ for which, after the principles advanced, is unnecessary. The exqui-

site tints of white which distinguish the French paper-hangings, and the distemper decoration of Italian rooms, are said to be produced from natural earths of peculiar quality—perhaps, more or less subject to artificial tinting. They are not carbonates of lime, however. A beautiful silico-aluminous distemper white is prepared at the Solfetara, near Naples, by the decomposition of *trachyte* by the steam and vapours naturally there emitted.

CHAPTER V.

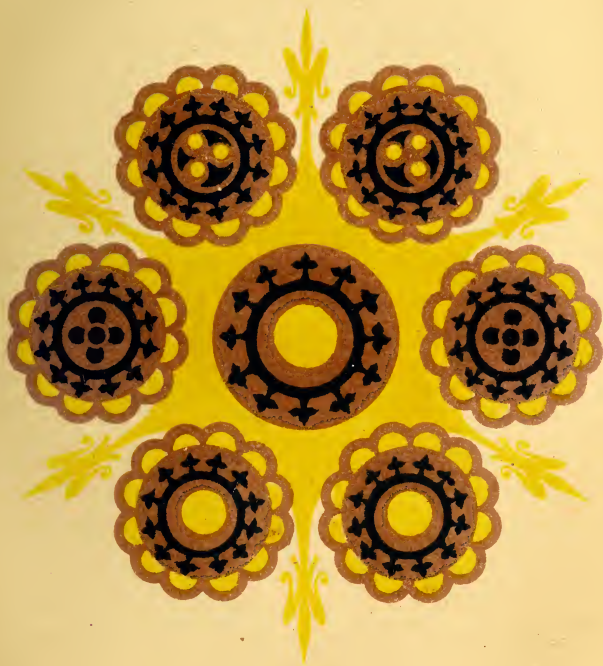
OF THE PRIMARY COLOURS.

I.—OF YELLOW.

YELLOW is the first of the primary or simple colours, nearest in luminosity to the neutral white, mixed with which it affords the faint hue 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, and its relatives, scarlet, &c., and other warm colours.

It is the ruling colour of 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, dun, drab, chesnut, roan, sorrel, hazel, auburn, Isabella, fawn, feuille-morte, &c. Yellow is naturally associated with red in the spectrum, and the two comport them-

FIG. 8. p. 68.



See also page 37.

selves 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 artificial production of *black*.

As a pigment, yellow is a tender delicate colour, easily defiled, when pure, by other colours. In painting, it diminishes the power of the eye by its action in a strong light, while itself becomes less distinct as a colour; 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 effect of the impression 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 red, by distance. The stronger tones of the same colour subdue its fainter ones 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 and the neutral white in artificial colours accord well in conjunction. Of all colours, except white, it contrasts blacks most powerfully.*

The sensible 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 in ancient paintings may have arisen not less from the great value and splendour of the metal, than from the paucity of fine yellows among those ancients 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 vermillion and ultramarine, the place of yellow was supplied by gilding, and in most cases the artist trusts to the

* Ruskin's Elements of Drawing, second edition, 1857, p. 7.

gilding of his frame for some portion of the effect of this colour in his picture : and in every case of decorating with gilding, similar allowances should be made. Gilding, however, possesses attributes wholly distinct from the yellowness of the gold, in virtue of its *texture*, more or less complete *polish*, and metallic *lustre*.

Such conditions, as co-addressing the eye, should never be left out of view in considering the effects of colour upon the eye and mind.

Yellow is a colour abundant throughout nature, and its class of pigments abounds in similar proportion. We have arranged them under the following heads, agreeably to our plan, according to their definiteness and brilliancy of colour; first, the opaque, and then the transparent, or finishing colours. 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 any mixture of other colours.

CHROME YELLOW

Is a pigment of modern introduction into general use, and a considerable variety of tints, which are all chromates of lead, in which the base 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 after some time lose their pure colour, and may even become greenish black, when in contact with organic matter or with deoxidizing agents. They nevertheless resist the sun's rays during a long time. Upon several colours they produce serious changes, ultimately destroying Prussian and Antwerp blues, when used therewith in the composition of greens, &c.

JAUNE MINERALE.

This pigment is also a chromate of lead, prepared in Paris, differing in no essential particular from the above, except in the paleness of its colour. The chrome yellows have also obtained other names from places or persons from whence they have been brought, or by whom they have been prepared, such as *Jaune de Cologne*; we pass over, however, such as have not been generally received. The following pigment passes also under the name of *Jaune Minerale*:—

PATENT YELLOW,

Turner's yellow, or *Montpellier yellow*, is a chloride of lead, which metal is the basis of most opaque yellow pigments; it is a hard, ponderous, sparkling substance, of a crystalline texture and bright yellow colour; very inferior in richness and body to chrome yellow. It has a tolerable body, and works well in oil and water, but is soon injured both by the sun's light and impure air; it is therefore little used, except for the common purposes of painting.

NAPLES YELLOW

Is a compound of oxide of lead and antimonious acid, anciently prepared at Naples under the name of *Giallolini*; and is a pigment of deservedly considerable reputation. It is not so vivid a colour as either of the above, but is of a pleasing light, cool, yellow tint. Like all the preceding yellows it is opaque, and in this sense is 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 palette with a spatula of ivory or horn. For the same reason it may be liable to 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 and clothing the particles of pigments, and so 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, its 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.

It is used in enamel painting, as it vitrifies yellow, and in this state it was formerly employed under the name of *Giallolini di fornace*, and has been again introduced, under an erroneous con-

ception that vitrification gives permanence to colours, when in truth it only increases the difficulty of levigation, and injures their texture for working. Naples yellow does not appear to have been generally employed by the early painters in oil. Antimony yellows are prepared of various depths.

MASSICOT,

Or *Masticot*, is a fused protoxide of lead, of a pale yellow colour, exceedingly varying in tint from the purest and most tender yellow or straw colour to pale ash colour or grey. It has in painting the properties of the white lead, from which it is prepared by gentle calcination in an open furnace, but in tint with which, nevertheless, it soon loses its colour and returns to white: if, however, it be used pure or unmixed, it is a useful delicate colour, permanent in oil under the same conditions as white lead, but ought not to be employed in water, on account of its changing in colour even to blackness by the action of damp and impure air. It appears to have been prepared with great care, and successfully employed, by the old masters, and is an admirable dryer, being in its chemical nature nearly the same as litharge, which is also sometimes ground and employed in its stead.

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 change of colour of the oil, they appear somewhat darkened. By burning they are converted into light reds. They are among the most ancient of pigments, may all be produced artificially, but not so good as they exist in nature, and iron is the principal colouring matter in them all. All ochres are hydrated silicates of alumina and iron containing, as found in nature, variable proportions of silicates of lime or magnesia, and minute proportions of oxides of manganese, or of a few other metals. The following are the principal natural species, but they are often confounded:—

OXFORD OCHRE

Is a native pigment from the neighbourhood of Oxford, semi-opaque, of a warm yellow colour and soft argillaceous texture, absorbent of water and oil, in both 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 above, 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, and for browns and dull reds in enamel. Varieties of ochreous colours are produced by burning and compounding with lighter, brighter, and darker colours,

but often very injudiciously, and adversely to the certainty of operation, effect, and durability.

ROMAN OCHRE

Is rather deeper and more powerful in colour than the above, but in other respects differs not essentially from them;—a remark which applies equally to yellow ochres of other denominations. There are ochres of every country.

BROWN OCHRE,

Spruce Ochre, or *Ocre de Rue*, is a dark coloured yellow ochre, in no other respects differing from the preceding:—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, chiefly sand and grit, and they acquire depth and redness by burning. They form with Prussian blue a variety of greens, and are of use in mixture of other colours.

TERRA DI SIENNA,

Or *Raw Sienna Earth*, &c., is also a ferruginous native pigment, or iron ochre. It is 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 some other ochres. Being little liable to change by the action of either light, time, or impure air, all ochres may be safely used either in oil or water, and in all the modes of practice. By burning it becomes deeper, orange, and more transparent and drying. See *Burnt Sienna Earth*. It is a valuable colour in grain-ing. The following are artificial ochres :—

IRON YELLOW,

Jaune de Fer, or *Jaune de Mars*, &c., is a bright iron ochre, prepared artificially, of the nature of Sienna earth. In its general qualities it resembles the natural ochres, with the same eligibilities and exceptions, but is more transparent. The colours of iron exist in endless variety in nature, and are capable of the same variation by art, from Sienna yellow, through orange and red, to purple, brown, and black. Artificial ochres have the useful and valuable distinction of being brighter and more transparent than native ochres. They were formerly introduced by the author, and have been lately received under the names of *orange de Mars*, *rouge de Mars*, *brun de Mars*, names which have the merit at least of not misleading the judgment.

When carefully prepared, these pigments dry well in proportion to their depth, and have the general habits of Sienna earths and ochres.

YELLOW ORPIMENT,

Or *Yellow Arsenic*, is a tersulphuret of arsenic, and is of a beautiful, bright, and pure yellow colour, not extremely durable in water, and less so in oil: in tint with white lead it is soon destroyed. 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, and red lead, and most other oxides and metallic colours: but with colours containing sulphur it may be employed with less danger, and was probably employed by the old painters, with ultramarine, in the composition of their greens; and is well suited to the factitious or French ultramarines. 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 are most subject to change; and it has appeared under various forms and



See also page 37.

denominations : 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 dryer, or perhaps they were sometimes used in simple varnish. When found in a native state this colour was usually known under the name of *zarnic* or *zarnich*, varying in colour from warm yellow to green. But orpiment, in all its varieties, more or less powerfully changes, and is changed, by many pigments having a metallic base : if employed, they are therefore best so in a pure and unmixed state. See *Orange Orpiment*.

KING'S YELLOW

Is a mixed compound of orpiment and arsenious acid, and has been much celebrated under this name, as it has also under the denomination of—

CHINESE YELLOW,

Which is a very bright sulphuret of arsenic, brought from China. Both are highly poisonous.

ARSENIC YELLOW,

Called also *Mineral Yellow*, an arsenite of lead, is prepared from arsenic fluxed with litharge, and reduced to powder. It is much like orpiment in colour, dries better, and, not being affected by

lead, is less liable to change in tint. It must not be forgotten that it is poisonous, nor that all arsenic colours are destructive of every tint of colours mixed with white lead.

CADMIUM YELLOW,

Sulphuret of Cadmium. The metal, cadmium, affords, by precipitation with sulphuretted hydrogen, a bright warm yellow pigment, which passes readily into tints with white lead, appears to endure light, and remains unchanged in impure air; but the metal from which it is prepared being hitherto scarce, it has been as yet little employed as a pigment, and its habits are, therefore, not fully ascertained.

GAMBOGE,

Or, *Gumboge*, is brought principally from Cambodja in India, and is the produce of several kinds of trees, chiefly of the *Hebradendron cambogioides*. It is a concrete vegetable substance, of a gum-resinous nature, and beautiful yellow colour, bright and transparent, but not of great depth. When properly used, it is more durable than generally reputed, both in water and oil; and conduces, when mixed with other colours, to their stability and durability, by means of its gum and resin. It is deepened in some degree by ammoniacal and

impure air, and somewhat weakened, but not easily discoloured, by the action of light. Time effects less change on this colour than on other bright vegetable yellows; white lead and other metalline pigments injure, and terreñe and alkaline substances redden it. It works remarkably well in water, with which it forms a transparent colour, without grinding or preparation, by means of its natural gum; but is with difficulty used in oil, &c. In its natural state it however dries well, and lasts in glazing when deprived of its gum. Glazed over other colours in water, its resin acts as a varnish which protects them; and under other colours its gum acts as a preparation which admits varnishing. It is injured by a less degree of heat than other pigments.

GALL-STONE

Is an animal colour formed from the taurine, or bile of the ox, found in the gall bladder. This varies a little in colour, but is in general of a beautiful golden yellow, more powerful than gamboge, and is highly reputed as a water colour; nevertheless its colour is soon changed and destroyed by strong light, though not subject to alteration by impure air. It is rarely intro-

duced in oil painting, and is by no means eligible therein.

INDIAN YELLOW

Is a pigment long employed in India under the name *Purree*, but has not many years been introduced generally into painting in Europe. It is imported in the form of balls, and is of a fetid odour. However produced, it appears to be an earthy base coloured by the constituents of urine of some lower animal, and containing phosphate of lime; it is of a beautiful pure yellow colour, and light powdery texture; of greater body and depth than gamboge, but inferior in these respects to gall-stone. Indian yellow resists the sun's rays with singular power in water-painting; yet in ordinary light and air, or even in a book or portfolio, the beauty of its colour is not lasting. It is not injured by foul air, and in oil is exceedingly fugitive, both alone and in tint. Its colour is no doubt, as in gall-stone, mainly owing to taurine.

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 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 influence 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.

DUTCH PINK, ENGLISH AND ITALIAN PINKS,

Are sufficiently absurd names of yellow colours prepared by impregnating whitening, &c., with vegetable yellow tinctures, in the manner of rose pink, from which they borrow their name.

They are bright yellow colours, extensively used in distemper and for paper-staining, and other ordinary purposes; but are little deserving attention in the higher walks of art, being in every respect inferior even to the yellow lakes, except the best kinds of English and Italian pinks, which are in fact yellow lakes, and richer

in colour than the pigments generally called yellow lake.

The pigment called *Stil*, or *Stil de Grain*, is a similar preparation, and a very fugitive yellow, the darker kind of which is called brown pink. All lakes, whatever may be their tints, are the result of precipitating vegetable colouring matters, naturally transparent and without any body, along with hydrated oxides—usually alumina—or with carbonate of lime, which was the material of the most ancient lakes known; by the opaque matters body is given to the colour.

II.—OF RED.

Red, one extreme of the spectrum, is the second and intermediate of the primary colours, *yellow* standing between it and *blue*. It is pre-eminent 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, morello, 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 connexion 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

* This word is of no fixed orthography, *Marone*, *Maroon*, *Marrone*, *Marroon*, all being employed. Etymology suggests the colour to have been named from that of the chestnut.

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 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 a 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 the proportional quantity of eleven to five of red, according to surface or intensity; and the complementary is, when the red inclines to scarlet or orange, a *blue green*; and, when it inclines to crimson or purple, is 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 contrast, to resolve or harmonize their dissonance.

In landscapes, &c., abounding with hues allied to green, a red object, properly posited according to such hues in light, shade, or distance, conduces wonderfully to the life, beauty, harmony, and connexion 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 harmonizes and contrasts to white or light better 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 pre-eminently 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:—

VERMILLION

Is a sulphuret of mercury, which, previous to its being levigated, is called *cinnabar*. It is an ancient pigment, the *κινναβάρη* of the Greeks, and 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.

Chinese vermilion is of a cooler or more crimson 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 vermillions 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 characters, suffer contamination and disrepute from bad association: it has happened, accordingly, that vermilion which has been

rendered lakey or crimson by mixture 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 in impure air, &c., both of which adulterations were formerly practised, and hence the ill-fame of vermilion both with authors and artists. We believe that neither light, time, nor foul air, effects sensible change in true vermillions, and that they may be used safely in oil, being colours of great chemical permanence, unaffected by other pigments, and among the least soluble of chemical substances. Vermillion, however, is incapable of being used in fresco, and is not a permanent water or distemper colour. Under conditions which have not been sufficiently examined, a blackish film almost instantly forms on wet vermilion ground in water-colour, and which appears to be a hydrated sulphuret of mercury; in a damp place the brilliancy of colour is completely thus destroyed; the contact of zinc, iron, lime, copper, also slowly decomposes it.

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 used in adulterating vermilion, muriatic acid applied to such pigments will turn them more or less white, or grey ; but pure vermillions will not be affected by the diluted acid, nor will they by diluted solutions of caustic alkalies.

IODINE SCARLET

Is a new pigment of a most vivid and beautiful scarlet colour, exceeding the brilliancy of vermilion. It has received several false appellations, but is truly *bin-iodide of mercury*, varying in degrees of intense redness. It has scarcely the body and opacity of vermilion, and should be used with an ivory palette-knife, as iron and most metals change it to colours varying from yellow to black. Strong light rather deepens and cools it, and impure air soon utterly destroys its scarlet colour, and even metallizes it in substance. The charms of beauty and novelty have recommended it, particularly to amateurs ; and dazzling brilliancy might render it valuable for high and fiery effects of colour, if any mode of securing it from change should be devised ; at any rate it should be used pure or alone. By time alone this colour vanishes in a thin wash or glaze, and it attacks almost

every metallic substance, and some of them even in a dry state. When used in water, gum ammoniac appears to secure it best from change; and it has been observed that, when gamboge is glazed over it, it preserves its hue with greater constancy.

RED LEAD,

Minium, or *Saturnine red*, is an ancient pigment, by some old writers confounded with cinnabar, and called *Sinoper*, or *Synople*; it is a deutoxide of lead, prepared by subjecting litharge to the heat of a furnace with an expanded surface and free access of air. It is of a scarlet colour and fine hue, warmer than common vermillion; bright, but not so vivid as the bin-iodide of mercury; though it has the body and opacity of both these pigments, and has been confounded, even in name, with vermillion, 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 metalize it.

On account of its extreme fugitiveness when mixed with white lead, it cannot be used in tints,

but employed, mixed 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 had a variable character for durability. It is in itself, however, an excellent dryer 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 OCHRE

Is a name proper rather to a class than to an individual pigment, and comprehends *Indian red*, *light red*, *Venetian red*, *scarlet ochre*, *Indian ochre*, *redding*, *ruddle*, *bole*, &c., besides other absurd appellations, such as *English vermillion* and *Spanish brown*, or *majolica*.

The red ochres are, for the most part, rather hues and tints than definite colours, or more properly

* Much learning has been spent in vain guessing at the etymology of vermillion, and at the singular confusion found in ancient authors between it and red lead. The truth appears to be that vermillion is a corruption for *verum minium*. The difference between the chemical constitution of minium and vermillion does not seem to have been known in Pliny's day at least.—R. M.

classed with the tertiary, semi-neutral, and broken colours ; they are nevertheless often very valuable pigments for tints in dead colouring, and for their permanence, &c., in water, oil, crayons, distempers, and fresco ; in a low key of colouring they have the value of primaries. The greater part of them are native pigments, found in most countries, and very abundantly, and exist fine in quality in our own ; but some are products of manufacture, and we have produced them in the variety of nature by art. The following are the most important of these pigments, most of which are available in enamel-painting.

INDIAN RED,

According to its name, is brought from Bengal, and 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 lakey tone of its tints. In a crude state it is a coarse powder, full of extremely hard and brilliant particles of a dark appearance, sometimes 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, time, 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 colourmen. *Persian red* is another name for this pigment.*

LIGHT RED

Is an ochre of 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 this 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

* The *aematito*, or *amatito*, of the early Italian painters, was no doubt some sort of hæmatite (αἷμα, blood), or Indian red, of a blood-red colour.

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. It affords also an excellent crayon.

Terra di puzzuoli and carnagione of the Italians differ from the above only in their hue, in which respect other denominations are produced by dressing and compounding.

VENETIAN RED,

Or *Scarlet ochre*. True Venetian red is said to be a native ochre, but the colours sold under this name are prepared artificially by calcination of sulphate or other salts of iron, or from the residuum in the manufacture of sulphuric acid from sulphate of iron. They are all of redder and deeper hues than light red, are very permanent, and have all the properties of good ochres.

Prussian red, *English red*, *Rouge de Mars*, are other names for the same pigment, and Spanish red is an ochre differing little from Venetian red. Red ochres are now produced largely in commerce, by the careful calcination of hydrated oxides of iron with hydrated clays, obtained as educts of certain chemical manufactures, more especially in

France, which may almost vie in brilliancy of colour and in body with red lead; these are known in commerce by the name of iron minium—*minium de fer*.

DRAGON'S BLOOD

Is a resinous substance from the juice of the *Dracena Draco*, brought principally from the East Indies. It is of a warm semi-transparent, rather dull, red colour, which is deepened by impure air, and darkened by light. There are two or three sorts, but that in drops is the best. White lead soon destroys it, and it dries with extreme difficulty in oil. It is sometimes used to colour varnishes and lacquers, being soluble in oils and alcohol, but notwithstanding it has been recommended as a pigment, it does not merit the attention of the artist. It was anciently confounded in name with cinnabar.

LAKE,

A name derived from the *lac* or *lacca* of India, is the cognomen of a variety of transparent red and other coloured pigments of great beauty, prepared for the most part by precipitating solutions of vegetable colours upon alumine and other earths, &c. The lakes are hence a nume-

rous 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 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.

All lakes ground in linseed oil are disposed to fatten, or become livery, or thick, but ground stiff in poppy oil they keep better for use.

Of the various red lakes the following are the principal :—

RUBRIC, OR MADDER LAKES.

These pigments are of various colours, of which we shall speak at present of the red or rose colours only; which have obtained, from their material, their hues, or their inventor, the various names of rose rubiate, rose madder, pink madder, and Field's lakes.

The pigments formerly called madder lakes were brick-reds of dull ochreous hues; but for many years past these lakes have been prepared from pure alizarine perfectly transparent, and literally as beautiful and pure in colour as the

rose; qualities in which they are unrivalled by the lakes and carmine of cochineal. The rose colours of madder have justly been considered as supplying a desideratum, and as the most valuable acquisition of the palette in modern times, since perfectly permanent transparent reds and rose colours were previously unknown to the painter.

These pigments are of hues warm or cool, from pure pink to the deepest rose colour;—they afford the purest and truest carnation colours known; form permanent tints with white lead; and their transparency renders them perfect glazing or finishing colours. They are less than most lakes liable to change by the action of either light or impure air, or by mixture with other pigments; but when not thoroughlyedulcorated, they are, in common with all lakes, tardy dryers in oil, the best remedy for which is the addition of a small portion of japanner's gold-size: or, as they are too beautiful and require saddening for the general uses of the painter, the addition of manganese brown, cappagh brown, or of burnt umber, as was the practice of the Venetian painters in the using of lake, adds to their powers and improves their drying in oils.

Though little known in ordinary painting they have been established by experience on the palettes of our first masters during nearly half a century. Madder lake may be tested by liquid ammonia, in which its colour is *not* soluble, as are those of animal lakes and carmine.

SCARLET LAKE

Is prepared in form of drops from cochineal (the *Coccus Cacti* insect), 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 slowly discolours and destroys it both in water and oil; 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 performances that aim at high reputation and durability. It is commonly tinted with vermillion, which has probably been mixed with lakes at all times to give them scarlet hue, and add to their weight; *Florentine lake*, *Hamburgh lake*, *Chinese lake*, *Roman* and

Venetian lakes, are but varieties of the same pigment.

LAC LAKE,

Prepared from the *lac* of India, also the produce of a *Coccus* insect, is perhaps the first of the family of lakes, and resembles the former. Its colour is rich, transparent, and deep,—less brilliant and more durable than that of cochineal, but inferior in both these respects to the colours of madder. Used in body or strong glazing, as a shadow colour, it is of great power and much permanence ; but in thin glazing, it changes and flies, as it does also in tint with white lead.

A great variety of lakes, equally beautiful with those of cochineal, have been prepared from this substance in a recent state in India and China, many of which we have tried, and found uniformly less durable in proportion as they were more beautiful. In the properties of drying, &c., they resemble other lakes.

This appears to have been the lake which has stood best in old pictures, and was probably used by the Venetians, who had the trade of India when painting flourished at Venice. It is sometimes called *Indian lake*.

CARMINE,

A name originally given only to the finest and first precipitated lake from cochineal, denotes generally at present any crimson lake remarkable in beauty, richness of colour, and fineness of texture. We hear of blue and other coloured carmines, though the term is principally confined to the crimson and scarlet colours produced from cochineal by precipitation with salts 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, durability — excellent pigments 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 renders purple lakes prepared from the red dye-woods, but does not dissolve their colours.

MADDER CARMINE,

Or *Field's Carmine*, is, as its name expresses, prepared from madder. It differs from the rose lakes of madder principally in texture, and in the greater richness, depth, and transparency of its colour, which is of various hues from rose colour to crimson. These in other respects resemble the rubric or madder lakes, and are the only *durable carmines* for painting either in water or oil; for both which their texture qualifies them without previous grinding or preparation.

ROSE PINK

Is a coarse kind of lake, produced by precipitating chalk or whitening with decoction of Brazil wood, &c. It is a pigment much used by paper-stainers, and in the commonest distemper painting, &c., but is too perishable to merit the attention of the artist.

III.—OF BLUE.

The third and last of the prismatic simple colours, is *blue*, which bears the same relation to shade that yellow does to light; hence it is the



See also page 37.

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 relations 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 most 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 its power of absorbing light: hence the eye of the artist is liable to be deceived when painting with blue in too low a light, or toward the close of day, to the endangering of the warmth and harmony of his work.

Blue mixed with yellow forms *greens*, and mixed with red it forms *purples*; it characterizes the tertiary *olive*, and is also the prime colour of the neutral *black*, &c., and also of 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 watchet or pale blues, the sky, &c. It is less active than the other primaries in reflecting light, and therefore sooner disappears by distance.

Blue is discordant in juxtaposition with green, and in a less degree so with purple, both which are cool colours, and therefore *blue* requires its contrast, *orange*, in equal proportion, either of service or intensity, to compensate or resolve its dissonances and correct its coldness. Botanists remark that blue flowers are much more rare than those of the other primary colours and their compounds, and hence advise the florist to cultivate blue flowers more sedulously: but in this they are opposed to nature, which has bestowed this colour principally upon noxious plants, and been sparing of it in the green hues of foliage. Artists, too, have sometimes acted upon this principle of the botanist in introducing blue flowers into pictures, preferring therein the novel effects of variety, to truth and harmony: the artist has, however, more command of his materials than the botanist in resolving a discord;—Nature nevertheless left to herself, is not long in harmo-

nizing the dissonances men put upon her. Florists may further remark, that *blue flowers* are readily changed by cultivation into red and white, but more rarely into yellow ; that *yellow flowers* are as readily converted into red and white, but more rarely into blue ; and that *red flowers* are changeable into orange or purple, but rarely into blue or yellow.

Of all colours, except black, blue contrasts with 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 either of the other primaries. These are, however, matters of taste, as in music, and subject to artificial rules though founded on the laws of chromatic combination.

As blue cannot be composed by mixture of other colours, 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 ; nor is the palette without novelty, nor deficient in pigments of this colour : of which the following comprise all

that are in any respect of importance to the painter.

ULTRAMARINE,

Or *Azure*, is prepared from the lapis lazuli, a precious stone found principally in Persia and Siberia. It is the most celebrated of all modern pigments, and, from its name and attributes, is probably the same as the no less celebrated *Armenian blue*, or *Cyanus*, of the ancients.

Ultramarine has not obtained its reputation upon slight pretensions, being, when skilfully prepared, of the most exquisitely beautiful blue, varying from the utmost depth of shadow to the highest brilliancy of light and colour,—transparent in all its shades, and pure in its tints. It is of a true medial blue, when perfect, partaking neither of purple on the one hand, nor of green on the other: it is neither subject to injury by damp and impure air, nor by the intensest action of light: and it is so eminently permanent, that it remains perfectly unchanged in the oldest paintings, unless where the oil has got brown through age and so rendered the colours greenish. The ancient Egyptians had blues, of which we have already mentioned their Armenian blue, and vitreous blues of copper frits, with which

they decorated their figures and mummies, and which have shown great permanence.

Ultramarine dries well, works well in oil and fresco, and neither gives nor receives injury from other good pigments. It has so much of the quality of light in it, and of the tint of air,—is so purely a sky colour, and is hence so singularly adapted to the direct and reflex light of the sky, and to become the antagonist of sunshine,—that it is indispensable to the landscape painter; and it is so pure and unchangeable in its tints and glazings, as to be no less essential in imitating the exquisite colouring of nature in flesh and flowers.

To this may be added, that it enters so admirably into purples, blacks, greens, greys, and broken colours, that it has justly obtained the reputation of clearing or carrying light and air into all colours both in mixture and glazing, and a sort of claim to universality throughout a picture.

Though unexceptionable as an oil colour, both in solid painting and glazing, it does not work so well as some other blues in water; but when extremely fine in texture, or when a considerable portion of gum, which renders it transparent,

can be used with it to give it connection or adhesion while flowing, it becomes a pigment no less valuable in water painting than in oil; but little gum can however be employed with it when its vivid azure is to be preserved, as in illuminated manuscripts and missals.

Pure ultramarine varies in shade from light to dark, and in hue from pale warm azure to the deepest cold blue; the former of which, when impure in colour, is called *ultramarine ashes*.

FACTITIOUS ULTRAMARINE,

French and German Ultramarine, a variety of these, English, French, and German, have been before the public under various names. They are in general of deep rich blue colours, darker and less azure than fine ultramarine of the same depths, and answer to the same acid test, but are variously affected by fire and other agents: none of them, however, possess the merits of genuine ultramarine. Fire generally darkens these colours, but the best way of distinguishing factitious ultramarine from the natural is by the violent effervescence of the former when dropped into nitrous acid. They may be regarded as a great improvement upon the previous factitious blues of

the palette, rivalling in depth, although not, as some think, equalling in colour, the pure azure of genuine ultramarine, for which in most if not in all cases they may be substituted, and they are a valuable acquisition in decoration where brilliancy is required—and in printing.

Natural ultramarine, or lapis lazuli, consists of

Silica	35·80
Alumina	34·80
Soda	43·20
Sulphur	3·10
Carb. Lime	3·10
	<hr/>
	100

as analysed by Clement and Dèsortmes, whose researches led to the discovery, by Gmelin of Tubingen, of the practicability of producing it artificially, and to the actual manufacture, due to Guimet, of Paris, for which he received the prize of the Société d'Encouragement in 1828. It is now manufactured in scores of tons, chiefly in France and Germany. The later researches of Wilkins view it as a compound of hyposulphite of soda and sulphide of sodium; iron not being an essential constituent. Notwithstanding some prejudices of artists, there is no doubt

that the artificial is a far finer colour in all respects than the natural one. The product is one of the great triumphs of modern chemists.

COBALT BLUE,

Is the name now appropriated to the modern improved blue prepared with the oxide of the metal cobalt; 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 by fire, 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 cannot manage the latter, and also on account of its cheapness. It resists the action of strong lights and acids, but its beauty declines by time, and impure air.

It dries well in oil, does not injure or suffer injury from pigments in general, and may be used with a proper flux in enamel painting, and perhaps also in fresco.

There are two totally different cobalt blues employed and found in common : smalt blue, which is a glass or frit coloured by fusion with oxide of cobalt, usually of very deep colour ; and the cobalt blue more commonly now employed by oil and water colour artists, which consists of oxide of cobalt precipitated from solution along with alumina by peculiar methods.

SMALT OR SMALTS,

Sometimes called *Azure*, is, as above stated, an impure vitreous cobalt blue, prepared upon a base of siliceous glass, and much used by the laundress for neutralizing the tawny or Isabella colour of linen, &c., under the name of *powder blue*. It is in general of a coarse gritty texture, light blue colour, and little body. It does not work so well as the preceding, but dries quickly,

and resembles it in other respects;—it varies, however, exceedingly in its qualities; and the finer sorts, called *Dumont's blue*, which is employed in water-colour painting, is remarkably rich and beautiful. It is made a magnificent colour by the Chinese, and employed in water colours by them.

PRUSSIAN BLUE,

Otherwise called *Berlin blue*, is rather a modern pigment, produced by the precipitation of a solution of per-sulphate of iron by ferro-cyanide of potassium. It is of a deep and powerful blue 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. It is generally mixed, if not adulterated, with carbonate of lime, or white clay.

Notwithstanding 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 develop-

ment of yellow oxide of iron. The colour of this pigment has also the singular property of fluctuating, or, of going or coming under some changes 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 its colour.*

It 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 it force and depth. It is also valuable in compounding deep purples with lake, and is a powerful neutralizer and component of black, and adds considerably to its intensity. It is a pigment much used when mixed with white lead in the common house painting, also in preparing blues for the laundress, in dyeing, and in compounding colours of various denominations. Lime and alkalies injure or destroy this colour.

ANTWERP BLUE

Is a lighter-coloured and somewhat brighter Prussian blue, its colour being altered by the addition of more white clay or chalk, but with

* The author's statements here demand caution in acceptance. R.M.

all the other qualities of that pigment, except its extreme depth. *Haerlem blue* is a similar pigment.

INDIGO,

Or *Indian blue*, is a pigment manufactured in the East and West Indies from several plants, but principally from the anil and various other species of *Indigofera*. It is of various qualities, and has been long known, and is 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 nevertheless very inferior even to Prussian blue.

It is injured by air containing sulphuretted hydrogen, 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 is 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 also becomes more durable, and much more powerful, transparent, and deep. It washes and works admirably in water: in other respects it has the properties of common indigo. We have been assured by an eminent architect, that these blues of indigo have the property while both colours are wet of pushing or detaching Indian ink from paper. The same is supposed to belong to other blues; but if this effect is chemical, it can hardly be an attribute of mere colour.

BLUE VERDITER

Is a hydrous oxide of copper, mixed with carbonate of lime; it is procured by the precipitation of the nitrate of copper of the silver refiner by lime or chalk, and is of a beautiful light blue colour. It is little affected by light; but time, damp, and impure air turn it green, and ultimately blacken it,—changes which ensue even more rapidly in oil than in water; it is therefore by no means an eligible pigment in oil, and its use is principally confined to distemper painting, and the wants of the paper stainer, though it has been found to stand well for many years in water-colour drawings

and in crayon paintings, when preserved dry. It has been improperly substituted for *Bice*.

SANDERS BLUE,

A corrupt name, from *Cendres Bleu*, the original denomination probably of *ultramarine ashes*, is of two kinds, the natural and the artificial; the artificial is a verditer prepared as above by lime or an alkali from nitrate or sulphate of copper; the natural is a blue mineral found near copper-mines, and is the same as *mountain blue*. A very beautiful blue substance of this kind, a hydrous *carbonate of copper*, exists, which is found of all tints from blue to green, in Cumberland and elsewhere. None of these blues of copper are, however, durable; used in oil, they become green, and, as pigments, are precisely of the character of verditers. *Schweinfurt blue* is a similar pigment in appearance, but is said to be an arsenite of copper.

BICE,

Blue bice, iris, or terre bleu, is sometimes confounded with the above copper blues; but the true bice is said to be prepared from the *lapis Armenius* of Germany and the Tyrol, and is of a light bright hue. The true Armenian stone of

the ancients was probably the lapis lazuli of later times, and the blue prepared therefrom the same as our ultramarine. Pale ultramarine may well supply the place of this pigment, but copper blues substituted for it are not to be depended on.

Ground smalts, blue verditer, and other pigments, have passed under the name of *Bice*; which has, therefore, become a very equivocal name, and is nearly obsolete: nor is it at present to be found in the shops, although much commended by old writers on the art.

CHAPTER VI.

OF THE SECONDARY COLOURS.

I.—OF ORANGE.

ORANGE is the first of the secondary colours in relation to light, being in all the variety of its hues composed of *yellow* and *red*. A true or perfect orange is such a compound of red and yellow as will neutralize a perfect blue in equal 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 names of *scarlet*, *poppy*, *coquilocot*, &c. In *gold* colour, &c., it leans towards yellow. It enters into combination with green in forming the tertiary *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, and diminishing its sensibility in proportion to the strength of the light in which it is viewed ; it is of the hue and partakes of the vividness of sunshine, as it does also of all the powers of its components, red and yellow.

This secondary is pre-eminently a *warm* colour, being the equal contrast or antagonist 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 well-known fruit of the *Citrus Aurantium* has been called *orange*, it is said from the town of Orange, in the South of France, where it has long been grown, and from that fruit this colour borrows its well-adapted name.

The poets confound orange with its ruling colour yellow, and, by a metonymy, use in its place the terms golden, gilding, &c. Gilding sometimes supplies the place of this colour in painting.

The list of original orange pigments is so deficient, that in some treatises, orange is not even named as a colour, most of them being

called reds or yellows : and orange being a colour compounded of red and yellow, the place of original orange pigments may be supplied by mixture of the two latter colours ; by glazing one over the other ; by stippling, or other modes of breaking and intermixing them in working, according to the nature of the work and the effect required. For reasons before given, 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, amongst which are those producing orange.

CHROME ORANGE

Is a beautiful orange pigment, and is one of the most durable and least exceptional chromates of lead, not of iron, as it is sometimes mistakenly supposed. It is a per-chromate of lead, when well prepared, of a brighter colour than vermillion, but 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 minerale* is a French pigment, a species of chromic orange, similar to the above. This name is also given to

orange oxide of iron, and to *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. Nevertheless it is a bad pigment, since light soon changes it to a deep russet colour, and foul air reduces it to blackness.

ORANGE OCHRE,

Called also *Spanish ochre*, &c., is a very bright yellow ochre, burnt, by which operation the iron is further oxidized and water driven off, and it acquires 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. It may be used in enamel-painting, and has all the properties of its original ochre in other respects.

MARS ORANGE

Is an artificial iron ochre, similar to which we formerly prepared a variety brighter, richer, and more transparent than the above, and in other respects of the same character. It requires to be

employed cautiously with colours affected by iron, being more chemically active than native ochres.

BURNT SIENNA EARTH

Is, as its name expresses, the *Terra di Sienna*, or ochre of that locality, burnt, and is of an orange russet colour. What has been said of orange ochre may be repeated of burnt Sienna earth. It is richer in colour, deeper, and more transparent, and works and dries better than *raw Sienna earth*; but in other respects has all the properties of its parent ochre, and is permanent and eligible wherever that may be useful; it is valuable in graining. *Light red* and *Venetian red*, before treated of, are also to be considered as impure, but durable orange colours; and several artificial preparations of iron afford excellent colours of this class.

ORANGE LEAD

Is an oxide of lead of a more vivid and warmer colour than *red lead*, but in other respects does not differ essentially from that pigment in its qualification for the palette. It is in reality red lead mixed with yellow litharge.

ORANGE ORPIMENT,

Or *realgar*, is the bi-sulphuret of arsenic, and called also *red orpiment*, since it is of a brilliant orange colour, inclining to yellow. There are two kinds of this pigment; the one *native*, the other *factitious*; the first of which is the *sandarac* of the ancients, and is of rather a redder colour than the factitious. They are the same in qualities as pigments, and differ not in this respect from *yellow orpiment*.

ANTIMONY ORANGE

Is a *hydro-sulphuret of antimony* of an orange colour, which is destroyed by the action of strong light. It is a bad dryer in oil, injurious to many colours, and in no respect an eligible pigment either in oil or water.

ARNATTO,

Arnatta, *annatta*, *caruera*, *chica roucou*, &c., are various names for the same or closely related vegetable substances brought from the West Indies, of an orange red colour, soluble in water and spirits of wine, but very fugitive and changeable, and not fit for painting. It is principally used by the dyer,

and in colouring cheese. It is also an ingredient in some lacquers. It is the colouring matter of the juice of the *Bixa orellana*, or of other species of that genus.

II.—OF GREEN.

Green, which occupies the middle station in the spectrum and in relation to light and shade, is the second of the secondary colours: it is composed of the 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 neutralize and contrast a perfect red in the proportions of *eleven* to *five* either of space or power, as adduced on our scale of chromatic equivalents. 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 to its constituents does it appear to the untutored eye. Green, mixed with orange, converts it into the one 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 single colour. In endless variety of tints and tones it has been adopted in nature as the general garb of the vegetable creation.

These attributes of green, which render it so universally effective in contrasting of colours, cause it also to become the least useful in compounding them, and the most apt to defile other colours in mixture: nevertheless it forms valuable semi-neutrals of the *olive* class with *black*, for of such subdued tones are the greens by which the more vivid hues of nature are contrasted; accordingly the various greens of foliage are always more or less semi-neutral in colour, declining into *grey*. As *green* is the most general colour of vegetable nature, and the principal in foliage, so *red*, its harmonizing colour, and compounds of red, are most general and principal in flowers. *Purple* flowers are commonly contrasted with centres or variegations of bright *yellow*, as *blue* flowers are with like relievings of *orange*; and there is a prevailing hue, or character, in the green colour of the foliage of almost every plant, by

which it is harmonized with the colours of its own flowers.

The principal discord of green is blue ; and when they approximate or accompany each other, they frequently require to be resolved by the apposition 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 the landscape. Mere *dicta* such as these, however, though having some basis in optical science, are but little to be depended on in determining what will and what will not affect the eye and mind agreeably, as will be obvious to any one who will carefully regard the exquisite beauty of the contrasts of blues and greens exhibited in nature in the *same plant*, as in the genera *Delphinium*, *Aconitum*, *Salvia*, &c. In all these it will be seen that many other conditions, such as texture, mass, relative intensity, &c., as well as mere colour, come into play and act on eye and mind together. 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 reason 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 more particularly so when contrasted with its compensating colour, red, as it often is in nature, and even in the green leaves and the young shoots of plants and trees ; and they are the most generally attractive of all colours in this respect.

The number of pigments of any colour is in general proportioned to its importance ; hence the variety of greens is very great, though their classes are not very numerous. The following are the principal :—

MIXED GREENS.

Green being a compound of *blue* and *yellow*, mixtures of these colours may be used to supply the place of green pigments, by compounding them in the several ways of working ; by mixing, glazing, hatching, or otherwise blending them in the proportions of the hues and tints required. In compounding colours, it is necessary that they should agree chemically, and desirable that they

should also have, as much as may be, the same degree of durability ; and in these respects Prussian or Antwerp blue and gamboge form a judicious, though not extremely durable, compound, similar to *Varley's green*, *Hooker's green*, &c., used in water. In common oil painting, greens are formed by 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 a great variety. But the yellow ochres with Prussian blue afford more eligible pigments than the brighter mixtures of chrome yellow afford. *Cobalt greens*, *chrome greens*, and *Prussian green*, are names for similar mixtures.

TERRE-VERTE.

True terre-verte is an ochre of a bluish green, not very bright, in substance moderately hard, and smooth in texture. It is variously a bluish or grey-green clay, whose colour is due to hydrous oxide of iron, combined with alumina. Although not a bright, it is a very durable pigment, being unaffected by strong light and impure air, and combining with other colours without injury. It has not much body, is semi-transparent, and dries well in oil. There are varieties of this pigment.

It has been called *Green Bice*, and the greens called *Verona green* and *Verdetto*, or *Holy green*, are similar native pigments of a warmer colour. These greens are found in the Mendip Hills, France, Italy, and the Island of Cyprus, and have been employed as pigments from the earliest times. Geologically, they are sub-Appennine marls.

CHROME GREENS

Were originally pure oxides of chromium, but those commonly so called are pigments, of which chrome yellow, with Prussian blue and sulphate of barytes, are the principal ingredients. Those also called *Brunswick green*, &c., are compounds of chromate of lead with Prussian or other blue colours, constituting fine greens to the eye, suitable to some of the ordinary purposes of decorative art; but unfit for fine art.

The true chrome green, the colouring matter of which is solely oxide of chrome, 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 rich than brilliant greens, and afford pure natural and durable tints. These 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. They afford some of the most valuable colours also in enamel-painting. To this substance it is, in part, that the emerald owes its green colour.

COBALT GREENS.

There are two pigments of this denomination, the one a mixture of cobalt blue and chrome yellow—the other, an original pigment prepared immediately from cobalt, with addition of oxide of zinc, which is of a pure but not very powerful green colour, and durable both in water and oil, in the latter of which it dries well. *Rinmann's green* is of this kind. Its habits are nearly the same as those of cobalt blue.

COPPER GREEN

Is the appellation of a class rather than of an individual pigment, under which are comprehended *Verdigris*, *Verditer*, *Malachite*, *Mineral green*, *Green Bice*, *Scheele's green*, *Schweinfurt* or *Vienna green*, *Hungary green*, *Emerald green*, true *Brunswick green*, *green Lake*, *Mountain green*, *African green*, *French green*, *Saxon green*, *Persian green*, *Patent green*, *Marine green*, *Olympian green*, &c.

Old authors mention others under the names of individuals who prepared them, such are Verde de Barildo, &c.

The general characteristics of these greens are brightness of colour, well suited to the purposes of house-painting, but not in general adapted to fine art. They have considerable permanence, except from the action of damp and impure air, which ultimately blackens them : they have also a tendency to blacken by time. They have a good body, and dry well in oil. They are all poisonous substances. The following are the principal sorts.

VERDIGRIS,

Or *Viride Æris*, is of two kinds, common or impure, and crystallized or, as it was called, *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 effloresce or rise to the surface through the oil. It

dries rapidly, and is useful occasionally as a siccativ in oil painting. Fresh ground in varnish it stands better ; but it is not upon the whole a safe or eligible pigment, either alone or compounded. Vinegar dissolves it, and the solution is used for tinting maps, &c.

GREEN VERDITER

Is the same in substance as blue verditer, a hydrous oxide of copper, but contains less water, the blue becoming thus green verditer by boiling. This pigment has the common properties of the copper greens above mentioned, and is sometimes called *green bice*.

EMERALD GREEN

Is the name of a new 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 brilliant, but harsh and not common in nature, but well suited for brilliant works. It works well in water, but with difficulty in oil, and dries badly therein.

MINERAL GREEN

Is the commercial name of various *greens*, prepared chiefly by mixture. These vary in hue and shade, have all the properties before ascribed to the class of copper greens, and afford the best common greens; and, not being liable to change of colour by oxygen and light, stand the weather well, and are excellent for the use of the house-painter, &c.: but are less eligible in the nicer works of fine art.

MOUNTAIN GREEN

Is the native anhydrous carbonate of copper, and is in nature often striated with veins of mountain blue, or hydrous carbonate of copper, to which malachite bears the same relation that green verditer does to blue verditer; nor does it differ from these and other copper greens in any property essential to the painter. The *malachite* employed by jewellers, is this substance, and *green bice* is also confounded therewith, being similar substances and of similar use as pigments. It is also called *Hungary green*, being found in the mountains of Kernhausen, as it is also in Cumberland, but chiefly in Russia and Australia.

SCHEELE'S GREEN

Is a compound oxide of copper and arsenious acid, or arsenite of copper, named after the justly celebrated chemist who discovered it. It is variously of a beautiful, light, warm, green colour, opaque, permanent in itself and in tint with white lead, but must be used cautiously with Naples yellow, by which it is said to be acted on. *Schweinfurt green* and *Vienna green* are also names of a preparation of the same kind as the above. These pigments are less affected by damp and impure air, and are therefore in these respects rather more eligible colours than the ordinary copper greens. These are still much employed in paper staining, and unhappily being highly poisonous, they render the dust of rooms also poisonous.

PRUSSIAN GREEN.

The pigment under this name is Prussian blue, to which sometimes Purree yellow, such as tincture of French berries, has been added, and is not in any respect, except transparency, superior as a pigment to the compounds of Prussian blue and yellow ochre.

SAP GREEN,

Or *Vert de Vessie*, is a vegetable pigment prepared from the inspissated juice of the berries of buckthorn, and other species of *Rhamnus*. It is usually preserved in bladders, and is thence sometimes, as above, called *bladder green*; when good it is of a dark colour and glossy fracture, when mixed for use extremely transparent, and of a fine natural green colour. Though much employed as a water-colour without gum, which it contains naturally, it is a very imperfect pigment, disposed to attract the moisture of the atmosphere, and to mildew. It has little durability in water-colour painting, and less in oil, in which indeed it is totally useless.

Similar pigments, prepared from coffee-berries, and called *Venetian* and *emerald greens*, are of a colder colour, very fugitive, and equally defective as pigments.

INVISIBLE GREEN.

A good deep olive of this denomination, for out-of-door painting and fresco, may be prepared by mixture of the yellow ochres with black and blue in small quantities; or by adding black or red browns to any of the ordinary green pigments. See *Olive Pigments*.

III.—OF PURPLE.

Purple, the third and last of the secondary colours, is composed of *red* and *blue*, in the proportions of five of the former to eight of the latter, which constitute a perfect purple, or one of such a hue as will neutralize, 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, orange, it constitutes in like manner the tertiary colour, *russet*. It is the coolest of the three secondary colours, and the nearest also in relation to *black* or 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 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 has been celebrated as a regal or imperial colour, as much perhaps from its ancient rarity in a pure state, as from its beauty. When inclining

to the rose, or red, this colour takes the names of *crimson*, &c., as it does those of *mauve*, *violet*, *lilac*, &c., when it inclines toward its other constituent, blue; which latter colour it serves to mellow, or follows well into shade.

The contrast, or harmonizing colour of purple, is yellow on the side of light; and it is itself the harmonizing contrast of the tertiary *citrine* on the side of shade, and less perfectly so of the semi-neutral *brown*. Purple, inclining towards redness, is a regal and pompous colour in its effects on the mind.

As the primaries, blue and yellow, when either compounded or opposed, afford the most pleasing consonance of colours, so 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 neutralizing power of yellowness if existing in the grounds upon which they are laid, as well as to the yellow tendency to subdue it, of almost all vehicles and varnishes with which this colour

is used ; for the same reason this colour appears much altered by candle or gas light.

MIXED PURPLES.

Purple 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 purple pigments of any required hue, either by compounding or grinding them together ready for use, or by combining them in the various modes of operation in painting. In such compounding, the more perfect the original colours are, the better in general will be the purple 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, under the influence of light and impure air. The blue and red of cobalt and madder afford also good purples. Some of the finest and most delicate purples in ancient paintings appear to have been similarly compounded of *ultramarine* and *vermillion*, which constitute tints equally permanent, but less transparent than the above. Facility of use, and other advantages, are obtained at too great a sacrifice by

the employment of perishable mixtures, such as are the carmines and lakes of cochineal, with *indigo* or *other blue colours* ; but common purples may be composed of Prussian blue and vermillion with additions of white.

GOLD PURPLE,

Or *Cassius's Purple Precipitate*, is the compound which is precipitated upon mixing certain solutions of gold and tin. It is not a bright, but is a rich and powerful colour, of great durability, varying in degrees of transparency, and in hue from deep crimson to a murrey or dark purple, and is scarcely used except by the miniature painter. It is largely employed in enamel-painting and porcelain, and works well in water, and is an excellent though expensive pigment, but is not much used as either a water or oil colour, as the madder purple is much cheaper, and perfectly well supplies its place.

MADDER PURPLE,

Purple Rubiate, or Field's Purple, is a very rich and deep carmine, prepared from madder. Though not a brilliant purple, its richness, durability, transparency, and superiority of colour, have

given it the preference to burnt carmine. It is a pigment of great body and intensity ; it works well, dries and glazes well in oil, and is pure and permanent in its tints, neither giving nor sustaining injury from other colours.

BURNT CARMINE

Is, according to its name, the carmine of cochineal submitted to gentle heating until it resembles in colour the purple of Cassius, for the uses of which in miniature and water-colour painting it is substituted, and has the same properties except its durability. In that quality, like the carmine it is made from, it is deficient, and therefore in this important respect is an ineligible pigment. A colour of this kind may also be obtained by gently heating *madder carmine* in a cup over a spirit lamp, stirring it till it becomes of the hue required.

PURPLE LAKE.

The best purple lake so called, is prepared from cochineal, and is of a rich and powerful colour, inclined to crimson. Its character as a pigment is that of the cochineal lakes already described. It is fugitive both in glazing and tint ; but, used in considerable body, as in the shadows of dra-

peries, &c., it will last under favourable circumstances a long time. Lac lake resembles it in colour, and may supply its place more although not perfectly durable.

PURPLE OCHRE,

Or *Mineral Purple*, the purple brown of house painters, is a dark ochre, native of the Forest of Dean, in Gloucestershire, and elsewhere. It is of a murrey or chocolate colour, and forms cool tints of a purple hue with white. It is of a similar body and opacity, and darker colour than *Indian red*, which has also been classed among purples, but in all other respects it resembles that pigment. It may be prepared artificially, and some natural red ochres burn to this colour, which has been employed under the denomination *Violet de Mars*.

CHAPTER VII.

OF THE TERNARY COLOURS.

I.—OF CITRINE.

CITRINE is the first of the class of ternary compounds of the primary *yellow*, *red*, and *blue*; in which *yellow* is the predominating colour, and blue the extreme subordinate; for citrine being an immediate compound of the secondaries, *orange* and *green*, of both which *yellow* is a constituent, the latter colour is of double occurrence therein, while the other two primaries enter singly into the composition of citrine,—its mean or middle hue comprehending eight blue, five red, and six yellow, of equal intensities.

Hence citrine, according to its name, which is that of a class of colours, is used commonly for a dark yellow, and in estimating its properties and effects in painting, it is to be regarded as participating of all the relations of yellow. By

some this colour is improperly called brown, as almost all broken colours are. The harmonizing contrast of citrine is a *deep purple*; and it is the most advancing of the ternary colours, or nearest in its relation to light. It is variously of a tender, modest, cheering character, and expressive of these qualities alike in painting and art. In nature, citrine begins to prevail in landscape before the other tertiaries, as the green of summer declines; and as autumn advances it tends towards its orange hues, including the colours called aurora, chamoise, and others before enumerated under the head Yellow.

To understand and relish the harmonious relations and expressive powers of the ternary colours, requires a cultivation of perception and a refinement of taste for which study and practice are requisite. They are at once less definite and less generally striking, but more delightful,—more frequent in nature, but rarer in common art, than the like relations of the secondaries and primaries; and hence the painter and the poet afford us fewer illustrations of effects less commonly appreciated or understood.

Original citrine-coloured pigments are not numerous, unless we include several imperfect

yellows, which might not improperly be called citrines: the following are, however, the pigments best entitled to this appellation:—

MIXED CITRINE.

What has been before remarked of the mixed secondary colours is more particularly applicable to the ternary, it being more difficult to select three homogeneous substances of equal powers as pigments, than two that may unite and work together cordially. Hence the mixed ternaries are still less perfect and pure than the secondaries; and as their hues are of extensive use in painting, original pigments of these colours are proportionately estimable to the artist. Nevertheless, there are two evident principles of combination, of which the artist may avail himself in producing these colours in the various ways of working; the one being that of combining two original secondaries,—*e.g.*, *green and orange* in producing a *citrine*; the other the uniting the three primaries in such a manner, in the case of citrine, that *yellow* predominate, and *blue* and *red* be subordinate in the compound.

These colours are, however, in many cases produced with best and most permanent effect, not

by the intimate combination of the pigments themselves, but by intermingling them on the canvas, so as to produce the effect at a proper distance of a uniform colour. This is applicable to the *citrine* colour of fruit and foliage; on inspecting specimens of which in nature we can sometimes distinctly trace stipplings of orange and green, or yellow, red, and green. Similar beautiful consonances are observable in the *russet* hues of foliage in the autumn, in which purple and orange have broken or superseded the uniform green of leaves; and also in the *olive* foliage of the rose-tree, produced in the individual leaf by the ramification of purple into green. Yet mixed citrines may be compounded safely and simply by slight additions to an original brown pigment of the primary or secondary tone which is requisite to give it the required hue, and red and yellow ochres mixed form good common paints of this colour.

BROWN PINK

Is a vegetable lake precipitated from a decoction of French berries, or of yellow 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: but being in general of an orange

broken by green, it falls into the class of citrine colours, sometimes inclining to greenness and sometimes toward the warmth of orange. It works well both in water and oil, in the latter of which it is of great depth and transparency, but dries badly. Its tints with white-lead are very fugitive, and in thin glazing it does not stand. Upon the whole, it is more beautiful than eligible.

UMBER,

Commonly called *Raw Umber*, is a natural ochre, abounding with brown decayed vegetable matter of the nature of peat, obtained from Umbria, in Italy;—it is found also in England, and in other parts of the world; but that which is sold under the name of Turkish 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, and one of the best drying colours we possess, and injures no other pigment with which it may be mixed. Although not so much employed as formerly, umber is perfectly eligible, according to its colour and uses, in grain-ing, &c.

Several browns, and other ochreous earths, approach also to the character of citrine; such are

the Terre de Cassel, Bistre, &c. But in the confusion of names, infinity of tones and tints, and variations of particular pigments, it is impossible to attain an unexceptionable or universally satisfactory arrangement.

II.—OF RUSSET.

The second or middle ternary colour, *Russet*, like citrine, is constituted ultimately of the three primaries, *red*, *yellow*, and *blue*; but with this difference, that instead of yellow as in citrine, *red* is the predominating colour in russet, to which yellow and blue are subordinates: for *orange* and *purple* being the immediate constituents of russet, and red being a component part of each of those colours, it enters doubly into their compound in russet, while yellow and blue enter it only singly; the proportions of its middle hue being eight blue, ten red, and three yellow, of equal intensities. It follows that russet takes the relations and powers of a subdued red; and many pigments and dyes of the latter denomination are in

strictness of the class of russet colours : in fact, the nominal distinction of colours is properly only relative ; the gradation from hue to hue, as from shade to shade, constituting an unlimited series, in which it is literally impossible to pronounce absolutely where any shade or colour ends and another begins.

The harmonizing, neutralizing, or contrasting colour of russet is a *deep green* ;—when the russet inclines to orange, it is a *grey*, or subdued blue. These are often beautifully opposed in nature, and form colours among the most agreeable to sense.

Russet, we have said, partakes of the relations of red, but moderated in every respect, and qualified for greater breadth of display in the colouring of nature and art ; less so, perhaps, than its fellow-tertiaries in proportion as it is individually more beautiful, the powers of beauty being ever most effective when least obtrusive ; and its presence in colour should be principally evident to the eye that seeks it. This colour is warm and soothing. Common acceptance substitutes the term brown for russet.

Of the ternary colours, russet is the most important to the artist ; and there are many pigments under the denominations of red, purple, &c.,

which are of russet hues. But there are few true russets, and one only which bears the name: of these are the following:—

MIXED RUSSET.

What has been remarked in the preceding chapter upon the production of mixed citrine colours is equally applicable in general to the mixed russets: we need not therefore, repeat it. By the immediate method of producing it by mixture from its secondaries, orange and purple ochres afford a compound russet pigment of a good and durable colour. Chrome orange and purple lake yield a similar but less permanent mixture.

It may be produced by adding red in due predominance to some browns; thus red and brown ochre mixed afford a good ordinary russet paint.

FIELD'S RUSSET,

Or *Madder Brown*, is, as its name indicates, prepared from the *Rubia tinctoria*, or madder-root. It is of a pure, rich, transparent, and deep purple-russet colour, and is of a true middle hue between orange and purple; not subject to change by the

action of light, impure air, time, or mixture of other pigments. It is valuable in water-colour painting, both as a local and auxiliary colour, in compounding and producing with yellow the glowing hues of autumnal foliage, &c., and with blue the beautiful and endless variety of greys in skies, flesh, &c. There are three kinds of this pigment, distinguished by variety of hue: russet, or *madder brown*, *orange russet*, and dark russet, or *intense madder brown*; which differ not essentially in their qualities as pigments, but as warm or cool russets, and are all good glazing colours, thin washes of which afford pure flesh-tints in water. The last dries best in oil, the others but indifferently. It is a valuable pigment in the graining of mahogany.

PRUSSIAN OF COPPER

Is chemically a ferrocyanide of copper. It varies in colour from russet to brown, is transparent and deep, but being very liable to change colour by the action of light and by other pigments, has been very little employed by the artist, and is practically useless as a pigment.

There are several other pigments which enter imperfectly into, or verge upon, the class of russet,

which having obtained the names of other classes to which they are allied, will be found under other heads; such are some of the ochres and Indian red. Burnt carmine and Cassius's precipitate are often of the russet hue, or convertible to it by due additions of yellow or orange, as burnt Sienna earth and various browns are by like additions of lake or other reds.

RUSSET OCHRE.

Although there is no pigment of this name in the shops, many of the native ochres are of this denomination of colour, and may be employed accordingly; and the red and yellow ochres of commerce ground together and burnt afford excellent russet colours in every mode of painting.

III.—OF OLIVE.

Olive is the third and last of the ternary colours, and nearest in relation to shade. It is constituted, like its co-ternaries, citrine and

russet, of the three primaries, *blue*, *red*, and *yellow*, so subordinated, that blue prevails therein; but it is formed as a tint more immediately of the secondaries, *purple* and *green*: and, since blue enters as a component principle into each of these secondaries, it occurs twice in the latter mode of forming olive, while red and yellow occur therein singly and subordinately. *Blue* is, therefore, in every instance, the predominating colour of olive; its perfect or middle hue comprehending sixteen of blue to five of red, and three of yellow; and it participates in a proportionate measure of the powers, properties, and relations of blue: accordingly, the antagonist, or harmonizing contrast of olive, is a *deep orange*; and, like blue also, it is a retiring colour, the most so of all the colours, being nearest of all in relation to *black*, and last of the regular distinctions of colours. Hence its importance in nature and painting is almost as great as that of black: it divides the office of clothing and decorating the general face of nature with green and blue; with both which, as with black and grey, it enters into innumerable compounds and accordances, changing its name, as either hue predominates, into *green*, *grey*, *ashen*, *slate*, &c.: thus the olive hues of foliage are called

green, and the purple hues of clouds are called *grey*, &c., for language is too general and inadequate to the infinite variety of natural colours.

As olive is usually a compound colour both with the artist and mechanic, and there is no natural pigment of this colour in use, in commerce there are few olive pigments. *Terre-vert*, already mentioned, is sometimes of this class, and several of the copper greens acquire this hue by burning. The following need only to be noticed :—

MIXED OLIVE GREEN

May be compounded in several ways ; directly, by uniting *green* and *purple*, or by adding to *blue* a smaller proportion of *yellow* and *red*, or by breaking much blue with little orange. Bluish-black pigments mixed with yellow ochre afford good olives. These hues are called *green* in landscape, and *invisible green* in decorative painting. The fine pigment sold under this name, principally as a water-colour, is an arbitrary compound, or mixed green. Any ordinary green mixed with black forms this colour for exterior painting in oil, &c. And an olive-green paint may be economically prepared by the mixing of yellow or

brown ochre with blue black, which may be varied by additions of purer blue or of green.

BURNT VERDIGRIS

Is what its name expresses, and is an olive-coloured mixture of oxide of copper with binacetate of copper. It dries remarkably well in oil, and is more durable and in other respects a more eligible pigment than the original verdigris. Scheele's green affords by burning* also a series of similar olive colours, which are as durable as their original pigment, and most of the copper greens may be subjected to the same process with the same results; indeed, we have remarked in many instances that the action of fire anticipates the effects of long-continued time, and that many of the primary and secondary colours may, by different degrees of burning, be converted into their analogous secondary and ternary, or semi-neutral colours.

* The vapours driven off in this operation are deadly, if inhaled.

CHAPTER VIII.

OF SEMI-NEUTRAL COLOURS.

I.—OF BROWN.

As colour, assumed descending according to the regular scale from *white*, properly ceases with the class of *olive*, the neutral *black* would here naturally terminate the series; but as, in a practical view, every coloured pigment, of every class or tribe, combines with black as it exists in pigments, a new series or scale of coloured compounds arises, having black for their base, which, though they differ not theoretically from the preceding order inverted, are nevertheless practically imperfect or impure; in which view, and as compounds of black, we have distinguished them by the term *semi-neutral*, and divided them into *three classes, Brown, Morone, and Grey*. Inferior as these semi-neutrals are in point of colour, they comprehend, nevertheless,

a great proportion of our most permanent pigments; and are, with respect to black, what *tints* are with respect to white; *i.e.*, they are, so to call them, black tints, or shades.

The first of the semi-neutral, and the subject of the present chapter, is BROWN, which, in its widest acceptation, has been used to comprehend vulgarly every denomination of dark broken colour, and, in a more limited sense, is the rather indefinite appellation of a very extensive class of colours of warm or tawny hues. Accordingly we have browns of every denomination of tint; thus we have yellow brown, red brown, orange brown, purple brown, &c. Any brown in which blue predominates is by such predominance of a cold colour carried into the class of grey, ashen, or slate-colour. Hence brown comprehends the hues called *feuillemort*, *mort d'or*, *dun*, *hazel*, *auburn*, &c.; several of which we have already enumerated as allied to the ternary colours.

The term *brown*, therefore, properly denotes a warm broken colour, of which *yellow* is a 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 *equa!*

quantities of either of the three primaries, the three secondaries, or the three ternaries, produce variously a brown mixture, and not the neutral black, &c.; because no pigment is essentially single, or pure in colour. Browns contribute to coolness and clearness by contrast when opposed to pure bright colours. Hence their vast importance in painting, and the necessity of keeping them from other colours in mixture, to which they give foulness.

The tendency in the compounds of colours to run into brownness and warmth is one of the general natural properties of colours, which occasions them to deteriorate or dirt each other in mixture: hence *brown* is synonymous with foul or defiled, in a sense opposed to *fair* and pure; and it is hence also that brown, which is the nearest of the semi-neutrals in relation to light, is to be avoided in mixture with light colours.

This tendency will account also for the use of brown in harmonizing and toning, and for the great number of natural and artificial pigments and colours we possess under this denomination; in fact, the failure to produce other colours chemically or by mixture is commonly productive of a brown: yet are fine transparent browns obviously

very valuable colours. If red or blue be added to brown predominantly, it falls into the other semi-neutral classes, marone or grey.

The wide acceptance 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 warmth 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*, along 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 and warmth, and in 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 ternaries will do the same; hence there can be no difficulty in producing them by mixture when required, which is seldom, as there are many brown pigments which are good and permanent, among which are the following:—

VANDYKE BROWN.

This pigment, hardly less celebrated than the great painter whose name it bears, is a species of peat or bog earth of a fine, semi-transparent brown colour. The pigment so much esteemed and used by Vandyke is said to have been brought from Cassel; and this seems to be justified by a comparison of *Cassel earth* with the browns of his pictures. The Vandyke browns in use at present appear to be terrene pigments of a similar kind, purified by grinding and washing over: they vary sometimes in hue and in degrees of drying in oil, which they in general do tardily, owing perhaps to their peaty nature, but are good browns of powerful body, and are durable both in water and oil. The *Campania brown* of the old Italian painters was a similar earth. All these browns

are compounds of ulmin with other vegetable matter, and with more or less aluminous or other earths, and oxides of iron or of manganese.

MANGANESE BROWN

Is a hydrous oxide of manganese, known to miners as *Wad*, of a fine, deep, semi-opaque brown of good body, which dries admirably well in oil, being a powerful siccative. It is deficient in transparency, but may be a useful colour for glazing or lowering the tone of white without tinging it, and as a local colour in draperies, dead colouring, &c. It is a perfectly durable colour both in water and oil.

CAPPAGH BROWN

Is the same as the preceding, a *Native Manganese Brown*, found at Cappagh, county Cork. It is naturally mixed with bog-earth or peat, mineralized by manganese in various proportions. The specimens in which the peat earth most abounds are of light weight, friable texture, and dark colour,—those which contain more of the metal are heavy and of a lighter colour.

As pigments, the peaty Cappagh brown is the

most transparent, deep and rich in colour, and dries promptly in oil, during which its surface cracks where it lies thick. This may be regarded as a superior Vandyke brown.

The other sort, containing more manganese, is a less transparent, and warmer brown pigment, which dries rapidly and smoothly in a body or thick layer, and may be viewed as a superior sort of Umber. The two extreme sorts should be distinguished as *light* and *deep* Cappagh browns; the first excellent for dead colouring and grounds, the latter for glazing and graining. These pigments are equally applicable to painting in water, oil, and varnish, working well in each of these vehicles. They have been introduced into commerce for decorative and marine painting under the names of *Euchrome* and *Mineral brown*, and are fine colours and valuable in their uses, and especially so in the graining of oak, &c. All manganetic oxide colours are powerful siccatives in oil.

BURNT UMBER

Is the fossil pigment called Umber, heated to a red heat, by which 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 dryer. It may be substituted for Vandyke brown, is a perfectly durable and eligible pigment in water, oil, and fresco, and may be produced artificially. The old Italians called it *falsalo*.

CASSEL EARTH

The true *terre de Cassel* is an ochreous pigment similar to the preceding, but of a brown colour, more inclined to the russet hue. In other respects it does not differ essentially from Vandyke browns.

COLOGNE EARTH

Is a native pigment, darker than the last two, and in no respect differing from Vandyke brown in its uses and properties as a colour. Similar earths abound in our own country. They are all ochres, mixed with more or less ulmin and bituminous matter in small proportions.

RUBENS BROWN.

The pigment still in use in the Netherlands under this appellation is an earth of a lighter colour and more ochreous texture than the Vandyke brown of the London shops: it is also of a warmer or more tawny hue than the latter

pigment, and is a beautiful and durable brown, which works well both in water and oil, and much resembles the brown used by Teniers.

BROWN OCHRE.

See *Yellow Ochre*. *Iron Brown*, *Mars Brun*, and *Prussian Brown* may be regarded as brown ochres, of which there is abundance in nature, and all imitable by art. See *Spanish Brown*, or *Tiver*, and *Red Ochre*.

BONE BROWN

And *Ivory Browns* are produced by torrefying, or roasting bone and ivory till by partial charring they become of a brown colour throughout. They may be made to resemble the first five browns above mentioned by management in the burning; and though much esteemed by some artists, are not perfectly eligible pigments, being bad dryers in oil, and their light shades not durable either in oil or water when exposed to the action of strong light, or mixed in tint with white-lead. The palest of these colours are also the most opaque: the deepest are more durable, and most so when approaching black. They are chiefly mixtures of animal tar with finely-divided charcoal.

ASPHALTUM,

Called also *Bitumen*, *Mineral Pitch*, *Jews' Pitch*, &c., is a bituminous substance rendered brown by the action of heat, or by time. Common pitch is the type of all these. The substances employed in painting under this name are residua of the distillation of various resinous and bituminous matters in preparing essential oils from them, and are all black and glossy like common pitch, which differs from them only in having been less acted upon by fire, and in thence being softer. Asphaltum is principally used in oil-painting; for which purpose it is first dissolved in oil of turpentine, by which it is fitted for glazing and shading. Its fine brown colour and perfect transparency are lures to its free use with many artists, notwithstanding the frequent destruction which awaits the work on which it is much employed, owing to its disposition to contract and crack by changes of temperature and by time; but for which it would be a most beautiful, durable, and eligible pigment. The solution of asphaltum in turpentine, united with drying oil, by heat, or the bitumen torrefied and ground in linseed or drying oil, acquires a firmer texture, but becomes

less transparent, and dries with difficulty. If also common asphaltum, as usually prepared with oil of turpentine, be used with some addition of Vandyke brown, umber, or Cappagh brown ground in drying-oil, it will acquire body and solidity, which will render it much less disposed to crack, and give it the qualities of native asphaltum; nevertheless, asphaltum is to be regarded in practice rather as a dark varnish than as a solid pigment, and all the faults of a bad varnish are to be guarded against in employing it. Coal tar, which is now produced in excessive abundance as an educt of the distillation of coal at the gas works, is in fact the basis also of this pigment.

The native bitumen, brought from Persia by Lieutenant Ford, had a powerful scent of garlic when rubbed. In the fire it softened without flowing, and burnt with a lambent flame; did not dissolve by heat in oil of turpentine, but ground easily as a pigment in pale drying-oil, affording a fine, deep, transparent brown colour, resembling that of the asphaltum of the shops; dried firmly nearly as soon as the drying-oil alone, and worked admirably both in water and oil. Asphaltum may be used as a permanent brown in water, and the native kind is also superior to the

artificial for this purpose, and would be useful from its transparent richness in graining. It can only be made soluble in water by means of an alkali.

MUMMY,

Or *Egyptian Brown*, is also a bituminous substance combined with animal remains brought from the catacombs of Egypt, where liquid bitumen was employed three thousand years ago in embalming; in which office it has suffered slow chemical changes during so many ages, which are supposed to give it a more solid and lasting texture than simple asphaltum: but in this respect it varies exceedingly. Its other properties and uses as a pigment are the same as those of asphaltum, for which it is employed as a valuable substitute, being less liable to crack or move on the canvas. This also may be used, when ground, as a water-colour.

ANTWERP BROWN

Is a preparation of asphaltum ground in strong drying-oil, by which it becomes less liable to crack. (See the last two articles.) Ochreous bitumens, bituminous coal, jet and other bituminous substances afford similar browns.

BISTRE

Is a brown pigment extracted by washing and subsidence from the soot of wood-fires, whence it retains a strong pyroligneous scent. It is of a wax-like texture, and of a citrine-brown colour, perfectly durable. It has been much used as a water-colour, particularly by the old masters, in tinting drawings and shading sketches, previously to Indian ink coming into general use for such purposes. In oil it dries with the greatest difficulty.

A substance of this kind collects at the back of fire-places in cottages where peat is the constant fuel burnt; which, purified by solution and evaporation, affords a fine bistre. Scotch bistre is of this kind. All kinds of bistre attract moisture from the atmosphere.

SEPIA,

Seppia, or *Animal Æthiops*. This pigment is secreted in the *Sepia octopus*, or cuttle-fish, called also the ink-fish, from its dark liquid having been used as an ink and pigment by the ancients. From this liquid our pigment sepia, which is brought principally from the Adriatic, though it may be

obtained from the fish on our own coasts, is said to be obtained ; and it is supposed that it enters into the composition of the *Indian ink* of the Chinese. *Sepia* is of a powerful dusky-brown colour, of a fine texture, works admirably in water, combines cordially with other pigments, and is very permanent.

It is much used as a water-colour, and in making drawings in the manner of bistre and Indian ink ; but is not used in oil, in which it dries very reluctantly.

MADDER BROWN.

See *Russet*, page 149 ; *Brown Pink*, page 147.

II.—OF MORONE.

As a semi-neutral it is only necessary to say, that for oil and water-colour painting there are no pigments found in nature capable of supplying the artist's wants without admixture. The shades and tints are innumerable, and can always be readily compounded.

III.—OF GREY.

Of the tribe of semi-neutral colours, GREY is the third and last, being nearest in relation of colour to black. In its common acceptation, and that in which we here use it, grey denotes a class of cool cinereous colours, faint of hue ; whence we have pure greys, olive greys, green greys, purple greys, and greys of all hues, in which blue predominates ; but no yellow or red greys, as where such hues prevail, they are carried into the class of brown and morone. In this sense the *semi-neutral* GREY is distinguished from the *neutral* GREY, which springs in an infinite series from the mixture of the neutral *black* and *white*—hence the natural alliance of the semi-neutral grey with black or shade ; an alliance which is strengthened by the latent predominance of blue in black, so that in the tints resulting from the mixture of black and white, so much of that hue is developed as to give apparent colour to the tints. This affords the reason why the tints of black and dark pigments are colder than their originals, so much so as in some instances to answer the purposes of positive colours.

The *greys* are the natural cold correlatives, or

contrasts, of the warm semi-neutral *browns*; and they are degradations of blue and its allies;—hence *blue* added to brown throws it into or toward the class of greys. Greys are equally abundant in nature and necessary in art; for the greys comprehend in nature and painting a widely-diffused and beautiful play of retiring colours in skies, distances, and the shadowings and reflections of pure light, &c.

According to the foregoing relations, greys favour the effects and force of warm colours, which in their turn also give value to greys, and by reconciling opposites, give repose to the eye.

As blue is the ruling power of all the colours which enter into the composition of greys, the latter partake of the relations and affections of blue. Grey colours are deep and dull; in signification and sentiment, *grey* is almost as common with the poet, and in its colloquial use, as it is in nature and painting; the greys, like the other semi-neutrals, contributing to the expression of cold, gloom, and sadness, bordering in these respects upon the powers of *black*, but aiding the livelier and more cheering expressions of other *colours* by connection and contrast.

MIXED GREYS

Are formed not only by the compounding of black and white pigments which yield *neutral greys*, and of black and blue, black and purple, black and olive, &c., which yield the *semi-neutral greys* of clouds, &c., but these may be well imitated by the mixture of russet, or madder browns, with blues, which form transparent compounds, which are much employed; greys are, however, as above remarked, so easily produced, that the artist will in this respect vary and suit his practice to his purpose. The *lead colours* of house-painting are formed by adding black to white-lead in oil. They are very useful grounds and dead colourings for greens, &c., and as decorative colours where suitable in shade, &c., are capable of much beauty.

NEUTRAL TINT.

Several mixed pigments of the class of grey colours sold for Neutral tint are variously composed of sepia and indigo or other blues, with madder or other lakes, and are designed for water-colour painting only, in which they are found extremely useful. And here it may be proper to mention those other useful pigments, sold under the name of tints, which belong to no

particular denomination of pigments, but being compounds, the results of the experience of accredited masters in their peculiar modes of practice serve to facilitate the progress of their pupils. Such are *Harding's* and *Macpherson's tints*, usually sold ready prepared in cakes and boxes for miniature and water-colour painting. These are composed of pigments which associate cordially; nevertheless, the skilled artist will in general prefer a dependence upon his own method and mixtures for the production of his tints in painting, both in water and oil.

ULTRAMARINE ASHES,

Or *Mineral Grey*, are the recrement of native lapis lazuli, from which ultramarine has been extracted, varying in colour from dull grey to blue. They consist of whitish earthy matter mixed with a little ultramarine. They are extremely useful oil pigments, affording greys much more pure and tender than such as are composed of black and white, or other blues, and better suited to the pearly tints of flesh, foliage, the greys of skies, and the shadows of draperies, but are not necessary to the ordinary painter, who can form them of cheaper pigments.

PHOSPHATE OF IRON

Is a native blue phosphate of the proto and peroxides of iron, known to mineralogists as *Vivianite*, which classes in colour with the deeper hues of ultramarine ashes, and may be employed for their uses. It has received the improper appellation of *blue ochre*. It contains nearly 30 per cent. of water, and must be perfectly valueless as a pigment.

Slate clays and several native earths class with greys; but the colours of both become brown by the peroxidation of the iron they contain. They have no body as pigments.

PLUMBAGO.

See *Black-lead*. It forms *grey* tints of greater permanence and purity than the blacks in general use, and it is now employed for this purpose with approved satisfaction by experienced artists.

IV.—OF THE NEUTRAL, BLACK.

Black is the opposite extreme from white—the extinction of colour. To be perfect it must be

neutral with respect to colour, and destitute of sheen or 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 pigments, 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 warm colours by partially neutralizing them, but it combines less injuriously with cold colours. Though it is the antagonist of white, yet added to it as a pigment in minute portion it in general renders white more neutral, with less of the character of light. Impure black is brown, but black in its purity is a cold colour, and communicates this property 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 retiring. It heightens the effect of warm as well as of 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. Having therefore the double office of colour and

of shade, black is one of the most important pigments to the artist, both as to its use and avoidance.

It is owing to the presence of blue in the constitution of black pigments that it contributes by slight 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. The dyer proceeds to dye black upon a deep *blue* basis of indigo, with the *ruddy* colour of madder, and sometimes the *yellow* of quercitron, galls, sumach, &c., so as to obtain, as nearly as possible, a perfect black.

A little black or white is equivalent in addressing the eye to much colour, and hence their use as pigments requires judgment and caution in painting.

Black may be rendered a harmonizing medium to all colours, and it gives brilliancy to them all by its sedative effect on the eye, and its powers of contrast; nevertheless, as a pigment it must be introduced with caution in painting when *hue* is of greater importance than *shade*. 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 the extinction of all colour. The best black pigments of the painter owe their colour to the carbon they contain: such are *Ivory* and *Bone blacks*, *Lamp-black*, *Blue black*, *Frankfort black*, &c. The first three 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.

Native or *mineral blacks* are heavy and opaque, but dry well.

Black pigments are numerous: the following are, however, the principal, all of which are permanent colours:—

IVORY-BLACK,

More properly *Bone-black*, is the animal charcoal of bone which has been subjected to a red heat in closed vessels. These pigments vary principally through want of care or skill in preparing them; when well made, they are fine neutral blacks, perfectly durable and eligible both 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. There is no such thing as ivory in commerce as a pigment: the bone-black commonly used, and immense quantities of which are consumed with sulphuric acid in manufacturing of *shoe-black*ing, consists of the exhausted animal charcoal of the sugar refiners.

LAMP-BLACK,

Or *Lamblack*, is a smoke-black, being the soot of resinous woods, obtained by the combustion of coal or vegetable tar with a deficiency of air. It is a carbonaceous substance, of a fine texture, intensely black, and perfectly durable, which works well, but dries slowly in oil. It is commonly stated that this pigment may be prepared extemporaneously for water-painting by holding a plate over the flame of a lamp or candle, and adding gum-water to the colour: the nearer the plate is held to the wick of the lamp, the more abundant and warm will be the hue of the black obtained; at a greater distance it will be more effectually charred and blacker, but the black so obtained is greasy. Of Indian ink, the colouring basis appears to be some sort of lamp-black. The

Nero di foglio of the Italians is prepared from the smoke of burnt paper.

FRANKFORT BLACK

Is said to be made of the lees of wine from which the tartar has been washed, by burning, in the manner of ivory-black; but Frankfort black is merely animal charcoal mixed with some fine sort of lamp-black: much mystery is made about its preparation. Fine Frankfort black, though almost confined to copper-plate printing, is one of the best black pigments we possess, being of a fine neutral colour, next in intensity to lamp-black. Strong light has the effect of deepening its colour; the blacks of the printing of engravings have proved of very variable durability, arising from the alterations in the paper and oil of the ink by time. It is probable that this black was used by some of the Flemish painters.

BLUE BLACK

Is also a well-burnt and levigated charcoal, of a cool, neutral colour, and not differing in other respects from the common Frankfort black above mentioned. Blue black was formerly much employed in painting, and, in common with all other

blacks, has, when duly mixed with white, an influence upon that colour in oils. A superior blue black may be prepared 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 produced in this way by charring. Blue black has been repeatedly obtained by the carbonization of vine stalks and grape seeds, &c., along with more or less of wine lees, containing argol or crude tartar, but there seems to be little doubt that what is at present sold as blue black consists of lamp-black of some sort, mixed in minute proportions with some blue pigment, probably indigo.

SPANISH BLACK

Is a soft black, prepared by burning *cork* in the manner of Frankfort and ivory blacks; and it differs not essentially from the former, except in being of a lighter and softer texture, and of a browner tint. It is subject to the variation of the above charred blacks, and eligible for the same uses. *Paper black*, the *Nero di foglio* of the Italians, often prepared in the same way, much resembles Spanish black, as does also the black prepared by roasting Prussian blue.

MINERAL BLACK

Is a native impure carbonaceous shale of a soft texture, found in Devonshire and Wales. It is blacker than plumbago, and without metallic lustre,—is of a neutral, greyer, and more opaque tint than ivory-black,—forms pure tints,—and being perfectly durable, and drying well in oil, it is valuable in dead colouring, on account of its solid body, as a preparation for black and deep colours before glazing. It would also be the most durable and best possible black for frescoes. *Russian black* is of this class.

MANGANESE BLACK.

The common black oxide of manganese answers to the character of the preceding pigment, and is the best of all blacks for drying in oil without addition or preparation of the oil. It is also a colour of much body and tinging power.

BLACK OCHRE

Is a variety of the mineral black above, combined probably with more iron.

BLACK COLOURS NOT IN COMMON USE.

Sea-coal and many black mineral substances have been and may be employed as succedanea

for the more usual blacks, if the latter are not procurable.

BLACK CHALK

Is an indurated black shale of the texture of white chalk, and is naturally allied to the preceding article. Its principal use is for cutting into crayons, which are employed in sketching and drawing.

Fine specimens have been found near Bantry in Ireland, and in Wales, but the Italian, found in the seams in the tertiary coal formations of the Apennines, has the best reputation. Crayons for these uses are also prepared artificially, which are deeper in tint and free from grit. Charcoal or wood is also cut into crayons for the same purpose, and the charcoals of soft woods, such as lime, poplar, &c., are fittest for this use.

INDIAN INK.

The pigment well known under this name is principally brought to us from China in oblong cakes, of a musky scent, ready prepared for painting in water, in which use it is so generally employed as hardly to require description. It varies, however, considerably in colour and qua-

lity, and is sometimes called *China ink*. Various accounts are given by authors of the mode of preparing this pigment, the principal substance or colouring-matter of which is a smoke-black, having the properties of our lamp-black; and the variety of its hues and texture seems to depend upon the degree of burning and levigating it receives. The pigment known by the name *sepia* is supposed to enter into the composition of the better sort. That imported in hexagonal prisms of about $4\frac{1}{2}$ inches long by $\frac{3}{4}$ inch diameter, with a vertical column of Chinese characters on one side, is found to be by much the best by all engineers and other draughtsmen. Very large sticks or blocks are extremely inferior, and run and blotch in water-colour.

BLACK-LEAD,

Plumbago, or *Graphite*, is a native carbon, found in many countries, but nowhere of a finer quality than at Borrodale in Cumberland, where there are mines of it, from which the best in Europe is obtained, and consumed in large quantity in the formation of crayons and black-lead pencils in use in writing, sketching, &c.; for which the facility with which it may be rubbed out by Indian rubber

or caoutchouc, or the crumb of bread, admirably adapts it.

Graphite is one of the *three* forms of molecular aggregation in which carbon presents itself—diamond and charcoal being the other two.

Though plumbago commonly contains a very little iron and other foreign substances, these are non-essential to it.

Enormous deposits of plumbago of the very finest quality have within a recent period been discovered in Siberia. It is also largely obtained in the United States, and in Mexico and Brazil. The very finest black-lead for artists' pencils, &c., free from all grit, is procured by Brookedon's patent process of levigation, washing, and recompressing into blocks.

Although not acknowledged as a pigment, it might be employed as a water-colour, levigated in gum-water in the ordinary manner. It may be used effectually with rapidity and freedom in the shading and finishing of pencil drawings, &c. Even in oil it might be used, as it possesses remarkably the property of covering, forms very pure *grey* tints, dries quickly, and injures no pigments chemically.

Although plumbago is frequently called *Black-*

lead, there is another substance more properly entitled to this appellation, and which might also be employed in the same manner, and with like effects as a pigment, namely, *Galena*, or *Sulphuret of Lead*, found native in the beautiful lead ore of Derbyshire, but without any advantage.

CHAPTER IX.

TABLES OF PIGMENTS, ETC.*

As there are circumstances under which some pigments may be very properly and safely used, which under others might prove injurious or destructive to the work, the following Lists or Tables are subjoined, in which they are classed according to various general properties, as guides to a judicious selection. These tables are the results of direct experiment and observation, and are composed, without regard to the common reputation or variable character of pigments, but according to the real merits of the various specimens tried.

As the properties and effects of pigments are much influenced by adventitious circumstances, and are sometimes varied or altogether changed by the grounds or surfaces on which pigments are used, by the vehicles in which they are used, by the siccatives and colours with which

* See Field's "Rudiments of the Painter's Art," p. 113.

they are mixed, and by the varnishes by which they are covered, these tables are offered only as approximations to the true characters of pigments, and as general guides to right practice. They render it also apparent, as a general conclusion, that the majority of pigments have a mediocrity of qualification, balancing their excellences with their defects, and that the number of good and eligible pigments overbalances those which ought in general to be rejected.

TABLE I.

In general it must be observed, that all pigments tend to lose brilliancy of colour if *long* in the dark; that all vegetable pigments tend to bleach or lose colour when *long* exposed to light, but after having been long in the dark, recover more or less brilliancy of colour for a time when again exposed to clear daylight. Some mineral colours alter, some losing, some gaining, depth of colour by light.

All vegetable colours are slowly injured by damp air, however pure, and several mineral colours also. The air and moisture of our coal-burning cities act upon *all* pigments more or

less, as well as to produce decay (of which damp is a chief agent) in all grounds of vegetable or animal nature, canvas, paper, parchment, &c.

Of pigments, the colours of which suffer different degrees of change by the action of light, oxygen, and pure air, but are little, or not at all, affected by shade, sulphuretted hydrogen, damp, and foul air :—

Yellow	{	Yellow Lake	}	Pink
		Dutch		
		English		
		Italian		
	{	Yellow Orpiment	}	
		King's Yellow		
		Chinese Yellow		
		Gamboge		
{	Gallstone	}		
	Indian Yellow			
Red ...	{	Rose Pink	}	Cochineal Lakes
		Carmine		
		Common		
		Florence		
		Scarlet		
		Hambro'		
Blue...	{	Indigo	}	
		Intense Blue		
		Antwerp Blue		
		Prussian Blue		
Orange	{	Orange Orpiment	}	
		Golden Sulphur of Antimony		
Green ...		Sap Green		
Purple	{	Purple Lake	}	
		Burnt Carmine		
		Lac Lake		
Brown	{	Brown Pink	}	
		Light Bone Brown, &c.		

REMARKS.—None of the pigments in this table are eminent for permanence. No white or black pigment whatever belongs to this class, nor does any ternary, and a few only of the original semi-neutrals. Most of those included in the list fade or become lighter by time, and also, in general, less bright.

TABLE II.

Pigments, the colours of which are little, or not at all, changed by light, oxygen, and pure air, but are more or less injured by the action of shade, sulphuretted hydrogen, damp, and impure air:—

White	{	Common White-lead	Blue...	{	Blue Verditer
		Flake White			Sanders Blue
Yellow	{	Creams White	Orange	{	Mountain Blue
		Roman White			Royal Blue
		Venetian White			Smalt and other
		Blanc d'Argent			Cobalt Blues
		Sulphate of Lead			
Red...	{	Massicot	Green	{	Orange-lead
		Patent Yellow			Orange Chrom
		Jaune Minérale			Chromate of Mercury
		Chrome Yellow			Laque Minérale
		Naples Yellow			
	{	Red-lead		{	Green Verditer
		Chrome Red			Mountain Green
		Dragon's Blood			Common Chrome
		Iodine Scarlet			Green
					Mineral Green
					Verdigris, and other
					Copper Greens

REMARKS.—Most of our best white pigments are comprehended in this table, but no black, ternary, or semi-neutral pigment.

Most of these colours, when secured by oils and varnish, &c., may be long protected from change. The pigments of this table may be considered as more durable than those of the preceding; they are nevertheless ineligible in a

water vehicle, and in fresco ; and most of them become darker by time alone in every mode of use.

This list is the opposite of Table I.

TABLE III.

Pigments the colours of which are subject to change by the action both of light and oxygen, and by sulphuretted hydrogen, damp, and impure air:—

White	{ Pearl or Bismuth White Antimony White	Orange	{ Sulphid of Antimony Annotta Chica
Yellow	{ Turpeth Mineral Patent Yellow	Green . . .	Verdigris
Red ...	{ Iodine Scarlet Dragon's Blood	Russet. . .	Prussiate of Copper
Blue...	{ Royal Blue Prussian Blue Antwerp Blue		

This table comprehends our most imperfect pigments, and demonstrates how few absolutely bad have obtained currency. Indeed, several of them are valuable for some uses, and not liable to sudden or extreme change by the agencies to which they are here subjected. Yet the greater part of them are destroyed by time.

These pigments unite the bad properties of those in the two preceding tables.

TABLE IV.

Pigments not at all, or little, liable to change by the action of light, oxygen, and pure air ; nor by shade, sulphuretted hydrogen, damp and impure air ; nor by the action of metallic lead or iron :—

White	{	Zinc White	Green	{	Chrome Greens
		Constant or Barytic White			Terre-Verte
	{	Tin White	Purple	{	Cobalt Green
		The Pure Earths			Gold Purple
Yellow	{	Yellow Ochre	Russet	{	Madder Purple
		Oxford Yellow			Purple Ochre
	{	Roman Ochre		{	Russet Rubiate, or
		Sienna Earth			Madder Brown
	{	Stone Ochre		{	Intense Russet
		Brown Ochre			
Red ...	{	Vermillion	Brown and Semi-neutral	{	Vandyke Brown
		Rubiates, or Madder Lakes			Bistre
	{	Madder Carmines		{	Raw Umber
		Red Ochre			Burnt Umber
	{	Light Red		{	Cassel Earth
		Venetian Red			Cologne Earth
Blue ...	{	Indian Red		{	Asphaltum
					Mummy, &c.
	{	Ultramarine	Black	{	Ultramarine Ashes
		Blue Ochre			Sepia
Orange	{	Orange Ochre		{	Manganese Brown
		Jaune de Mars			Cappagh Brown
	{	Burnt Sienna Earth		{	Ivory-Black
		Burnt Roman Ochre			Lamp-Black
	{	Light Red, &c.		{	Frankfort Black
					Mineral Black
					Black Chalk
					Indian Ink
					Graphite

This table comprehends all the best and most permanent pigments, and such as are eligible for water and oil painting. It demonstrates that the best pigments are also the most numerous, and browns the most abundant, and in these respects stands opposed to the three tables preceding.

TABLE V.

The pigments subject to change variously by the action of white-lead, and preparations of that metal and of other pigments :—

Yellow	Massicot	Blue . . . Indigo	
	Yellow Orpiment		
	King's Yellow		
	Chinese Yellow		
	Gamboge		
	Gallstone		
	Indian Yellow		
	Yellow Lake		
	Dutch		
	English		
Red ...	Italian	Orange	Orange-lead
	Iodine Scarlet		Orange Orpiment
	Red-lead		Golden Sulphide of Antimony
	Dragon's Blood		Annotta, or Roucou
	Common		Chica
Red ...	Cochineal	Green . . . Sap Green	
	Florence		
	Scarlet		
	Hambro'		
	Lac		
	Carmine		
	Rose Pink		
Purple	Purple Lake		
	Burnt Carmine		
Citrine ... Brown Pink			

Acetate (or sugar) of lead, litharge, and oils rendered drying by oxides of lead, are all in some measure destructive of these colours. Light, bright, and tender colours are those most readily susceptible of change by the action of lead.

The colours of this table are very various in their modes of change, and thence do not harmonize well by time : it follows, too, that when any of these pigments are employed, they should be used pure or unmixed, and by preference in varnish ; while their tints with white-lead ought to be altogether rejected.

TABLE VI.

Pigments the colours of which are subject to change by metallic iron, or by pigments into which ferruginous substances enter as components :—

White	{ Sulphate of Lead Blanc d'Argent	Blue ..	{ Blue Verditer Mountain Blue Intense Blue
Yellow	{ King's Yellow Patent Yellow Naples Yellow Chinese Yellow	Orange	{ Golden Sulphide of Antimony
Red ..	{ Iodine Scarlet Carmine Scarlet Lake	Green	{ Verdigris Green Verditer
		Russet ...	Prussiate of Copper

Several other delicate pigments are slightly affected by iron and its preparations; and with all such, as also with those of the preceding table, and with all pigments not well freed from acids or salts, the iron palette knife is to be avoided or used with caution, and one of ivory or horn substituted in its place. Nor can the pigments of this table be in general safely combined with the ochres. Strictly speaking, any degree of friction which abrades particles of steel from the palette knife in rubbing pigments therewith is injurious to every bright colour.

TABLE VII.

Pigments more or less transparent, and generally fit to be employed as graining and finishing colours, if not disqualified according to Tables I., II., and III. :—

Yellow	{	Sienna Earth	Purple	{	Madder Purple		
		Gamboge			Burnt Carmine		
		Indian Yellow			Purple Lake		
		Gallstone			Lac Lake		
	{	Italian	{	Citrine	{	Brown Pink	
		English				Pink	Citrine Lake
		Dutch					
	Yellow Lake						

produced by the skill of the artist in breaking and mingling without mixing them, &c.

The great importance of transparent pigments is to unite, and give tone and atmosphere generally, with beauty and life, to solid or opaque colours of their own hues; to convert primary into secondary, and secondary into tertiary colours with brilliancy; to deepen and enrich dark colours and shadows, and to give force and tone to black itself.

TABLE VIII.

Pigments the colours of which are little or not at all affected by heat or fire:—

White	<ul style="list-style-type: none"> Tin White Barytic White Zinc White The Pure Earths 	Orange	<ul style="list-style-type: none"> Orange Ochre Jaune de Mars Burnt Sienna Earth Burnt Roman Ochre
Yellow	<ul style="list-style-type: none"> Naples Yellow Patent Yellow Antimony Yellow 	Green	<ul style="list-style-type: none"> True Chrome Green Cobalt Green
Red . .	<ul style="list-style-type: none"> Red Ochre Light Red Venetian Red Indian Red 	Purple	<ul style="list-style-type: none"> Gold Purple Purple Ochre
Blue . .	<ul style="list-style-type: none"> Royal Blue Smalt Dumont's Blue and all Cobalt Blues Ultramarine 	Brown	<ul style="list-style-type: none"> Rubens's Brown Burnt Umber Cassel Earth Cologne Earth Antwerp Brown Manganese Brown
		Black	<ul style="list-style-type: none"> Graphite Mineral Black

Many of the pigments of this table are employed in enamel and porcelain painting, and most of them are durable in the other modes.

TABLE IX.










Pigments which are little affected by *carbonate of lime*, and are in various degrees eligible for fresco, distemper, and crayon painting:—

White	{	Barytic White	Green	{	Green Verditer
		Pearl White			Mountain Green
Yellow	{	Gypsum, and all Pure Earths	Green	{	Chrome Green
		Yellow Ochre			Mineral Green
		Oxford Ochre			Emerald Green
		Roman Ochre			Verdigris and other Copper Greens
		Sienna Earth			Terre-Verte
		Stone Ochre	Purple	{	Cobalt Green
		Brown Ochre			Gold Purple
		Indian Yellow			Madder Purple
		Patent Yellow			Purple Ochre
		Naples Yellow	Brown and Semi-neutral	{	Bone Brown
Red . .	{	Massicot			Vandyke Brown
		Vermillion			Rubens's Brown
		Red-lead			Bistre
		Red Ochre			Raw Umber
		Light Red			Burnt Umber
		Venetian Red			Cassel Earth
Blue .	{	Indian Red			Cologne Earth
		Madder Reds			Antwerp Brown
Blue .	{	Ultramarine			Chestnut Brown
		Smalt, and all Cobalt Blues			Asphaltum
					Mummy
					Ultramarine Brown
					Manganese Brown

Orange	{	Orange-lead	|	Black	{	Ivory-Black
		Orange Chrome				Lamp-Black
		Laque Minérale				Frankfort Black
		Orange Ochre				Mineral Black
		Jaune de Mars				Black Chalk
		Burnt Sienna Earth				Indian Ink
		Light Red, &c.				Graphite

This table shows the multitude of pigments from which the painters in fresco, scagliola, distemper, and crayons may select their colours; in doing which, however, it will be necessary they should consult the previous tables respecting other qualities of pigments essential to their peculiar modes of painting. These modes are exciting renewed interest in the world of art, tending to their extension in practice, particularly the latter of them.

TABLE X.
HERALDIC COLOURS.

Escutcheons.	How Engraved.	Colours.	Gentlemen	Nobles.	Sov. Princes.	Signs.
			Tinctures.	Jewels.	Planets.	
	Blank	White.....	Argent ..	Pearl	Luna.....	☾
	Dotted	Yellow ...	Or	Topaz	Sol	☉
	Perpendicular } Lines ... }	Red	Gules	Ruby	Mars.....	♂
	Horizontal } Lines	Blue.....	Azure	Sapphire...	Jupiter	♃
	Diag. Dexter ...	Green	Vert	Emerald...	Venus	♀
	Diag. Crossed...	Orange ...	Tenne.....	Jacynth ...	Dragon's } head ... }	♁
	Diag. Sinister...	Purple.....	Purple ...	Amethyst.	Mercury ...	♄
	Horizontal ... } Diagonal ... }	Murrey ...	Sanguine...	Sardonyx .	Dragon's } tail..... }	♂
	Horizontal } Perpendicular }	Black	Sable	Diamond .	Saturn	♄

Heraldry, although arbitrary and having no foundation whatever in nature, has employed colours with more consistent classification than the practisers of the fine arts. Being intimately connected with decorative painting in the emblazoning of arms, again so generally revived, and in the illuminating of missals, books, deeds, and treaties, of which modern illuminations are more or less close copies, and being also of occasional reference to higher art, a brief notice of heraldic colouring and its symbols may be considered as a useful appendage to a work on painting. The present table may also serve, by the comparison of colours, jewels, &c., to denote the colours themselves, and identify their names according to natural resemblances.

The manner of denoting colours by the scoring and crossing of lines on escutcheons may be usefully employed by artists in pen or pencil sketching as memoranda for painting the accidental and local colours of objects.

PART III.

CHAPTER X.

ON VEHICLES, VARNISHES, ETC.

PIGMENTS, in order to be spread upon the surface to be coloured by them, whether by the brush or otherwise, must be rendered plastic or liquid. The fluids with which this is effected must be of such a nature as to cause the pigments to adhere to the surface,—to become dry or hard, and fixed, and ought to tend to preserve both the pigment and the surface or ground on which it is spread. These fluids are *Vehicles*. Since colours and pigments are liable to much influence and changes of effect from the materials employed in painting for tempering, combining, distributing, and securing them on their grounds in the various modes of the art, the powers and properties of oils, vehicles, and varnishes are of hardly less impor-

tance than those of colours themselves ; they are, therefore, an essential branch of our subject. Vehicles (a term borrowed from pharmacy) are, indeed, among the chief materials and indispensable means of painting, and give name to its principal methods under the titles of painting in Water-colours, Oil, Varnish, Distemper, and Fresco : we will consider them, therefore, in these respects.

It is observable that the colours of pigments bear out with effects differing according to the liquids with which they are combined, and the substances those liquids hold in solution, which in some instances obscure or depress, and in others enliven or exalt the colours ; in the first case by the tinge and opacity of the fluid, and in the latter by its colourless transparency, and sometimes also much more so by remaining quite transparent, as in varnishes made of pure resinous substances, which have a very evident and peculiarly exalting effect upon colours, that continues when they are dry ; because resins form a glossy transparent cement, while the media formed by expressed oils become horny, or semi-opaque. And this principle applies also to aqueous and spirituous vehicles in water-colour painting, ac-

according to the nature of the substances they may hold in solution.

I.—WATER VEHICLES.

The most natural or fit distribution of vehicles is into those of *water*, *oils*, and *varnishes*; under which heads we proceed to regard them, and the various substances employed as additions, according to the variety of practice.

As the action of AQUEOUS LIQUIDS and solvents upon colours is stronger and more immediate than that of oils and varnishes, it is of great importance to the water-colour painter that he should attend to the pureness of his water, as in all hard and impure waters colours are disposed to separate and curdle, so that it is often impossible a clear flowing wash, or gradation of colour, should be obtained with them. Natural waters containing iron in considerable quantity must always be injurious to the fine and durable effects of the water-colour painter; water having a bad smell from sulphuretted hydrogen likewise.

Well waters in towns often, though pellucid,

contain nitrates, and may injure some colours, especially vegetable ones : common salt, carbonate and sulphate of lime, which are the main constituents of hard waters, are not likely to be injurious, except to a very few metallic pigments.

As water is not sufficient to connect, bear out, and secure colours on their grounds in painting, owing to its entirely evaporating in drying, additions of permanently adhesive substances soluble therein are necessary ; such as vegetable gums, mucilages, farinaceous paste, sugar, animal glues or size, or albumen obtained from glair of egg, serum of blood, milk, curd, whey, &c., and finally mineral solids, such as quicklime, alum, borax, &c. : whence a variety of empirical methods of painting.

Water, as a vehicle compared with *oil*, is of simple and easy use, drying quickly, the pigments being subject to little alteration of colour or effect subsequently ; for notwithstanding oils and varnishes are less chemically active upon colours than aqueous fluids, the vehicles of the oil-painter subject him to all the perplexities of their bad drying, change of colour, blooming, and cracking, —to habits varying with a variety of pigments, and to the contrariety of qualities by which they

are required to unite tenuity with strength, and to be fluid without flowing out of place upon the ground, &c.; to provide for and reconcile all which has continually exercised the ingenuity of the oil-painter.

MUCILAGES.

Gum, or some mucilaginous substance, is a necessary addition to water, to give the pigments of the water-colour painter their requisite cohesion, and to attach the colours to the grounds on which they are applied, as well as to give them the property of bearing out to the eye, according to the intention of the artist; upon which, and upon the pigments used, depend the proportions of gum to be employed, gum being already a constituent of some pigments, while others are of textures to require it added in considerable quantity to give them proper tenacity—qualities we have adverted to in speaking of individual pigments. As a general rule, however, the proportion of gum, &c., employed with a colour should be sufficient to prevent its abrasion, but not so much as to occasion its scaling or cracking, both of which are easily determined by trial upon paper; nor should the amount of gum, unless with special intention, cause gloss or “sheen” upon the surface.

GUMS.

Of *Gums*, SENEGAL is the strongest and best suited to dark colours, being of a brown hue; but the light-coloured pieces may be employed for the more delicate pigments. All gums dissolved in water soon ferment, and develop an acid very unfavourable to their preservation in a fluid state. This acetic acid requires, therefore, to be neutralized by the addition of some alkaline substance, of which we have found the carbonate of ammonia, being volatile, to be the best; a small portion of which being shaken into the dissolved gum, will purify it by precipitating all its foulness, and preserve it a very long time for use, and much improve the working of colours, without occasion for gall: the gum will rarely require more than one scruple of the powdered carbonate to an ounce of the gum dissolved by maceration in two or three ounces of cold water. A drop or two of an essential oil, such as oil of cloves, greatly retards the fermentation of dissolved gums in water.

GUM ARABIC is in general clearer and whiter than Senegal, and hence is better adapted to the brighter and more delicate colours. It should be

picked and purified by solution in cold water, straining, and decanting, and should be used fresh, or preserved by addition of alcohol, or by ammonia, in the manner already described.

AMMONIA, or *Gum Ammoniac*, is a gum resin, soluble in spirit and in water, in the latter of which it forms a milky fluid that dries transparent: it has many properties which render it useful in water-painting. It is avoided by insects, is very tenacious, and affords a middle vehicle between oil and water, with some of the advantages of both. It contributes also, in the manner of a varnish, to protect the more fugitive colours over which it may be glazed, or with which it may be mixed, and on this account it is eligible in water-painting. Dextrine (or British gum of the calico printer), now so much employed by the photographer, affords an admirable substitute for the water-colour painter for all the natural gums. Its finest qualities, sold as French dextrine, afford almost perfectly colourless solutions with boiling water, and when moderately concentrated (*i.e.*, as thick as cream), resist the tendency to ferment and grow sour very much longer than any natural gum.

Water-colours mixed in dextrine will probably

prove, *ceteris paribus*, more durable on paper grounds, &c., than in any natural gum. Pure gum, such as natural gum Arabic, is in chemical constitution shown by the formula ($C_{12} H_{11} O_{11}$).

Dextrine, which is an artificial gum produced by the torrefaction of starch, is almost identical with the preceding in constitution, viz., ($C_{12} H_{10} O_{10}$).

TRAGACANTH

Is a strong colourless gum, miscible but not soluble in hot or cold water, and of excellent use when colours are required to lie flat, or not bear out with gloss, and also when a gelatinous texture of the vehicle is of use to prevent the flowing of the colours. *Starch*, as prepared by the laundress; water in which *rice* has been boiled, used by the Chinese; and *paste* of wheaten flour, are available for the same purpose. *Sugar* and *honey* have also been employed, mixed with gums to retard the rapidity of their drying, as in what are called *moist colours*.

Gum tragacanth consists almost entirely of *bassorine*, a paramorphous form of dextrine, insoluble in water, though having the same constitution ($C_{12} H_{10} O_{10}$).

SIZE

Is prepared either by long boiling the shreds of vellum or parchment, or the refuse of raw hides, &c. It is a form of glue made by soaking in cold water, and subsequently dissolving by heat. The quantity to be used depends, like that of gums, on the quality of the pigments employed, and caution is more necessary than with the gums not to use it in excess, on account of its disposition to contract in drying, and occasion the colour to crack and scale off. The lighter-coloured *fish-glue* and *isinglass* are substituted for the nicer kinds of painting. *Albumen*, or *white of egg*, and also the *yolk*, employed by glovers, are used in some cases. *Ox-gall* is useful when the surface to be painted upon is polished, or works greasy. Size is sometimes worked into oil colours instead of mastic varnish to gelatinize and give them crispness.

MILK OF LIME,

Or common whitewash, is employed in distemper painting, with or without size, as a white basis and cement of colours, &c., and with or without the addition of some drying oil, when dry, stands weather with considerable firmness. It is pre-

pared by slacking lumps of white quicklime in water, forming what is called lime-putty, afterwards diluted with more water.

BORAX,

A neutral salt, the borate of soda, is sometimes used as a *medium* for uniting varnishes and oils with water in an intermediate mode of painting, which after drying is insoluble in water, and may be washed.

MEDIUMS.

Many attempts have been made to unite the advantages of the two modes of painting—of water and oil—either by successive processes, or by the use of a vehicle of a compound or intermediate affinity to both of these fluids, and thence technically denominated a *medium*, a term otherwise properly applicable to every vehicle.

With regard to *mediums*, all the gelatinous substances before mentioned as additions to water vehicles may be combined by mixture with linseed and other oils, and such compounds may be employed as vehicles, and will keep their place as delivered by the brush in painting. Indeed, starch, as prepared by the laundress, has been lately recommended for this purpose. Neverthe-

less we regard these mixtures as both chemically and mechanically inferior to the combination of lac and borax, which is equally diffusible in water and in oil, and does not contract in drying, or render the painting penetrable by moisture, as farinaceous and mucilaginous substances do, nor, in the end, dispose the work to crack. It has accordingly been proposed that artists should adopt the Indian process of painting, in which the gum-resin lac is rendered saponaceous and miscible in water by the medium of borax ; but against this process the foul colour and opacity of the vehicle have been heretofore justly objected. If, however, one part of borax be dissolved in twelve of boiling water, and the solution be added in equal or other proportions to white lac varnish, a perfectly transparent colourless liquid is formed, which diffuses freely in water, and may be used, with some difficulty, as a quick-drying vehicle for painting instead of oil, and when dry, is not acted on or removable by water ; add to this, that as this lac vehicle is as freely miscible with oil as it is with water, it supplies a true medium or connecting-link between painting in water and oil, which may, in ingenious hands, unite the advantages of both.

II.—GENERAL PROPERTIES OF OILS, DRYERS, VARNISHES, ETC.

The oils employed by the painter may be divided into fixed or fat oils, and volatile or essential oils.

Linseed oil and olive oil are types of the former, spirit of turpentine of the latter class. Fat oils, again, are divisible into two classes—those which are naturally or may be by proper treatment rendered *siccative*, or made into *drying oils*, and those which naturally are not so, and can with difficulty be rendered so. There is no oil, however, which may not, by chemical treatment, be rendered more or less siccative, so that the distinction is not absolute.

Fat oils exist in nature chiefly in the seeds and fruits of plants, and are obtained by expression, aided sometimes by heat or by boiling water. They have a specific gravity of from 0.90 to 0.97, and thus float upon water. They boil at 500° of Fahrenheit, and upwards. Chemically, they consist of carbon, hydrogen, and oxygen, in the state of oleic acid ($C_{36} H_{34} O_4$), and stearic acid ($C_{36} H_{32} O_4$), combined with glycerine, $C_3 H_5 O_3$, which has a sweet taste: hence

its name ($\gamma\lambda\upsilon\kappa\upsilon\varsigma$, Gr.). They are eminently combustible bodies, though requiring a much higher temperature to inflame them than essential oils. They are all slowly oxidable by exposure to air (especially in sunshine), or air and water vapour, and are also oxidized by various chemical agents, amongst which are found all bodies employed as dryers.

The effect of all such oxidation, whether by air and time or by dryers or other oxidating agents, is to so alter the chemical constitution of the oil that it approaches more or less to the nature and physical properties of a resin or varnish.

Fat oils, as first expressed, are mixed with much vegetable albumen and other impurities, from which they are purified by repose and subsidence, by washing with water, by filtrations, and by washing with solution of caustic soda, alternately with sulphuric acid, &c. When perfectly pure, fat oils are nearly devoid of smell, and their odour is never nauseous ; but in the earliest stages of atmospheric oxidation they become more or less *rancid*, and then contain many complex organic compounds, such as butyric, caproic, valerianic, and other acids. Castor oil, when freshly

expressed cold from recent beans of the *Ricinus communis*, is devoid of any smell, and almost of taste, and in that state alone is employed in Italian and Eastern pharmacy ; but after it has been expressed only a few hours, unless kept secured from *air* and *light*, it acquires the too well-known nauseous smell and taste of even “ the best cold-drawn castor oil ” of our apothecaries.

The principal naturally drying oils, or those rendered so, and most commonly in use, are, linseed oil, poppy-seed oil, walnut, hemp-seed, cotton-seed, grape-seed, to which may be added sperm and cod-liver oils, which are drying, but not employed by painters.

The chief naturally non-drying fat oils are, almond, colza, olive, rape, beech-nut, gingelly or oil of sessamum, sunflower-seeds, and castor oil. None of these are commonly employed by the painter, though all after a length of time, longer or shorter, become more or less siccative. It seems probable that olive oil was, after some unknown preparation, employed by the ancient painters of Greece, in combination with wax and bitumen, or gum resins, as a vehicle. A non-drying oil may be distinguished at once from a drying oil by the fact that the former is solidified

when treated with a strong solution of the proto-nitrate of mercury.

Oxygen is absorbed so rapidly by fat oils—especially siccative oils, when exposing a large surface—that cotton waste, rags, fibres, &c., soaked in such liquids, have repeatedly taken fire spontaneously by the exaltation of temperature due to the combustion of the hydrogen out of the oil. Painters should therefore guard against spilling oils on cloths, &c., for fear of accidents by fire.

Linseed oil, which is the most common European vehicle for oil paints, is mixed with the pigment usually in two forms—viz., as *raw linseed oil*, and as *drying oil* or *boiled oil*. Boiling alone is sufficient to render linseed or other like oils perfectly drying; but the process is much expedited, and probably the result better, by adding to the oil previously some oxidizing metallic oxide—*i.e.*, one that readily yields up some of its oxygen. The most usual bodies employed for this purpose are—litharge, or protoxide of lead, peroxide of lead, peroxide of manganese, sulphate of zinc, acetate of copper, and chromic acid, developed by sulphuric acid from bichromate of potash.

M Chevreul, whose researches upon the subject

of oil-colours are of the highest importance, has shown amongst other facts that three hours' boiling with litharge $\frac{1}{16}$ in weight of the oil, renders the oil *more* perfectly drying than when the boiling is continued (as is the common practice) a much longer time, and that the oil acquires a darker colour, and so becomes injured in transparency, the longer it is boiled. He has further shown that merely *heating* linseed oil to 170° Fahrenheit, along with a small quantity of peroxide of manganese, as completely renders it siccativous 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, or, as chemists say, *catalytically*, 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 siccativous property in it than new litharge. Sulphate of zinc and acetate of copper are decomposed by the oil when boiled with it, oxides of zinc or of copper subsiding.

Chevreul has remarked the singular fact that some metallic oxides—notably the oxide of

antimony—possess what he has called *anti-siccative* properties—*i.e.*, they actually retard the drying of the oil upon surfaces, when mixed with it as pigments. He has also remarked the curious and not unimportant fact that the same oil paint dries much more rapidly upon surfaces of certain bodies than of others, though equally or even less absorptive of the oil. Thus white-lead paint dries on the first coat much faster upon a surface of sheet-lead than upon one of porcelain or of oak timber; and the second coat of the same dries on all of these faster than the first. These facts admit of scientific explanation, but we cannot produce it in an elementary work like this. Fat oils, when heated with alkalies, alkaline earths, or some metallic oxides in large quantity, produce soaps, or metallic soaps, such as diachylon plaster, which is a soap of lead, made with oil and litharge. Hence some few pigments tend to make fat oils miscible or partially soluble in water, and as a covering in paint, liable, when exposed to the weather, to wash off. Common white-lead paint that has been long exposed to air, light, and moisture is always thus more or less loosened, and may be rubbed partially off from wood-work by the finger.

The atmospheric oxidation of siccative oils tends

to induce its own state of oxidation upon organic bodies that it may be in contact with. Hence the canvas of old paintings, even when encased in oil paint on both sides, tends to become brown, brittle, and rotten in fibre.

The mixture of raw linseed oil with drying oil is merely done in order to temper or delay the rate at which the oil paint shall dry. When drying takes place too fast, the paint is liable to crack or crumple, or, on wood, to blister.

The *drying* of oil paint is merely a conventional term; nothing like actual drying, *i.e.*, evaporation of the oil (as like water from a wetted surface), takes place, as Chevreul has proved. Drying of paint, in reality, means its *solidification* after being spread, without loss of weight, but, on the contrary, with a *gain* of weight, due to the oxygen absorbed, by which the oils, both fat and volatile, are converted into *resins* more or less completely. At the same time, there is no doubt that some of the volatile oil (turpentine) is lost by evaporation or diffusion of its vapour in the air.

Oil paints, both as employed for protective coatings and for decorative or fine-art purposes, are usually mixed—*i.e.*, the ground pigments united, not only with fat oil, but with more or less

of volatile oil, and in Europe spirit of turpentine is almost universally employed for this.

The uses of the admixture of this with the fat oil appear to be the following:—1. To promote oxidation or drying, by the powerful affinity all volatile oils have for oxygen. 2. To increase the liquidity of the paint, and make it spread under the brush more thinly and evenly. 3. To vary the degree of final gloss. Thus, decorative paints intended to have *no* gloss, and called technically “flatted colours,” are mixed almost with turpentine alone. 4. To prevent cracking upon solidification, which results mainly from the thinner spreading of the paint.

The *volatile* or *essential oils* exist in nature principally in the cells of the rind or bark of the stems, leaves, and flowers of plants, and occasionally in the seeds or pericarps of these, and are obtained almost wholly by distillation along with water, from which the oils are, after condensation, separated.

Their boiling-points vary much, as do their specific gravities—most have specific gravities between 0·8 and 0·9, but a few are heavier than water. These oils may be divided, as regards chemical constitution, into three great classes—

viz. : 1. Pure hydrocarbons. 2. Oxidized hydrocarbons ; and 3. Sulphur oils, *i.e.*, hydrocarbons, containing also sulphur, and frequently nitrogen.

Of the first, spirit of turpentine may be taken as a type as to most of the chemical and physical properties of all the volatile oils, amongst which, however, are contained many of the most remarkable compounds with which organic chemistry presents us. The finest perfumes, neroli, attar of roses, as well as some of the most valuable medicinal drugs, as the oils of asafoetida, cajaput, garlic, juniper, and mustard, and some of our most delicious spices, as cloves, cinnamon, &c., are here found.

The investigator of physical optics, too, has here found some of the most remarkable relations to light amongst material substances.

The pure hydrocarbon volatile oils have the general constitution ($C_{20} H_{16}$). Though the vapour of all is diffusible at all temperatures in air (especially *moist* air, as the perfume-laden air of a dewy morning or evening in a garden proves), their boiling-point is high, generally about 320° Fahrenheit. They all greedily absorb oxygen ; and it has been thought that their varied and remarkable odours only exist or address the sense of

smell in virtue of the oxidation going on in the air-diffused vapour.

Turpentine is obtained from the cells of every part of many coniferous trees, and is of many varieties. The common turpentine of commerce is obtained from the *Pinus abies*. When the crude turpentine is distilled with water, rectified *spirit of turpentine* passes over, and *colophony*, or common resin, remains in the retort. The latter is a highly complex compound, and has been separated into at least nine distinct chemical compounds of carbon and hydrogen, or carbon, hydrogen, and oxygen.

When pure volatile oil of turpentine ($C_{20} H_{16}$) is exposed to air and moisture (*i.e.*, ordinary air), it rapidly absorbs oxygen, and gives off hydrogen; so that soon, if the surface exposed be large, as when it is spread in a paint, it becomes ($C_{20} H_6 O_2 + 2 H O$), and tends ultimately to assume the same composition as common resin, which, as a whole, has the composition ($C_{40} H_{39} O_3 + H O$). It results from this, that when mixed with a fat drying oil, it exalts the tendency of the latter to oxidize; and the final product of the oxidation of the whole, or of "the drying of the paint," is the production of a tough, unctuous,

solid resin, in which the pigments are involved, and by which they adhere and cohere. Turpentine dissolves fat oils and resins, so that a liquid paint is not a mere mixture of fat and volatile oils, but a true solution (if the proportion of volatile oil be sufficient) of fat oil in volatile oil, with a pulverulent pigment (or a dissolved one, if present) held in suspension in the thick fluid, from which it slowly deposits, unless occasionally stirred up. Oxidated turpentine or resin contains several organic acids,—silvic, pinic, pimaric acids, &c. Some of them act with great energy upon some metals, especially upon copper, brass, and bronze, and produce green soluble salts, which deeply tinge the solvent, and produce a green paint, of which the pigment is in actual solution. Both fat and volatile oils appear to dissolve in small quantity some metallic oxides—notably litharge—and are capable of robbing several metallic oxides and salts of part of their oxygen. They may therefore react upon some metallic pigments injuriously in this way.

Varnishes are produced by the solution of resins, either natural or artificial (such as common resin) in volatile oils, or partly in fat oils, aided by heat; or in other volatile liquids, such as wood-spirit,

or methylic alcohol, ordinary alcohol, or in benzole, or coal naphtha, &c.

The drying of a varnish consists simply in the volatilization of the solvent, leaving the resinous matter in a solid, adherent state : it is accordingly essentially different from the so-called drying of oil-paint.

Further oxidation of the resin, especially if a natural one, however, always occurs by time, after the varnish has set hard : hence the varnish of old pictures, &c., becomes brown and semi-opaque. The resin has then passed more or less into the state of bitumen or asphaltum. The natural resins that are most used for varnishes are, Dammara gum (the resin of the *Dammaris Australis*), turpentine resins of several varieties, such as Burgundy pitch, anime, mastic (from *Pistachia lentiscus*), amber, copal (from *Rhus copallina* and *Hymenæa verrucosa*), sandarac (from the *Juniperus communis*), shell-lac (the resin of the crude lac produced by a coccus insect upon many tropical trees, *Ficus Indica* chiefly), and Venice or Chian turpentine, the source of which seems still uncertain.

In accordance with the nature of the solvent, varnishes are called spirit varnishes—turpentine or volatile-oil varnishes—or fat-oil varnishes. The

first are those whose solvent is rarely ether, chloroform, &c., commonly spirit of wine or wood-spirit, and they dry off most rapidly. These are very thin in coat when dry, and are best suited for paper fans or any fine work requiring perfect transparency in the varnish.

Volatile-oil varnishes, in which the solvents are spirit of turpentine, or coal naphtha, or the like, are those mostly employed by the oil-painter.

Fat-oil varnishes are made by the addition of highly-oxidized fat oils in small proportions to the latter class, by which the drying is retarded, and made to depend partly on oxidation as to the fat oil, and by which greater body and thickness of coat are secured, and greater durability: such varnishes are most suitable to oil paints, &c., exposed to the weather out of doors.

Into the manufacture of varnishes, upon which very much may be said, we cannot enter in this elementary treatise.

Besides these artificial varnishes, several *natural varnishes* of great beauty and value exist, none of which have as yet been brought into use in Europe, though long employed with great advantages by Eastern nations, especially the Burmese, Chinese, and Japanese peoples. These consist of natural

resins, or gum resins, found, in the juices of the plants whence they are obtained, ready dissolved in natural volatile oils. The, in India, well-known Silhet varnish, the juice of the *Hologarna longifolia*, according to Dr. Royle; the Japanese varnishes, from the *Rhus vernix*, it is said; and the varnish of the Malayan Islands, from the *Stagmaria verniciflua*, are examples of these. Many others exist, and are worthy of the attention of European technologists.

Varnishes may be variously coloured by coloured gum resins, such as gamboge, dragon's blood, &c., which are soluble in the same solvents as those of the varnishes themselves; and of course varnishes may be employed as quick drying vehicles for insoluble or merely suspended pigments as well as oils.

For further information as to the chemical, physical, and technical properties of the oils, varnishes, &c., see Muspratt's "Chemistry applied to the Arts," Knapp's "Chemical Technology," Gmelin's "System of Chemistry," Cooley's "Encyclopædia of Practical Receipts," "Dictionnaire Technologique," and the valuable papers and memoirs of Chevreul, Berthelot, &c.; and for experimental and theoretic results as to the

preservative powers of paints and varnishes, as protective coverings against air and moisture, see Mr. Mallet's "Reports on the Action of Air and Water upon Iron," *Trans. British Association for Advancement of Science*.

III.—TECHNICAL REMARKS UPON DRYERS, ETC.

Dryers may be mixed with paints at the moment of application to accelerate drying; but an excess of dryer renders oils saponaceous, is inimical to drying, and injurious to the permanent texture of the work. Some colours, however, dry badly from not being sufficientlyedulcorated or washed, and many are improved in drying by passing through the fire, or by age. Sulphate of zinc, as a dryer, is less powerful than acetate of lead, but is preferable in use with some colours, upon which it acts less injuriously; but it is supposed to set the colours running, which is not positively the case, though it will not retain those disposed to run, because it wants the property the acetate of lead possesses, of gelatinizing the mixture of oil and varnish. These two dryers should not be employed together, as frequently directed, since they decompose each other, forming two

new substances, the acetate of zinc, which is an ill dryer, and the sulphate of lead, which is insoluble, white, and opaque.

It is not always that ill drying is attributable to the pigments or oils; the states of the weather and atmosphere have great influence thereon. The oxygenating power of the direct rays of the sun renders them peculiarly active in drying oils and colours, and was probably resorted to before dryers were added to oils, as was also the atmosphere along with light, by which its drying property is exalted. The ground may also advance or retard drying, because some pigments, united either by mixing or glazing, are either promoted or obstructed in drying by their conjunction. Artificial gentle heat also promotes drying.

The various affinities of pigments occasion each to have its more or less appropriate dryer; and it would be a matter of useful experience if the habits of every pigment in this respect were ascertained; other siccatives, such as the *acetate of copper*, *massicot*, *red-lead*, and the *oxides of manganese* and others, might come into use in particular cases. Many other accidental circumstances may also affect drying. Dryers should be added to pigments only at the time of using

them, because they exercise their drying property while chemically combining with the oils employed, during which the latter become thick or fatten, and render additional oil and dryer necessary when again used. *Acetate of lead* dissolved in water, spirit, or turpentine may be used as a dryer of oil-paints with convenience and advantage in some cases.

In the employment of dryers attention is necessary—1. Not to add them uselessly to pigments that dry well in oil alone. 2. Not to employ them in excess, which retards drying. 3. Not to add them to the colour till it is to be used. 4. Not to add several kinds of dryers to the same colour; and 5. To use simple dryers in preference to nostrums recommended and vended for drying of paints. Impurity of the pigment sometimes retards drying, in which case it should be washed.

Another attention should be, that one coat of paint should be thoroughly dry before another is applied; for if the upper surface of paint get dry before the surface beneath it, it will *rivel* by the expansion and contraction of the under surface as the oil afterwards desiccates. Overloading with paint will be attended by the same evil, and if the upper surface be of varnish or brittle, *cracking* of the paint will ensue.

IV.—OF PARTICULAR FAT OILS.

LINSEED OIL.

Of the expressed or drying oils appropriate to painting, “honest linseed” is by far the strongest, and that which dries best, most tenaciously, and firmest under proper management; which properties it owes to its being at once viscid, resinous, and oleaginous. It never totally loses its transparency while liquid, in the manner of non-drying oils by cold, but preserves it during the most intense frost; as a resin it becomes ultimately fixed, hard, and solid, by combining with the oxygen of the atmosphere; but it lies under the great disadvantage of acquiring, after drying, and by exclusion from light and pure air, a semi-opaque and yellow-brown colour, which darkens by age. To obviate this as much as possible, when painting with oil alone, it is best to work the colour as stiff as may be, so as to use as small a portion of the vehicle as may suffice; for it is a fact proved by direct and repeated experiments, that *little oil diffused through much colour is subject to little change* upon the canvas, and that a thin coating of linseed oil is similarly preserved by light and the action of the atmosphere.

Linseed oil varies in quality according to the goodness of the seed from which it is expressed; the best is yellow, transparent, comparatively sweet-scented, and has a flavour somewhat resembling that of a cucumber. Great consequence has been attributed to the cold-drawing of this oil, but it is of little or no importance in painting 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 mere beauty to the eye in a liquid state, without communicating any permanent advantage, since there is not any known process for preventing the discolourment we have spoken of as consequent to 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, that the artist may depend upon the continuance of his tints, and use his vehicle accordingly, than that he should be betrayed by an evanescent beauty in his vehicle to use it too freely. Linseed oil that has been long boiled upon litharge in a water-bath to preserve it from burning acquires colour, and is, when diluted with oil of turpentine, less disposed

to run than pure linseed oil, and affords one of the most eligible vehicles of the oil-painter.

The most valuable qualities of linseed oil as a vehicle consist in its great strength and flexibility. Some have preferred it when bleached by exposure to sun and air; others, when *new and fresh*, or that which is *cold-drawn*; but that is the best which will temper most colour in painting; and oil expressed with a gentle heat, which does not discolour it, is equal in all respects to the cold-drawn.

To purify and preserve a stock of any kind of oil in its limpid state, and prevent its forming resin, according to its kind, it is requisite to keep it excluded from air. A simple oil apparatus for this purpose may easily be constructed. Take a glass or tin vessel of any required size, having some water at the bottom; insert at the top a small funnel, with a pipe passing through a cork down to the water, and a small cock, formed without an external tube, to prevent the concrescence of the oil therein; by which means the artist may obtain as much oil as he requires by a like quantity of water poured into the funnel. Any sediment will sink into the water, which may be removed when the oil is exhausted, or

may be drawn off by the lower cock and replaced by fresh water run into the funnel.

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 neutralize its brown colour. This affords *pale drying oil* for light and bright colours, which may be preserved for use in the above-described apparatus.*

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 pur-

* See Chevreul's process, described at p. 217.

posely in the making of *Printers' Varnish and Printing Ink*, and also for painting and the preparation of JAPANNERS' GOLD SIZE. As dark and transparent colours are in general comparatively ill dryers, *japanners' gold size* is sometimes employed as a powerful means of drying them. This material is very variously and fancifully prepared, often with needless, if not pernicious ingredients, but may be simply, and to every useful purpose in painting, prepared as follows:—Powder finely of asphaltum, litharge, or red-lead, and burnt umber, or manganese, each one ounce; 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 cloth and diluted with turpentine for use. *Gold size* for gilding is commonly made of boiled oil and fine Oxford ochre.

POPPY OIL

Is much celebrated in some old books under the appellations of *oil of pinks* and *oil of carnations*, as erroneously translated from the French *œillet*, or *olivét*, 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 to be preferred to it. Boiled as above, it is the *Oglio Cotto*, or the *baked oil* of the Italians.

NUT OILS

Resemble poppy oil in painting, but with inferior powers; and the *fish oils* of the *sperm whale*, *seal*, and *cod*, though sometimes used with dryers in the coarser painting, are inferior in qualities to them all, and little better than *tar* similarly employed.

MEGILP,

Or *English Varnish*, &c. Half a century ago, the jellied vehicles which receive the cant appellations

of *megilp* and *gumption* were the favourite nostrums of the initiated painter, and have maintained a preference with many artists to this day. These compounds of one part or more of strong mastic varnish with two of linseed or other oils, rendered drying as above and coagulable by the salts and oxides of lead, were, according to the preceding intentions, improvements upon the simple oil vehicle used on impenetrable grounds, by diluting it, and giving it a gelatinous texture, which enables it, while flowing freely from the pencil, to keep its place in painting, glazing, graining, &c.

GUMPTION,

Composed of not more than an eighth of the acetate or sugar of lead, with simple oil and strong varnish, which is subject to less change ultimately, particularly when the varnish abounds in the compound. In the using of sugar of lead, if the acid abound, which it does usually in the purer and more crystalline kinds, its power of drying is weakened, and it may have some injurious action upon colours, such as those of ultramarine and lakes. In this case a small addition of some of the pure oxides of lead, such as litharge ground fine, will increase the drying

property of the sugar of lead, and correct its injurious tendency. A similar composition of ground litharge rubbed with twice its quantity of nut or linseed oil and a sixth of bees'-wax, and used with mastic varnish, is called *Italian varnish*.

CANADA BALSAM

Is a natural, thick, and perfectly colourless turpentine in a liquid state, and may be employed both as a vehicle and diluted as a varnish; it is of great strength in either use, and preserves its naturally pale colour. It is seldom used in painting, but is for many purposes a valuable varnish substance.

V.—VOLATILE OILS, ETC.

OIL OF TURPENTINE.

The rectified oil, improperly called *spirit of turpentine*, &c., is preferable only on account of its being thinner, and more free from resin. 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 proportion as it prevents its bearing out, and when used entirely alone it will not fix the paint.

OIL OF LAVENDER

Is of two kinds, the fine-scented English oil, and the cheaper foreign oil, called *oil of spike*. These are rather more volatile and more powerful solvents than the oil of turpentine, which render them preferable in enamel-painting, of which they are the proper vehicles ; they have otherwise no advantage over the latter oil, unless they be fancied for their perfume. The other essential oils, such as oil of rosemary, thyme, &c., are very numerous ; but it has not appeared that they possess any property that gives them superiority in painting over that of turpentine : some of them have, however, more power in dissolving resins in the making of varnishes, as is the case also with naphtha, the rectified spirit of coal-oil, obtained by distillation from coal-tar.

NAPHTHA.

This substance is even a more powerful solvent than the vegetable essential oils; but on this account, and the usual bad scent of the latter, it is less eligible for the painter's use as a vehicle: the rectified naphtha may, however, be deprived of its nauseous smell by agitating it during several days with dilute sulphuric acid, and subsequently washing the oil with a little powder or milk of lime.

BENZOLE AND CHLOROFORM

Are useful solvents for removing recent or old oil-paints by solution, or for softening them by exposure to their vapours.

SPIRIT OF WINE,

Or *Alcohol*, is weaker and more dilute than essential oils, or even than water, and is so volatile as to be of use in vehicles only as a medium for combining oils with resins, &c., as a powerful solvent in the formation of spirit varnishes, and in some degree as an innocent promoter of drying in oils and colours. It affords also powerful means of removing varnishes, &c.

VI.—ON VARNISHES, ETC.

The last operation of painting is *varnishing*, which completes the intention of the vehicle, by causing the design and colouring to bear out with their fullest freshness, force, and keeping; supplies, as it were, a transparent atmosphere to the whole; while it forms a glazing which secures the work from injury and decay. It is especially necessary for graining, and often in ornamental and fancy works of art.

Varnishes are prepared from an immense variety of substances, of which the *resins*, improperly called in commerce gums, afford the best, and those principally used; and a vast number of preparations thereof uselessly compounded of many ingredients, and little to be depended on, are recorded in different works, wherein, as usual, the simplest are the best. Varnishes are best classed according to their solvents as spirit varnishes, essential-oil varnishes, and oil varnishes, but more usually distinguished according to the substances from which they are prepared.

RESINOUS VARNISHES.

The principal varnishes hitherto introduced and to be preferred in painting are the following:—

MASTIC VARNISH.

It is true that other soft resins are sometimes substituted for that of mastic, and that very elaborate compounds of them have been recommended and celebrated, but none that possess any evident advantage over the simple solution of mastic in rectified oil of turpentine. Some have used a varnish of *common white resin* mixed with *naphtha*. Others have employed *mastic* and *sandarac* dissolved in *nut*, *poppy*, or *linseed oil*, and this is indicated probably by the difficulty of removing varnishes from very old pictures. Mastic varnish is easily prepared by digesting in a bottle during a few hours, in a warm place, one part of the dry picked mastic with three or four of the oil of turpentine. A sufficient quantity of this cleared varnish to gelatinize or set up either of the before-mentioned drying oils of linseed constitutes the transparent *mégilp* of the painter, &c. If, instead of drying oil, the simple pure linseed oil be used with about an eighth of acetate of sugar of lead dissolved in water, or ground fine, we obtain the opaque mixture called *gumption*.

COPAL VARNISH.

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 as varnishes 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 varnish contract, and consequently crack, in drying, and hence the addition of linseed oil is essential to prevent its cracking. The mixture of copal varnish and linseed oil is best effected by the medium of oil and turpentine, and for this purpose heat is sometimes requisite. Strong copal varnish and oil of turpentine in equal portions, with one-sixth of drying oil mixed together hot,

afford a good painter's vehicle; and if about an eighth of pure bees'-wax be melted into it, it will enable the vehicle to keep its place in the manner of megilp. Elemi, Anime, and resins of inferior hardness are sometimes substituted for copal in preparing its varnish.

LAC VARNISH.

Prepared by dissolving in alcohol the lac resin of India, deprived chemically of colouring matter, and purified from extraneous substances with which it is naturally combined; without which process the varnish it affords is of the dark colour of the japans and lacquers of the East. When thus purified, this varnish is brilliant, transparent, very hard, and nearly colourless. This varnish being a spirit varnish, requires a warm temperature, which is useful in all varnishing, and it dries rapidly. Its place is usually supplied by the *light hard varnish* of the shops, in which softer resins are used with shell-lac. Crude lac as imported is of three principal kinds, namely, *Stick-lac*, *Seed-lac*, and *Shell-lac*, of dark or light amber colours, of which the last is the purest, and that of palest colour is the best for varnishes. They are all soluble in pure spirit of wine. Various compo-

sitions of *lac* with less than a fourth of mastic or sandarac, all dissolved, without fire, in spirit of wine, afford the *French polishes*, which are applied to cabinet-work by a roll of woollen list or cloth wound tight, the face of which being dipped into the varnish and covered with a fine linen rag, having a drop only of linseed oil on the centre, is used circularly as a rubber for the varnishing and polishing the plain surfaces of the work by an easy and efficacious process, the carvings and mouldings which the rubber cannot reach being varnished with the brush. The dipping of the rubber and supplying the drop of oil are to be repeated alternately as the work goes on, as required, till the whole is completed.

COWDIE.

A new resin which exudes naturally from the *cowdie pine* of Australia into the soil at the foot of the trees, from which being dug, it has obtained the improper name of *Fossil Gum*, under which it has been imported, and being a fine, transparent *resin* nearly of the hardness of copal, and of similar habits, may become a valuable substitute for the hard varnishes in decorative painting and fine art. But it has hitherto been rejected by

manufacturers of varnishes, first, from the want of success in forming a permanent solution, owing to its precipitating from the solvents after being dissolved, and secondly, from the danger of ebullition, inflammation, and explosion of gas evolved during its solution.

This latter defect arises from the water absorbed by the resin in its growth, or in the earth, which renders it opaque, but from which it may be freed by grossly powdering and drying, when the resin becomes transparent as glass, and may be melted and dissolved with the safety of other resins; and the first-named difficulty we have effectually remedied by the following simple formula, which yields a strong varnish that dries readily and with a fine surface:—

Take of broken and dried *condie resin* one part, melt it in the ordinary vessel with the usual caution, and stir well and gradually into it, over a fire sufficient to boil without burning it, four parts or more of hot oil of turpentine till the solution is completed; finally, stir it well and keep it hot off the fire one hour to clear. In this way, strictly followed, the *cowdie* or fossil resin will afford an excellent varnish applicable to the purposes of the usual copal varnishes, and superior

to that of mastic varnish for pictures in not cracking like copal, and being more permanent than mastic, and as easily and safely removed when requisite; but it does not megilp with drying oil, although it may be mixed and employed therewith.

We are of opinion also that, from the abundance, cheapness, and excellence of this resin, it is especially applicable to the purposes of civil, military, and naval architecture, in whatever works a varnish may be required or can be usefully employed, to which the difficulty and danger of permanent solution have been hitherto the obstacles with manufacturers of varnishes accustomed to the old *resins* of elemi, copal, sandarac, &c., improperly called *gums*, but which objections are entirely remedied by the preceding formula. And it is, we presume, for the uses here suggested that the American merchants have become great purchasers of the cowdie resin.

GENERAL REMARKS.

Upon comparing the qualities of the varnishes of mastic, cowdie, copal, and lac, it will appear that the latter are successively harder and more

perfect as varnishes, and in proportion to their perfection as *varnishes* is the difficulty of using them as *vehicles*; and as it is necessary that before varnishing with any of them the picture should be thoroughly dry, to prevent subsequent cracking, this is perhaps more essential for the latter than for the former. Notwithstanding this necessity, there is one highly important advantage which seems to attend early varnishing; namely, that of preserving the colour of the vehicle used from changing, which it is observed to do when a permanent varnish is passed over colours and tints newly laid; but this it does always at the hazard, and often at the expense, of cracking, and early varnishing with soft varnish dries slowly and is more disposed to bloom.

This saving grace of early varnishing appears to arise from the circumstance that, while linseed and other oils are in progress of drying, they attract oxygen, by the power of which they entirely lose their colour; but, after becoming dry, they progressively acquire colour. It is at the mediate period between oils thus losing and acquiring colour, which commences previously to the oil becoming perfectly dry, that varnish preserves the colour of the vehicle, probably by

preventing its farther drying and oxidation, which latter may in the end amount to that degree which constitutes combustion and produces colour: indeed, it is an established fact, that oils attract oxygen so powerfully as in many cases to have produced spontaneous combustions and destructive fires.

It is eminently conducive to good varnishing, in all cases, that it should be performed in fair weather, whatever varnish may be employed, and that a current of cold or damp air, which chills and blooms them, should be avoided. To escape the perplexities of varnishing, some have rejected it altogether, contenting themselves with oiling-out—a practice which, by avoiding an extreme, runs to its opposite, and subjects the work to ultimate irrecoverable dulness and obscurity.

The manufacturing processes for the varnishes now generally used have been detailed in the *Transactions of the Society of Arts*, &c., vol. xlix., and also in the *Annales de Chimie*. But with regard to the recipes for compounding varnishes, &c., superabounding in ancient and modern treatises, however flatteringly recommended, there are few eligible, and yet fewer justifiable, to art and good chemistry, by the simplicity upon which

certainty of effect depends, being in general quite of the class of the recipes and formulæ of the old cookery-books and dispensatories.

Presuming the decorator and painter to have acquainted himself with the principles of colours, &c., so as to apply them with taste and effect, as well as with a due knowledge of his materials, both of which are indispensable, there will yet remain to the complete mastery of his art the various modes and operations of painting, &c., in which they are to be applied, but for which he must rely upon his acquirement of skill and practice. These, therefore, we proceed finally to describe, with such observations and additions as may appear expedient.

PART IV.

CHAPTER XI.

MODES AND OPERATIONS OF PAINTING.

GROUND

Are of first consideration to the artist in every mode of painting, a well-prepared surface being an essential basis for the work, whether it be on wood, canvas, paper, plaster, stucco, stone, or metal; on all which it is necessary to produce a clean and even face by the application of pumice-stone, scraping, filing, &c., to remove roughnesses, and to stop and putty cracks and hollows, and to prime and prepare according to the nature of the work and of the ground itself.

PAINTING IN OIL

On wood requires first the smoothing, cleaning, and dusting of the surface. What is technically

called "stopping out," or *killing of the knots*, consists in applying wet lime over them, which, when dry, should be rubbed with a hot iron to melt out resin or turpentine that might flow and disturb the paint; they may then be pumiced and made smooth. The usual mode of stopping out knots before priming in oil paint is to give each a strong coat of boiled glue, tinged with red-lead to show where it has been placed. It is not absolutely effectual, as turpentine sometimes in hot weather oozes through this and the subsequent paint. The true method in really good wainscot-work is to *cut out* the knots, and let in pieces of sound wood to fill accurately the cavities. Holes and cracks must be stopped with putty, which is made by kneading whiting or powdered chalk into a tenacious mass with boiled linseed oil and some red-lead, which dries hard as stone. Puttying is best performed after the priming, or first coat of oil paint, which secures its adhesion.

PRIMING,

For works that are to stand damp and weather, consists in a first thin painting with linseed oil and red-lead, or litharge; but for in-door and dry work *clear-colling* is cheaper, which consists in

using *size* of glue instead of oil in the priming ; but it is liable to peel and scale off in damp places. Work thus prepared, smoothed, and primed is ready for the painting and finishing ; but in no case should wood in a wet state, or green and unseasoned wood, be painted in oil ; the consequence in such cases being either the speedy decaying of the wood, or the scaling and casting off of the paint. The usual process of oil-painting requires the ground white-lead to be diluted with linseed oil and very little spirit of turpentine for the first coat ; equal volume of both for the second coat, and for the third or finishing coat twice as much turpentine as linseed oil ; and still more of the turpentine in proportion for dead flatting, according to the tints and colours. For work exposed to weather the turpentine may be omitted, and oil alone employed ; the paint is then more durable. When painting external work in imitation of free-stone, it is a valuable practice to strew the second or last full coat of oil paint, while wet, with fine washed and sifted sand, which, adhering and drying on with the paint, forms a durable coat exactly resembling stone, and protecting the work from weather. This is called painting and sanding. Powdered talc, gold and silver leaf, bronzes,

smalts, and colours are thus occasionally employed in ornamental works.

FLATTING

Consists in employing nearly exclusively spirit of turpentine instead of linseed oil in diluting of the colour, so that no more oil is used than is necessary to bind the paint and fix it on the ground, and not sufficient to make it bear out with the gloss of ordinary oil-painting; a third or fourth of the oil for that being here sufficient. This mode is of course only suited to internal and delicate works in which the change of colour and glare of light are to be avoided, and it might in some cases appear to advantage mixed and compared with ordinary painting, diversified by dead colour and gloss; the latter may be produced subsequently by varnish, as well as by oil in mixing.

The priming coat under the same conditions is the same for wood, plaster, stucco, and stone; but for paper and canvas, which are made soft or rotten by oil, the priming must be of animal size; and for iron-work, first freed from rust, it is best in all cases of drying oil, avoiding the use of any pigment of copper, as a first coat. For small

works of fine art primed canvas may be obtained from the colourmen. Dryers are requisite in priming, as they dispose the upper painting to dry quicker and unite better. Sponging with water previously to applying each coat of paint disposes it to work and unite better, and in work exposed to the sun prevents blistering.

GRAINING

Is the imitation of the natural grain of woods, marbles, tortoiseshell, &c., 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, going over that with a coat of transparent colour of the proper hue and full depth of the grain, prepared either with turpentine or water-colour with size. These operations are performed with common brushes, and as soon as the latter coat is dry, the graining 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, palette knives, and rubbers, which being, as occasion requires, dipped into turpentine, or water when water-colour has been used, are passed quickly and lightly over

the paint, so as to leave the streaks, grains, and knots intended to remain, untouched, according to the skill and fancy of the painter, when it is immediately wiped off judiciously with a rag, which takes up the upper coat of the paint where dissolved by the turpentine or water, leaving the graining as required, and exhibiting the ground between. The finishing operation consists in varnishing only, to fix the top coat, which may be done with varnish of copal, anime, the cowdie varnish, or mastic, according to the work, observing that the strongest oil varnish is best for external work, and in some cases boiled oil alone.

Of course the skill and practice of hand of the grainer are principal in these operations, which are so admirably performed by many as to imply a degree of taste, observation, and dexterity that places this art in rank above common painting. The art is modern—was invented and perfected in this country, where the best workmen are to be found, who have been indebted for their art to the progress and practice of colouring in fine-art painting, in water and oil, both of which enter with solid painting and glazing into the practice of the grainer.

MARBLING

Is executed by a like process in a broader manner, and dexterous wiping out; and where streaks are required whiter than the general colour of the stone or marble to be imitated, or of various colours, they are to be added with solid paint and pencil in the first case, or with transparent colours in the latter. In particular imitations, as of lapis lazuli, metallic particles and grainings are to be given with leaf-gold, Dutch leaf, or bronzes. The final operation is varnishing as above directed.

STAIN-GRAINING.

In addition to the art of imitating the graining of woods, marbles, &c., by oil-colours, there are methods of bringing out with effect and beauty, as well as of preserving the natural grain of woods, &c., and also of imitating, heightening, and improving this artificially, which, though less practised, is not less ingenious nor unworthy of attention from the grainer, it being as desirable to heighten and preserve the natural beauty of wood-works as by artificial painting to imitate them.

For bringing out the natural grain of wood-work where it is of sufficient beauty, it is enough to apply successive coats of drying oil, or to varnish the naked work till it bears out, which is sufficient for ordinary joiner's work; but in the nicer cabinet-work, in which the choice ornamental woods are employed, French-polishing is necessary, which is performed with a spirit varnish containing shell-lac, applied by rubbers with linseed oil, as before described, and is now so much employed as to have become a distinct business.

In other cases graining may be performed on the naked wood with transparent colours in turpentine or water, which, when dry, may be varnished or French-polished, or the same may be done on the ordinary woods previously stained of the colours of the more valuable sorts.

Or a beautiful variety of graining may be executed with strong acids on plain wood brought out by heat. Applied in this way, the nitric acid or aquafortis affords amber and yellow shades, and sulphuric acid or vitriol yields shades of a darker and dusky hue, so as together to imitate the various hues of tortoiseshell, &c. ; after which the work is to be cleaned off, and varnished

or polished. This is, however, in several respects a very objectionable process.

TRANSPARENCIES

Are usually painted on white linen cloth, or on calico, stretched even and tight on a flat frame. It is then either first varnished with bees'-wax dissolved in turpentine, or sized according to the occasion; on either of which any of the transparent pigments ground in turpentine, or oil-colours, may be applied with diluted varnish in execution of the design. See Table VII.

SMELL OF PAINTS.

Painting is perhaps of as little inconvenience as any other mechanical operation carried on in an inhabited house; and even of less, except from the scent of its oils, which is stronger the quicker they dry, but the sooner gone off. The best remedies are fires in the rooms, and a free circulation of air in fine weather. The using of aromatics only increases the evil. It is important also, in this respect, that all paint-pots, oil-cans, brushes, cloths, and tools imbued with paint should be removed as soon as possible, and the floors, &c., washed clean, which will at once re-

move the greater part of the ill-scents and promote the drying of the work. Nor can we too earnestly recommend to the painter thorough *cleanliness* of person and operation, as most essential to his own health and the well-doing of his work, and as a principal mark of the ablest and most respectable workman.

The employment of disinfecting fumes of acids, chlorine, &c., can only remove a disagreeable smell by one more so, and may do mischief by injuring some colours, and rather retard than promote drying, after which the ill-scent of paint ceases. Powdered charcoal in large flat pans, however, rapidly absorbs all odours.

INODOROUS PAINTING.

Attempts have been made to execute ordinary painting with a vehicle which should have the qualities of drying oils without their powerful scents. The *usual* spirit varnishes, or other varnishes, form a liquid that may be applied with the *usual* pigments of the oil-painter, and with less bad odour than that from linseed oil.

ANOTHER MODE.

Dissolve any requisite quantity of alum in four times as much boiling water, and then stir

slowly in fine cream of slacked lime till the mixture becomes thickened by the precipitation of alumina: sufficient pyroligneous acid or vinegar is then added to re-dissolve the alumina, and the sulphate of lime suffered to subside.

This *sulphate of lime* is of a fine white colour, and may be employed with the liquid, instead of the white-lead of the oil-painter, as a basis in this kind of painting; or fine prepared plaster of Paris, which is a sulphate of lime, or the constant white of the artists, which is a sulphate of barytes, may supply its place, and be employed in producing tints with most of the painter's colours in the above liquid, to which some fresh size may be added, and the paints thus produced applied in the manner of painting in distemper. By this vehicle the more delicate colours are rather improved than injured; and after it becomes dry it resists moisture, and a coat of it over painting so fixes it that it may be washed. It may also be employed in rendering cloth, paper, &c., waterproof.

RULES OF PAINTING.

The following *General Rules* may be followed with advantage in painting:—1. Let the ground or surface to be painted be properly cleaned, smoothed, and dry. 2. See that your colours are

well ground and duly mixed. 3. Do not mix much more nor any less paint than is necessary for immediate application. 4. Keep the paint well stirred up while the work is going on. 5. Have your paint of due thickness, and lay it on equally and evenly. 6. Do not apply a succeeding coat of paint before the previous one is sufficiently dry. 7. Do not, if possible, employ a lighter colour over a darker. 8. Do not add dryers to colours long before they are used. 9. Avoid using any excess of dryers, or a mixture of different sorts. 10. Do not overcharge your brush with paint, nor replenish it before it is sufficiently exhausted. 11. Begin with the highest part and proceed downwards with your work. 12. Work the brush always in the same final direction, and generally in that of the longest dimension of the work.

FRESCO.

The art of painting in fresco is naturally adapted to decorative painting, and the zealous attention of eminent artists being at present turned to the revival of this great and free mode of art, we will not withhold our observations thereon.

Fresco-painting is performed with pigments prepared in water, and applied upon the surface of *fresh-laid plaster* of lime and sand, with which walls

are covered; and as it is that mode of painting which is least removed in practice from modelling or sculpture, it might not be improperly called *plastic* painting; for which the best lime, perfectly burnt and kept long slacked and in a wet state, is most essential. And as lime in an active state is the common cementing material of the ground and colours employed in fresco, it is obvious that such colours or pigments only can be used therein as remain unchanged by lime. This need not, however, be a universal rule for painting in fresco, since other cementing materials as strong or stronger than lime may be employed, which have not the action of lime upon colours—such as calcined gypsum, or plaster of Paris, which, being a neutral anhydrous sulphate of lime, exceedingly unchangeable, has little or no chemical action upon colours, and would admit even Prussian blue, vegetable lakes, and the most tender colours to be employed thereon, so as greatly to extend the sphere of colouring in fresco adapted to its various designs. This basis merits also the attention of the painter in crayons, scagliola, and distemper.

So far, too, as regards durability and strength of the ground, the Portland cements now so gene-

rally employed in architectural modellings would probably afford a new and advantageous ground for painting in fresco; and as it resists damp and moisture, it is well adapted, with colours properly chosen, to situations in which paintings, executed in other modes of the art, or even in ordinary fresco, would not long endure. This cement might be made almost perfectly white.

As these materials, or other than lime, were either unknown or unemployed by the ancient painters in fresco, their practice was necessarily limited to the pigments enumerated in the preceding Table IX.; but every art demands such a variation in practice as adapts it to circumstances and the age in which it is exercised, without attention to which it may degenerate, or, at best, remain stationary, but cannot advance.

Although differing exceedingly in their mechanical execution, the modes of fresco, distemper, and scagliola agree in their chemical relations; so far, therefore, as respects colours and pigments the foregoing remarks apply to these latter arts. One of the greatest improvements in fresco-painting was that made about fifteen years ago by Kaulbach, of Berlin, a pupil of the renowned Cornelius, of Munich, of the mode of fixing the

water-colours he employed by means of solution of silicate of soda, or soluble glass.

TEMPERA, OR DISTEMPER-PAINTING.

The carbonate of lime or whiting, employed as a basis in this, is less active than the hydrate of 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 four ounces 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 the glue may be 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-paints, without destroying their limpidity, 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.

Of more difficult introduction in these modes of painting is *bees'-wax*, although it has been employed successfully in each of them, and in the encaustic of the ancients, who finished their work therein by heating the surface of the painting till the wax melted and was absorbed by the porous plaster ground.

Theatrical scene-painting is generally executed in distemper, upon grounds of canvas, paper, wood, or wire gauze. The same method has been for three centuries, if not longer, employed throughout Italy and Sicily, for the decoration of the walls of edifices, public and private. Noble examples of its use occur in churches and monasteries in the ancient kingdom of Naples.

SCAGLIOLA,

Which requires all the conditions of the fresco-painter in respect to the materials employed, combined with the skill of the grainer in imitating marbles, comes nearer to the plasterer's than the painter's art, although the decorator is best qualified for its performance. Its basis is plaster

of Paris mixed with the colours of fresco, laid on a solid ground of plaster or cement, according to the design, and, when dry and hard, it is polished. Solid fragments of polished marbles, or of already hard scagliola, are frequently laid into the coloured plaster, and all ground off to an even surface. Marbles are thus imitated with great facility, cheapness, and elegance.

CHAPTER XII.

SUPPLEMENTARY.

CLEANING AND RESTORING PAINTINGS.

OF the importance of this minor function of the art of painting a just estimate may be formed by considering that there is hardly a limit to the time works in oil-painting may be preserved by care and attention. These are subject to deterioration and disfigurement by surface dirt—by the failure or decay of their grounds—by the obscuration and discolourment of vehicles and varnishes—by the fading and changing of colours—by the cracking of the body and surface—by damp, mildew, and foul air—and by mechanical violence. The first thing necessary to be done is to restore the ground, if on canvas, by

stretching or lining with new canvas. In cases of simple dirt, washing with a sponge or soft leather with soap and water, judiciously used, is sufficient. Varnishes are removed by friction or chemical and mechanical means united when the varnish is combined, as commonly happens, with oil and a variety of foulness.

IN REMOVING VARNISH

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 continued rubbing removes the varnish. If it be a 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 this purpose 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 dirt, oil, and varnish from a picture, which it does powerfully; it must there-

fore be much diluted with water, according to the power required, and employed with judgment and caution, stopping its action on the painting at the proper time by the use of pure water and a sponge.

Many other methods of cleaning have been recommended and employed, and in particular instances, for sufficient chemical reasons, with success; some of which we will recount, because, in art so uncertain, it is good to be rich in resources.

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, and leave the picture pure; and an architect of the author's acquaintance has succeeded in a similar way in restoring both paintings and gilding to their original beauty by coating them with wet clay. Ox-gall is even more efficacious than soap.

In filling cracks and replacing portions of the ground, putty formed of white-lead, whiting, varnish, and drying oil, tinted somewhat lighter than the local colours require, may be employed, as may also plaster of Paris in some cases; and, in restoring colours accidentally removed, it should be done with a vehicle of simple varnish, because

of the change of tint which takes place after drying in oil.

The picture cleaner or restorer is frequently an ignorant pretender, who is no more than a picture destroyer. The art of the genuine artist in restoring damaged, and cleaning old or dirtied pictures is, however, one full of ingenious processes and varied resources, and anything like a clear description of those would fill a small volume. It is quite a miracle of skill to see the old, rotten canvas completely removed from the back of the oil-paint of an old and valuable painting, and without the slightest disturbance the latter transferred to new canvas. Great improvements in this art have latterly been made in Germany, amongst which ranks highly the softening and cleaning of old varnishes by simple exposure to the vapour of chloroform.

REMOVING PAINT.

In cases in which it is requisite to remove painting entirely from its ground, it is usual to resort to mechanical scraping, or to the somewhat dangerous operation of setting fire to the paint on the surface immediately after sprinkling it over with oil of turpentine, for destroying it on old

disfigured work. That end may be more safely and easily accomplished by laying on a thick cream or plaster of fresh-slacked quicklime mixed with soda, which is thus rendered caustic, and while making soap with the oil of the old paint, &c., the latter may be washed off with water the following day, carrying with it the paint, grease, and other foulness, so that when the wood beneath is clean and dry, the painting may be renewed as on fresh work. *Clear-colling* is sometimes resorted to over old painting, for the purpose of repainting, in which case the surface exposed to the sun's rays or alternations of temperature is liable to become blistered and scale off. In place of burning, as above, scorching off with a chaffer of ignited charcoal or coke is now more common, and is much more safe. Delicate projecting mouldings on wood-work suffer more or less by either process. The caustic alkali is the only one that ought to be practised on wood or metal.

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